Centurion University of Technology and Management

School of Pharmacy and Life Sciences

M.Pharm (Industrial Pharmacy)

Mission:

An institution dedicated to touch human lives in health care and happiness to ensure holistic societal development through skill based education, research, Drug development and community welfare services.

Vision:

- Contribute to the national programmes of providing manpower trained through interdisciplinary integration such as Pharmaceutical sciences et al.
- To achieve professional excellence to meet effective competency and to undertake the task of meeting professional and social needs like identification, cure, mitigation of disease and innovative drug design.
- Enable students to seek fulfilling career in pharmaceutical sector, research and entrepreneurship.
- Enhancing student research in academics beyond the class room study like hand on practice by involving themselves on making dissertation and small tenured projects in pharmacy and life sciences.
- Managing Govt. and Non Govt projects by the faculties and students with pharmacy skills contributing towards a healthy State and Nation.

Programme Objectives:

1. To produce pharmacy graduates with strong basics and high technical knowledge to cater the various areas of Pharmaceutical industry.

2. To provide the required training in all aspects to the graduates to work as a health care professional in community and hospital pharmacy.

3. To provide a Pharmacists to the society with skill and will to make and serve quality pills.

POs: Pharmacy Graduates will be able to:

Sl No.	Programme Outcomes
PO1	**Applied Pharmacy Knowledge**: Possess knowledge of the core and fundamental principles associated with modern pharmaceutical technologies, biopharmaceutics, drug regulatory affairs, formulation and evaluation of novel drug delivery systems.
PO2	**Research and Development**: Utilize skills for the development of novel drug delivery approaches for diverse type of active pharmaceutical ingredients. Demonstrate an understanding of the computer-aided processes required to conduct pharmaceutical research.
PO3	**Problem analysis**: Develop ability for in depth analytical and critical thinking in order to identify, formulate and solve the issues related to pharmaceutical development, manufacturing and regulatory processes.

PO4	**Modern tool usage:** Select modern formulation optimization technologies with application of statistical hypothesis testing during development and evaluation of nanoformulation. Use *in silico* approaches for biopharmaceutical studies.
PO5	**Communication:** Make effective documentation, report writing and presentations as per the needs of pharmaceutical industry and academia.
PO6	**Professional identity:** Demonstrate typical professional, legal manners, conforming to all the guidelines of regulatory bodies. Contribute to the training of pharmacy students and the growth and success of pharmacy profession.
PO7	**Leadership skills:** Demonstrate the ability to implement plans and organize tasks within deadlines in the areas of research and manufacturing. Able to apply skills related to management of resources.
PO8	**Planning abilities:** Develop and apply skills for planning and executing activities related to formulation development, manufacturing and regulatory filings.
PO9	**Pharmaceutical ethics:** Apply ethical principles while making decisions and take accountability for the outcomes related to the decisions.
PO10	**Environmental sustainability (SDG):** Address the issues of environmental pollution, industrial waste, and utilization of huge amount of water by applying skills to improve production processes and to ensure environmental sustainability.
PO11	**Life-long learning:** Ability to involve in independent and continuous learning process as per the need and technological advancements. Use of feedback from other professionals and identification of learning requirements for life-long learning improvement. Understand the role of conferences, seminars and workshops for knowledge progression.

PSO (Program Specific Outcomes)

Sl No.	Program Specific Outcomes
PSO1	Work in different divisions of pharmaceutical industry like manufacturing, quality control, quality assurance, analytical research, formulation research and regulatory affairs.
PSO2	Become an entrepreneur in the areas of formulation research and development, pharmaceutical manufacturing, pharmaceutical consultancy services, drug sales and distribution.
PSO3	Explore opportunities in collaboration with various pharmaceutical companies and variety of health care professionals to ensure clinical drug trials as per regulatory guidelines for the testing of drugs.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PSO1	H	M	H	H	H	M	L	L	H	M	H	H
PSO2	H	H	H	M	H	M	M	M	M	L	M	H
PSO3	H	H	L	L	M	M	M	H	L	M	H	H

Course Outcome (CO)

1st Semester

CUTM2000- MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

Course Objective: This subject deals with various skilled advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	The analysis of various drugs in single and combination dosage forms.
CO-2	Analysis of Chemicals and Excipients
CO-3	Theoretical and practical skills of the instruments.
CO-4	Explain general principles and theory of spectroscopy.
CO-5	Learn various separation techniques by employing chromatographic methods.

CUTM2001- PHARMACEUTICAL FORMULATION DEVELOPMENT

Course Objective: This course is designed to impart skilled knowledge and skills necessary to train the students on par with the routine of Industrial activities in R&D and F&D.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	The scheduled activities in a Pharmaceutical firm.
CO-2	The criteria for selection of drugs and polymers for the development of delivering system
CO-3	The significance of dissolution and product stability.
CO-4	The pre formulation studies of pilot batches of pharmaceutical industry.
CO-5	The significance of dissolution and product stability

CUTM2002- NOVEL DRUG DELIVERY SYSTEMS

Course Objective: This course is designed to impart skilled knowledge and skills necessary to train the students in the area of novel drug delivery systems.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	The need, concept, design and evaluation of various customized, sustained and controlled release dosage forms
CO-2	To get knowledge on formulation and evaluation of various novel drug delivery system.

CO-3	Drug delivery system give a detailed information transporting a pharmaceutical compound in the body as needed to safely achieve its desired therapeutic effect.
CO-4	They know the different types of Drug carrier used in the process of drug delivery which serves to improve the selectivity, effectiveness, and/or safety of drug administration.
CO-5	The students will know the latest drug delivery knowledge and think to develop new formulation based on the individual Requirement.

CUTM2003- INTELLECTUAL PROPERTY RIGHTS

Course Objective: This course is designed to impart skilled knowledge and skills necessary to train the students to be on par with the routine of Industrial activities in drug regulatory affairs

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Assist in Regulatory Audit process.
CO-2	Establish regulatory guidelines for drug and drug products.
CO-3	The Regulatory requirements for contract research organization.
CO-4	The Role of enterprise in national and global economy.
CO-5	Demands and challenges of Growth Strategies and Networking.

2nd Semester

CUTM2006-ADVANCED BIOPHARMACEUTICS & PHARMACOKINETICS

Course Objective: This course is designed to impart knowledge and skills necessary for dose calculations, dose adjustments and to apply Biopharmaceutics theories in practical problem solving.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	The basic concepts in Biopharmaceutics.
CO-2	The use of raw data and derive the pharmacokinetic models and parameters the best describe the process of drug absorption, distribution, metabolism and elimination.
CO-3	To critically evaluate Biopharmaceutics studies involving drug product equivalency.
CO-4	To design and evaluate dosage regimens of the drugs using pharmacokinetic and biopharmaceutic parameters.
CO-5	The basic concepts in pharmacokinetics.

CUTM2007- SCALE UP AND TECHNOLOGY TRANSFER

Course Objective: This course is designed to impart knowledge and skills necessary to train the students to be on scale up, technology transfer process and industrial safety issues.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Manage the scale up process in pharmaceutical industry.
CO-2	Assist in technology transfer.
CO-3	To establish safety guidelines, which prevent industrial hazards.
CO-4	Explain the different laws and acts that regulate pharmaceutical industry.
CO-5	Describe the role and responsibility of regulatory agencies in the approval of drugs.

CUTM2008 - PHARMACEUTICAL PRODUCTION TECHNOLOGY

Course Objective: This course is designed to impart knowledge and skills necessary to train the students to be on par with the routine of Industrial activities in Production.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Handle the scheduled activities in a Pharmaceutical firm.
CO-2	Manage the production of large batches of pharmaceutical formulations.
CO-3	Optimization Techniques in Pharmaceutical Formulation
CO-4	Computers in Market Analysis
CO-5	Artificial Intelligence (AI) and Robotics

CUTM2009 - ENTREPRENEURSHIP MANAGEMENT

Course Objective: This course is designed to impart knowledge and skills necessary to train the students on entrepreneurship management.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	The Role of enterprise in national and global economy.
CO-2	Dynamics of motivation and concepts of entrepreneurship.
CO-3	Demands and challenges of Growth Strategies And Networking.
CO-4	Understand the nature of entrepreneurship.
CO-5	Understand the function of the entrepreneur in the successful, commercial application of innovations.


Centurion
UNIVERSITY

Centurion University of Technology and Management

School of Paramedics and Allied Health Sciences

B. Sc. – Medical Laboratory Technology/ Clinical Microbiology/ Optometry / Medical Radiation Technology/ Emergency Medicine Technology/ Anaesthesia Technology/ Operation Theatre Technology/ Bachelor of Physiotherapy

Programme Objectives;

Paramedical courses have emerged as an important branch of medical science, in discovering greater realms of human health. The objective of Paramedical courses is to propagate the science in Para Medical Technology. The Programme focuses on educating and training students by imparting quality education, training and conducting research in the field of Para Medical Technology. It will provide skill and will establish the students in Community Health Practice in the Diagnostic division.

POs: Paramedics Graduates will be able to;

PO	**Outcomes**
PO1	Apply knowledge of basic science and allied health science.
PO2	Design and conduct experiments, as well as to carry out problem analysis data interpretation
PO3	Design and develop process to meet desired needs within realistic constraints.
PO4	Function effectively as a leader and member of multidisciplinary teams.
PO5	Isolate, identify, synthesize, formulate and solve complex healthcare problems.
PO6	Understanding of professional and ethical responsibility
PO7	Communicate effectively
PO8	Understand the impact of allied healthcare in a global, economic, environmental, and societal context
PO9	Manage contemporary healthcare projects and their financial implications.

PO10	Use the techniques, skills, and modern healthcare instruments and tools necessary for allied health profession.
PO11	Analyze, screen and ensure quality in healthcare delivery.
PO12	Engage in life-long learning

A. PSOs: Department of Medical Laboratory Technology:

PSO1. To provide quality, accurate and timely laboratory results in a cost-effective manner. Comply with all legal, regulatory, and ethical requirements associated with the practice and employability in medical laboratory science

PSO2. To establish a diagnostic laboratory and validate laboratory results with accuracy and precision, to improve the skill and provide accurate and meaningful results that reflect current standards in healthcare.

PSO3. Graduates will be able to qualify various entrance exam/competitive examinations.

***Correlation is noted as "H" for High, "M" for Medium and "L" for Low**

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO7**	**PO8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**
PSO1	**H**	**M**	**M**	**M**	**H**	**H**	**M**	**H**	**H**	**M**	**H**	**M**
PSO2	**M**	**H**	**M**	**M**	**H**	**H**	**H**	**M**	**H**	**H**	**H**	**M**
PSO3	**M**	**M**	**L**	**L**	**M**	**M**	**M**	**M**	**L**	**L**	**M**	**H**

Course Outcomes
B. Sc. Medical Laboratory Technology

Code	Subject Name	Course Outcome
CUTM1729	Cell Biology	• To understand the Scopes of biology, functions of cell organelles • To learn about Carbohydrate metabolism and respiration • Understand cell signaling and how it regulates cellular functions, also how its dis- regulation leads to cancer and other diseasess
CUTM1708	Human Anatomy & Physiology	• To understand the scopes of anatomy & physiology, detailed anatomy of human body,

		detailed physiology of human body • Identify and describe locations of major organs of each system covered; explain interrelationships among molecular, cellular, tissue, and organ functions in each system
CUTM1730	Medical Instrumentation and Techniques	• Learning principle, instrumentation & application of Centrifugation • To learn the principle, instrumentation & application of Microscopy, principle of Spectroscopy, microtome sectioning • Handling instruments required in Medical Laboratory set up
CUTM1732	Biochemistry	• Understanding the significance of biomolecules in metabolic activities and detection of abnormal range of these molecules from patient sample
CUTM1715	Clinical pathology	• Performing tests using blood specimen • Performing pathological investigations of urine, stool and other biological specimen
CUTM1736	Immunology	• Understanding the concept of Innate & adaptive immune system; complement system; Hypersensitivity. • Understanding clinically relevant serological analysis
CUTM1737	Molecular Biology	• Understanding basic techniques applicable in Molecular Biology • Conceptual understanding of the central dogma of life
CUTM1731	Hematology	• Differentiate various laboratory test findings with their associated clinical conditions
CUTM1733	Microbiology	• Concept of the pathogenecity and culturing of microorganisms • To understand the significance of microorganisms
CUTM1734	Medical Law and Ethics	• Apply local, state, and federal standards and regulations for the control and use of health information
CUTM1720	Histology	• Learning special staining procedures & handling & testing of various cytological specimens • Understanding the concept of Histotechnology, histopathology, decalcification, sectioning
CUTM1727	Advanced Hematology	• To compare and contrast hematology values under normal and abnormal conditions • Understanding the lab diagnosis for Leukamoid reactions, DIC

CUTM1738	Analytical Biochemistry	• Learning various tests carried out for biochemical analysis & Hormone investigations • Understanding of principle of spectrophotometry, colometry, photometry • Performing clinical biochemistry tests
CUTM1749	Applied Hematology	• Understanding of Haemopoietic disorders and their laboratory diagnosis • Understanding of Haemopoietic disorders, laboratory diagnosis of leukemia, hemolytic anemia, haemophilia, ITP, L. E. cell phenomenon
CUTM1750	Immunopathology	• Learning the organization and functioning of the immune system, their diagnostic tests described on immunological techniques • To understand Immunological aspects of clinically significant diseases
CUTM1748	Parasitology	• Identification of pathogenic parasite in disease diagnosis and treatment • Understanding the life cycle and lab diagnosis of various clinically significant parasite
CUTM1742	Basic Computer and Information Science	• Understand the difference between an operating system and an application program, and what each is used for in a computer • Study of basic input & output device of a computer, processor & memory, word, excel, power point
CUTM1721	Research Methodology	• Provide learning opportunities to critically evaluate research methodology and findings • Study of Scientific writing, Selection of problem, criteria for selecting a research title, research hypothesis, sample designing
CUTM1725	Blood Banking	• Plan and execute investigations relating to fungi to virus
CUTM1751	Medical Laboratory Management	• Recognize the role of clinical laboratory scientist in the assurance of quality health care • Study of standards for clinical laboratory professionals, GLP • Learning of patient management and quality management
CUTM1753	Introduction to Quality and Patient Safety	• Understand policy related to managing lab and infection control • Study of health literacy • Understanding of teamwork and culture of safety, quality improvement innovations

CUTM1752	Mycology & Virology	• Plan and execute investigations relating to fungi to virus • Study of culture of medically important fungi, medically important virus
CUTM1754	Mini Project	• Research paper publication/ case study/ clinical study/ community service/ survey
CUTM1756	Project	• Working on a disease/ disorder specific assignment to fill the research gap in the specific area
CUTM1755	Internship	• Dealing with patient, analysis and interpretation of diseases
CUTM1010	Environmental Studies	• Understand the natural environment and its relationships with human activities. • Characterize and analyze human impacts on the environment. • Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems. • Design and evaluate strategies, technologies and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments. • Remediation or restoration of degraded environments.
CUTM1693	Proficiency in English	• Improve effective writing skills • Improvise articulating abilities
CUTM1016	Job Readiness	• To improvise the ability of the students towards facing job interviews

B. PSOs: Department of Applied and Clinical Microbiology:

PSO1. To employ treatment strategies including specimen handling, processing and the appropriate use of antimicrobial agents and common mechanisms of antimicrobial action and resistance.

PSO2. To monitor the Quality Control and Quality Assurance in Microbiology and Pathology Labs. To establish labs and to evaluate methods used in identifying infectious agents in the clinical microbiology lab.

PSO3. Graduates will be able to qualify various entrance exam/competitive examinations.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	PO 2	PO3	PO 4	PO 5	PO 6	PO7	PO8	PO 9	PO1 0	PO1 1	PO12
PSO1	**H**	**M**	**M**	**M**	**H**	**H**	**M**	**H**	**H**	**M**	**H**	**M**
PSO2	**M**	**H**	**M**	**M**	**H**	**H**	**H**	**M**	**H**	**M**	**H**	**M**
PSO3	**M**	**M**	**L**	**L**	**M**	**M**	**M**	**M**	**L**	**L**	**M**	**H**

Course Outcomes
B. Sc. Clinical Microbiology

SEMESTER I		
Code	**Subject Name**	**Course Outcome**
CUTM1729	Cell Biology	• To understand the Scopes of biology, functions of cell organelles • To learn about Carbohydrate metabolism and respiration • Understand cell signaling and how it regulates cellular functions, also how its dis- regulation leads to cancer and other diseasess
CUTM1708	Human Anatomy & Physiology	• To understand the scopes of anatomy & physiology, detailed anatomy of human body, detailed physiology of human body • Identify and describe locations of major organs of each system covered; explain interrelationships among molecular, cellular, tissue, and organ functions in each system
CUTM1730	Medical Instrumentation and Techniques	• • Learning of principle, instrumentation & application of Centrifugation • To learn the principle, instrumentation & application of Microscopy, principle of Spectroscopy, microtome sectioning • Handling instruments required in Medical Laboratory set up
CUTM1732	Biochemistry	• Understanding the significance of biomolecules in metabolic activities and detection of abnormal range of these molecules from patient sample
CUTM1715	Clinical pathology	• Performing tests using blood specimen • Performing pathological investiations of urine, stool and other biological specimen
CUTM1736	Immunology	• Understanding the concept of Innate & adaptive immune system; complement system; Hypersensitivity. • Understanding about clinically relevant serological analysis

CUTM1737	Molecular Biology	• Understanding basic techniques applicable in Molecular Biology • Conceptual understanding of the central dogma of life
CUTM1731	Hematology	• Differentiate various laboratory test findings with their associated clinical conditions
CUTM1733	Microbiology	• Study of concept of the pathogenecity and culturing of microorganisms • To understand the significance of microorganisms
CUTM1734	Medical Law and Ethics	• Apply local, state, and federal standards and regulations for the control and use of health information
CUTM1738	Analytical Biochemistry	• Learning various tests carried out for biochemical analysis & Hormone investigations • Understanding of principle of spectrophotometry, colometry, photometry • Performing clinical biochemistry tests
CUTM1742	Basic Computer and Information Science	• Understand the difference between an operating system and an application program, and what each is used for in a computer • Study of basic input & output device of a computer, processor & memory, word, excel, power point
CUTM1746	Epidemiology	• Understanding the scopes of epidemiology • Study of Epidemiology of communicable diseases, prevention & control of diseases
CUTM1747	Diagnostic Bacteriology	• Study of Lab diagnosis for Enteric infection, RTI, Oral & stomach infection
CUTM1745	Diagnostic Mycology	• Study of lab diagnosis of medically important fungi
CUTM1735	Systemic Virology & Mycology	• Understanding the epidemiology, pathogenesis, treatment of viruses, pathogenic group of fungi
CUTM1743	Diagnostic Virology	• Study of lab diagnosis of viral infection

CUTM1744	Diagnostic Parasitology	• Study of lab diagnosis of Intestinal, vaginal, Tissue and blood parasite
CUTM1739	Pharmaceutical Microbiology	• Understanding of types & synthesis of antimicrobial agents • Manufacture of antibiotics • Study of mechanism of action of antibiotics
CUTM1740	Public Health Microbiology	• Understanding the role of microbiologist in public health
CUTM1713	Systemic Bacteriology	• Understanding of morphology, pathogenesis, lab diagnosis on gram positive & negative bacteria
CUTM1721	Research Methodology	• Study of Scientific writing, Selection of problem, criteria for selecting a research title, research hypothesis • To learn about Sample designing
CUTM1754	Mini Project	• Research paper publication/ case study/ clinical study/ community service/ survey
CUTM1756	Project	• Working on a disease/ disorder specific assignment to fill the research gap in the specific area
CUTM1755	Internship	• Dealing with patient, analysis and interpretation of diseases
CUTM1010	Environmental Studies	• Understand the natural environment and its relationships with human activities. • Characterize and analyze human impacts on the environment. • Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems. • Design and evaluate strategies, technologies and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments. • Remediation or restoration of degraded environments. •
CUTM1693	Proficiency in English	• Improve effective writing skills • Improvise articulating abilities

CUTM1016	Job Readiness	• To improvise the ability of the students towards facing job interviews

C. PSOs: Department of Optometry

PSO1. To employ quality eye and vision care through comprehensive and appropriate examination, measurement, assessment, diagnosis, treatment and management of eye and vision conditions.

PSO2. To understand the pathogenesis of disease and the implications for ocular health and function and be knowledgeable in ocular and laboratory testing used in the assessment of systemic, visual and ocular function.

PSO3. Graduates will be able to qualify various entrance exam/competitive examinations.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO7**	**PO8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**
PSO1	**H**	**M**	**M**	**M**	**H**	**H**	**M**	**H**	**H**	**M**	**M**	**M**
PSO2	**M**	**H**	**M**	**M**	**H**	**H**	**M**	**M**	**M**	**M**	**H**	**M**
PSO3	**M**	**M**	**L**	**L**	**M**	**M**	**M**	**M**	**L**	**L**	**M**	**H**

Course Outcomes
B. Sc. Optometry

Code	Subject Name	Course Outcome
CUTM1760	Cell Biology	• To understand the Scopes of biology, functions of cell organelles • The student will learn regarding the Carbohydrate metabolism and respiration, understand how these cellular components are used to generate and utilize energy in cells
CUTM1757	GENERAL ANATOMY	• To study of gross anatomy, involving dissection or non-invasive methods • To understand how both structure and function are modified by exercise or disease • To understand and predict the body's responses to stimuli • To understand how the body maintains condition

		• To comprehend the normal disposition, inter-relationships, gross, functional and applied anatomy of various structures in the human body
CUTM1758	GENERAL PHYSIOLOGY	• The subject aims to understand the mechanisms of living things • The overall goal of this course is to enable students to understand the role of molecules, cells, tissues, organs, and organ systems • To know the physiological principles underlying pathogenesis of disease
CUTM1759	BASIC BIOCHEMISTRY	• Biochemistry helps in clinical diagnosis, understanding pathology of diseases, treatment of diseases, designing of drugs and understanding their metabolism and manufacture of various biological products like amino acids, proteins, antibiotics, hormones, enzymes, nutrients, etc. It is expected that the students become conversant with the Fundamentals of Biochemistry which can be applied in clinical diagnosis of the metabolic disorders.
CUTM1785	INTRODUCTION TO OPTOMETRY	• At the end of the course students will be thorough in the following aspects: Understand what is optometry as a profession and its scope in future awareness on terms used in optometry. Understand the purpose of different instruments used in optometry. They will be able to test visual acuity of people and handle retinoscope comfortably. Understand the concept of vision screening .
CUTM1784	PHYSICAL OPTICS	• The objective of this course is to equip the students with a thorough knowledge of properties of light. • At the end of this course, students will be able to predict the distribution of light under various conditions.
CUTM1782	OCULAR ANATOMY	• To comprehend the normal disposition, inter-relationships, gross, functional and applied anatomy of various structures in the eye and adnexa. • Identifying the microscopic structures of various tissues in the eye and correlate the structure with the functions. • Comprehending the basic structure and connections between the various parts of the central nervous system and the eye so as to

		understand the neural connections and distribution. • To understand the basic principles of ocular embryology.
CUTM1783	OCULAR PHYSIOLOGY	• To understand the normal functioning of all structures of the eye and their interactions. • To elucidate the physiological aspects of normal growth and development of the eye. • To understand the phenomenon of vision. • Listing out the physiological principles underlying pathogenesis and treatment of diseases of the eye.
FCBS 0101	ENVIRONMENTAL SCIENCE	• Gaining basic knowledge about environment and biodiversity.
CUTM1789	OCULAR MICROBIOLOGY AND PATHOLOGY	• The candidates should demonstrate fundamental knowledge and insight into general microbiology and pathology. Knowledge and understanding should be demonstrated in the areas of general medical disorder and how they can affect. • The course concepts will focus on the cause, development and progress of disease, and how the eye is affected. They are able to demonstrate an understanding of how knowledge of pathological processes can be utilized in the investigation, management and prevention of disease.
CUTM1786	VISUAL OPTICS – I	• The objective of this course is to equip the students with a thorough knowledge of mirrors and lenses. • At the end of this course, students will be able to predict the basic properties of the images formed on the retina by the optics of the eye.
CUTM1787	OPTOMETRIC OPTICS- I	• To learn techniques such as measurement of lens power, lens centration using conventional techniques. Transposition of various types of lenses. • Gain knowledge to identify different forms of lenses (equi-convex, planoconvex, periscopic, etc.) • Knowledge to select the tool power for grinding process. • Measurement of surface powers using lens measure. • Method of laying off the lens for glazing process. • Ophthalmic prism knowledge –effects, units, base-apex notation, compounding and resolving prisms.

CUTM1790	CLINICAL EXAMINATION OF VISUAL SYSTEM	• At the end of the course the students will have practical knowledge on the purpose of each test, its indications and contraindications and will be able to perform various clinical tests in step-by-step procedures and set- up the required environment and also learn the interpretation and documentation of the findings.
CUTM1788	OCULAR DISEASES -I	• At the end of the course the students will be knowledgeable in the following aspects of ocular diseases: Etiology, epidemiology, symptoms, signs, course sequelae of ocular disease. Diagnostic approach and management of the ocular diseases.
CUTM1791	VISUAL OPTICS II	• Upon completion of the course, the student should be able: To understand the fundamentals of optical components of the eye To gain theoretical knowledge and practical skill on visual acuity measurement, objective and subjective clinical refraction
CUTM1792	OPTOMETRIC OPTICS II & DISPENSING OPTICS	• To select the tool power for grinding process • Understand different types of materials used to make lenses and its characteristics • Learn lens designs–Bifocals, progressive lens, Tinted, Protective & Special lenses, Spectacle frames –manufacture process & materials • Understand the art and science of dispensing spectacle lens and frames based on the glass prescription. • Reading of spectacle prescription. Counselling the patient, lens edge thickness calculation • To learn frame & lens measurements and selection. • Writing spectacle lens order • To learn the facial measurements - Interpupillary distance measurement and measuring heights (single vision, multifocal, progressives) • To understand lens verification and axis marking and fitting of all lens types • Understand concept of final checking of finished spectacle with frame adjustments, delivery and follow-up

		• Troubleshooting complaints and handling patient's questions
CUTM1798	BASIC AND OCULAR PHARMACOLOGY	• At the end of the course the students will acquire knowledge in the following aspects- • Learning basic principle of pharmacokinetics & Pharmacodynamics, commonly used ocular drugs, mechanism, indications, contraindications, drug dosage and adverse effects.
CUTM1794	OCULAR DISEASES II	• At the end of the course the students will be knowledgeable in the following aspects of ocular diseases: Knowledge on etiology, epidemiology, symptoms, signs, course sequelae of ocular diseases. Diagnostic approach, and management of ocular diseases.
CUTM1793	CONTACT LENSES-I	• Understand the basics of contact lenses • Learn the important properties of contact lenses, finalise the CL design for various kinds of patients, recognize various types of fitting, identify and manage the adverse effects of contact lens
CUTM1799	BINOCULAR VISION I	• At the end of the course students will be able to understand the following concepts: Grades of Binocular vision Fundamental theories of binocular vision Binocular muscle coordination Integration of motor and sensory system into binocular vision Depth perception Binocular optical defects Basic binocular evaluation Differentiate different types of strabismic anomalies - horizontal, vertical, torsional, paralytical& mechanical restrictive. Identify non strabismic anomalies related to accommodation & convergence Perform necessary investigations & its interpretation Provide the appropriate management
CUTM1795	CONTACT LENSES-II	• Understanding the basics of contact lenses • Finalising the CL design for various kinds of patients • Recognizing various types of fitting • Explaining all the procedures to patient

		• Identifying and manage the adverse effects of contact lens
CUTM1797	LOW VISION AND REHABILITATION	• At the end of the course, the student will be knowledgeable in the following: Definition and epidemiology of Low Vision Clinical examination of Low vision subjects Optical, Non-Optical, Electronic, and Assistive devices. Training for Low Vision subjects with Low vision devices Referrals and follow-up
CUTM1784	MEDICAL LAW AND ETHICS	• The role of law and the importance of ethics in medical practice.
CUTM1802	OCCUPATIONAL OPTOMETRY	• At the end of the course students will be knowledgeable in the following aspects: In visual requirements of jobs In effects of physical, chemical and other hazards on eye and vision To identify occupational causes of visual and eye problems To be able to prescribe suitable corrective lenses and eye protective wear To set visual requirements, standards for different jobs
CUTM1799	BINOCULAR VISION –II	• On completion of the course, students will be able to: Differentiate different types of strabismic anomalies - horizontal, vertical, torsional, paralytical & mechanical restrictive. Identify non strabismic anomalies related to accommodation & convergence Perform necessary investigations & its interpretation Provide the appropriate management
CUTM1800	PEDIATRIC & GERIATRIC OPTOMETRY	• The student on taking this course will be able to: Identify, investigate the age-related changes in the eyes. Be able to counsel the elderly Be able to dispense spectacles with proper instructions. Adequately gain knowledge on common ocular diseases.
CUTM1803	OPTOMETRIC INSTRUMENTS	• Upon completion of the course, the student will be able to: Gain theoretical knowledge and basic practical skill in handling the advanced instruments

CUTM1801	SYSTEMIC DISEASES AND EYE	• At the end of the course, students should get acquainted with the following: Common Systemic conditions: Definition, diagnostic approach, complications and management options Ocular findings of the systemic conditions First Aid knowledge
CUTM1804	PUBLIC HEALTH & COMMUNITY OPTOMETRY	• At the end of the course students will be be knowledgeable in the following areas: Community based eye care in India. Prevalence of various eye diseases Developing Information Education Communication materials on eye and vision care for the benefit of the public Organize health education programmes in the community Vision screening for various eye diseases in the community and for different age groups.
CUTM1809	PROJECT	• Working on a disease/ disorder specific assignment to fill the research gap in the specific area
CUTM1810	INTERNSHIP	• Dealing with patient specimens, analysis and interpretation of diseases

D. PSOs: Department of Radiology

PSO1: To understand how to prepare patients for radiology studies, dealing with allergies, contrast reactions, MRI safety, radiation exposure and safety issues in Radiology Clinical practice and to understand the Clinical and Technical aspects of Radiology.

PSO2: To have basic understanding of special imaging studies such as CT, Ultrasound, MRI, Fluoroscopy, Nuclear Medicine, interventional radiology and to be able to interpret major findings on Chest X-Ray.

PSO3: Graduates will be able to qualify various entrance exam/competitive examinations.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO 6**	**PO7**	**PO8**	**PO 9**	**PO1 0**	**PO1 1**	**PO12**
PSO1	**H**	**M**	**M**	**M**	**M**	**H**	**M**	**H**	**M**	**H**	**M**	**M**
PSO2	**M**	**H**	**H**	**M**	**H**	**H**	**H**	**H**	**M**	**H**	**H**	**M**
PSO3	**M**	**L**	**M**	**L**	**M**	**M**	**M**	**M**	**L**	**L**	**M**	**H**

Course Outcomes
B. Sc. MRT

Code	Subject Name	Course Outcome
CUTM1760	Cell Biology	• To understand the Scopes of biology, functions of cell organelles, carbohydrate metabolism and respiration • To understand how these cellular components are used to generate and utilize energy in cells
CUTM1757	GENERAL ANATOMY	• To understand and predict the body's responses to stimuli • To understand how the body maintains condition • Comprehend the normal disposition, inter-relationships, gross, functional and applied anatomy of various structures in the human body
CUTM1758	GENERAL PHYSIOLOGY	• Aims to understand the mechanisms of living things • Overall goal of this course is to enable students to understand the role of molecules, cells, tissues, organs, and organ systems, know the physiological principles underlying pathogenesis of disease
CUTM1762	Basic Radiation Physics	• To understand cancer treatment that uses high doses of radiation to kill cancer cells and shrink tumors. • To learn proper use of radiation monitoring devices; Performance of different techniques with minimal exposure
CUTM1765	Basic Medical Instrumentation &Techniques	• To learn the principle, instrumentation & application of Microscopy, principle, instrumentation & application of Centrifugation, principle of Spectroscopy • To obtain Knowledge about the basic electronic sensor systems. • To learn the functionality of the Biopotential records and advanced Medical instrumentation to work with the patient in real-time
CUTM1010	Environmental Studies	• Understanding the natural environment and its relationships with human activities. • Characterize and analyze human impacts on the environment. • Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems. • Design and evaluate strategies, technologies and methods for sustainable management of

		environmental systems and for the remediation or restoration of degraded environments. • Remediation or restoration of degraded environments.
CUTM1693	Proficiency in English	• Improve effective writing skills • Improvise articulating abilities
CUTM1763	Fundamental of Medical Imaging	• Understanding x-rays and the production and emission • Learning the skills to read the requisition slip; make entries in the register; understand the quality of the film; practice film processing • Understanding post-processing
CUTM1764	PRINCIPLES OF RADIATION THERAPY	• Understanding x-rays and the production and emission • Understanding about ultrasound and transducers • Understanding about basic concept of CT, MRI • Understanding about linear accelarators
CUTM1759	Basic Biochemistry	• To understand the concept of metabolism of carbohydrates, amino acids, lipids
CUTM1768	BASIC EQUIPMENT IN RADIOTHERAPY	• Understanding about Linear Accelerators • Learning basics of gamma rays • Basic features of simulators, magnetrons and klystron • To get the knowledge about the basic principle, physics and construction in Radiotherapy machine
CUTM1764	PRINCIPLES OF RADIATION THERAPY	• To study effects of different factors of x-ray • To check the developing time test and function • Learning about care and maintenance of X-Ray equipment • Primary treatment option for cancer before surgery to shrink cancerous tumors
CUTM1766	APPLIED RADIATION PHYSICS & RADIATION PROTECTION	• The purpose of radiation protection is to provide an appropriate level of protection for humans • Learning the principles for radiation safety: time, distance, and shielding. • Learning to prevent the occurrence of harmful deterministic effects
CUTM1769		• Understand about ultrasound and related equipment's

	MAMMOGRAPHY AND ULTRASOUND	• To understand about basic principle of Mammography • To learn the functionality of the mammography, ultrasound and Doppler techniques to work with the patient in real-time
CUTM1772	RADIOGRAPHIC TECHNIQUE-2	• Apart from normal procedure it teaches us about the special procedures Importance of contrast media
CUTM1770	APPLIED EQUIPMENT OF RADIO DIAGNOSIS	• Preparation of patients for general radiologic procedures. • Learning the concept of radiological contrast agents. • Introduction to nuclear medicine and PET scan
CUTM1016	Job Readiness	• To improvise the ability of the students towards facing job interviews
CUTM1767	RADIOGRAPHIC TECHNIQUE -1	• To learn various radiographic positions • Application of contrast media • Darkroom procedures
CUTM1771	Radiotherapy and Brachy Therapy Techniques in Malignant and Non Malignant Diseases	• Understanding about the treatment of cancer • Conceptual learning of dose limits for individuals
CUTM1774	INTERVENTIONAL RADIOLOGY& DRUGS USED IN DIAGNOSTIC RADIOLOGY	• Understanding of role of anaesthesia in diagnostic radiology. • Learning the principles of Cath-Lab equipments, special radiographic procedures and related contrast media
CUTM1742	Basic Computer & Information Science	• Study of basic input & output device of a computer, processor & memory, word, excel, power point
CUTM1777	IMAGE INTERPRETATION OF X-RAY MAMMOGRAPHY, CT & MRI	• Exposure to different hospitals • Identifying the Anatomy of body parts in X-ray, Mammography, Ultrasound, CT, and MRI images • Hands on training of x-ray, CT and MRI
CUTM1775	Computerized Tomography (CT scanning) Method and Procedure	• Diagnose muscle and bone disorders, such as bone tumors and fractures. • Guide procedures such as surgery, biopsy and radiation therapy • Gaining knowledge of imaging methods and techniques with their common appearances • Detecting and monitoring diseases and conditions such as cancer, heart disease, lung nodules and liver masses
CUTM1776	Basics of Magnetic Resonance Imaging	• Understanding of MRI, MRI scans of different organs

		• Understanding patient positioning during the MRI procedure of different organ system to obtain well defined images for proper diagnosis of MRI films and images • Interpretation of MRI report format and data analysis
CUTM1734	Medical Law and Ethics	• Understanding the significance of co-existence and professional ethics • Apply local, state, and federal standards and regulations for the control and use of health information
CUTM1778	ORIENTATION IN CLINICAL SCIENCES COURSE CONTENTS	• Understanding about different diseases and medicines • To Classify diseases of various body systems and how they manifest clinically and histopathologically • Learning of Orthopedics related problems
CUTM1773	Basic physical Principles of CT and MRI	• Conceptual understanding of CT and MRI • Indication of CT & MRI
CUTM1779	PROJECT	• Working on a disease/ disorder specific assignment to fill the research gap in the specific area
CUTM1780	Internship	• Dealing with patient, analysis and interpretation of diseases

E. Department of Emergency Medicine Technology

PSO1: Establish case-specific differential diagnoses for each patient you encounter. Demonstrate knowledge of the indications, contraindications, necessary equipment, and technique for a variety of commonly performed procedures.

PSO2: Demonstrate the capacity to interact with patients, families, and coworkers in a timely, professional, and effective manner. Communicate respectfully and culturally appropriate with patients and their families.

PSO3: Graduates will be able to qualify various entrance exam/competitive examinations.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	**PO 2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO10**	**PO1 1**	**PO12**
PSO1	**H**	**H**	**M**	**H**	**H**	**H**	**M**	**H**	**M**	**H**	**M**	**M**
PSO2	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**	**M**
PSO3	**M**	**L**	**M**	**M**	**M**	**M**	**L**	**M**	**L**	**M**	**M**	**H**

Centurion University

COURSE OUTCOME

B. Sc. EMT

Code	Subject Name	Course Outcome
CUTM1760	Cell Biology	• To understand the Scopes of biology, functions of cell organelles, carbohydrate metabolism and respiration • To understand how these cellular components are used to generate and utilize energy in cells
CUTM1757	General Anatomy	• Use anatomical terminology to identify and describe locations of major organs of each system. • Explain interrelationships among molecular, cellular, tissue, and organ functions in each system • Detailed anatomy of human body
CUTM1758	General Physiology	• Learn about the Scopes of anatomy & physiology • Detailed physiology of human body • Understand the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems
CUTM1732	Biochemistry	• Demonstrate an understanding of fundamental biochemical principles, such as the structure/function of metabolic pathways, and the regulation of biological/biochemical processes • Apply modern instrumentation theory and practice to biochemical problems • Recognize potential laboratory safety concerns and address them using appropriate techniques.
CUTM1729	Cell Biology	• Describes the evolution, diversity and replication of cells; • Explains the role of compartmentalization and signalling in cellular biology; • Interpret and explain key experiments in the history of cell biology; • Evaluate and apply knowledge of modern techniques in cellular biology.
CUTM1839	Medical Terminology and Record keeping	• Ensuring successful learning of basic and advance medical terminology • Student will able to read, write, spell and understand the medical terminology • Understand the types, importance and role of medical records and its management techniques.

CUTM1742	Basic computer and Information Science	• Understand the difference between an operating system and an application program, and what each is used for in a computer • Identify the factors that go into an individual or organizational decision on how to purchase computer equipment • Identify how to maintain computer equipment and solve common problems relating to computer hardware. • Identify how software and hardware work together to perform computing tasks and how software is developed and upgraded
CUTM1734	Medical Law and Ethics	• The course provides an introduction to ethics generally and more specifically to medical ethics, examining in particular the principle of autonomy, which informs much of medical law. • The course then considers the general part of medical law governing the legal relationship between medical practitioners and their patients. • It considers the legal implications of the provision of medical advice, diagnosis and treatment. Selected medico-legal issues over a human life are also examined. • These may include reproductive technologies, fetal rights, research on human subjects, organ donation, the rights of the dying and the legal definition of death.
CUTM1753	Introduction to Quality and Patient safety	• Understand policy related to managing lab and infection control • Study of health literacy • Teamwork and culture of safety • Quality improvement innovations
CUTM1813	Pharmacology	• To acquire knowledge regarding the Pharmacokinetics and pharmacodynamics of drugs • To acquire knowledge regarding Drugs and its inter-actions on different body systems • Detailed study about different anesthetic drugs.
CUTM1733	Microbiology	• Understand the natural environment and its relationships with human activities. • Characterize and analyze human impacts on the environment. • • Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems. • Design and evaluate strategies, technologies and methods for sustainable management of

		environmental systems and for the remediation or restoration of degraded environments. • Remediation or restoration of degraded environments
CUTM1818	Basic principles of Hospital Management	• Understand the role and functions of operations within the organisation. • Analyzing the key concepts, theories and techniques for the adequate functioning of the hospital. • Identify and demonstrate the dynamic nature of the environment in which the organization is functioning and the implications of it the competitive market. • Appling the conceptual frameworks, theory and techniques to various inventory management aspects in the hospital. • Evaluate the relevance of the equipments and the inventories in the critical functioning of the hospital.
CUTM1862	Hospital & Clinical Pharmacy	• Know various drug distribution methods • Know the professional practice management skills in hospital pharmacies. • Provide unbiased drug information to the doctors. • Interpret evidence and patient data. • Implement and/or recommend patient care plans. • Monitor the patient and adjust the care plan as needed.
CUTM1851	Introduction to emergency services-Part I	• For Understanding the Basic Principle of resuscitation • For Understanding Specific resuscitative procedures • For Understanding Universal Precautions and Infection Control
CUTM1852	Emergency Department Equipment Part - I	• For Understanding Basic principle, description, types, usage, calibration and maintenance of Laryngoscopes, Endo-tracheal tubes (ETT), boogie Ambu bag and mask • To Learn Basic principle, description, types, usage, calibration and maintenance of ICD tubes, bags, jars, instrument tray , Suction apparatus
CUTM1853	Emergency Department Pharmacology Part-I	• To Learn Preparation of injections and infusions • To Learn Routes of administration of medications • To Learn Indications for use, dosage, route and method of administration

CUTM1854	Introduction to emergency services - Part II	• To Learn the Basic principle, description, types, usage, calibration and maintenance of Electrocardiograph, Multi-parameter monitors, Ventilator, Defibrillator, AED, Trolleys and stretchers, Anesthesia work-station, Splints, Plaster of Paris and immobilization devices • To Learn the Emergency Department Equipment Application/ connection to patient, usage, calibration, changing settings, demonstrating maintenance of equipment
CUTM1855	Emergency department equipment -Part II	• To Understand Review of prescription writing, parts of a prescription, abbreviations used and their interpretation • To Learn Indications for use, dosage, route and method of administration and adverse effects of drugs commonly used in the Emergency Department • To learn Emergency Department Pharmacology Problems based on drug dosage calculation
CUTM1856	Emergency Department Pharmacology-Part II	• For Learning Review of prescription writing, parts of a prescription, abbreviations • To Learn Indications for use, dosage, route and method of administration • For learn Medication errors look alike and sound alike drugs, strategies to reduce error • For understanding Demonstration of strategies to reduce medication error • To Learn Preparation of IV injection
CUTM1807	Medical Psychology	• To Learn Scope of Psychology. Branches of psychology • To Learn Identifying psychological disorders • Learning; Meaning, definition, Theories of learning. Pavlov's classical conditioning. Skinner's operant conditioning • Therapeutic Techniques. Counselling-meaning and definition. Psychotherapy
CUTM1857	Psychiatric, Geriatric & Obstetric Emergencies	• For Learning Approach to the geriatric patient • To understand Assessment of a pregnant patient • To understand clinical assessment and point of care investigations in the field and emergency department • To learn Depression - presenting symptoms, clinical assessment, basic initial management
CUTM1858	Medical emergencies - Part I	• To Understanding Cardiovascular Emergencies • To Understand the Pulmonary Emergencies • To Understand Fluid and Electrolyte Disturbances • To Understand Neurological Emergencies

		• To understand Preparing an ambulance for medical emergency
CUTM1859	Medical emergencies-Part II	• To understand Gastrointestinal Emergencies • To understand Endocrine and Metabolic Emergencies • To understand Renal Emergencies • To understand Bites and Stings • To understand Other Medical Emergencies
CUTM1751	Medical Laboratory Management	• Become professionally competent in medical laboratory. • Exhibit a sense of commitment to the ethical and human aspect of patient care. • Recognize the role of clinical laboratory scientist in the assurance of quality health care. • Application of safety and governmental regulation and standards as applied to medical laboratory practice.
CUTM1715	Clinical Pathology	• Able to collect pathological specimen • Able to detect diabetes, ketosis, nephritis, jaundice and other physiological disorder • Able to detect infectious disease (UTI, Hematuria, Filaria, Dysentery, Ulcer, TB, etc.) • Preservation and processing of pathological sample. • Identification of Parasites • Analysis of Infertility disorder
CUTM1860	Project	• Working on a disease/ disorder specific assignment to fill the research gap in the specific area with the surgical procedures.
CUTM1861	Internship	• Dealing with patient, analysis, evaluating, treatment planning and execution of treatment with respect to the patient conditions or diseases

F. Department of Anaesthesia Technology

PSO1: Aid the anaesthesia practitioner with patients of all types, ages, and physical states for a variety of surgical and medical procedures while incorporating technical and critical thinking and clinical reasoning. As an anaesthetic technologist, demonstrate current and emerging standards of care.

PSO2: Providing culturally competent care, paying attention to the unique demands of distinct multicultural and complicated client populations. Participate in initiatives that strengthen the role of anaesthesia technologists and positively affect health-care policy decisions. Personal and professional demonstration of honesty and integrity.

PSO3: Graduates will be able to qualify various entrance exam/competitive examinations.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	PO 2	PO3	PO4	PO 5	PO6	PO7	PO8	PO 9	PO10	PO1 1	PO12
PSO1	**H**	**M**	**M**	**M**	**H**	**H**	**M**	**H**	**M**	**H**	**M**	**M**
PSO2	**M**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**	**M**
PSO3	**M**	**L**	**M**	**L**	**M**	**M**	**L**	**M**	**L**	**L**	**M**	**H**

COURSE OUTCOME

B. Sc. AT

Subject Code	Subject Name	Subject Outcome
CUTM1757	General Anatomy	• To acquire knowledge about the general anatomy – the structure of different organs and position of the organ. • Students get familiarized with the different anatomical terminology and positions of the body and how the structures are modified by exercise or disease.
CUTM1758	General Physiology	• To acquire Knowledge about the general physiological systems and physiological terminology. • To familiarize the student with the functionality of different physiological systems. • To develop the technical skills in identifying the Biopotential and their recording and advanced systems. • Overall goal of this course is to enable students to understand the role of molecules, cells, tissues, organs, and organ systems • To know the physiological principles underlying pathogenesis of disease

CUTM1732	Biochemistry	• After completion of the course the student will develop a very good understanding of various biomolecules which are required for development and functioning of cells. • The conceptual understanding of the subject provides opportunities for skill enhancement and scopes for higher education • Understanding the significance of biomolecules in metabolic activities by carbohydrates, proteins and enzymes and detection of abnormal range of these molecules from patient sample
CUTM1729	Cell Biology	• To understand the Scopes of biology, functions of cell organelles, carbohydrate metabolism and respiration • To understand cell signalling and how it regulates cellular functions, also how its dis-regulation leads to cancer and other diseases
CUTM1742	Basic Computer and Information Science	• Understand the difference between an operating system and an application program, and what each is used for in a computer • Identify the factors that go into an individual or organizational decision on how to purchase computer equipment • Identify how to maintain computer equipment and solve common problems relating to computer hardware. • Identify how software and hardware work together to perform computing tasks and how software is developed and upgraded • Identify different types of software, general concepts relating to software • categories, and the tasks to which each type of software is most suited or not suited
CUTM1734	Medical Law and Ethics	• The course provides an introduction to ethics generally and more specifically to medical ethics, examining in particular the principle of autonomy, which informs much of medical law. • The course then considers the general part of medical law governing the legal relationship between medical practitioners and their patients. • It considers the legal implications of the provision of medical advice, diagnosis and treatment. Selected medico-legal issues over a human life are

		also examined, which includes reproductive technologies, fetal rights, research on human subjects, organ donation, the rights of the dying and the legal definition of death.
CUTM1815	Basics of Nursing	• Knowledge on concept of health, health-illness continuum and health care delivery system. • Knowledge on scope of nursing practice. • Knowledge on concepts, theories and models of nursing practice. • Desirable attitude to ethics and professional conduct.
CUTM1814	Basics in Medical Physics & Electronics	• Understand the basics of laser, radiation & nuclear physics, Electromagnetism. • Identify medical radiation related instrumentation and apply techniques associated with diagnostic imaging and radiation oncology. • Compare theoretical, practical and professional information and communicate knowledge, ideas and procedures to other health care professionals/practitioners, researchers and other key stakeholders.
CUTM1733	Microbiology	• Apply the knowledge to understand the microbial physiology and to identify the microorganisms. • Understand the regulation of biochemical pathway and possible process modifications for improved control over microorganisms for microbial product synthesis.
CUTM1816	Introduction to anesthesia and OT Technology	• Understand the safe anesthesia techniques for various elective and emergency procedures in and outside the operation theatre. • Obtain knowledge about the proper functioning of various anesthetic equipment such as the work station, anesthesia monitors, syringe pumps etc. • Assist the anesthesiologists efficiently during procedures in and outside the operation theatre. • Perform Basic skills of cardiopulmonary resuscitation, post-operative and intensive care unit management. • Learn the basic nursing skills of various surgical procedures including the surgical instruments used in the surgical procedures.

CUTM1813	Pharmacology	• Understand the chemistry of drugs with respect to their pharmacological activity • Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs • Know the Structural Activity Relationship of different class of drugs • Study the chemical synthesis of selected drugs.
CUTM1820	Pharmacology related to Anesthesia Technology	• Understanding various organ systems, anaesthetics agents and its pharmacokinetics
CUTM1833	Clinical Hospital Practice for AT-I	• Concept on cleaning and sterilization of anesthetic equipment, Pre operative preparation, Emergency drugs, Anesthesia induction
CUTM1821	Concepts of Diseases and Techniques in Regional & General Anesthesia including	• Understanding the basics of Balanced anesthesia, Pre anaesthetic assessment, Investigations and Pre-anaesthetic orders, Intraoperative management and Postoperative complications & management • Understand the technique and practical concept to handle patient with critical condition
CUTM1834	Clinical Hospital Practice for AT-II	• After completion of the course the student will be confident about Advanced technique and gain knowledge of good skilled to handle patient with critical condition on Drugs and anaesthetic consideration
CUTM1979	Anesthesia for Specialty Surgeries	• In this course, students learn the general concepts related to health and disease, and become familiar with some common diseases of different body organs, their effect(s) on the functioning of other organs, diagnostic-therapeutic measures, and common operations on different body systems and their possible side effects after the application of Anesthesia. Meanwhile, students also learn about the necessary patient care measures before and after surgery.
CUTM1825	Anesthesia for Patients with Medical disorders	• In this course, students learn the general concepts and principles of patient care. They also become familiar with the basics of working in the operating and recovery rooms, the way to admit, prepare, and transfer the patient to the operating room, and the general principles of patient care before, during and after surgery.

CUTM1835	Clinical Hospital Practice for AT-III	• In this course, students become familiar with patient preparation and patient care methods for general or local anesthesia, with the use of different methods to make patients unconscious and bring them back to consciousness in specialty and subspecialty surgeries, and with other diagnostic-therapeutic measures. They also gain the ability needed for taking good care of patients.
CUTM1828`	Post Anesthesia care Unit	• In this course, students become familiar with the structure, instruments, equipment, and standards of the post-anesthesia care unit, and the way to manage and work in that unit. • They also learn how to take good care of inpatients that need special attention. Meanwhile, they will be able to understand the possible postoperative complications and act under an anesthesiologist's supervision to prevent them, provide a proper report, and help in their treatment.
CUTM1829	Health Care Management	• This course provide a brief knowledge about the Concept of Health Care and Health Policy, Health Organisation, Health Policy and National Health Programme
CUTM1822	Anesthesia Techniques Including Complication	• Learning the principles and methods of general and local anesthesia, patient preparation, different body systems monitoring, complications of anesthesia, and patient care before, during and after general and local anesthesia. • Setting up of the required equipment for general anaesthesia, Monitoring and diagnostic procedures in ICU, Intraoperative Management.
CUTM1827	Anesthesia for Specialties (Including Critical Care Assistance and Ventilation)-Paper II	• After completion of this course student will get good idea to process the application of Cardiac anaesthesia, Neuro Anaesthesia, Anaesthesia for Trauma & Shock, Obstetric Anaesthesia, Paediatric Anaesthesia
CUTM1836	Clinical Hospital	• In this course, students become familiar with insertion of nasopharyngeal tube, methods of defibrillation, anaesthesia in MRI etc.

	Practice for AT-1V	
CUTM1837	Internship	• Dealing with patient, analysis, evaluating, treatment planning and execution of treatment with respect to the patient conditions or diseases
CUTM1838	Project	• Working on a disease/ disorder specific assignment to fill the research gap in the specific area

G. Department of Operation Theatre Technology

PSO1: Prepare the operating room, load and label required medications, and gather and assemble surgical equipment for common surgical procedures based on their complexity and duration. Recognize patients' anxiousness during the peri-operative period and provide necessary assistance in shifting, inducing anaesthesia, and positioning them for surgical procedures.
PSO2: Help in the implementation, setup, commissioning, maintenance, and management of operation theatres, emergency departments, intensive care units, cardiac catheterization labs, and emergency response services.
PSO3: Graduates will be able to qualify various entrance exam/competitive examinations.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	**PO 2**	**PO3**	**PO4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO10**	**PO1 1**	**PO12**
PSO1	**H**	**M**	**M**	**M**	**H**	**H**	**M**	**H**	**M**	**H**	**M**	**M**
PSO2	**M**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**	**M**
PSO3	**M**	**L**	**M**	**L**	**M**	**M**	**L**	**M**	**L**	**L**	**M**	**H**

COURSE OUTCOME

B. Sc. OTT

Code	**Subject Name**	**Course Outcome**

CUTM1757	General Anatomy	• Use anatomical terminology to identify and describe locations of major organs of each system. • Understanding interrelationships among molecular, cellular, tissue, and organ functions in each system
CUTM1758	General Physiology	• Learn about the Scopes of anatomy & physiology, detailed physiology of human body • Understanding the functions of important physiological systems including the cardio-respiratory, renal, reproductive and metabolic systems
CUTM1732	Biochemistry	• Demonstrate an understanding of fundamental biochemical principles, such as the structure/function of metabolic pathways, and the regulation of biological/biochemical processes • Applying modern instrumentation theory and practice to biochemical problems • Recognizing the potential laboratory safety concerns and address them using appropriate techniques.
CUTM1729	Cell Biology	• Understanding the evolution, diversity and replication of cells • Understanding the role of compartmentalization and signalling in cellular biology • Evaluate and apply knowledge of modern techniques in cellular biology.
CUTM1839	Medical Terminology and Record keeping	• Ensuring successful learning of basic and advance medical terminology • Student will be able to read, write, spell and understand the medical terminology • Understand the types, importance and role of medical records and its management techniques.

CUTM1742	Basic computer and Information Science	• Understand the difference between an operating system and an application program, and what each is used for in a computer • Identifying the factors that go into an individual or organizational decision on how to purchase computer equipment • Identifying how to maintain computer equipment and solve common problems relating to computer hardware. • Identifying how software and hardware work together to perform computing tasks and how software is developed and upgraded
CUTM1734	Medical Law and Ethics	• The course provides an introduction to ethics generally and more specifically to medical ethics, examining in particular the principle of autonomy, which informs much of medical law. • The course then considers the general part of medical law governing the legal relationship between medical practitioners and their patients. • It considers the legal implications of the provision of medical advice, diagnosis and treatment. Selected medico-legal issues over a human life are also examined which includes reproductive technologies, fetal rights, research on human subjects, organ donation, the rights of the dying and the legal definition of death.
CUTM1753	Introduction to Quality and Patient safety	• Understand policy related to managing lab and infection control • Study of health literacy • Understanding aspects of teamwork and culture of safety • Learning of quality improvement innovations

CUTM1840	Practical orientation on Community and Health care sector industry	• Demonstrate adequate knowledge and mastery of techniques relevant to hospital management and/or to demonstrate a clear understanding of concepts, information and techniques at the forefront of the hospital management discipline • Develop awareness of the responsibilities of senior hospital management, including understanding the role and functions of hospitals and their health care context and prepare to handle the management and development issues faced by a hospital manager, including structure and organization; planning and managing resources; and reviewing and evaluating services. • Recognize how operational problems and situations are handled in practice by undertaking and reporting at a hospital attachment
CUTM1813	Pharmacology	• To acquire knowledge regarding the Pharmacokinetics and pharmacodynamics of drugs • To acquire knowledge regarding Drugs and its inter-actions on different body systems • Detailed study about different anesthetic drugs.
CUTM1733	Microbiology	• This study demonstrates the theory and practical skills in microscopy and their handling techniques and staining procedures. • Understanding the details of microbial cell organelles. • Provides knowledge on the growth of microorganism. • Studying the significance of microorganisms • Learning the various role of various cell organelles in the survival of microorganisms • Exposure to different techniques applicable for sterilization

CUTM1818	Basic principles of Hospital Management	• Understand the role and functions of operations within the organisation. • Analyzing the key concepts, theories and techniques for the adequate functioning of the hospital. • Identify and demonstrate the dynamic nature of the environment in which the organization is functioning and the implications of it the competitive market. • Appling the conceptual frameworks, theory and techniques to various inventory management aspects in the hospital. • Evaluate the relevance of the equipments and the inventories in the critical functioning of the hospital.
CUTM1845	Clinical practices in hospital for OTT- I	• Understanding the basic operations of the operation theatre while interacting with the multidisciplinary team members involved in providing optimal care to the patients. • Able to learn terminologies, equipment, and techniques used for preparation and management of the OT.
CUTM1862	Hospital & Clinical Pharmacy	• Know various drug distribution methods • Know the professional practice management skills in hospital pharmacies. • Provide unbiased drug information to the doctors. • Interpret evidence and patient data. • Implement and/or recommend patient care plans. • Monitor the patient and adjust the care plan as needed.
CUTM1816	Introduction to Anesthesia and OT Technology	• Demonstrate ability to prepare and maintain Operation Theater • Able to identify and move to maintain a sterile field • Manage and maintain theatre equipments • Suggesting a simple anesthetic plan commonly used anesthesia noninvasive • Monitoring in the Operation Theatre
CUTM1822	Anesthesia Techniques	• Learning the principles and methods of general and local anesthesia, patient preparation, different body systems monitoring, complications of anesthesia, and

	Including Complications	patient care before, during and after general and local anesthesia. • Setting up of the required equipment for general anaesthesia, Monitoring and diagnostic procedures in ICU, Intraoperative Management.
CUTM1846	Clinical practices in hospital for OTT- II	• Students will gain additional skills in clinical preparation, interaction with patients and professional personnel. • Students apply knowledge from previous clinical learning experience under the supervision of a senior technical officer.
CUTM1841	Basics of Surgical procedures	• To be able to assist anesthesiologists in pre-operative, surgical theater, recovery room, and post-operative intensive care procedures in both minor and major surgeries.
CUTM1814	Basics in Medical Physics & Electronics	• Understand the basics of laser, radiation & nuclear physics, Electromagnetism. • Identify medical radiation related instrumentation and apply techniques associated with diagnostic imaging and radiation oncology. • Compare theoretical, practical and professional information and communicate knowledge, ideas and procedures to other health care professionals/practitioners, researchers and other key stakeholders.
CUTM1842	CSSD Procedures	• Understanding the basics of Sterilization • Learning the methods of disinfection • Learning the Laboratory Safety Rules
CUTM1847	Clinical practices in hospital for OTT- III	• Students will improve their skills in clinical procedures. • Progressive interaction with patients and professional personnel are monitored as students practice in a supervised setting. • Learning the problem solving, identifying machine components and basic side effect management.Students will demonstrate competence in beginning, intermediate, and advanced procedures.

CUTM1843	Advance surgical techniques	• The programme aims to offer knowledge and expertise to provide a transition between theory and your own clinical practice. • The multifaceted nature of caring for surgical patients is evaluated from an evidence-based perspective. • Teaching considers the full journey of the surgical patient, starting with admission and preoperative preparation through to postoperative care and discharge.
CUTM1844	Basic Intensive care	• Understanding the Care and maintenance of ventilators, suction machine, monitoring devices. • Basic knowledge on Sterilization and disinfection of ventilators. • Basic learnings on Suctioning and posturing of semiconscious and unconscious patients
CUTM1848	Clinical practices in hospital for OTT- IV	• The course provides students the opportunity to continue to develop confidence and increased skill in simulation and treatment delivery. • Students will participate in advanced and specialized treatment procedures.
CUTM1849	OTT Project	• Working on a disease/ disorder specific assignment to fill the research gap in the specific area with the surgical procedures.
CUTM1850	OTT Internship	• Dealing with patient, analysis, evaluating, treatment planning and execution of treatment with respect to the patient conditions or diseases

H. PSOs: Department of Physiotherapy

PSO1: The objective of this course is to outline the cognitive, emotional, and psychomotor abilities that are necessary for examining, diagnosing, planning, and documenting physiotherapy treatment. It is expected to enhance the ability to assess patients for impairments and functional limitations and then perform routine physiotherapeutic procedures based on the findings.

PSO2: To operate and maintain physiotherapy equipment used in patient treatment, as well as to design and carry out physiotherapy treatment (both electrotherapy and exercise therapy) and procedures. To educate patients about different physiotherapeutic techniques.

PSO3: Graduates will be able to qualify various entrance exam/competitive examinations.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	PO 2	PO3	PO4	PO 5	PO6	PO7	PO8	PO 9	PO10	PO1 1	PO12
PSO1	**H**	**M**	**M**	**M**	**M**	**H**	**H**	**M**	**M**	**H**	**M**	**H**
PSO2	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**M**	**H**	**H**	**H**
PSO3	**M**	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**L**	**M**	**M**	**H**

COURSE OUTCOME

Bachelor in Physiotherapy

Subject Code	Subject Name	Subject Outcome
CUTM1757	General Anatomy	• To acquire knowledge about the general anatomy – the structure of different organs and position of the organ. • Student get familiarize with the different anatomical terminology and positions of the body and how the structures are modified by exercise or disease.
CUTM1758	General Physiology	• To acquire Knowledge about the general physiological systems and physiological terminology. • To familiarize the student with the functionality of different physiological systems. • To develop the technical skills in identifying the Biopotential and their recording and advanced systems. • overall goal of this course is to enable students to understand the role of molecules, cells, tissues, organs, and organ systems

		• Know the physiological principles underlying pathogenesis of disease
CUTM1732	Biochemistry	• After completion of the course the student will be developed a very good understanding of various biomolecules which are required for development and functioning of cells. • The conceptual understanding of the subject provides opportunities for skill enhancement and scopes for higher education • Understanding the significance of biomolecules in metabolic activities by carbohydrates, proteins and enzymes and detection of abnormal range of these molecules from patient sample
CUTM1729	Cell Biology	• To understand the Scopes of biology • Functions of cell organelles • Carbohydrate metabolism and respiration • Understand cell signaling and how it regulates cellular functions, also how its dis- regulation leads to cancer and other diseases
CUTM1733	Microbiology	• This study demonstrates the theory and practical skills in microscopy and their handling techniques and staining procedures. • Understanding the details of microbial cell organelles. • Provides knowledge on the growth of microorganism. • Provides knowledge Culturing microorganism.
CUTM1715	Clinical Pathology	• Able to collect pathological specimen • Able to detect diabetes, ketosis, nephritis, jaundice and other physiological disorder

		• Able to detect infectious disease (UTI, Hematuria, Filaria, Dysentery, Ulcer, TB, etc.) • Preservation and processing of pathological sample. • Identification of Parasites. • Analysis of Infertility disorder
CUTM1813	Pharmacology	• To acquire knowledge regarding the Pharmacokinetics and pharmacodynamics of drugs • To acquire knowledge regarding Drugs and its inter-actions on different body systems • Detailed study about different anesthetic drugs
CUTM1613	Proficient English	• Ability to communicate fluently in different business situation • Effective oral and written communication • Appropriate word usage with correct pronunciation • Clarity of word stress and intonation.
CUTM1010	Environmental Science	• Understand the natural environment and its relationships with human activities. • Characterize and analyze human impacts on the environment. • Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems. • Design and evaluate strategies, technologies and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments. • remediation or restoration of degraded environments
CUTM1734	Medical Law and Ethics	• Understanding the significance of co-existence and professional ethics in the medical field. • The maintenance of professional standards in the healthcare profession, and the role of policy

		in the formation of law as it relates to medicine.
CUTM1742	Basic Computer and Information Science	• Understand the difference between an operating system and an application program, and what each is used for in a computer • Study of basic input & output device of a computer • Processor & memory • Word, excel, power point
CUTM1721	Research Methodology	• Provide learning opportunities to critically evaluate research methodology and findings • Study of Scientific writing, Selection of problem, criteria for selecting a research title, research hypothesis • Sample design
CUTM1976	Electro therapy - I	• Students get to Know the indications and contraindications of various types of electrotherapeutic currents • Demonstrate the knowledge on application of electrotherapy on nerve lesions, facilitation of muscle contraction and pain relief by low frequency currents. • Understand physiology of electrical stimulation on excitable tissue principles, techniques and effects of electrotherapy as a therapeutic modality in the restoration of physical function.
CUTM1977	Exercise therapy	• Analysis of various types of massage techniques and their effects. • Analysis of various types of therapeutic exercise and movements. • Knowledge on the clinical measurements available in the rehabilitation process and interpret them. • Interpretation of the Merits and demerits of manual muscle testing.
CUTM1978	Psychology and Sociology	• Understanding specific psychological factors and effects in physical illness.

		• Development of holistic approach in their dealing with patients during admission, treatment, rehabilitation and discharge. • Understanding the social and economic aspects of community that influence the health of the people. • Identification of social institutions and resources. • Appreciation of the role of therapist as a member of society and the interdependence of individuals and society. • Demonstration of an understanding of the role of socio cultural factors as determinants of health and behaviors in health and sickness.
CUTM1979	Electrotherapy - II	• Acquire knowledge of the physics of heat, sound and soft laser and their effects on tissues along with principles, techniques and effects of them as a therapeutic modality in restoration of physical function. • Understand the physiology of electromagnetic field on excitable tissue, principles, techniques and effects of electrotherapy as a therapeutic modality in the restoration of physical function. • Indications and contraindications of various types of electrotherapy, actinotherapy ,cryotherapy and describe their effects.
CUTM1980	Biomechanics and Kinesiology	• Demonstration of an understanding of the principles of biomechanics and kinesiology and their application in health and disease • Analysis of normal human movement from a global perspective, integrating biomechanics, muscle mechanics and motor control theory
CUTM1981	Community Medicine	• The influence of social and environmental factors on the health of the individual and society. • The effects of the environment and the community dynamics on the health of the individual.
CUTM1982	Physiotherapy in Cardio-Pulmonary Condition	• Learn how to undertake physiotherapeutic measures as preventive/restorative

		rehabilitative purposes for pulmonary/cardiac patients.
CUTM1983	Principle of Rehabilitation	• Demonstrate an understanding of the concept of team approach in rehabilitation and implementation with contributions from all members of the team, medical and surgical aspects of disabling conditions. • Identify the residual potentials in patients with partial or total disability.
CUTM1984	Paediatrics and Geriatrics	• Students will be able to Understand the aging process and its physiological effect. • Understand Diet & Nutritional requirements of the younger and elderly ones.
CUTM1985	Surgery - I	• Demonstrate a general understanding of the diseases that therapists would encounter in their practice. • Demonstrate skill in providing the treatment for the disabilities identified according to the clinical picture and rehabilitation need of the patient.
CUTM1986	General Medicine- I	• Demonstrate a general understanding of the diseases that therapists would encounter in their practice. • Know the etiology and pathology, the patient's symptoms, the resultant functional disability and the limitations imposed by the disease on any therapy.
CUTM1987	Medicine - II (Cardiology and Work Physiology)	• Understand the goals of pharmacological therapy in those diseases in which physical therapy will be an important component of overall management

CUTM1988	Medicine - III (Neurology)	• To Understand the disability and plan treatment for these disabilities due to pathology in nervous system. • To Demonstrate skill in providing the treatment for the disabilities identified according to the clinical picture and rehabilitation need of the patient.
CUTM1989	General Orthopedics	• In Identification of disability and plan treatment for these disabilities due to pathology in the musculoskeletal system, as well as evaluate and document them. • To Demonstrate of skill in providing the treatment for the disabilities identified according to the clinical picture and rehabilitation need of the patient.
CUTM1990	Surgery II	• In Identification of disability and plan treatment for these disabilities due to pathology in the musculoskeletal system, as well as evaluate and document them. • To Demonstrate of skill in providing the treatment for the disabilities identified according to the clinical picture and rehabilitation need of the patient.
CUMT1991	Medicine IV (Psychiatry)	• Understanding the elementary principles of behaviour for applying in the therapeutic environment. • Understanding specific psychological factors and effects in physical illness. • Development of a holistic approach in their dealing with patients during admission, treatment, rehabilitation and discharge.
CUTM1992	Physical Diagnosis and Physical Fitness	• Demonstrate to assess patients, utilizing various principles. • Analyze the patients problem.

		• Conclude physical diagnosis.
CUTM1993	Yoga and Naturopathy	• Demonstrate to assess patients, utilizing various principles. • Analyze the patient problem. • Analysis on Yoga and its relationship with Healthcare.
CUTM1994	Physiotherapy in Medical Condition	• To Identify cardio respiratory dysfunction, understand and analyze the clinical problems of the described conditions. • To Understand the goals of pharmacological therapy in those diseases in which physical therapy will be an important component of overall management.
CUTM1995	Physiotherapy in Surgical Condition	• Gain the skill of clinical examination; apply special tests & interpretation of the preoperative old cases & all the post-operative cases. • Be able to interpret Pathological / Biochemical studies pertaining to various diseased conditions.
CUTM1996	Physiotherapy in Orthopaedic Conditions	• Understand the disability and plan treatment for these disabilities due to pathology in musculoskeletal system. • Demonstrate skill in providing the treatment for the disabilities identified according to the clinical picture and rehabilitation needs of the patient.
CUTM1997	Physiotherapy in Neurological Conditions	• Understand the disability and plan treatment for these disabilities due to pathology in the nervous system. • Demonstrate skill in providing the treatment for the disabilities identified according to the

		clinical picture and rehabilitation needs of the patient.
CUTM1998	Internship	• Dealing with patient, analysis, evaluating, treatment planning and execution of treatment with respect to the patient conditions or diseases
CUTM1999	Project	• Working on a disease/ disorder specific assignment to fill the research gap in the specific area

M. Sc. – Medical Laboratory Technology/ Applied and Clinical Microbiology/ Optometry

Programme Objectives;

The programme aims at preparing the students to furnish primary medical aid in rural areas. It also aims to bestow hands on training to increase proficiency and upskilling the technical knowledge of the students in cutting edge biomedical techniques. These courses accord experience to the deserving, qualified person with adequate experience. It aims at providing adequate training to the unemployed youth and to help them for setting up under self-employment schemes and increasing entrepreneurship.

POs: Paramedics Masterates will be able to;

PO	**Outcomes**
PO1	Apply knowledge of basic science and allied health science.
PO2	Design and conduct experiments, as well as to carry out problem analysis data interpretation
PO3	Design and develop process to meet desired needs within realistic constraints.
PO4	Function effectively as a leader and member of multidisciplinary teams.

PO5	Isolate, identify, synthesize, formulate and solve complex healthcare problems.
PO6	Understanding of professional and ethical responsibility
PO7	Communicate effectively
PO8	Understand the impact of allied healthcare in a global, economic, environmental, and societal context
PO9	Manage contemporary healthcare projects and their financial implications.
PO10	Use the techniques, skills, and modern healthcare instruments and tools necessary for allied health profession.
PO11	Analyze, screen and ensure quality in healthcare delivery.
PO12	Engage in life-long learning
PO13	Demonstrate a knowledge and understanding of contemporary technologies, their applications and limitations, contemporary research in the broader context of relevant fields

A. PSOs of Department of Medical Laboratory Technology:

PSO1. The Programme enables the student to be employed in diagnosis and prevention of diseases through the use of clinical laboratory tests by helping doctors to detect, diagnose and treat diseases.

PSO2. Students will be able to analyze body fluids, tissues, and perform blood typing, microorganism screening, chemical analyses, cell counts of human body etc. Allows them to determine the presence, extent or absence of disease and provide data needed to evaluate the effectiveness of treatment.

PSO3. Post graduates will be able to qualify various entrance exam/competitive examinations.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO 1	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PO1 3**
PSO 1	**H**	**H**	**M**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**

PSO 2	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**
PSO 3	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**H**	**H**

Course Outcomes
M. Sc. Medical Laboratory Technology

Code	Subject Name	Course Outcome
CUTM1708	Human Anatomy and Physiology	• Use anatomical terminology to identify and describe locations of major organs of each system. • Explain interrelationships among molecular, cellular, tissue, and organ functions in each system • Learn about the Scopes of anatomy & physiology, detailed anatomy of human body, detailed physiology of human body
CUTM1709	Analytical Techniques	• Understanding the working principle of common instruments used in a diagnostic lab • To understand the Principle, instrumentation & application of microscopy, centrifugation, microtome, spectroscopy
CUTM1710	Biological Chemistry	• Demonstrating an understanding of fundamental biochemical principles, such as the structure/function of metabolic pathways, and the regulation of biological/biochemical processes
CUTM1712	Clinical Hematology	• Differentiating various hematological procedures and the use of basic equipment essential to working in a Hematology Laboratory • To perform tests performed in hematology laboratory based on Hematological disorders
CUTM1715	Clinical Pathology	• The student will get acquainted with collection and tests performed on urine sample, stool sample and other body fluids • They will understand the Anatomical pathology
CUTM1714	Cell and Molecular Biology	• Understanding the mechanism of gene expression and protein synthesis; understand the use of several molecular techniques in disease diagnosis • Understanding the central dogma of life • To understand the concept of regulation and its impact • Understanding of molecular diagnostic techniques

CUTM1718	Clinical Biochemistry	• Understanding of principle of Clinical biochemistry tests • To study about diseases related to biochemical and hormone imbalance in human body
CUTM1720	Histology	• To learn special staining procedures & handling & testing of various cytological specimens • To learn about Histotechnology, fixation in histopathology lab, decalcification and sectioning of tissues
CUTM1723	Medical Laboratory Technology	• Learning of Quality management in diagnostic division • Understanding the Basic Laboratory principle • Learn about the code of conduct of medical laboratory personnel, clinical specimen collection, storage, disposal, clinical laboratory record maintenance
CUTM1725	Blood Banking	• To perform phlebotomy and related donor room activity in blood bank • The student will learn about various blood group systems • The subject focuses on study of Blood collection and transfusion techniques and possible errors associated with it and quality control in blood bank
CUTM1726	Health Programme in India	• Learning the scopes of a health care team manager
CUTM1724	Medical Microbiology	• To demonstrate practical skills in the use of tools, technologies and methods common to microbiology. • To apply the scientific method and hypothesis testing in the design and execution of experiments • To understand the scopes of Microbiology, growth of microorganisms, properties of viruses
CUTM1728	Immunology & Parasitology	• To diagnose the immunological investigations and parasites • Understanding the concept of Innate & adaptive immune system; complement system; Hypersensitivity. • Learning of clinically relevant serological analysis • To study the laboratory examination & diagnosis of different human pathogenic parasites
CUTM1727	Advanced Hematology	• To compare and contrast hematology values under normal and abnormal conditions

CUTM1721	Research Methodology	• Providing learning opportunities to critically evaluate research methodology and findings • Conceptual understanding of Research design, data collection, sampling, report writing
CUTM1754	Mini Project	• Research paper publication/ case study/ clinical study/ community service/ survey
CUTM1756	Project	• Working on a disease/ disorder specific assignment to fill the research gap in the specific area
CUTM1010	Environmental Studies	• Understand the natural environment and its relationships with human activities. • Characterize and analyze human impacts on the environment. • Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems. • Design and evaluate strategies, technologies and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments. • Remediation or restoration of degraded environments.
CUTM1693	Proficiency in English	• Improve effective writing skills • Improvise articulating abilities
CUTM1016	Job Readiness	• To improvise the ability of the students towards facing job interviews

B. PSOs of Department of Applied and Clinical Microbiology:

PSO1. To recognize and diagnose diseases from clinical presentation and to assess treatment strategies including specimen handling, processing and the appropriate use of antimicrobial agents and common mechanisms of antimicrobial action and resistance.

PSO2. To monitor the Quality Control and Quality Assurance in Microbiology and Pathology Labs. To evaluate methods for identifying diseases caused by common infectious agents.

PSO3. Post graduates will be able to qualify various entrance exam/competitive examinations.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO 1	**PO 2**	**PO3**	**PO 4**	**PO 5**	**PO6**	**PO7**	**PO8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PO1 3**

PSO 1	**H**	**H**	**M**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**
PSO 2	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**
PSO 3	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**M**	**H**	**H**

Course Outcomes
M. Sc. Applied & Clinical Microbiology

Code	Subject Name	Course Outcome
CUTM1708	Human Anatomy and Physiology	• Use anatomical terminology to identify and describe locations of major organs of each system. • Explain interrelationships among molecular, cellular, tissue, and organ functions in each system • Learn about the Scopes of anatomy & physiology, detailed anatomy of human body, detailed physiology of human body
CUTM1709	Analytical Techniques	• Understanding the working principle of Common instruments used in a diagnostic lab • To understand the Principle, instrumentation & application of Microscopy • Principle, instrumentation & application of centrifugation, microtome, spectroscopy
CUTM1710	Biological Chemistry	• Demonstrate an understanding of fundamental biochemical principles, such as the structure/function of metabolic pathways, and the regulation of biological/biochemical processes
CUTM1712	Clinical Hematology	• Differentiate various hematological procedures and the use of basic equipment essential to working in a Hematology Laboratory • To perform tests performed in hematology laboratory based on Hematological disorders
CUTM1715	Clinical Pathology	• The student will get acquainted with collection and tests performed on urine sample, stool sample and other body fluids • Understanding the Anatomical pathology
CUTM1714	Cell and Molecular Biology	• Understand the mechanism of gene expression and protein synthesis; understand the use of several molecular techniques in disease diagnosis • Understanding the central dogma of life • To understand the concept of regulation and its impact

		• Understanding of molecular diagnostic techniques
CUTM1718	Clinical Biochemistry	• Understanding of principle of Clinical biochemistry tests • To study about diseases related to biochemical and hormone imbalance in human body
CUTM1720	Histology	• Learning special staining procedures & handling & testing of various cytological specimens • To learn about Histotechnology, fixation in histopathology lab, decalcification and sectioning of tissues
CUTM1711	General Microbiology	• Learning practical skills in microscopy and their handling techniques and staining procedures
CUTM1713	Systemic Bacteriology	• Conceptual basis for understanding pathogenic microorganisms and the mechanisms by which they cause disease in the human body
CUTM1717	Applied microbiology	• Microbiology in diagnostics, hospitals and community
CUTM1716	Medical Parasitology and Mycology	• Identification of pathogenic parasite and fungus in disease diagnosis and treatment
CUTM1719	Immunology & Virology	• Learning immunological investigations and viral diagnosis
CUTM1722	Clinical Bacteriology	• Diagnosis of bacteria from infective regions of the body
CUTM1721	Research Methodology	• Provide learning opportunities to critically evaluate research methodology and findings • Concept of Research design, data collection, sampling, report writing
CUTM1754	Mini Project	• Research paper publication/ case study/ clinical study/ community service/ survey
CUTM1756	Project	• Working on a disease/ disorder specific assignment to fill the research gap in the specific area
CUTM1010	Environmental Studies	• Understand the natural environment and its relationships with human activities. • Characterize and analyze human impacts on the environment. • Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems. • Design and evaluate strategies, technologies and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments. • remediation or restoration of degraded

		environments.
CUTM1693	Proficiency in English	• Improve effective writing skills • Improvise articulating abilities
CUTM1016	Job Readiness	• To improvise the ability of the students towards facing job interviews

C. PSOs of Department of Optometry:

PSO1. To instil community optometry knowledge, sensitivity, and clinical exposure. They are the primary health-care providers for eye illnesses and refractive problems diagnosis and treatment.

PSO2. They can work in the private, semi-governmental, and governmental sectors as an Optician, Optometrist, Refractionist, and Ophthalmic Technician in rural and urban environments.

PSO3. Post graduates will be able to qualify various entrance exam/competitive examinations.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO1 0**	**PO1 1**	**PO1 2**	**PO13**
PSO 1	**H**	**H**	**H**	**M**	**M**	**H**	**M**	**H**	**H**	**H**	**M**	**M**	**H**
PSO 2	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**	**H**	**M**	**H**
PSO 3	**M**	**M**	**M**	**M**	**L**	**M**	**M**	**M**	**L**	**M**	**M**	**H**	**H**

Course Outcomes
M. Sc. OPTOMETRY

Code	Subject Name	Course Outcome
CUTM1708	Human Anatomy and Physiology	• Use anatomical terminology to identify and describe locations of major organs of each system. • Explain interrelationships among molecular, cellular, tissue, and organ functions in each system • Learn about the Scopes of anatomy & physiology, detailed anatomy of human body, detailed physiology of human body
CUTM1958	Business and Clinical Aspects of Optometry	• After the end of the course the students will be able understand the basic business models and

		also gather the knowledge of developing their own Optometry practice set up.
CUTM1960	Applied Optometric Optics	• Understanding the fundamental optical properties of eyes and lighting system with focus on learning the special optical techniques involved. • Understanding the advance and detailed procedure of ophthalmic lens dispensing technique along with idea about the specialty lens and frames dispensing.
CUTM1961	Advanced Ophthalmic Diagnostic Procedures & Instrumentation	• The objective of this course is to equip the students with a thorough knowledge of ophthalmic instruments. At the end of this course, students will be able to: perform all the ophthalmic instrumentation procedures and know about their appropriate clinical uses.
CUTM1962	Epidemiology and Community Optometry	• Understanding the fundamentals of epidemiology and its types. • Understanding what are the epidemiological prevelance of common eye disorders worldwide. • Understanding the community service procedure in optometry.
CUTM1963	Introduction to LASER Technology	• The outcome of this Course will prepare the students/trainees to use this knowledge for applications of lasers in specific fields of their interest.
CUTM1964	LASER in Refractive Surgery	• The outcome of this Course will prepare the students/trainees to use this knowledge for understanding how LASER is adding in refractive surgeries and the scope of the LASER technology in dealing various corneal conditions.

CUTM1721	Research Methodology	• Students can understand the ethical and philosophical issues associated with research in education • This study provides knowledge on various modes of presenting and disseminating research findings. • Enable students to acquire expertise in the use and application of the methods of data collection and analysis. • Provide learning opportunities to critically evaluate research methodology and findings. • Enable students to be reflexive about their role and others' roles as researchers.
CUTM1965	Orthoptics and Vision Therapy	• After the end of the course the students will be able to: Gather in depth knowledge about how the orthoptic functions of the human eye through case discussions and practical exposures. Understand in detail how a vision therapy works and what are the clinical practice in it.
CUTM1966	Advanced contact lens practice -I	• At the end of the course, the student should be able to: Gather in depth knowledge about how to dispense a contact lens, Deal with any challenges from contact practice, Understand in depth about international standards for practicing contact lens clinic.
CUTM1967	LASER in Anterior segment disorders & Glaucoma	• The outcome of this Course will prepare the students/trainees to use this knowledge for understanding how LASER is adding in cataract surgeries and the scope of the LASER technology in dealing various anterior segment conditions.
CUTM1968	Paediatric Optometry and binocular Vision I	• After the completion of the course the students will: Understand how to deal with paediatric patients as a part of specialization.

		Have a robust idea about how binocular vision functions in humans in details.
CUTM1969	LASER in Posterior segment disorders	• The outcome of this Course will prepare the students/trainees to use this knowledge for understanding how LASER is adding in cataract surgeries and the scope of the LASER technology in dealing various anterior segment conditions.
CUTM1971	Recent Advancement in Optometry	• After the end of the course the students will: Have a thorough idea about various research projects and scope of research in the field of optometry. Have a knowledge about various international journals vested for the research in optometry.
CUTM1970	Paediatric Optometry and Binocular Vision II	• After the completion of the course the students will: Understand how to deal with paediatric patients as a part of specialization. Have a robust idea about how binocular vision functions in humans in details.
CUTM1972	Advance contact lens practice II	• At the end of the course, the student should be able to: Gather in depth knowledge about how to dispense a contact lens, Deal with any challenges from contact practice, Understand in depth about international standards for practicing contact lens clinic.
CUTM1973	Ocular diseases & Therapeutics	• At the end of the course the students will be able to: Understand how a disease develops and how to diagnose the disease within the purview of one's filed. Understand the general and ocular pharmacology in details.
CUTM1974	Neuro Optometry	• The objective of this course is to: Equip the students with a thorough knowledge of the neurological functioning of the eyes. To clinically correlate with the findings.

CUTM1975	Specialty Clinic	• Clinical postings in Community Diagnostic Centre/hospitals/clinical set-up (for a maximum period of 2 months in the entire 4th semester) to get hands-on experience of special diagnostic clinics and also for carry forwarding the dissertation project under the guidance of senior Optometrist/Ophthalmologist and taking part in community outreach camps • Handling special instruments: OCT, A-scan, B-scan
CUTM1976	Dissertation	• Team of students will be doing a research project under the guidance of a supervisor (who could be optometrists/ ophthalmologist). Student will get the experience of doing a research in systematic approach – identifying the primary question, literature search, identifying the gaps in the literature, identifying the research question, writing up the research proposal, data collection, data analysis, thesis writing and presentation.

Centurion University of Technology and Management

School of Pharmacy and Life Sciences

B.Pharm

Mission:

An institution dedicated to touch human lives in health care and happiness to ensure holistic societal development through skill-based education, research, Drug development and community welfare services.

Vision:

- Contribute to the national programmes of providing manpower trained through interdisciplinary integration such as Pharmaceutical sciences.
- To achieve professional excellence to meet effective competency and to undertake the task of meeting professional and social needs like identification, cure, mitigation of disease and innovative drug design.
- Enable students to seek fulfilling career in pharmaceutical sector, research and entrepreneurship.
- Enhancing student research in academics beyond the class room study like hand on practice by involving themselves on making dissertation and small tenured projects in pharmacy and life sciences.
- Managing Govt. and Non Govt projects by the faculties and students with pharmacy skills contributing towards a healthy State and Nation.

Programme Objectives:

1. To produce pharmacy graduates with strong basics and high technical knowledge to cater the various areas of Pharmaceutical industry.

2. To provide the required training in all aspects to the graduates to work as a health care professional in community and hospital pharmacy.

3. To provide a Pharmacists to the society with skill and will to make and serve quality pills.

POs: Pharmacy Graduates will be able to:

Sl No.	Programme Outcomes
PO1	Apply knowledge of basic science and pharmacy.
PO2	Design and conduct experiments, as well as to carry out problem analysis data interpretation
PO3	Design and develop process to meet desired needs within realistic constraints.
PO4	Function effectively as a leader and member of multidisciplinary teams.
PO5	Isolate, identify, synthesize, formulate and solve complex pharmaceutical problems.
PO6	Understanding of professional and ethical responsibility

PO7	Communicate effectively
PO8	Understand the impact of pharmaceutical solutions in a global, economic, environmental, and societal context
PO9	Manage contemporary pharmaceutical projects and their financial implications.
PO10	Use the techniques, skills, and modern pharmaceutical instruments and tools necessary for pharmacy profession.
PO11	Analyze, screen and ensure quality of drugs/pharmaceuticals.
PO12	Engage in life-long learning

PSO (Program Specific Outcomes)

Sl No.	Program Specific Outcomes
PSO1	Perform research on various medical aspects and implement the Pharmaceutical knowledge in formulating the best suitable dosage form to provide high quality medicines to the society.
PSO2	Render the services to the public by providing patient centric effective treatments to curb the therapeutic issues with the required medicines and explain the effects of the drugs by analyzing the scientific literature for improving their health and well-being.
PSO3	Graduates will able to qualify GPAT, NIPER and other competitive examinations and Explore opportunities in different government and non-government organizations as drug analyst, academician, research scientist and drug inspector.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PSO1	H	M	H	H	H	M	L	L	H	M	H	H
PSO2	H	H	H	M	H	M	M	M	M	L	M	H
PSO3	H	H	L	L	M	M	M	H	L	M	H	H

Course Outcome (CO)

1st Semester

BPHT1101- HUMAN ANATOMY AND PHYSIOLOGY I– THEORY

Course Objective: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Student get basic skill on gross morphology, structure and functions of various organs of the humanbody.
CO-2	Describe the various homeostatic mechanisms and their imbalances
CO-3	Identify the various tissues and organs of different systems of human body
CO-4	Perform the various experiments related to special senses and nervous system
CO-5	Appreciate coordinated working pattern of different organs of each system

BPHT1102 - PHARMACEUTICAL ANALYSIS I – THEORY

Course Objective: This course deals with the fundamentals of analytical chemistry and principles of electrochemical analysis of drugs

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the principles of volumetric and electro chemical analysis
CO-2	Carryout various volumetric and electrochemical titrations
CO-3	Develop analytical skills
CO-4	To develop various methodologies for assay of drugs and pharmaceuticals with the skills and knowledge gained.
CO-5	Develop new methods for the estimation of drug

BPHT1103- PHARMACEUTICS I – THEORY

Course Objective: This course is designed to impart a fundamental knowledge on the preparatorypharmacy with arts and science of preparing the different conventional dosage forms.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know the history of profession of pharmacy
CO-2	Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
CO-3	Basic skill of handling of prescription
CO-4	Preparation of various conventional dosage forms
CO-5	Develop entrepreneurship skills that support the growth

	of Pharmaceutical Industry

BPHT1104- PHARMACEUTICAL INORGANIC CHEMISTRY – THEORY

Course Objective: This subject deals with the monographs of inorganic drugs and pharmaceuticals.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know the sources of impurities and methods to determine the impurities in inorganicdrugs and pharmaceuticals
CO-2	Understand the medicinal and pharmaceutical importance of inorganic compounds
CO-3	Able to compare and analyse different cations and anions.
CO-4	Learning different skills to determine percentage purity of different pharmaceuticals.
CO-5	Able to classify inorganic pharmaceuticals and can apply them in new therapy.

BPHT1105- COMMUNICATION SKILLS – THEORY

Course Objective: This course will prepare the young pharmacy student to interact effectively with doctors, nurses, dentists, physiotherapists and other health workers. At the end of this course the student will get the soft skills set to work cohesively with the team as a team player and will add value to the pharmaceutical business
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the behavioural needs for a Pharmacist to function effectively in the areas of pharmaceutical operation
CO-2	Communicate effectively (Verbal and Non Verbal)
CO-3	Effectively manage the team as a team player
CO-4	Develop interview skills
CO-5	Develop Leadership qualities and essentials

BPHT1106- REMEDIAL BIOLOGY – THEORY

Course Objective: To learn and understand the components of living world, structure and functional system of plant and animal kingdom.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know the classification and salient features of five kingdoms of life
CO-2	Understand the basic components of anatomy & physiology of plant
CO-3	Know understand the basic components of anatomy & physiology

	animal with special reference to human
CO-4	Able to attain knowledge morphology and histology of various plant parts and taxonomic classification
CO-5	Able to explain plant and animal cells and tissues

BPHT1107- REMEDIAL MATHEMATICS – THEORY

Course Objective: This is an introductory course in mathematics. This subject deals with the Introduction to Partial fraction, Logarithm, matrices and Determinant, Analytical geometry, Calculus, differential equation and Laplace transform.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know the theory and their application in Pharmacy
CO-2	Solve the different types of problems by applying theory
CO-3	Appreciate the important application of mathematics in Pharmacy
CO-4	Able to find solutions of trigonometry problems
CO-5	Able to learn about basic skills and extend their knowledge as they prepare for more advanced work.

2nd Semester

BPHT1201- HUMAN ANATOMY AND PHYSIOLOGY II – THEORY

Course Objective: This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Basic learning skill on gross morphology, structure and functions of various organs of theHuman body.
CO-2	Describe the various homeostatic mechanisms and their imbalances
CO-3	Identify the various tissues and organs of different systems of human body.
CO-4	Perform the haematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse andrespiratory volume.
CO-5	Appreciate the interlinked mechanisms in the maintenance of normal functioning (Homeostasis) of human body.

BPHT1202- PHARMACEUTICAL ORGANIC CHEMISTRY I – THEORY

Course Objective: This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical

properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Able to acquire knowledge about pharmaceutical organic compounds, with emphasis on their synthetic process, physical and chemical properties and compare them with each other
CO-2	Able to write mechanisms involved in various reactions that could help the students to understand the synthesis of higher organic compounds.
CO-3	Account for reactivity/stability of compounds,
CO-4	Identify/confirm the identification of organic compound
CO-5	Able to analyze various reactions for the synthesis of higher organic compounds.

BPHT1203- BIOCHEMISTRY – THEORY

Course Objective: Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	To get knowledge catalytic role of enzymes, importance of enzyme inhibitors indesign of new drugs, therapeutic and diagnostic applications of enzymes.
CO-2	Understand the metabolism of nutrient molecules in physiological andpathological conditions.
CO-3	Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.
CO-4	Able to understand biochemical organization of living system
CO-5	Able to understand metabolism of complex biochemical compounds

BPHT1204- PATHOPHYSIOLOGY – THEORY

Course Objective: Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes. This course is designed to impart thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Describe the aetiology and pathogenesis of the selected disease states

CO-2	Name the signs and symptoms of the diseases
CO-3	Able to apply basic principles of cell injury and inflammation in understanding various diseases
CO-4	To get skill in analysing various pathophysiological changes in major systems of human body and correlate with diseases
CO-5	Able to correlate relation between pathophysiology and clinical skills

BPHT1205- COMPUTER APPLICATIONS IN PHARMACY – THEORY

Course Objective: This subject deals with the introduction Database, Database Management system, computer application in clinical studies and use of databases.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	know the various types of application of computers in pharmacy
CO-2	know the various types of databases
CO-3	To get the knowledge about various applications of databases in pharmacy
CO-4	Students will be able to learn the basic concepts of CRD, RBD and Latin Square Designs
CO-5	Able to learn the application of statistical methods to medical, biological and health related problems

BPHT1206- ENVIRONMENTAL SCIENCES – THEORY

Course Objective: Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Create the awareness about environmental problems among learners.
CO-2	Impart basic knowledge about the environment and its allied problems
CO-3	Develop an attitude of concern for the environment
CO-4	Motivate learner to participate in environment protection and environment Improvement
CO-5	Acquire skills to help the concerned individuals in identifying and solving environmental problems

3RD SEMESTER

BPHT2101- PHARMACEUTICAL ORGANIC CHEMISTRY II – THEORY

Course Objective: This subject deals with general methods of preparation and reactions of someorganic compounds. Reactivity of organic compounds are also studied here. The

syllabus emphasizes on mechanisms and orientation of reactions. Chemistry of fats and oils are also included in the syllabus.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Write the structure, name and the type of isomerism of the organic compound
CO-2	Write the reaction, name the reaction and orientation of reactions
CO-3	Able to write structure, synthesis and reactions of compounds like poly nuclear hydrocarbons and heterocyclic compounds
CO-4	Able to compare different heterocyclic compounds and their synthetic methods
CO-5	Able to get skill in solve organic reactions schematic equations based puzzles reacted to the compounds.

BPHT2102- PHYSICAL PHARMACEUTICS I – THEORY

Course Objective: The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand various physicochemical properties of drug molecules in the designing the dosage forms
CO-2	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
CO-3	Demonstrate use of physicochemical properties in the formulationdevelopment and evaluation of dosage forms.
CO-4	Develop skills and techniques those are parts of pharmaceutical procedures through the actual use of equipment and instruments.
CO-5	Knowledge in drug design, interfacialphenomena ,colloids ,particle size & distribution is known.

BPHT2103- PHARMACEUTICAL MICROBIOLOGY – THEORY

Course Objective: Study of all categories of microorganisms especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc.
Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand methods of identification, cultivation and preservation of various microorganisms
CO-2	To understand the importance and implementation of sterilization in pharmaceutical processing and industry
CO-3	Learn sterility testing of pharmaceutical products.
CO-4	Carried out microbiological standardization of Pharmaceuticals.

CO-5	To acquire and demonstrate competency in laboratory safety and in routine and specialized microbiological laboratory skills applicable to microbiological research or clinical methods, including accurately reporting observations and analysis.

BPHT2104- PHARMACEUTICAL ENGINEERING – THEORY

Course Objective: This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	To know various unit operations used in Pharmaceutical industries
CO-2	To understand the material handling techniques
CO-3	To get knowledge to perform various processes involved in pharmaceutical manufacturing process
CO-4	To carry out various test to prevent environmental pollution
CO-5	To appreciate and comprehend significance of plant lay out design for optimum use of resources

4TH SEMESTER

BPHT2201- PHARMACEUTICAL ORGANIC CHEMISTRY III– THEORY

Course Objective: This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the methods of preparation and properties of organic compounds
CO-2	Explain the stereo chemical aspects of organic compounds and stereo chemical Reactions
CO-3	To get knowledge about the medicinal uses and other applications of organic compounds
CO-4	Able to apply concept learnt to analogues reactions
CO-5	Able to solve organic reactions schematic equations based puzzles reacted to the compounds.

BPHT2202- MEDICINAL CHEMISTRY I – THEORY

Course Objective: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of

drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	understand the chemistry of drugs with respect to their pharmacological activity
CO-2	understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
CO-3	To get knowledge about Structural Activity Relationship (SAR) of different class of drugs
CO-4	write the chemical synthesis of some drugs
CO-5	Able to summarize definition, classification, mechanism of action along with structures of drugs belongs to various category

BPHT2203- PHYSICAL PHARMACEUTICS II – THEORY

Course Objective: The course deals with the various physical and physicochemical properties, and principles involved in dosage forms/formulations. Theory and practical components of the subject help the student to get a better insight into various areas of formulation research and development, and stability studies of pharmaceutical dosage forms.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand various physicochemical properties of drug molecules in the designing the dosage forms
CO-2	Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
CO-3	Demonstrate use of physicochemical properties in the formulationdevelopment and evaluation of dosage forms.
CO-4	Develop skills and techniques those are parts of pharmaceutical procedures through the actual use of equipment and instruments.
CO-5	Able to identify the type of flows-Newtonian & Non-Newtonian to calculate the viscosities of liquid drugs

BPHT2204- PHARMACOLOGY I – THEORY

Course Objective: The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the pharmacological actions of different categories of drugs

CO-2	Explain the mechanism of drug action at organ system/sub cellular/macromolecular levels.
CO-3	Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
CO-4	Observe the effect of drugs on animals by simulated experiments
CO-5	To get knowledge for the practical skills required to conduct the preclinical toxicity studies.

BPHT2205- PHARMACOGNOSY AND PHYTOCHEMISTRY I– THEORY

Course Objective: The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, photochemical present in them and their medicinal properties.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	to know the techniques in the cultivation and production of crude drugs
CO-2	to know the crude drugs, their uses and chemical nature
CO-3	know the evaluation techniques for the herbal drugs
CO-4	to carry out the microscopic and morphological evaluation of crude drugs
CO-5	A good knowledge of thebasic and applied know-how and professional skills in Herbal drugScienceand Technology and the necessary training for admission to the postgraduate courses in this field.

5th Semester

BPHT3101- MEDICINAL CHEMISTRY II – THEORY

Course Objective: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the chemistry of drugs with respect to their pharmacological activity
CO-2	Get knowledge about drug metabolic pathways, adverse effect and therapeutic value of drugs
CO-3	Know the Structural Activity Relationship of different class of drugs
CO-4	Study the chemical synthesis of selected drugs
CO-5	Able to interpret structural activity relationship and synthesis of different medicinal compounds

BPHT3102- INDUSTRIAL PHARMACYI (THEORY)

Course Objective: Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	Knowledge about various considerations in development of pharmaceutical dosage forms
CO-2	Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality
CO-3	Know the various pharmaceutical dosage forms and their manufacturing techniques.
CO-4	Able to describe the role of packaging materials and their evaluation.
CO-5	Able to classify ophthalmic preparations, aerosols and semi solids and additives used in the formulation

BPHT3103- PHARMACOLOGY-II (THEORY)

Course Objective: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	Understand the mechanism of drug action and its relevance in the treatment of different diseases
CO-2	Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
CO-3	Demonstrate the various receptor actions using isolated tissue preparation
CO-4	Appreciate correlation of pharmacology with related medical sciences
CO-5	To get knowledge for the practical skills required to conduct the preclinical toxicity studies.

BPHT3104- PHARMACOGNOSY AND PHYTOCHEMISTRY II (Theory)

Course Objective: The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	To know the modern extraction techniques, characterization and identification of

	the herbal drugs and phytoconstituents
CO-2	To understand the preparation and development of herbal formulation.
CO-3	To understand the herbal drug interactions
CO-4	To carryout isolation and identification of phytoconstituents
CO-5	To get professional, Practical skills & time management skills in extraction , Isolation and Phytochemical analysis of Natural products.

BPHT3105 - PHARMACEUTICAL JURISPRUDENCE (Theory)

Course Objective: This course is designed to impart basic knowledge on important legislations related to the profession of pharmacy in India.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
CO-2	Various Indian pharmaceutical Acts and Laws
CO-3	Develop entrepreneurship skills Pharmaceutical field
CO-4	The code of ethics during the pharmaceutical practice
CO-5	Able to apply knowledge in the area of pharmaceutical legislation, rules, laws, ethics, acts and amendments related to drugs.

6TH SEMESTER

BPHT3201 MEDICINAL CHEMISTRY – III (Theory)

Course Objective: This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	Understand the importance of drug design and different techniques of drug design.
CO-2	Understand the chemistry of drugs with respect to their biological activity.
CO-3	Know the metabolism, adverse effects and therapeutic value of drugs.
CO-4	To develop entrepreneurship qualities that support growth of pharmaceutical
CO-5	Implementing the knowledge to determine Structure, nomenclature, metabolism and uses of Various Antibiotics., Chemotherapeutic agents.

BPHT3202 - PHARMACOLOGY-III (Theory)

Course Objective: This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immune-pharmacology and in addition, emphasis on the principles of toxicology and chrono-pharmacology.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
CO-2	Comprehend the principles of toxicology and treatment of various poisonings
CO-3	Appreciate correlation of pharmacology with related medical sciences.
CO-4	Able to appraise the principles of pharmacology aspects of various rugs
CO-5	To get knowledge for the practical skills required to conduct the preclinical toxicity studies.

BPHT3203- HERBAL DRUG TECHNOLOGY (Theory)

Course Objective: This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, Nutraceuticals etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	understand raw material as source of herbal drugs from cultivation to herbal drug product
CO-2	know the WHO and ICH guidelines for evaluation of herbal drugs
CO-3	Knowledge about the herbal cosmetics, natural sweeteners, Nutraceuticals
C0-4	Appreciate patenting of herbal drugs, GMP.
CO-5	Develop Competency in testing of herbal drugs and Knowledge about IPR and Patenting

BPHT3204- BIOPHARMACEUTICS AND PHARMACOKINETICS (Theory)

Course Objective This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arised therein.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	Understand the basic concepts in Biopharmaceutics and pharmacokinetics and their significance.
CO-2	Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism,

	excretion, elimination.
CO-3	To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
CO-4	Develop entrepreneurship skills that support the growth of Pharmaceutical Industry
CO-5	Able to Interpret various Pharmacokinetic Parameters using Compartment Model

BPHT3205 - PHARMACEUTICAL BIOTECHNOLOGY (Theory)

Course Objective - Biotechnology has a long promise to revolutionize the biological sciences andBiotechnology is leading to new biological revolutions in diagnosis, prevention Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technology makes the subject interesting. Technology. Biotechnology has already produced transgenic crops and animals and the future and cure of diseases, new and cheaper pharmaceutical drugs. It is basically a research-based subject. Promises lot more.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
CO-2	Genetic engineering applications in relation to production of pharmaceuticals
CO-3	Importance of Monoclonal antibodies in Industries
CO-4	To imparts a comprehension of advanced skills necessary for developing novelty work in the field of biotechnology
CO-5	Able to apply the concepts of Immunology, Enzyme Immobilization, Microbial Transformation to Prepare Vaccines, Diagnostic Agents, Immuno Serums, and Enzymes

BPHT3206- PHARMACEUTICAL QUALITY ASSURANCE (Theory)

Course Objective-This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	understand the cGMP aspects in a pharmaceutical industry
CO-2	appreciate the importance of documentation
CO-3	understand the scope of quality certifications applicable to pharmaceutical industries
CO-4	understand the responsibilities of QA & QC departments
CO-5	To develop skill in Pharmaceutical quality assurance.

7th SEMESTER

BPHT4101- INSTRUMENTAL METHODS OF ANALYSIS (Theory)

Course Objective-These subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
CO-2	Understand the chromatographic separation and analysis of drugs.
CO-3	Perform quantitative & qualitative analysis of drugs using various analytical instruments.
CO-4	Able to separate and analyses drugs by chromatography Radioimmunoassay and Electrophoresis
CO-5	student interpretation skills will be improve by the course content in terms of choice of analytical techniques to perform the estimation of different category drugs.

BPHT4102- INDUSTRIAL PHARMACYII (Theory)

Course Objective- This course is designed to impart fundamental knowledge on pharmaceutical product development and translation from laboratory to market

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	Know the process of pilot plant and scale up of pharmaceutical dosage forms
CO-2	Understand the process of technology transfer from lab scale to commercial batch
CO-3	Know different Laws and Acts that regulate pharmaceutical industry
CO-4	Understand the approval process and regulatory requirements for drug products
CO-5	To develop entrepreneurship qualities that support growth of pharmaceutical

BPHT4103 - PHARMACY PRACTICE (Theory)

Course Objective- In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug information, and therapeutic drug monitoring for improved patient care. In community pharmacy, students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling for improved patient care in the community set up.

Course Outcomes: On completion of this course, the successful students should be able to:

CO-1	know various drug distribution methods in a hospital
CO-2	appreciate the pharmacy stores management and inventory control
CO-3	monitor drug therapy of patient through medication chart review and clinical review

C0-4	To review literature pertaining to entrepreneurship in pharmacy practice
C0-5	To develop entrepreneurship qualities that support growth of pharmaceuticaldentify drug related problems

BPHT4104 - NOVEL DRUG DELIVERY SYSTEMS (Theory)

Course This subject is designed to impart basic knowledge on the area of novel drug delivery systems.

Course Outcomes: On completion of this course, the successful students should be able to:

CO-1	To understand various approaches for development of novel drug delivery systems.
CO-2	To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation
CO-3	Able to know the validation of Analytical Methods
CO-4	Design &Develop novel dosages form for the benefit of patient
CO-5	Describe Controlled and Sustained drug delivery systems and their method of Preparation and Evaluation which helps in employability

8TH SEMESTER

BPHT4201 - BIOSTATISITCS AND RESEARCH METHODOLOGY (Theory)

Course Objectives- To understand the applications of Biostatics in Pharmacy. This subject deals with descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, Non Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R and MINITAB statistical software's, analyzing the statistical data using Excel.

Course Outcomes: On completion of this course, the successful students should be able to:

CO-1	Know the operation of M.S. Excel, SPSS, R and MINITAB ® , DoE (Design of Experiment)
CO-2	Know the various statistical techniques to solve statistical problems
CO-3	To develop Entrepreneurship *skill* .Appreciate statistical techniques in solving the problems.
CO-4	Develop the ability to apply the methods while working on a research project work.
CO-5	Describe the appropriate statistical methods required for a particular research design

BPHT4202-SOCIAL AND PREVENTIVE PHARMACY

Course Objective- The purpose of this course is to introduce to students a number of health issues and their challenges. This course also introduced a number of national health programmes. The roles of the pharmacist in these contexts are also discussed.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.
CO-2	Have a critical way of thinking based on current healthcare development.
CO-3	Evaluate alternative ways of solving problems related to health and pharmaceutical issues
CO-4	Acquire knowledge of the business and professional practice management skills in community pharmacies.
CO-5	Knowledge on social, health medicine and preventive medicine

BPHT4204- PHARMACEUTICAL REGULATORY SCIENCE (Elective)

Course Objective- This course is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like US, EU, Japan, Australia,UK etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statement
CO-1	To get knowledge about the process of drug discovery and development
CO-2	Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
CO-3	Know the regulatory approval process and their registration in Indian and international markets
CO-4	To understand the drug approval process using new drug applications (NDA) and (ANDA) applications
CO-5	To know about various regulatory concepts and terminology including code of federal regulatory (CFR) etc.

BPHT4209 - COSMETIC SCIENCE (Theory)

Course Objectives: Theoretical Principles and Applications covers the fundamental aspects of cosmetic science that are necessary to understand material development, formulation, and the dermatological effects that result from the use of these products. The book fulfils this role by offering a comprehensive view of cosmetic science and technology, including environmental and dermatological concerns.

Course Outcomes: On completion of this course, the successful students should be able to:

CO-1	Formulate and evaluate various cosmeceutical products
CO-2	Know the key components used in different cosmeceutical products
CO-3	Recognize the role of ingredients and herbs used in cosmeceutical products
CO-4	Know the advanced current technology used for manufacturing the cosmetics at lab scale and industry scale

CO-5	Employable skills and high technical competence for Pharmaceutical Industry

BPHP4201- POJECT WORK

Course Objectives- Collection of data, information regarding drug product and substance and carry out the practical work like formulation, synthesis, evaluation, validation, standardization of the drug and conclude the content.

Course Outcome- On completion of this course, the successful students should be able to:

CO	Statement
CO-1	Generate the research topic for the project
CO-2	Collect the information from the relevant source
CO-3	Assemble the information into a more realistic draft ethically and conclude the content
CO-4	Prepare the presentation and explain it to the audience
CO-5	To develop entrepreneurship qualities that support growth of pharmaceutical intellectual property and contribute for economical development throughout the world.

Centurion University of Technology and Management

School of Applied Sciences

Department of Physics

Program Objectives

1.To expand scientific temper and can prove to be more beneficial for the society as the scientific developments can make a nation or society to grow at a rapid pace.

2. To obtain a professional job as scientist ,researcher ,entrepreneur and to get jobs in marketing, business &other technical fields.

POs; Science Graduates will be able to;

POs	Outcomes
PO1	Apply mathematics, science, fundamentals and specialization to the conceptualization of different scientific models
PO2	Identify, formulate, research literature and solve complex science related problems reaching substantiated conclusions using first principles of mathematics and applied sciences
PO3	Design solutions for complex scientific problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations
PO4	Conduct investigations of complex problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
PO5	Create, select and apply appropriate techniques, resources, and modern engineering tools, including prediction and modeling, to complex scientific activities, with an understanding of the limitations
PO6	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
PO7	Communicate effectively on complex science activities with the science community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO8	Demonstrate understanding of the societal, health, safety, legal and cultural issues andthe consequent responsibilities relevant to scientific application
PO9	Understand and commit to professional ethics and responsibilities and norms of engineering practice
PO10	Understand the impact of science solutions in a societal context and demonstrate knowledge of and need for sustainable development

PO11	Recognize the need for, and have the ability to engage in independent and life-long learning
PO12	Demonstrate a knowledge and understanding of contemporary technologies, their applications and limitations, contemporary research in the broader context of relevant fields
PO13	Demonstrate the ability to succeed in national and international competitive events in therelevant fields

PSOs: Department of Physics

PSO1. Provide knowledge about material properties and its application for developing technology to ease the problems related to the society. Applied course will enable them to be suitable for various fields.

PSO2. Understood the basic concepts, fundamental principles and the scientific theories related to various phenomena of Physics and their relevancies in the day-to-day life.

PSO3. Learn the concepts as Classical Mechanics, Solid State Physics, Quantum Mechanics, Relativity, Nuclear and Particle Physics, Electronics etc. Analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.

COs:

COs	**Skills**
CO1	Knowledge
CO2	Observe, Classify, Quantify, Interpret and Communicate
CO3	Investigation and Judgements
CO4	Problem Solving
CO5	Leadership & Entrepreneurship
CO6	Product/Publication/Patent

***Correlation is noted as "H" for High, "M" for Medium and "L" for Low**

Mapping PSOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
PSO1	**H**	**H**	**M**	**M**	**L**	**M**	**L**	**H**	**H**	**L**	**M**	**M**	**M**
PSO2	**H**	**H**	**M**	**H**	**H**	**M**	**M**	**M**	**M**	**M**	**M**	**H**	**M**
PSO3	**H**	**H**	**M**	**M**	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**	**M**

Course Code	*Course Title*	*Course Type*	*Credits*	*Prerequisite*	CO1	CO2	CO3	CO4	CO5	CO6	PSO 1	PSO 2	PSO 3
BSFL1101	English	Theory	2	NIL	H	M		-	-	-	H	H	-
FCBS0101	Environmental Science	Theory	2	NIL	H	M		-	-	-	M	M	-
BSPH1101	Mathematical Physics-1	Theory+ Practice	6	12^{th} class pass	H	H		H	-	-	H	H	**H**
BSPH1102	Mechanics	Theory+ Practice	6	12^{th} class pass	H	H		H	-	-	H	M	**M**
BSPH1201	Thermal Physics	Theory+ Practice	6	12^{th} class pass	H	H		H	-	-	H	M	**M**
BSPH1202	Waves and optics	Theory+ Practice	6	12^{th} class pass	H	H		H	-	-	H	M	**M**
BSPH2301	Mathematical Physics II	Theory+ Practice	6	Mathematical Physics-1	H	H		H	-	-	H	M	**M**

Course Code	*Course Title*	*Course Type*	*Credits*	*Prerequisite*	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**	**PSO 1**	**PSO 2**	**PSO 3**
BSPH2302	Electricity and Magnetism	Theory+ Practice	6	Mathematical Physics-1	H	H	-	H	-	-	H	M	**M**
BSPH2303	Analog systems and Applications	Theory+ Practice	6	12th class pass	H	H	-	H	L	-	H	H	H
BSPH2401	Mathematical Physics III	Theory+ Practice	6	Mathematical Physics-2	H	H	H	H	-	-	H	M	H
BSPH2402	Elements of Modern Physics	Theory+ Practice	6	12th class pass	H	H	H	H	-	-	H	M`	-
BSPH2403	Digital systems and Applications	Theory+ Practice	6	Analog systems and Applications	H	H	H	H	L	-	H	M	L
BSPH3501	Quantum Mechanics & Applications	Theory+ Practice	6	Elements of Modern Physics	H	H	H	H	-	-	H	H	H
BSPH3502	Solid State Physics	Theory+ Practice	6	Elements of Modern Physics	H	H	M	H	-	-	H	H	H
BSPH3601	Electro-magnetic Theory	Theory+ Practice	6	Mathematical Physics-1 & 2	H	H	M	H	-	-	M	M	M
BSPH3602	Statistical Mechanics	Theory+ Practice	6	Studied semester I and II	H	H	H	H	-	-	H	M	M
BSPH3503	Experimental Techniques	Theory+ Practice	6	12th class pass	H	H	H	H	L	-	M	L	L
BSPH3504	Embedded systems-Introduction to Microcontroller	Theory+ Practice	6	Studied 1st & 2nd year	H	H	H	H	L	-	H	H	H

Course Code	*Course Title*	*Course Type*	*Credits*	*Prerequisite*	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**	**PSO 1**	**PSO 2**	**PSO 3**
BSPH3505	Physics of Devices and Communication	Theory+ Practice	6	Studied 1st & 2nd year	H	H	M	H	L	-	H	M	H
BSPH3506	Advanced Mathematical Physics-I	Theory+ Practice	6	Studied 1st & 2nd year	H	H	M	H	-	-	H	M	H
BSPH3507	Advanced Mathematical Physics-II	Theory	6	Studied 1st & 2nd year	H	H	M	H	-	-	H	M	H
BSPH3508	Classical Dynamics	Theory	6		H	H	M	H	-	-	H	M	M
BSPH3603	Applied Dynamics	Theory	6	Classical Dynamics	H	H	M	H	-	-	H	M	M
BSPH3604	Communication System	Theory+ Practice	6	Studied 1st & 2nd year	H	H	M	H	L	-	H	M	M
BSPH3605	Nuclear and Particle Physics	Theory	6	Studied 1st & 2nd year	H	H	M	H	L	-	H	M	M
BSPH3606	Astronomy and Astrophysics	Theory	6	Studied 1st & 2nd year	H	H	M	H	L	-	H	M	H
BSPH3607	Dissertation	Project	6	Nil	H	H	M	H	L	H	H	M	M
BSPH2001	Physics Workshop Skills	Practice	2	Nil	H	H	H	H	-	-	H	M	M
BSPH2002	Computational Physics Skills	Practice	2	Nil	H	H	H	H	-	-	M	M	M
BSPH2003	Electrical circuits and Network Skills	Practice	2	Nil	H	H	H	H	-	-	M	M	M
BSPH2004	Basic Instrumentation Skills	Practice	2	Nil	H	H	H	H	-	-	M	M	M
BSPH2005	Applied Optics	Practice	2	Nil	H	H	H	H	-	-	M	M	M

Code (Prefix "CUTM")	Course Title	Credit	Type (T+P+Pj)
1483	Mathematical Physics-I	6	3-2-1
1484	Mechanics	6	3-2-1
1485	Thermal Physics	6	3-2-1
1486	Waves and Optics	6	3-2-1
1487	Mathematical Physics-II	6	3-2-1
1488	Electricity and Magnetism	6	3-2-1
1489	Analog System and Application	6	3-2-1
1490	Mathematical Physics-III	6	3-2-1
1491	Elements of Modern Physics	6	3-2-1
1492	Digital Systems and Applications	6	3-2-1
1493	Quantum Mechanics and Applications	6	3-2-1
1494	Solid State Physics	6	3-2-1
1495	Electromagnetic Theory	6	3-2-1
1496	Statistical Mechanics	6	3-2-1

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1483	Mathematical Physics-I	3-2-1	Nil

Objective

This course aims to

- To introduce the students to understand the physical meaning of different mathematical methods.
- The emphasis of course is on applications in solving problems of interest to physicists.
- Highlights the use of computational methods to solve physical problems.

Learning outcome

After successfully completing this course, the student should be able to

- Understand the mathematical and physical interpretation of vector.
- Handle different coordinate systems .
- Introduced to the concept of probability.

Course Outlline

Module-I (6 Hours Theory+ 4 Hours Practice+ 2Hours Flipped Class)

Matrices and Calculus:

Special types of matrices (conjugate and its transpose, periodic, Idempotent, Nilopotent, symmetric and antisymmetric, Hermitian and skew-hermitian, orthogonal and unitary matrix). Rank of a matrix, Eigen value and Eigen vector. Caley -Hamilton theorem.Approximation, Taylor and

binomial series (statements only).Solution of 1st order differential equation(linear, homogeneous, non-homogeneous and exact). Wronskian and general solution. Complimentary function and Particular Integral.

Practice-1 Introduction and Overview (Computer architecture and organization, memory andInput/output devices)

Practice-2 Basics of scientific computing.

Module-II **(5 Hours Theory+ 4 Hours Practice+ 2Hours Flipped Class)**

Vector Calculus:

Recapitulation of vectors, Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

Practice-3 Errors and error Analysis

Practice-4 Algorithm

Module-III **(5 Hours Theory+ 4 Hours Practice+ 1 Hours Flipped Class)**

Vector Differentiation:

Directional derivatives and normal derivative. Gradient of ascalar field and its geometrical interpretation. Divergence and curl of a vector field. Del and Laplacian operators. Vector identities.

Practice-5 Introduction to C language and variables, keywords, data types, operators, constants, escape sequence in C.

practice-6 Control statements (decision making and looping statements) (If-statement. If-else Statement. Nested if Structure. Else-if Statement. Ternary Operator. Goto Statement. Switch Statement.

Module-IV (6 Hours Theory+ 4 Hours Practice+ 3 Hours Flipped Class)

Vector Integration:

Ordinary Integrals of Vectors. Multiple integrals, Jacobian. Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of Vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stokes Theorems and their applications (no rigorous proofs).

Practice-7 Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops.
Practice-8 Programs: Sum & average of a list of numbers, largest of a given list of numbers

Module-V (3 Hours Theory+ 2 Hours Practice+ 2Hours Flipped Class)

Orthogonal Curvilinear Coordinates:

Orthogonal Curvilinear Coordinates. Derivation of Gradient, Divergence, Curl andLaplacian in Cartesian, Spherical and Cylindrical Coordinate Systems.

Flipped Class-9:- Divergence, Curl and Laplacian in Cartesian and Spherical coordinates

Flipped Class-10:- Application and example of Divergence, Curl and Laplacian in cyllindrical system

Practice-9 *Solution of linear and quadratic equation.

*Using C calculate conversion of temperature from Fahrenheit to Celsius.

Module-VI (4 Hours Theory+ 4 Hours Practice+ 1Hours Flipped Class)

Introduction to probability:

Independent random variables: Probability distribution functions; binomial, Gaussian and Poisson, with examples. Mean and variance. Dependent events: Conditional Probability. Bayes' Theorem and the idea of hypothesis testing.

Flipped Class-11:- Mean and variance of binomial, Gaussian and Poisson

Practice-10 Array (1 D and 2D), Strings and user defined functions.

Practice- 11 *Write a Programme to print day of the week using switch case.

*Write a programme to print first 10 natural number using for, While and do while loop.

* Write a programme to display all the even numbers within the range given by the user.

Module-VII **(1 Hours Theory+ 2 Hours Practice)**

Dirac Delta function and its properties:

Definition of Dirac delta function. Representation as limit of a Gaussian function andrectangular function. Properties of Dirac delta function.

Practice-12 *Evaluation of trigonometric functions of sine series.

*Find the real roots of a quadratic equation.

*Using C^{++} find prime number between 1 and n.

*Find the real and imaginary roots of a quadratic equation.

Total: Theory=30 Hours Practice=24 Hours & Flipped Class=12Hours

Text Books:

1. Mathematical Physics by Satyaprakash, Chand&Co.
2. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7th Edn., Elsevier.

Reference Books:

1. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning
2. Differential Equations, George F. Simmons, 2007, McGraw
3. Mathematical Tools for Physics, James Nearing, 2010, Dover
4. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
5. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning

6. Mathematical Physics, Goswami, 1st edition, Cengage Learning
7. Engineering Mathematics, S.Pal and S.C. Bhunia, 2015, Oxford University Press
8. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley
9. Essential Mathematical Methods, K.F.Riley&M.P.Hobson, 2011, Cambridge Univ. Press

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1484	Mechanics	3-2-1	Nil

Objective

- This course would empower the student to acquire skills and practical knowledge, which help the student in their everyday life.
- This syllabus will cater the basic requirements for their higher studies.
- This course will provide a theoretical basis for doing experiments in related areas.
- This is an introductory course for undergraduate science students.

Learning outcome

- Understand the analogy between translational and rotational dynamics and application of both motions simultaneously in analyzing rolling without slipping.
- Understand the phenomena of collisions and idea about center of mass frames of reference and laboratory frames of reference and their correlation.
- Understand the non-inertial systems and the fictitious forces.
- Understand the principles of elasticity and principle of fluid flow.
- Apply Kepler's law to describe the motion of planets and satellite in circular orbit, through the study of law of gravitation.
- Explain the phenomena of simple harmonic motion and the properties of systems executing such motions.

Course outline

Module I **(4 Hours Theory+2 Hours Practice)**

Work and energy:

Work and kinetic energy theorem, conservative and non-conservative forces, potential Energy, force as gradient of potential energy, work & potential energy, work done by non-conservative forces, law of conservation of energy.

Practice-1: To verify work energy theorem using Newton's second law simulator. (Vlab)

Module II **(2 Hours Theory +4 Hours Practice+1 Hours Flipped Class)**

Collisions:

Elastic and inelastic collisions between particles, centre of mass, centre of mass and laboratory frames, two dimensional elastic collision in centre of mass frame, advantage of centre of mass frame of reference.

Practice-2: To measure the speed of a bullet and to verify the law of conservation of momentum by ballistic pendulum simulator.(Vlab)

Practice-3: Verification of elastic and inelastic collision. (Virtual lab)

Module III **(5 Hours Theory +2 Hours Practice+1 Hours Flipped Class)**

Rotational dynamics:

Angular momentum of a particle and system of particles, torque, principle of conservation of angular momentum, rotation about a fixed axis, moment of inertia, calculation of moment of inertia for rectangular, cylindrical and spherical bodies.

Practice-4: To determine the moment of inertia of a flywheel

Module IV **(3 Hours Theory)**

Non-inertial systems:

Frames of reference, inertial frames, non-inertial frames and fictitious forces, uniformly rotating frame, laws of physics in rotating coordinate systems, centrifugal force, Coriolis force and its application.

Module V **(4 Hours Theory+10 Hours Practice+1 Hours Flipped Class)**

Elasticity: Relation between elastic constants, twisting couple in a cylinder or wire.

Practice-5: To determine the Young's modulus of a wire by Searle's method.

Practice-6: To determine the modulus of rigidity of a wire by static torsion method.

Practice-7: To determine the modulus of rigidity of a wire by torsional pendulum/Maxwell needle.

Fluid motion: Kinematics of moving fluids, Poiseuille's equation for flow of a liquid.

Practice-8: To determine coefficient of viscosity of water by capillary flow method (Poiseuille's method).

Practice-9: To determine coefficient of viscosity of oil by falling ball viscometer.

Module VI **(6 Hours Theory +3 Hours Flipped Class)**

Gravitation and Central force motion:

Law of gravitation, gravitational potential energy, inertial and gravitational mass, potential and field due to spherical shell and solid sphere. Motion of a particle under a central force field, two-body problem and its reduction to one-body problem and its solution, the energy

equation and energy diagram, Kepler's Laws, satellite in circular orbit and applications, geosynchronous orbits, weightlessness, basic idea of global positioning system (GPS).

Module VII (6 Hours Theory+6 Hours Practice+6 Hours Flipped Class)

Oscillations:

Simple harmonic oscillations, differential equation of SHM and its solution, kinetic energy, potential energy, total energy and their time-average values, damped oscillation, forced oscillations, transient and steady states, resonance, sharpness of resonance, power dissipation and quality factor, compound pendulums.

Practice-10: To determine the value of g using bar pendulum.

Practice-11: To determine the value of g using Kater's pendulum.

Practice-12: To determine the moment of inertia of a torsion pendulum

Total: Theory=30 Hours Practice=24 Hours & Flipped Class=12Hours

Text Book:

1. Mechanics, D.S. Mathur, S. Chand and Company Limited.

Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley
3. Physics for scientists and Engineers with Modern Phys. ,J.W. Jewett, R.A. Serway, 2010, Cengage Learning

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1485	Thermal Physics	3-2-1	Nil

Objective

- To acquire working knowledge of the zeroth, first and second law of thermodynamics.
- To apply the laws of thermodynamics and its application to understand thermo dynamical behavior.
- To link thermodynamics to the micro description used in Classical Statistical Mechanics.

Learning outcome

Upon successful completion of this course,

- Student identifies the relationship and correct usage of work, energy, heat capacity, specific heat, latent heat, and enthalpy.
- Student can compute entropy for simple systems such as the ideal gas (Sakur-Tetrode equation), the Einstein solid, and the two-level paramagnet.
- Student can compute the value of selected thermodynamical variables at thermal, mechanical, and/or diffusive equilibrium.
- Student can compute the efficiency of idealized engines such as the Carnot cycle, the Otto cycle, and the Diessel cycle.

Course outline

Module-I **(5 Hours Theory+10 Hours Practice+2 Hours Flipped Class)**

Introduction to Thermodynamics:

Zeroth and first law of thermodynamics, Extensive and intensive thermodynamic variables, Thermodynamic equilibrium, Zeroth law of thermodynamics & concept of temperature, Concept of work & heat, Conduction, Convection and Radiation, Concept of black body, State functions, First law of thermodynamics and its differential form, Applications of first law, Work and internal energy in different processes.

Practice-1: Heat transfer by conduction

Practice-2: Heat transfer by radiation

Practice-3: Heat transfer by natural convection/To determine the coefficient of thermal conductivity of a bad conductor by Lee's method

Practice-4: To determine the coefficient of thermal conductivity of Cu by Searle's

Practice-5: Black body radiation

Module-II (4 Hours Theory+2 Hours Practice+1 Hour Flipped Class)

Second Law of Thermodynamics:

Reversible and irreversible process with examples, Conversion of work into heat and heat into work, Heat engines, Carnot's cycle, Carnot engine & efficiency, Carnot's theorem, Refrigerator & coefficient of performance, 2nd Law of thermodynamics and applications of second law of thermodynamics, Kelvin-Planck and Clausius statements and their equivalence, Absolute scale of temperature.

Practice-6: To determine mechanical equivalent of heat, J, by Joule's calorimeter.

Module-III (4 Hours Theory+2 Hour Practice+1 Hour Flipped Class)

Entropy:

Concept of entropy, Phase change, Second law of thermodynamics in terms of entropy, Entropy of a perfect gas, Principle of increase of entropy, Entropy changes in reversible and irreversible processes with examples, Entropy of the universe, Temperature–entropy diagrams for Carnot's cycle, Third law of thermodynamics. Unattainability of absolute zero.

Practice-7: The study of phase change

Module-IV **(4 Hours Theory+1 Hour Flipped Class)**

Thermodynamic Potentials:

Thermodynamic potentials: internal energy, enthalpy, Helmholtz free energy, Gibb's free energy, Their definitions, properties and applications, Cooling due to adiabatic demagnetization, Clausius-Clapeyron equation, Maxwell's thermodynamic relations and applications.

Module-V **(4 Hours Theory+3 Hours Flipped Class)**

Kinetic Theory of Gases

Distribution of velocities: Maxwell-Boltzmann law of distribution of velocities in an Ideal gas, Mean, RMS and most probable speeds; degrees of freedom, Law of equipartition of energy (No proof required), Specific heats of gases.

Module-VI **(4 Hours Theory+2 Hours Flipped Class)**

Molecular Collisions:

Mean free path, Collision probability, Estimates of mean free path, Transport phenomenon in ideal gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion, Brownian motion and its Significance.

Module-VII **(5 Hours Theory+10 Hour Practice+2 Hours Flipped Class)**

Thermo-electricity and Newton's Law of Cooling

Introduction to Thermoelectricity, Seebeck Effect, Peltier Effect, Thermoelectric Devices, Thermistor, Newton's Law of Cooling

Practice-8: To determine the temperature coefficient of resistance by platinum resistance thermometer (PRT)

Practice-9: Thermo couple Seebeck effect

Practice-10: To study the variation of thermo-emf of a thermocouple with difference of temperature of its two junctions

Practice-11: Characteristics of thermistor

Practice-12: Newton's law of cooling

Total theory 30 hours, total practice 24 hours and total flipped class 12 hours

Textbook:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981,McGraw-Hill.

Reference Books:

1. A Treatise on Heat, MeghnadSaha, and B.N.Srivastava, 1958, Indian Press
2. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
3. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
4. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger 1988, Narosa.
5. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press.
6. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications

Code	**Course Title**	**T-P-Pj (Credit)**	**Prerequisite**
CUTM1486	**Waves and Optics**	3-2-1	Nil

Objective

- To aware the students about the various phenomena of waves and optics.
- To solve many types of problems involving wave motion.
- To understand the phenomenon like Interference, Diffraction tHoursough practice mode.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Understand the physics behind various phenomena in waves and optics.
- Understand various natural phenomena (like interference and diffraction) that are happening in their surroundings.
- Understand longitudinal, transverse waves and their applications.

Course outline

Module-I **(6 Hours Theory+3 Hours Flipped Class)**

Superposition of Collinear Harmonic oscillations: Linearity and Superposition Principle. Superposition of two collinear oscillations having (1) equal frequencies and (2) different frequencies (Beats).

Wave Motion: Plane and Spherical Waves. Longitudinal and Transverse Waves. Plane Progressive (Travelling) Waves. Wave Equation. Particle and Wave Velocities. Differential Equation. Pressure of a Longitudinal Wave. Energy Transport. Intensity of Wave. Water Waves: Ripple and Gravity Waves.

Module-II **(2 Hours Theory +1 Hours Flipped Class)**

Velocity of Waves: Velocity of Transverse Vibrations of Stretched Strings. Velocity of Longitudinal Waves in a Fluid in a Pipe. Newton's Formula for Velocity of Sound. Laplace's Correction.

Module-III **(6 Hours Theory+2 Hours Flipped Class)**

Superposition of Two Harmonic Waves:

Standing (Stationary) Waves in a String: Fixed and Free Ends. Analytical Treatment. Phase and Group Velocities. Changes with respect to Position and Time. Energy of Vibrating String. Transfer of Energy. Normal Modes of Stretched Strings. Plucked and Struck Strings. Melde's Experiment. Longitudinal Standing Waves and Normal Modes. Open and Closed Pipes. Superposition of N Harmonic Waves.

Module-IV **(6 Hours Theory+4 Hours Practice+2 Hours Flipped Class)**

Wave Optics

Interference:

Huygens Principle. Division of amplitude and wave front. Young's double slit experiment. Lloyd's Mirror and Fresnel's Biprism. Phase change on reflection: Stokes' treatment. Interference in Thin Films: parallel and wedge-shaped films. Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes). Newton's Rings: Measurement of wavelength and refractive index.

Practice 1. To determine the wavelength of sodium light using Newton's Rings.

Practice 2. To determine the refractive index of liquid using Newton's Rings.

Module-V **(2 Hours Theory+6 Hours Practice+2 Hours Flipped Class)**

Interferometer:

Michelson Interferometer-(1) Idea of form of fringes (No theory required), (2) Determination of Wavelength, (3) Wavelength Difference, (4) Refractive Index, and (5) Visibility of Fringes. Fabry-Perot interferometer.

Practice 3. To determine the wavelength of sodium source using Michelson's interferometer.

Practice 4. To determines the refractive index of a thin glass plate using Michelson's interferometer.

Practice 5. To determine the wavelength of a laser using Michelson's interferometer.

Module-VI **(4 Hours Theory + 4 Hours Practice+1 Hours Flipped Class)**

Fraunhofer diffraction:

Single slit. Circular aperture, Resolving Power of a telescope. Double slit. Multiple slits. Diffraction grating. Resolving power of grating.

Practice 6. To determine the wavelength of Na source using a plane diffraction grating.

Practice 7. To determine dispersive power and resolving power of a plane diffraction grating.

Module-VII **(4 Hours Theory+10 Hours Practice+1 Hours Flipped Class)**

Fresnel Diffraction:

Fresnel's Assumptions. Fresnel's half-Period Zones for Plane Wave. Explanation of Rectilinear Propagation of Light. Theory of a Zone Plate: Multiple Foci of a Zone Plate. Fresnel's Integral, Fresnel diffraction pattern of a straight edge, a slit and a wire.

Practice 8. To study Lissajous Figures.

Practice 9. To calculate the velocity of ultrasonic sound tHoursough different liquid media

Practice 10. To calculate the adiabatic compressibility of the given liquid

Practice 11. To calculate the beam of divergence and spot size of the given laser beam.

Practice 12. To investigate the motion of coupled oscillators

Total theory 30 hours, total practice 24 hours and total flipped class 12 hours

Text Books:

1**.** Optics, AjoyGhatak, 2008, Tata McGraw Hill

Reference Books:

1.Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7th Edn., 1999, Pergamon Press.
4. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
5. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
6. Fundamental of Optics, A. Kumar, H.R. Gulati and D.R. Khanna, 2011, R. ChandPublications.

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1487	Mathematical Physics-II	3-2-1	Nil

Objective

This course aims to

- Fourier series and its application to the solution of partial differential equations.
- Study of Second order linear differential equations and their importance
- Introduce the concepts of Laplace equation, its application, basic statistical data analysis and curve fitting.

Learning outcome

After successfully completing this course, the student should be able to

- Fourier series and its application to the solution of partial differential equations.
- Study of Second order linear differential equations and their importance
- Introduce the concepts of Laplace equation, its application, basic statistical data analysis and curve fitting.

Course Outline

Module I (6 Hours Theory+ 4 Hours Practice+ 1 Hour Flipped Class)

Fourier series: Periodic functions. Orthogonality of sine and cosine functions, Dirichlet Conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period.

Practice-1 Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window

Practice-2 Variables and arrays, Initializing variables in Scilab, Multidimensional arrays, Subarray

Module-II (5 Hours Theory+ 4 Hours Practice+ 2 Hours Flipped Class)

Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of Infinite Series. Term-by-Term differentiation and integration of Fourier series. Parseval Identity.

Practice-3 Special values, Displaying output data, data file, Scalar and array operations Hierarchy of operations, Built in Scilab functions

Practice-4 Introduction to plotting, 2D and 3D plotting

Module-III (5 Hours Theory+ 4 Hours Practice+ 2 Hours Flipped Class)

Frobenius Method and Special Functions: Singular Points of Second order linear differential Equations and their importance. Frobenius method and its applications to differential equations. Legendre, Bessel, Hermite and Laguerre Differential Equations.

Practice-5 Branching Statements and program design, Relational & logical operators

Practice-6 The while loop, for loop, details of loop operations, break & continue statements

Module-IV (4 Hours Theory+ 4 Hours Practice+ 2 Hours Flipped Class)

Properties of Legendre Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre Polynomials. Bessel Functions of the First Kind: Generating Function, simple recurrence relations. Zeros of Bessel Functions (Jo(x) and J1(x))and Orthogonality.

Practice-7 Curve fitting for experimental Data. Solution of AX=B Using Gauss Elimination.

Practice-8 Numerical Integration using Trapizoidal Rule and Simpson's Rule

Module-V (3 Hours Theory+ 2 Hours Practice+ 2 Hours Flipped Class)

Some Special Integrals: Beta and Gamma Functions and Relation between them.Expression of Integrals in terms of Gamma Functions. Error Function (Probability Integral).

Practice-9 Find the eigen value and eigen vector of the input matrix. Solution Of Radioactive decay .

Module-VI (3 Hours Theory+ 4 Hours Practice+ 1 Hours Flipped Class)

Theory of Errors: Systematic and Random Errors. Propagation of Errors. Normal Law of Errors. Standard and Probable Error. Least-squares fit. Error on the slope and intercept of a fitted line.

Practice-10 An introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program

Practice-11 Ohms law to calculate R, Hooke's law to calculate spring constant.

Module-VII (4 Hours Theory+ 2 Hours Practice+ 2 Hours Flipped Class)

Partial Differential Equations: Solutions to partial differential equations, using separation of variables: Laplace's Equation in problems of rectangular, cylindrical and spherical symmetry. Wave equation and its solution for vibrational modes of a stretched string

Practice-12 Solution of simple pendulum and Double Pendulum using Euler and RK4 method

Total Theory 30 hours, Total Practice 24 Hours, Total Flipped Class 12 hours

Text Book:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.

Reference Books:

1. Mathematical Physics by B.S.Rajput, APragati
2. Mathematical Physics by Satyaprakash, Chand&Co.
3. Introduction to Mathematical Physics by Charlie
4. Mathematical Physics by H.K.Dass and Dr. Rama Verma, S.Chand
5. Mathematical Physics by D.Gupta.

6. Fourier analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
7. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.

Code	**Course Title**	**T-P-Pj (Credit)**	**Prerequisite**
CUTM1488	**Electricity and Magnetism**	3-2-1	Nil

Objective

- Study the electric and magnetic fields in details.
- Study and explore the dielectric properties of matter.
- Study the relation between electric and magnetic fields.

Learning outcome

Upon successful completion of this course, students will be able to:

- Understand the characteristics and properties of electric and magnetic fields.
- Understand the behavior and use of dielectrics.
- Understand the Maxwell equation and their usefulness.
- Experiences electricity & magnetism in practice mode

Course outline

Module-I (4 Hours Theory+2 Hours Flipped Class)

Electric field:

Electric field lines. Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic Field. Electrostatic Potential. Laplace's and Poisson equations. The Uniqueness Theorem. Potential and Electric Field of a dipole. Force and Torque on a dipole.

Module-II (4 Hours Theory + 2 Hours Practice+1 Hour Flipped Class)

Electrostatic energy:

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor. Method of Images and its application to: (1) Plane Infinite Sheet and (2) Sphere.

Practice 1: Determination dielectric constant by using parallel plate capacitors

Module-III (2 Hours Theory+1 Hour Flipped Class)

Dielectric Properties of Matter:

Electric Field in matter. Polarization, PolarizationCharges. Electrical Susceptibility and Dielectric Constant. Capacitor (parallel plate, spherical, cylindrical) filled with dielectric. Displacement vector D. Relations between E, P and D. Gauss' Law in dielectrics.

Module-IV (6 Hours Theory + 4 Hours Practice+6 Hours Flipped Class)

Magnetic Field:

Magnetic force between current elements and definition of MagneticFieldB. Biot-Savart's Law and its simple applications: straight wire and circular loop. Current Loop as a Magnetic Dipole and its Dipole Moment (Analogy with Electric Dipole). Ampere's Circuital Law and its application to (1) Solenoid and (2) Toroid. Properties of B: curl and divergence. Vector Potential. Magnetic Force on (1) point charge (2) current carrying wire (3) between current elements. Torque on a current loop in a uniform Magnetic Field. Magnetic Properties of Matter: Magnetization vector (M). Magnetic Intensity(H). Magnetic Susceptibility and permeability. Relation between B, H, M. Ferromagnetism. B-H curve and hysteresis.

Practice 2: To study the variation of magnetic field with distance along the axis of a circular coil carrying current.

Practice 3: To determine the reduction factor of the given tangent galvanometer (K).

Module-V (6 Hours Theory + 6 Hours Practice+1 Hour Flipped Class)

Electromagnetic Induction:

Faraday's Law. Lenz's Law. Self-Inductance and MutualInductance. Reciprocity Theorem. Energy stored in a Magnetic Field. Introduction to Maxwell's Equations. Charge Conservation and Displacement current.

Practice 4: To determine self-inductance of a coil by Anderson's bridge.

Practice 5: To determine self-inductance of a coil by Rayleigh's method.

Practice 6: To determine the mutual inductance of two coils

Module-VI (4 Hours Theory + 8 Hours Practice+1 Hour Flipped Class)

Electrical Circuits:

AC Circuits: Kirchhoff's laws for AC circuits. Complex Reactanceand Impedance. Series LCR Circuit: (1) Resonance, (2) Power Dissipation and (3)

Quality Factor, and (4) Band Width. Parallel LCR Circuit.

Practice 7: To design series RC circuit and find out the current flowing thorugh each component.
Practice 8: To design series LC circuit and find out the current flowing thorugh each component.
Practice 9: To design Series RL circuit and find out the current flowing thorugh each component.
Practice 10: To study the variation in current and voltage in a series LCR circuit

Module-VII **(4 Hours Theory + 4 Hours Practice)**

Network theorems:

Ideal Constant-voltage and Constant-current Sources. NetworkTheorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum Power Transfer theorem. Applications to dc circuits.

Practice 11: To verify the Thevenin theorems.
Practice 12: To verify the Norton theorems

Total theory 30 hours, total Practice 24 hours and 12 hours Flipped Class

Text Books:

1. Electricity and Magnetism by D.C.Tayal, Himalaya Publishing House.

Reference Books:

1. Electricity and Magnetism - K. K. Tiwari
2. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
3. Engineering Electromagnetics by W.H.Hayt&J.A.Buck.
4. Introduction to Electrodynamics by D J Griffiths, PHI Learning, 2009.
5. Electricity and Magnetism - Segal, Chopra, Segal.
6. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
7. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1489	Analog System and Application	3-2-1	Nil

Objective

- The objectives of this subject are to Learn Fundamentals of electronic devices.
- Design and Applications of electronic circuits.

- Learn through practice mode the fundamental electronic devices

Learning outcome

Upon successful completion of this course, students will be able to:

- Student identifies the relationship and correct usage of work, energy, heat capacity, specific heat, latent heat, and enthalpy.
- Understand Semiconductor diodes, bipolar junction transistor.
- Sketch, explain and design the amplifier circuit for given specification and analyze them discuss oscillator principles, and frequency stability.
- Analyze the different types of Oscillators

Course outline

Module I (4 Hours Theory+2 Hours Practice+1 Hours Flipped Class)

Semiconductor Diodes:

P and N type semiconductors. Energy Level Diagram. Conductivity and Mobility, Concept of Drift velocity. PN Junction Fabrication (Simple Idea). Barrier Formation in PN Junction Diode. Static and Dynamic Resistance. Current Flow Mechanism in Forward and Reverse Biased Diode. Drift Velocity. Derivation for Barrier Potential, Barrier Width and Current for Step Junction. Current Flow Mechanism in Forward and Reverse Biased Diode.

Practice-1: V-I characteristics of PN junction diode

Module II (4 Hours Theory+ 4 Hours Practice+2 Hours Flipped Class)

Two-terminal Devices and their Applications:

(1) Rectifier Diode: Half-wave Rectifiers. Centre-tapped and Bridge Full-wave Rectifiers, Calculation of Ripple Factor and Rectification Efficiency, C-filter (2) Zener Diode and Voltage Regulation. Principle and structure of (1) LEDs, (2) Photodiode and (3) Solar Cell.

Practice-2: V-I characteristics of Light emitting diode.

Practice-3: V-I characteristics of a Zener diode and its use as voltage regulator.

Module III (5 Hours Theory+ 2 Hours Practice+1 Hours Flipped Class)

Bipolar Junction transistors:

n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC Configurations. Current gains α and β Relations between α and β. Load Line analysis of Transistors. DC Load line and Q- point. Physical Mechanism of Current Flow. Active, Cut-off and Saturation Regions.

Practice-4: To study the characteristics of a Bipolar Junction Transistor in CE, CB and CC configuration

Module IV (5 Hours Theory+ 2 Hours Practice+1 Hours Flipped Class)

Amplifiers:

Transistor Biasing and Stabilization Circuits. Fixed Bias and Voltage Divider Bias. Transistor as 2-port Network. h-parameter Equivalent Circuit. Analysis of a single-stage CE amplifier using Hybrid Model. Input and Output Impedance. Current, Voltage and Power Gains. Classification of Class A, B & C Amplifiers.

Practice-5: To study the various biasing configurations of BJT for normal class A ,B and C operation.

Module V (4 Hours Theory+ 1 Hours Practice+1 Hours Flipped Class)

Coupled Amplifier:

Two stage RC-coupled amplifier and its frequency response

Feedback in Amplifiers:

Effects of Positive and Negative, Feedback on Input, Impedance, Output Impedance, Gain, Stability, Distortion and Noise.

Practice-6: To study the frequency response of voltage gain of a RC-coupled transistor amplifier

Module VI (3 Hours Theory+ 4 Hours Practice+2 Hours Flipped Class)

Operational Amplifiers (Black Box approach):

Characteristics of an Ideal and Practical Op-Amp. (IC 741) Open-loop and Closed-loop Gain. Frequency Response. CMRR. Slew Rate and concept of Virtual ground.

Practice-7:inverting amplifier using Op-amp (741,351) for dc voltage of given gain

Practice-8:inverting amplifier using Op-amp (741,351) and study its frequency response

Practice-9:non-inverting amplifier using Op-amp (741,351) & study its frequency response.

Module VII (5 Hours Theory+6 Hours Practice +2 Hours Flipped Class)

Applications of Op-Amps:

(1) Inverting and non-inverting amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Log amplifier, (7) Zero crossing detector (8) Wein bridge oscillator.

Practice-10: To study the zero-crossing detector and comparator.

Practice-11: Two dc voltages using Op-amp in inverting and non-inverting mode.

Practice-12: To investigate the use of an op-amp as a Differentiator and Integrator.

Total theory 30 hours , total Practice 24 hours and total Flipped Class 12 hours

Textbook:

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill

Reference Books:

1. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
2. Solid State Electronic Devices, B.G.Streetman & S.K.Banerjee, 6th Edn.,2009, PHI Learning
3. Electronic Devices & circuits, S.Salivahanan & N.S.Kumar, 3rd Ed., 2012, Tata Mc-Graw Hill
4. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
5. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press.
6. Electronic circuits: Handbook of design & applications, U.Tietze, C.Schenk,2008, Springer
7. Semiconductor Devices: Physics and Technology, S.M. Sze, 2nd Ed., 2002, Wiley India
8. Microelectronic Circuits, M.H. Rashid, 2nd Edition, Cengage Learning
9. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1490	Mathematical Physics-III	3-2-1	Nil

Objective

This course aims to

- The main objective of this course is to familiarize students with a range of mathematical methods that are essential for solving advanced problems in theoretical physics.
- The laws of physics are often expressed tHoursough the relatively complex mathematical apparatus.
- This course is intended to give mathematical tools necessary for a better understanding of the later courses in physics such as classical electrodynamics, quantum mechanics, solid-state physics, and statistical physics.

Learning outcome

After successfully completing this course, the student should be able to

- Perform algebra of complex numbers
- Express analytic complex function as power series.
- Identify the isolated singularities of a function and determine the types of singularity
- Calculate the Laplace Transform of basic functions using the definition
- Able to solve complex integrals
- Use the residue theorem to compute some definite integrals

Course Outline

Module I (4 Hours Theory+ 6 Hours Practice+ 2 Hours Flipped Class)

Complex Analysis Basic Concepts

Motivation and introduction to Complex analysis; Brief revision of complex no and their graphical representation; the triangular inequality. Polar coordinates; Euler's formula and complex exponentials, polar form; Roots of the complex number- nth root, De-Moivers theorem; Representing complex multiplication as matrix multiplication, examples; Numerical problems

Practice-1: Basics of python

Practice-2: Basics of Python

Practice- 3: Basics of Python

Module II (6 Hours Theory+ 6 Hours Practice+ 1 Hours Flipped Class)

Analytic function Basic Concepts-II

The derivative preliminaries. Numerical problems; Limits and continuous functions. Properties of limits and continuous functions, limit involving infinity; Branch cut, branch point and branches. Numerical problems; Cauchy-Riemann equation. Numerical problems; Complex line integral. Cauchy Integral theorem; Singular points, poles; Cauchy Integral formula for functions; Cauchy Integral formula for derivatives.

Numerical problems; Harmonic function; Complex line integral.Cauchy Integral theorem; Numerical problems; Singular points, poles; Cauchy Integral formula for functions; Cauchy Integral formula for derivatives. Numerical problems: Harmonic function

Practice-4: Compute nth roots of unity for n=2, 3, 4....

Practice-5: Find the Fourier Transform of exp(-x2)

Practice -5: Integrate 1/(x2+1) numerically and check with computer

Module III **(4 Hours Theory+ 1 Hour Flipped Class)**

Taylor and Laurent series:

Finite and infinite geometric series, convergence of power series; Taylor series; Numerical problems: Singularities, types of singularities; Laurent's series, examples;

Module IV **(3Hours Theory+ 2 Hour Flipped Class)**

Residues:

Poles and residues;Residue theorem; Examples of poles and residues; Examples of poles and residues; Application of Residue theorems; Numerical problems-Solution of some definite integral using Residue theorem

Module V **(6 Hours Theory+ 4 Hours Practice+ 1 Hour Flipped Class)**

Fourier Transform:

Introduction, Fourier Integral trans form, examples; Fourier transforms- sine and cosine transforms; Fourier transform properties; Inverse Fourier transform, examples; Fourier transform- infinite wave train, Dirac Delta function and Gaussian function; Convolution of Fourier transform, Parseval Identity. Numerical Problems; Application of Fourier transform to one dimensional wave equation

Practice-7: Compute the Fourier Transform of exp(-x2)using Python and compare with numerically calculated solution

Module VI **(2 Hours Theory+6 hours practice+1 Hour Flipped Class)**

Laplace Transform;

Introduction. Laplace transform of elementary function; Properties of Laplace transform;; Examples LT of 1st and 2nd order derivative; Inverse Laplace Transform; Examples LT of 1st and 2nd order derivative; Numerical problems; LT of a unit step function, Dirac Delta function; Application of LT to 2nd order differential equation, Application to damped harmonic oscillator. Impulse function and Lcr circuits

Practice-8: Solve Kirchoff's current law for any node of an arbitrary circuit using LT

Practice-9: Solve Kirchoff's voltage law for any node of an arbitrary circuit using LT

Practice-10: Perform circuit analysis of a general LCR circuit using Laplace Transform

Module VII **(5 Hours Theory + 4 hours practice)**

Green's Function:

Introduction. Greens function for the one-dimensional problem; Construction of Greens function; Non-homogeneous boundary value problem; Homogeneous Boundary condition. Sturm- Liouville problem; Eigenvalue and Eigen function expansion of Greens function; Parseval Formula-complete condition for the Eigen function

Practice 11: Derive the Green's function for the operator d2/dx2 with boundary condition y(0)=0 and y(1)=0

Practice 12: Find an appropriate Green's function for the equation y"+1/4y=f(x) with boundary condition y(0)=y(π)=0

Total Theory 30 hours, Total Practice 24 Hours, Total Flipped Class 10 hours

Textbook:

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier

Reference Books:

1. Mathematical Physics by B.S.Rajput, Pragati Edition.
2. Mathematical Physics by Satyaprakash, S.Chand&Co.
3. Introduction to Mathematical Physics by Charlie Harper.
4. Mathematical Physics by H.K.Dass and Dr. Rama Verma, S.Chand Publication.
5. Mathematical Physics by B.D.Gupta.

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1491	Elements of Modern Physics	3-2-1	Nil

Objective

- This course covers certain conceptual courses of physics by virtue of which the students will be able to understand some concepts of Quantum Mechanics, Atomic Physics and Nuclear Physics.
- It also imparts the basic principles of Quantum mechanics, Schrodinger equation and its applications
- To introduce students to the fundamentals of atomic physics and nuclear physics.
- To introduce them to the basic Laser principles and Properties.

Learning outcome

Upon successful completion of this course, students will be able to:

- Understand and explain the differences between classical and quantum mechanics.
- Solve Schrodinger equation for simple potentials.
- Assess whether a solution to a given problem is physically reasonable.
- Identify properties of the nucleus and other sub-atomic particles.
- Describe theories explaining the structure of atoms and the origin of the observed spectra.
- Explain different Laser used and make a comparison between them.

Course outline

Module-I **(7 Hours Theory+8 Hours Practice+3 Hours Flipped Class)**

Planck's quantum, Planck's constant and light as a collection of photons; Blackbody Radiation: Quantum theory of Light; Photo-electric effect and Compton scattering. De Broglie wavelength and matter waves; Davisson-Germer experiment. Wave description of particles by wave packets. Group and Phase velocities and relation between them. Two-Slit experiment with electrons. Probability. Wave amplitude and wave functions.

Practice-1: Measurement of Planck's constant using black body radiation and photo-detector **Practice-2**: Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light

Practice-3: To determine the wavelength of H-alpha emission line of Hydrogen atom.

Practice-4: To determine the ionization potential of mercury.

Module-II **(3 Hours Theory+4 Hours Practice+1 Hour Flipped Class)**

Position measurement- gamma ray microscope thought experiment; Wave-particle duality, Heisenberg uncertainty principle (Uncertainty relations involving Canonical pair of variables): Derivation from Wave Packets impossibility of a particle following a trajectory; Estimating minimum energy of a confined particle using uncertainty principle; Energy-time uncertainty principle- application to virtual particles and range of an interaction.

Practice-5: To setup the Millikan oil drop apparatus and determine the charge of an electron.

Practice-6: To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.

Module-III **(4 Hours Theory)**

Entropy:

Two slit interference experiment with photons, atoms and particles; linear superposition principle as a consequence; Matter waves and wave amplitude; Schrodinger equation for non-relativistic particles; Momentum and Energy operators; stationary states; physical interpretation of a wave function, probabilities and normalization; Probability and probability current densities in one dimension.

Module-IV **(2 Hours Theory+2 Hours Practice)**

One dimensional infinitely rigid box- energy eigenvalues and Eigen functions, normalization; Quantum dot as example; Quantum mechanical scattering and tunneling in one dimension-across a step potential & rectangular potential barrier.

Module-V **(5 Hours Theory)**

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, NZ graph, Liquid Drop model: semi-empirical mass formula and binding energy, Nuclear Shell Model and magic numbers.

Module-VI **(6 Hours Theory)**

Radioactivity: stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay- energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus.Fission and fusion- mass deficit, relativity and generation of energy; Fission - nature of fragments and emission of neutrons.

Module-VII **(5 Hours Theory+8 Hour Practice+6 Hours Flipped Class)**

Lasers: Einstein’s A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser and He-Ne Laser. Basic lasing.

Practice-8: To determine the wavelength of laser source using diffraction of double slits.

Practice-9: To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating

Practice-10: To show the tunneling effect in tunnel diode using I-V characteristics.

Practice-11: Monte-Carlo Simulation of charged particle induced effects on various materials

Practice-12: (Sputtering Calculation) Monte-Carlo Simulation of charged particle induced effects on various materials

Flipped Classs: Monte-Carlo Simulation of charged particle induced effects on various materials (SRIM & IRADINA)

Total theory 30 hours, total practice 24 hours and total flipped class 12 hours

Textbook:

1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill.

Reference Books:

1. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill
2. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.
3. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill
4. Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan
5. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning.
6. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2ndEdn, Tata McGraw-Hill Publishing Co. Ltd.
7. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co.

Text Books (Practice)

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House

Reference Books:

1. Advanced level Physics Practical's, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011,Kitab Mahal

Reference Books (Flipped Classs on Monte-Carlo Simulation) : SRIM, The stopping and range of ions in matter, James F. Ziegler, Jochen P. Biersack, Matthias D. Ziegler

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1492	**Digital Systems and Applications**	3-2-1	Nil

Objective

- To make the student understand the digital system.
- To understand the Boolean algebra and data processing circuit.
- Knowing computer architecture.
- Understanding the arithmetic and sequential circuit and microprocessors.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Gain both theoretical and experimental knowledge about digital electronics.
- Understand computer architecture.
- Verify and design various logic gates.
- Write programs using 8085 microprocessor.

Course outline

Module-I **(3 Hours Theory)**

Introduction to CRO:

Block Diagram of CRO. Electron Gun, Deflection System and Time Base. Deflection Sensitivity. Applications of CRO: (1) Study of Waveform, (2) Measurement of Voltage, Current, Frequency, and Phase Difference.

Module-II **(3 Hours Theory +2 Hours Flipped Class)**

Integrated Circuits (Qualitative treatment only):

Active & Passive components. Discrete components. Wafer. Chip. Advantages and drawbacks of ICs. Scale of integration: SSI, MSI, LSI and VLSI (basic idea and definitions only). Classification of ICs. Examples of Linear and Digital lCs.

Module-III **(5 Hours Theory + 10 Hours Practice + 3 Hours Flipped Class)**

Digital Circuits:

Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion. BCD, Octal and Hexadecimal numbers. AND, OR and NOT Gates (realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates and application as Parity Checkers.

Practice 1. Basics of OR gate and its application in industrial control.

Practice 2. Basic NOT gate and its application in fuel level indicator.

Practice 3. Washing machine control using basic AND & NOT gates.

Practice 4. Water level control using basic AND & NOT gates.

Practice 5. Basics of AND gate and its application in car wiper control.

Module-IV (6 Hours Theory + 4 Hours Practice+ 3 Hours Flipped Class)

Boolean algebra:

De Morgan's Theorems. Boolean Laws. Simplification of Logic Circuit using Boolean algebra. Fundamental Products. Idea of Minterms and Maxterms. Conversion of a Truth table into Equivalent Logic Circuit by (1) Sum of Products Method and (2) Karnaugh Map.

Data processing circuits:

Basic idea of Multiplexers, De-multiplexers, Decoders, Encoders.

Practice 6. Analysis and Synthesis of Boolean Expressions using Basic Logic Gates.

Practice 7. 1 Bit Full Adder using Multiplexer.

Module-V (5 Hours Theory + 10 Hours Practice+ 2 Hours Flipped Class)

Arithmetic Circuits:

Binary Addition. Binary Subtraction using 2's Complement. Half and Full Adders. Half & Full Subtractors, 4-bit binary Adder/Subtractor.

Sequential Circuits:

SR, D, and JK Flip-Flops. Clocked (Level and Edge Triggered) Flip-Flops. Preset and Clear operations. Race-around conditions in JK Flip-Flop. M/S JK Flip-Flop.

Practice 8. Analysis and Synthesis of Arithmetic Expressions using Adders / Subtractors.

Practice 9. Analysis and Synthesis of Sequential Circuits using Basic Flip-Flops.

Practice 10. To implement Half adder by using basic and universal gates.

Practice 11. To implement J-K flip-flop by using basic and universal gates.

Practice 12. To implement Parallel Binary Adder by using basic and universal gates.

Module-VI **(4 Hours Theory+ 1 Hours Flipped Class)**

Computer Organization:

Input/Output Devices. Data storage (idea of RAM and ROM).Computer memory. Memory organization & addressing. Memory Interfacing. Memory Map.

Module-VII **(4 Hours Theory+ 1 Hours Flipped Class)**

Intel 8085 Microprocessor Architecture:

Main features of 8085. Block diagram. Components. Pin-out diagram. Buses. Registers. ALU.

Introduction to Assembly Language: 1 byte, 2 byte & 3 byte instructions.

Total theory 30 hours, total practice 24 hours and total flipped class 12 hours

Text Books:

1. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., 2011, Tata McGraw.

Reference Books:

1. Fundamentals of Digital Circuits, Anand Kumar, 2ndEdn, 2009, PHI Learning Pvt. Ltd.
2. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
3. Digital Systems: Principles & Applications, R.J.Tocci, N.S.Widmer, 2001, PHI Learning.

4. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
5. Digital Electronics, S.K. Mandal, 2010, 1st edition, McGraw Hill
6. Microprocessor Architecture Programming & applications with 8085, 2002, R.S. Goankar, Prentice Hall.

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1493	Quantum Mechanics and Applications	3-2-1	Nil

Objective

This course aims to

- Train the B.Sc. (Physics Honours) students with an understanding of the basic concepts of Quantum Mechanics and its mathematical frame work to describe the systems of microscopic objects (like atoms, molecules) and their properties
- Illustrate, in detail, the procedure of solving the 1D and 3D ScHoursodinger equations for microscopic systems interacting with time independent Central Potentials.
- Offer hands-on simulation experience of obtaining numerical solutions of ScHoursodinger Equation for various use-cases along with visualization of the solutions tHoursough Python
- Illustrate some present day and some futuristic applications of Quantum Mechanics like Tunnel Diodes, Scanning Tunnelling Microscopy, Bose-Einstein Condensation, Quantum Computers etc.

Learning outcome

After successfully completing this course, the student should be able to

- Solve, both analytically and numerically, time-independent and simple time-dependent ScHoursodinger Equations for systems of particles interacting via time-independent Central Potentials along with appropriate Boundary and Initial Conditions
- Generate appropriate visualizations of the solutions of ScHoursodinger Equations and interpret them
- Get a qualitative knowledge of how Quantum Mechanics operates in macroscopic devices like Tunnel Diodes, Scanning Tunneling Microscopes or large scale objects like the Sun as well as the evolving technologies like Quantum Computers and Bose-Einstein Condensates.

Course Outline

Module I (4 Hours Theory+ 4 Hours Practice+ 4 Hours Flipped Class)

Basic Concepts-I

Introduction to Quantum Mechanics (the What and Why of QMech), The relevance of Quantum Mechanics in our day-to-day life, Postulates of Quantum Mechanics; The Time dependent ScHoursodinger equation and dynamical evolution of a quantum state; Properties of Wave Function.

Interpretation of Wave Function Probability and probability current densities in tHoursee dimensions; Conditions for Physical Acceptability of Wave Functions. Normalization. Linearity and Superposition Principles. Eigenvalues and Eigenfunctions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Wave Function of a Free Particle.

Practice-1: Given candidate wave functions, check for validity of each candidate using computer visualization and compute the Position Probability Density in each valid case

Practice-2: Given candidate wave functions, check for valid wave functions using computer visualization and compute current probability density

Module II (3 Hours Theory+ 2 Hours Practice+ 2 Hours Flipped Class)

Basic Concepts-II

Time independent ScHoursodinger equation-Hamiltonian, stationary states and energy eigenvalues; expansion of an arbitrary wave function as a linear combination of energy eigenfunctions; General solution of the time dependent ScHoursodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave function; Position-momentum uncertainty principle.

Practice-3: Free Particle wave function, Gaussian wave packet and its time evolution

Module III (7 Hours Theory+ 10 Hours Practice+ 2 Hours Flipped Class)

1D Applications:

General discussion of bound states in an arbitrary potential- continuity of wave function, boundary condition and emergence of discrete energy levels; application to one-dimensional problem-1.Infinite square well potential; 2. The case of Finite Square-Well Potential and Quantum Tunneling, The working principle of Tunnel Diodes, Scanning Tunnelling Microscope, Quantum mechanics of simple harmonic oscillator-energy levels and energy eigenfunctions using Frobenius method; Hermite polynomials; ground state, zero point energy and uncertainty principle for 1D Simple Harmonic Oscillator.

Practice-4 : Solution of 1D time independent ScHoursodinger Equation: Infinite Square Well Potential, Emergence of quantized eigenfunctions, normalization of wave function

Practice-5 : Solution of 1D ScHoursodinger Equation with Finite Square-Well Potential: Eigenvalues and Eigenfunctions

Practice-6 : Solution of 1D ScHoursodinger Equation with Finite Square-Well Potential: Tunnelling probability of wave function

Practice-7: Solution of 1D ScHoursodinger Equation with Harmonic Oscillator potential

Practice-8 : Solution of 1D ScHoursodinger Equation with Harmonic Oscillator potential, computation of eigenvalues and eigenfunctions

Module IV (4 Hours Theory+ 4 Hours Practice+ 2 Hours Flipped Class)

3D Applications-I (The H-Atom and Hydrogen-like cases)

Quantum theory of Hydrogen and Hydrogen-like atoms: time independent ScHoursodinger equation in spherical polar coordinates; separation of variables for second order partial differential equation; angular momentum operators and quantum numbers; Radial wave functions from Frobenius method; shapes of the probability densities for ground and first excited states; Orbital angular momentum quantum numbers l and m; s, p, d,.. shells.

Practice-9: Solution of radial ScHoursodinger equation with Coulomb Potential (Hydrogen atom)

Practice-10: Solution of radial ScHoursodinger equation with Coulomb Potential (Hydrogen atom), Computation of eigenvalues and eigenfunctions in Ground State

Module V (6 Hours Theory+ 4 Hours Practice+ 1 Hour Flipped Class)

3D Applications-II (A Single Electron Atom in External EM Fields)

Atoms in Electric & Magnetic Fields: Electron angular momentum. Space quantization. Electron Spin and Spin Angular Momentum. Larmor's Theorem. Spin Magnetic Moment. Stern-Gerlach Experiment. Zeeman Effect: Electron Magnetic Moment and Magnetic Energy, Gyromagnetic Ratio and BoHours Magneton. Atoms in External Magnetic Fields (Qualitative discussions only): Normal and Anomalous Zeeman Effect. Paschen-Back and Stark Effect (Qualitative Discussion only).

Practice-11: Numerical solution of radial ScHoursodinger equation for Screened Coulomb Potential (He- and other atoms)

Module VI **(2 Hours Theory+ 1 Hour Flipped Class)**

3D Applications-III (Many Electron Atoms: Alkali Atoms)

Many electron atoms: Pauli's Exclusion Principle. Symmetric & Anti-symmetric Wave Functions. Periodic table. Fine structure. Spin orbit coupling. Spectral Notations for Atomic States. Total angular momentum. Vector Model. Spin-orbit coupling in atoms-L-S and J-J couplings. Hund's Rule. Term symbols. Spectra of Hydrogen and Alkali Atoms (Na etc.).

Practice-12 : Numerical solution of radial ScHoursodinger equation with Morse Potential for H2 molecule

Module VII **(4 Hours Theory)**

Technology Applications:

Tunnel Diode; Scanning Tunnel Microscope; Magnetic Resonance Imaging (MRI); Quantum Computations with Qubits; Bose-Einstein Condensates: A case of "Macro-atoms"

Total Theory 30 hours, Total Practice 24 Hours, Total Flipped Class 12 hours

Textbook:

Quantum Mechanics: Concepts and Applications by N Zettili, John Wiley & Sons Ltd., 2016.

Reference Books:

A Text book of Quantum Mechanics, P.M.Mathews and K.Venkatesan, 2nd Ed., McGraw Hill, 2010.

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM 1494	**Solid State Physics**	(3-2-1)	Nil

Course Objective:

- Basic understanding of symmetry, electronic and thermodynamic properties of solid state systems and their technological applications.
- To impart knowledge of basic theories of the electronic structure of materials.
- Students should learn how to understand physical behavior of solids and electronic devices.

Learning Outcomes:

Upon successful completion of this course, students will be able to:

- Understand the elastic properties of solids and lattice vibration.
- Have an understanding of the magnetic properties of condensed matter.
- Have an understanding of the optical properties of solids and the relation to their electronic properties.

- Develop the facility for problems associated with the solid state with respect to semi-conductor physics.
- Outline the importance of solid state physics in the modern society.

Course Outline

Module I: (3 Hours Theory+4 Hours Practice+1 Hour Flipped Class)

Crystal Structure:

Amorphous and crystalline materials. Lattice translation vectors. Lattice with a basis – central and non-central elements, Unit cell., Miller indices., Reciprocal lattice. Types of lattices. Brillouin zones., Diffraction of X-rays by crystals. Bragg's law., Atomic and geometrical factor.

Practice 1: Various crystal structure

Practice 2: Interatomic vander waals forces

Module-II : (4 Hours Theory+4 Hours Practice+1 Hour Flipped Class)

Elementary Lattice Dynamics:

Lattice vibrations and phonons: Linear monoatomic lattice , Diatomiclattice Chains. Acoustical and optical Phonons. Qualitative description of the phonon spectrum in solids., Dulong and Petit's Law, Einstein theory of specific heat of solids.

Practice -3: Determination of specific heat of a solid

Practice -4: Interatomic electrostatic forces

Module III: (5 Hours Theory+8 Hours Practice+1 Hour Flipped Class)

Magnetic Properties of Matter:

Dia-, para-, ferri- and ferromagnetic materials. Classical Langevin theory of diamagnetic domains., Classical theory of paramagnetism., Quantum mechanical treatment of paramagnetism. Curie's law, Weiss's theory of ferromagnetism and ferromagnetic domains., Discussion of B-H curve. Hysteresis and energy Loss.

Practice 5: To draw the B-H curve of Fe using solenoid & determine energy loss from hysteresis.

Practice 6: Magnetic material characterization via hystersis (Remote trigger).

Practice 7: Curie temperature of paramagnetism

Practice 8: Determination of paramagnetic substance by Quinck's method.

Module-IV: (5 Hours Theory+4 Hours Practice+1 Hour Flipped Class)

Dielectric Properties of Materials:

Dielectric properties of materials: Polarization. Local electric field at an atom., Depolarization field., Electric susceptibility., Polarizability., Clausius-Mosotti equation., Classical theory of electric polarizability., Normal and anomalous dispersion, Cauchy and Sellmeir relations. Langevin-Debye equation., Complex dielectric constant. Optical phenomena.

Practice 9: Curie Weiss law of ferroelectric material.

Practice 10: Determination of dielectric constant of a material.

Module-V: (4 Hours Theory+1 Hour Flipped Class).

Superconductivity:

Experimental results. Critical temperature. Critical magnetic field., Meissner effect., Type I and type II superconductors, London's equation and penetration depth. Isotope effect, Idea of BCS theory (No derivation).

Module VI : (6 Hours Theory+4 Hours Practice+2 Hour Flipped Class).

Elementary Band Theory:

Elementary band theory, Kronig Penny model, Band gap. Classification of materials: conductor, semiconductor and insulator, Semiconductors: intrinsic and extrinsic semiconductor, Conductivity of semiconductor, mobility, Hall effect , Direct and indirect band gap semiconductors and their behavior to external field.

Practice 11: To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150 0C) and to determine its band gap.

Practice 12: Hall effect

Module-VII: (3 Hours Theory+5 Hour Flipped Class).

Semiconductor devices.

Semiconductor materials for solar cell, Semiconductor properties, Transport properties, optical properties, Basic equations of device physics, Semiconductor materials for optoelectronic devices., Photodiode.

Total theory 30 hours, total practice 24 hours and total flipped class 12 hours.

Text Books:

1. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

2. Solid State Physics, S .O.Pilai
3. Solid State Physics, Gupta Kumar

Reference Books:

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 4th Edition, 2015, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1495	**Electromagnetic Theory**	3-2-1	Nil

Objective

- To provide the basic skills required to understand, develop, and design various engineering applications involving electromagnetic fields.
- To lay the foundations of electromagnetism and its practice in modern communications such as wireless, guided wave principles such as fiber optics and electronic electromagnetic structures.
- To understand the transverse nature of light.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Apply vector calculus to static electric-magnetic fields in different engineering situations.
- Analyze Maxwell's equation in different forms.
- Examine the phenomena of wave propagation in different media and its interfaces and in applications of microwave engineering.

Course Outline

Module I

Maxwell Equations: (7Hours Theory+ 2Hours Practice+2Hours Flipped Class)

Review of Maxwell's equations. Displacement Current. Gauge Transformations: Lorentz and Coulomb Gauge. Boundary Conditions at Interface between Different Media.Wave Equations. Plane Waves in Dielectric Media. Poynting Theorem and Poynting Vector. Electromagnetic (EM) Energy Density. Physical Concept of Electromagnetic Field Energy Density.

Practice-1:-To study of reflection and refraction of microwave.

Module-II (3HoursTheory+ 2Hours Practice+ 1Hours Flipped Class)

EM Wave Propagation in Unbounded Media:

Plane EM waves tough vacuum and isotropic dielectric medium, transverse nature of plane EM waves, refractive index and dielectric constant, wave impedance. Wave propagation tough dilute plasma, electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation tough ionosphere.

Practice-2:- To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.

Module III (4Hours Theory + 4Hours Practice +2Hours Flipped Class)

EM Wave in Bounded Media:

Reflection & Refraction of plane waves at plane interface between two dielectric media-Laws of Reflection & Refraction. Fresnel's Formulae for perpendicular polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection.

Practice-3:- To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection.

Practice-4:- To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.

Module-IV (1Hours Theory + 2Hours Practice+ 1Hours Flipped Class)

Electromagnetic Waves in anisotropic media Propagation of E.M. Waves in Anisotropic Media. Symmetric Nature of Dielectric Tensor. Fresnel's Formula.

Practice-5:- To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction tough ultrasonic grating

Module V (7Hours Theory+ 4Hours Practice + 3Hours Flipped Class)

Polarization of Electromagnetic Waves:

Description of Linear, Circular and Elliptical Polarization.Double Refraction. Nicol Prism. Production & detection of Plane, Circularly and Elliptically Polarized Light. Phase Retardation Plates: Quarter -Wave Plates.

Practice-6:- To verify the law of Malus for plane polarized light.

Practice-7:- To measure the sample birefringence by using a Babinet's compensator.

Module-VI (5Hours Theory+ 4Hours Practice + 2Hours Flipped Class)

Rotatory Polarization:

Optical Rotation.. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Experimental verification of Fresnel's theory. Specific rotation. Laurent's half-shade polarimeter.

Practice-8:- To study Polarization and double slit interference in microwaves.

Practice-9:- To determine the specific rotation of sugar solution using Polarimeter.

Module-VII (3Hours Theory + 6Hours Practice+ 1Hours Flipped Class)

Optical Fibres:

Numerical Aperture. Step and Graded Indices (Definitions Only).

Single and Multiple Mode Fibres (Concept and Definition Only).

Practice-10:- To verify the Stefan`s law of radiation and to determine Stefan's constant. (2Hours)

Practice-11:- To determine the Boltzmann constant using V-I characteristics of PN junction diode.

Practice-12:- To study dependence of radiation on angle for a simple Dipole antenna.

Total Theory=30Hours ,Total Practice=24Hours,Total Flipped Class=12Hours

Text Books:

Introduction to Electrodynamics D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.

Reference Books:

1. Electrodynamics by Satya Prakash
2. A Textbook of Optics , Brijla and Subramanyam
3. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
4. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
5. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill
6. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
7. Engineering Electromagnetic, Willian H. Hayt, 8th Edition, 2012, McGraw Hill.
8. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1496	Statistical Mechanics	3-2-1	Nil

Objective

- To relate the microscopic properties of individual atoms and molecules to the macroscopic or bulk properties of materials.
- To explore the different types of distribution functions in order to explain the behavior of the particles
- To study of quantum theory of radiation and explain black body radiations with help of the various theories and models,
- To explain the thermodynamic behavior of the atoms and molecules

Learning outcome

Upon successful completion of this course, students will be able to:

- Understand the basic properties of thermodynamics and statistical mechanics.
- Understand the blackbody radiation and distribution functions.
- Distinguish between classical and quantum radiation

Course outline

Module I (5 Hours Theory+4 Hours Practice+1 Hours Flipped Class)

Classical Statistics-1:

Macrostate & microstate, Elementary concept of ensemble, Phase space, Entropy and thermodynamic probability, Maxwell-Boltzmann distribution law, Partition function, Thermodynamic functions of an ideal gas.

Practice-1

Plot Maxwell-Boltzmann distribution functions with energy at different temperatures. (Using Scilab / Python)

Practice-2

Computation of the partition function Z(β) of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Maxwell-Boltzmann statistics : Study of how Z(β), average energy <E>, energy fluctuation ΔE and specific heat at constant volume Cv depend upon the temperature and total number of particles N

Module II (5 Hours Theory+6 Hours Practice+1 Hours Flipped Class)

Classical Statistics-2:

Classical entropy expression, Gibbs paradox, Sackur Tetrode equation, Law of equipartition of energy (with proof) – applications to specific heat and its limitations.

Practice-3

Plot specific heat of solids according to Dulong-Petit law for high temperature and low temperature and compare them for these two cases.

Practice-4

Plot specific heat of solids according to Einstein distribution function for high temperature and low temperature and compare

Practice-5

Plot specific heat of solids according to Debye distribution function for high temperature and low temperature and compare them for these two cases.

Module III (4 Hours Theory+2 Hours Flipped Class)

Classical Theory of Radiation-1:

Properties of thermal radiation, Black body radiation, Pure temperature dependence, Kirchhoff's law, Stefan-Boltzmann law: thermodynamic proof.

Module IV (4 Hours Theory+4 Hours Practice+2 Hours Flipped Class)

Classical Theory of Radiation-2:

Radiation pressure, Wien's displacement law, Wien's distribution law, Saha's ionisation formula, Rayleigh-Jean's law, Ultraviolet catastrophe.

Practice-6

Plot Wien's distribution Law

Practice-7

Plot Rayleigh-Jeans Law

Module V (4 Hours Theory+2 Hours Practice+2 Hours Flipped Class)

Quantum Theory of Radiation:

Spectral distribution of black body radiation, Planck's quantum postulates, Planck's law of black body radiation: experimental verification, Deduction of (1) Wien's distribution law, (2) Rayleigh-Jeans law, (3) Stefan-Boltzmann law, (4) Wien's displacement law from Planck's law.

Practice-8

Plot Planck's law for black body radiation and compare it with Raleigh-Jeans law at high temperature and low temperature

Module VI (4 Hours Theory+4 Hours Practice+2 Hours Flipped Class)

Bose-Einstein Statistics:

B-E distribution law, Thermodynamic functions of a strongly degenerate Bose gas, Bose Einstein condensation, properties of liquid He (qualitative description), Radiation as a photon gas and thermodynamic functions of photon gas.

Practice-9

Plot Bose-Einstein distribution functions with energy at different temperatures

Practice-10

Computation of the partition function $Z(\beta)$ of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Bose-Einstein statistics : Study of how $Z(\beta)$, average energy $\langle E \rangle$, energy fluctuation ΔE and specific heat at constant volume Cv depend upon the temperature and total number of particles N

Module VII (4 Hours Theory+4 Hours Practice+2 Hours Flipped Class)

Fermi-Dirac Statistics:

Fermi-Dirac distribution law, Thermodynamic functions of a completely and strongly degenerate fermi gas, Fermi energy, Electron gas in a metal.

Practice-11

Plot Fermi-Dirac distribution functions with energy at different temperatures

Practice-12

Computation of the partition function $Z(\beta)$ of systems with a finite number of single particle levels (e.g., 2 level, 3 level, etc.) and a finite number of non-interacting particles N under Fermi-Dirac statistics : Study of how $Z(\beta)$, average energy $\langle E \rangle$, energy fluctuation ΔE and specific heat at constant volume Cv depend upon the temperature and total number of particles N .

Total theory-30 hours, total practice-24 hours and total flipped class-12 hours

Text Book:
Statistical Mechanics by R.K. Pathria, Butterworth Heinemann: 2nd Ed., 1996, Oxford University Press.

Reference Books:

1. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
2. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
3. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
5. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press

B.Sc Mathematics Curriculum

Objectives

- To educate students in applied sciences, enabling them with necessary skill to contribute to the social, technological, and economic development of our state, nation, and global community, in an environment that fosters teamwork, cultural and intellectual diversity, a strong sense of public responsibility, and lifelong learning.
- To Provide the highest level of education in applied sciences to produce competent, creative and innovators.
- To Create an intellectual reservoir to meet the various demands of the Industry/Society in facilitating employment, creating enterprise and to pursue higher studies/research.

POs: Sciences Graduates will be able to;

Pos	Outcomes
PO1	Apply mathematics, science, fundamentals and specialization to the conceptualization of different scientific models
PO2	Identify, formulate, research literature and solve complex science related problems reaching substantiated conclusions using first principles of mathematics and applied sciences
PO3	Design solutions for complex scientific problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations
PO4	Conduct investigations of complex problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
PO5	Create, select and apply appropriate techniques, resources, and modern engineering tools, including prediction and modeling, to complex scientific activities, with an understanding of the limitations
PO6	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
PO7	Communicate effectively on complex science activities with the science community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO8	Demonstrate understanding of the societal, health, safety, legal and cultural issues andthe consequent responsibilities relevant to scientific application
PO9	Understand and commit to professional ethics and responsibilities and norms of engineering practice

PO10	Understand the impact of science solutions in a societal context and demonstrate knowledge of and need for sustainable development
PO11	Recognize the need for, and have the ability to engage in independent and life-long learning
PO12	Demonstrate a knowledge and understanding of contemporary technologies, their applications and limitations, contemporary research in the broader context of relevant fields
PO13	Demonstrate the ability to succeed in national and international competitive events in the relevant fields

PSOs: B.Sc Mathematics

PSO1. Graduates will develop their ability to apply critical thinking skills to solve problems that can be modelled mathematically, to critically interpret numerical and graphical data, to read and construct mathematical arguments and proofs.

PSO2. Graduates will have an ability to design, implement, and evaluate a computer based hypothetical solution

PSO3. Graduates will able to qualify JAM/JEST and other PSU examinations.

Course Outcomes:

Cos	Skills
CO1	Knowledge
CO2	Observe, Classify, Quantify, Interpret and Communicate
CO3	Investigation and Judgements
CO4	Problem Solving
CO5	Leadership & Entrepreneurship
CO6	Product/Publication/Patent

Scale: H: High, M: Medium, L: Low, -: Nil

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
PSO1	H	H	H	H	H	H	H	H	H	H	H	H	H
PSO2	H	H	H	H	H	H	H	H	M	H	H	H	L
PSO3	H	H	H	H	H	H	H	H	L	H	H	H	L

Mapping COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	H	H	H	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	H	M	H	H	H	H
CO3	M	H	H	M	H	H	H	M	M	H	H	H	H
CO4	H	H	H	H	H	H	H	H	M	H	H	H	H
CO5	H	H	H	M	H	H	H	M	M	H	H	H	H
CO6	M	M	H	M	H	M	H	L	M	H	H	H	H

Course Code	Course Title	Course Type	Credits	Prerequisite	CO1	CO2	CO3	CO4	CO5	CO6	PSO1	PSO2	PSO3
BSMA1101	Calculus	Theory + Practice	6	NIL	H	H	M	H	L	L	M	M	M
BSMA1102	Linear Algebra	Theory + Practice	6	NIL	H	H	M	H	L	L	M	M	M
BSMA1201	Analysis-I	Theory	6	NIL	H	H	M	M	L	L	M	H	M
BSMA1202	Ordinary Differential Equation	Theory + Practice	6	NIL	H	H	M	H	L	L	M	M	M
BSMA2301	Analysis-II	Theory	6	NIL	H	H	M	M	L	L	M	H	M
BSMA2302	Modern Algebra	Theory	6	NIL	H	H	M	M	L	L	M	H	M
BSMA2303	Partial Differential Equations and System of Ordinary Differential Equations	Theory + Practice	6	NIL	H	H	M	H	L	L	M	M	M
BSMA2401	Numerical Analysis	Theory + Practice	6	NIL	H	H	H	H	L	L	H	M	H

BSMA2402	Advanced Analysis	Theory	6	NIL	H	H	M	M	L	L	M	H	M
BSMA2403	Programming in C	Theory + Practice	6	NIL	H	H	H	H	L	L	H	H	M
BSMA3501	Complex Analysis	Theory	6	NIL	H	H	M	M	L	L	M	M	M
BSMA3502	Probability and Statistics	Theory	6	NIL	H	H	H	H	L	L	H	H	M
BSMA3601	Linear Programming	Theory	6	NIL	H	H	M	H	L	L	M	M	M
BSMA3602	Discrete Mathematics	Theory	6	NIL	H	H	M	H	L	L	M	M	M
BSFL1101	English	Theory	2	NIL	H	H	M	L	H	L	M	L	L
FCBS0101	Environmental Science	Theory	2	NIL	H	H	M	L	H	L	M	L	L
DEHD0101	Statics & Dynamics	Theory	6	NIL	H	H	M	H	L	M	M	M	M
DEHD0102	Introduction to Hydrodynamics	Theory	6	NIL	H	H	M	H	L	M	M	M	M
DEHD0401	MAT LAB Programming for Numerical Computation	Theory + Practice	6	NIL	H	H	M	H	M	M	M	M	H
DEHD0201	Numerical Solution of Hydrodynamic Problems using Matlab	Practice	2	NIL	H	H	M	H	M	M	M	M	H
DEET0300	Project	Project	6	NIL	H	H	M	H	H	H	M	H	H
BSMA3503	Programming in C + +	Theory + Practice	6	NIL	H	H	M	H	L	L	M	M	M
BSMA3504	Integral Transforms	Theory	6	NIL	H	H	M	H	L	L	M	M	M
BSMA3505	Mathematical Modelling	Theory	6	NIL	H	H	M	H	M	M	M	H	H

BSMA3604	Graph Theory	Theory	6	NIL	H	H	M	H	L	L	M	M	M
BSMA2001	Communicative English and Writing Skill	Practice	2	NIL	H	H	M	L	L	L	M	M	L
BSMA2002	Fortran -95 Programme	Practice	2	NIL	H	H	M	H	M	M	M	M	H
BSMA2003	MAT LAB	Practice	2	NIL	H	H	M	H	M	M	M	M	H
CUTM1511	Calculus	(Th+Pr+Pj)	6	NIL	H	M	M	H		M	M		
CUTM1512	Linear Algebra	(Th+Pr+Pj)	6	NIL	H	M	M	H		M	H	M	
CUTM1513	Analysis-I	(Th+Pj)	6	NIL	H	M	M	H		H	M	L	
CUTM1514	Ordinary Differential Equations	(Th+Pr+Pj)	6	NIL	H	M	M	H		H	M	L	
CUTM1515	Analysis-II	(Th+Pj)	6	NIL	H	M	M	H		H	H	L	
CUTM1516	Modern Algebra	(Th+Pj)	6	NIL	H	H	M	H		H	H	L	
CUTM1517	Partial Differential Equations and System of Ordinary Differential Equation	(Th+Pr+Pj)	6	NIL	H	M	M	H		H	H	L	
CUTM1518	Numerical Analysis	(Th+Pr+Pj)	6	NIL	H	M	M	H		H	H	L	
CUTM1519	Advanced Analysis	(Th+Pj)	6	NIL	H	L	M	H		H	H	L	
CUTM1520	Complex Analysis	(Th+Pr+Pj)	6	NIL	H	L	M	H		H	H	L	
CUTM1521	Integral Transformations	(Th+Pr+Pj)	6	NIL	H	L	M	H		H	H	L	

CUTM1522	Discrete Mathematical Structure	(Th+Pr+Pj)	6	NIL	H	L	H	H		H	H	L	
CUTM1523	Linear Programming	(Th+Pr+Pj)	6	NIL	H	L	H	H		H	H	L	
CUTM1524	Probability and Statistics	(Th+Pr+Pj)	6	NIL	H	M	H	H	M	H	H	L	

CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT ODISHA

CHOICE BEASED CREDIT SYSTEM

COURSE STRUCTURE & SYLLABUS

B.Sc (Core Courses)

[*With effect from 2021-22 Academic Session]*

Course Structure

(Core Courses)

Sl.No	Code	Subject Name	Cerdit	Course Type (Th+Pr+Pj)
1	CUTM1511	Calculus	6	3+1 +2
2	CUTM1512	Linear Algebra	6	3+1 +2
3	CUTM1513	Analysis-I	6	3+0 +3
4	CUTM1514	Ordinary Differential Equations	6	3+ 2+1
5	CUTM1515	Analysis-II	6	3+0 +3
6	CUTM1516	Modern Algebra	6	3+0 +3
7	CUTM1517	Partial Differential Equations and System of Ordinary Differential Equation	6	3+2 +1
8	CUTM1518	Numerical Analysis	6	3+ 2+1
9	CUTM1519	Advanced Analysis	6	3+ 0+3
10	CUTM1520	Complex Analysis	6	3+ 1+2
11	CUTM1521	Integral Transformations	6	3+1 +2
12	CUTM1522	Discrete Mathematical Structure	6	3+1 +2
13	CUTM1523	Linear Programming	6	3+2 +1
14	CUTM1524	Probability and Statistics	6	3+1 +2
		Total	84	

Course outline

CUTM1511 CALCULUS

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
CALCULUS	CUTM1511	Theory + Practice + Project	3-1-2	Nil

Objective

- To study how things change. It provides a framework for modeling systems in which there is change, and a way to deduce the predictions of such models.
- To construct a relatively simple quantitative models of change, and to deduce their consequences.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Understand the importance of linear functions in mathematics.
- Deals with the major problems of differential and integral calculus.
- Recognize other important classes of functions (such as trigonometric and rational functions), and will be able to use calculus with these functions.

Course Outline

MODULE – I: Curvature (3hr+0hr+4hr)

Curvature, circle of curvature and radius of curvature, Radius of curvature in Cartesian and polar form.

Project 1: To find radius of curvature (Intrinsic and Parametric form)

Project 2: To find radius of curvature (Pedal form)

Module-II: Asymptotes(3hr+0hr+2hr)

Asymptotes and determination of asymptotes, Asymptotes parallel to coordinate axis, Rules to find asymptotes.

Project 3: To find asymptotes of different curves in implicit form

Module-III: Curve Tracing(4hr+6hr+6hr)

Curve Tracing, Tracing of Cartesian, parametric and polar curves.

Project 4: To trace some Cartesian curves (Folium of Descartes, Astroid)

Project 5: To trace some polar curves (Cardioid, Lemniscate of Bernaulli)

Project 6: To trace few more curves (Cartenary, Cycloid etc) and Loops

Practice 1: Plotting the graphs of the functions e^{ax+b}, log (ax + b), 1/(ax + b), sin (ax + b), cos(ax + b), |ax +b| and to illustrate the effect of a and b on the graph

Practice 2: Plotting the graphs of the polynomial of degree 4 and 5, the derivative graph, the second derivative graph and comparing them

Practice 3: Sketching parametric curves (e.g. Trochoid, cycloid, epicycloids, hypocycloid)

Module-IV: Reduction Formula(4hr+0hr+4hr)

Reduction formula, Reduction formula involving sine and cosine function sin ^nx cos ^nx, Reduction formula for integrals with limits from 0 to pi/2, Reduction formula for integral of sin^px, Cos^qx and also with limits from 0 to Pi/2.

Project 7: To find the Reduction formula for integrals of tan^nx, Cot ^nx, sec^nx, cosec^nx

Project 8: To find the Reduction formula for integral of sin^pxcos^qx for different values of p and q and different cases

Module-V: Rectification and Quadrature(6hr+0hr+2hr)

Rectification of curves, finding arc length for polar curves, area of plane regions for Cartesian, parametric and polar curves, Sectorial area.

Project 9: To find the Area bounded by closed curves

Module-VI: Volume of Solid Body Revolution(3hr+6hr+0hr)

Volume of solid of revolution, Volume of solid of revolution about any axis, Pappus theorem for volume of revolution.

Practice 4: Tracing of conics in Cartesian coordinates/polar coordinates

Practice 5: Sketching ellipsoid, hyperboloid of one and two sheets,

Practice 6: Sketching elliptic cone, elliptic paraboloid, hyperbolic paraboloid using Cartesian coordinates

Module-VII: Vector Differential Calculus(7hr+0hr+6hr)

Introduction to vector calculus: Definitions and characteristics of vectors, algebraic operations, Directional derivatives and directional derivatives along any line, Gradient of scalar point function, Divergence and curl of vector point functions, Second order differential operator the Laplacian operator and its properties.

Project 10: To explain about vector, different types of vector and vector algebra with suitable example

Project 11: To explain the geometrical significance of Gradient of scalar point function with some examples

Project 12: To discuss Laplacian operator and its different properties

Text Books:

1. A Text book of Calculus Part – II : Shanti Narayan

   Chapters: 8 (Art. 24, 25), 10 (Art. 33, 34, 35, 36, 37, 38).

2. A Text book of Calculus Part-III : Shanti Narayan

   Chapters: 1 (Art. 1, 2, 3), 3(Art 7, 8, 9), 4(Art 10, 11, 12) omitting Simpson's rule), 5(Arts 13, 14), 6(Arts 15, 16).

3. A Textbook of Vector Calculus by Shanti Narayan & P. K. Mittal, S. Chand & Co., 2003

   Chapters: 1, 6.

Reference Books:

1. J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education). Delhi, 2007.
2. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002.
3. B. Thomas and R. L. Finney. Calculus, 9th Ed., Pearson Education, Delhi, 2005
4. Courant and F. John Introduction to Calculus and Analysis (Volumes I & II). Springer-Verlag. New York. Inc., 1989

Course outline

CUTM1512 LINEAR ALGEBRA

Subject Name	Code	Type of course	T-P-Pj	Prerequisite
LINEAR ALGEBRA	**CUTM 1512**	**Theory ,Practice & Project**	**3-1-2**	**NIL**

Objective

- This course unit aims to introduce the basic ideas and techniques of linear algebra for use in many other lecture courses.
- Solve systems of linear equations using various methods including Gaussian and Gauss Jordan elimination and inverse matrices.
- Prove basic results in linear algebra using appropriate proof-writing techniques such as linear independence of vectors; properties of subspaces; linearity, injectivity and surjectivity of functions; and properties of eigenvectors and eigenvalues.

Learning outcome

Upon successful completion of this course, students will be able to:

- Use the basic concepts of vector and matrix algebra, including linear dependence / independence, basis and dimension of a subspace, rank and nullity, for analysis of matrices and systems of linear equations.
- Evaluate determinants and use them to discriminate between invertible and non-invertible matrices.
- Solve systems of linear equations using multiple methods, including Gaussian elimination and matrix inversion. Carry out matrix operations, including inverses and determinants.
- Demonstrate understanding of linear independence, span, and basis.

Course outline

Module I

Vector spaces, definition and examples,Subspace,Span of a set.

Project-1: Preparation of detail report on Vector space,Subspace

Project-2: To show that span of a subset of a vector space is a Vector space

Module II
Linear dependence and independence **,** Dimension and basis

Project-3: Preparation of detail report on dependency of vectors .

Project-4: Finding dimension and basis of a vector Space.

Module III
Linear transformation, definition and examples, Range and kernel, Rank and nullity, The space L (U,V)

Project-5:To find out Range and Kernel of different Linear Transformations.

Project-6: Establishment of R(T) and N(T) are sub spaces of V and U respectively in the linear map T:U-->V

Module IV
Composition of Linear maps,Matrix and linear map,linear operations,matrix multiplication

Project-7: To show that L(U,V) is a vector space

Project-8: Establish the condition of non Singularity of Linear Map.

Module V
Rank and nullity of matrix,Transpose of a matrix,Elementary row operations

Project-9: Preparation of working rule for finding rank of a matrix with example.

Project-10:To find the matrix associated with Linear Maps

Practice 1 : Introduction to MATLAB. Matrix addition and multiplication

Practice 2 : Matrix Transpose , Matrix Inversion

Module VI
Systems of linear equations,Matrix inversion,Determinants, minors **,**Rank of a matrix

Project-11: Finding rank of a matrix by Determinant Method

Practice 3: Finding Rank of a Matrix

Practice 4: Solution of AX=B using Gauss Elimination method .

Module VII
Product of determinants,Application to linear equations,Eigen value and Eigen vector

Project-12: Finding the eigen value and eigen vector of a 3x3 matrix having repeated root in it's characteristic equation.

Practice 5 : Solution of AX=B using, Gauss Seidal and Gauss-Jacobi method

Practice 6 : Finding Eigen Values and Eigen vectors of Matrix

Text Book:

An Introduction to Linear Algebra by V. Krishnamurty,V.P.Mainra, J.L.Arora, Affiliated East-West press Pvt.Ltd.

Chapters: 3,4 (4.1 to 4.7), 5,6 (6.5 to 6.8)

Reference Books:

Basic Structures in Algebra, Part-I : J.N. Patnaik

Matrix Theory and Linear Algebra : I.N. Herstein and D.J. Winter (Ma Chilan Publishing company)

First course in Linear algebra : Bhattacharya, Jain and Nagpaul (New Age International)

Developed by:(Faculty name) : Dr T.N.Samantara

Developed on (Month and Year): May 2020:

Course outline

CUTM-1513 ANALYSIS-I

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
ANALYSIS-I	CUTM-1513	Theory	3-0-3	Nil

Objective:

- Analysis extends and refines calculus; it encompasses differentiation, integration, measure, limits, infinite series, and analytic functions, primarily in the context of real and complex number systems.
- In much of analysis, the emphasis is not on finding explicit solutions to specific problems, but rather on determining which problems can be solved and what general properties solutions may share

Learning Outcome:

Upon successful completion of this course, students will be able to:

- Describe the real line as a complete, ordered field, Use the definitions of convergence as they apply to sequences, series, and functions,
- Determine the continuity, differentiability, and integrability of functions defined on subsets of the real line, Produce rigorous proofs of results that arise in the context of real analysis.

Course Outline

Module-I (5 hr+0 hr+4 hr)

Field Structure and Order Structure; Bounded and unbounded Sets, Supremum, Infimum; Completeness in the Set of Real numbers; Archimedean Property of Real numbers; Inequalities and Metric property of R

project 1: A study on completeness property of R and its application.

project 2: A Report on Some Inequalities of Real Numbers.

Module-II (5 hr+0 hr+6 hr)

Neighborhood of a point, Interior point of a set, Open Sets; Some Important Theorems on open Sets; Limit point of a Set, Closed Sets, Closure of a Set, Dense Set; Some Useful Theorems on Open Set and Closed Sets; Blozano-weirstrass theorem for Sets.

Project 3 : A study on some Useful Theorems on Limit point of a Sets.

Project 4: A Study on some Useful Theorems on Open Set and Closed Sets.

Project 5: A study on the Blozano-weirstrass theorem for Sets.

Module-III (6 hr+0 hr+6 hr)

Real Sequences and Theorems on Convergence of Sequence; Limit point a Sequence and Bolzano-Weierstrass theorem for Sequences; Convergent and Non-Convergent Sequences; Cauchy's general Principle of Convergence and Cauchy Sequence; Some Important theorems on Real Sequences; Monotonic Sequences and Sub sequences.

Project 6: A Report on Cauchy's general Principle of Convergence and Cauchy Sequence.

Project 7: A Report on Convergent and Non-Convergent Sequences.

Project 8: A study on Some Important Theorems of Real Sequences.

Module-IV (5 hr+0 hr+6 hr)

Infinite Series and Some Preliminary Theorems; Positive term Series and Condition for Convergence ; Geometric Series and Comparison Series for Convergence of Infinite Series; Comparison Tests for Positive Term Series ; Cauchy's Root test and D' Alembert's Ratio Test.

Project 9: A study on Some useful theorems of Infinite Series.

Project 10: A report on Comparison Test for Positive term Series.

Project 11: A Report on Cauchy's Root test and D' Alembert's Ratio Test.

Module-V (3 hr+0 hr+4 hr)

Alternating Series and Leibnitz Test ; Absolute and Conditional Convergence; Solving problems on Absolute and Conditional Convergence.

Project 12: A Report on Alternating Series and Leibnitz Test.

Project 13: A Report on Absolute and Conditional Convergence.

Module-VI (4 hr+0 hr+4 hr)

Limit and Continuity of Functions; Discontinuities and Types of Discontinuity;Uniform continuity and related Theorems; Differentiability of Real functions.

Project 14: A Report on Finding Limit and continuity of Functions.

Project 15: A Report on Differentiability of Real functions.

Module-VII (4 hr+0 hr+6 hr)

The Derivative and Higher Order Differentiation's; Darboux's Theorem and Roll's Theorem; Lagrange's Mean value theorems and Cauchy's Mean value Theorem ;Taylor's Theorem with Reminder.

Project 16: A Report on Darboux's Theorem and Roll's Theorem .

Project 17: A Report on Lagrange's Mean value theorems and Cauchy's Mean value Theorem.

Project 18 : A study on Taylor's Theorem with Remainder and its Importance.

Text Book:

1. Mathematical Analysis (Wiley Eastern) : S.C. Malik and S.Arora (4 th Edition)

Chapters: 1 (except 4.3 and 4.4), 2, 3, 4 (upto Art.5 and Art 10.1, 10.2), 5, 6,

Reference Books:

1. Fundamental of Mathematical Analysis :G. Das&S.Pattanayak
2. Fundamentals of Real Analysis :S.L.Gupta& Nisha Rani
3. Mathematical Analysis-II : Sharma &Vasistha

Course outline

CUTM1514 ORDINARY DIFFERENTIAL EQUATIONS

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
ORDINARY DIFFERENTIAL EQUATIONS	CUTM1514	Theory + Practice	3-2-1	Nil

Objective

- To understand most of the physical phenomena from Science and Engineering which are modeled by differential equations
- To develop the ability to apply differential equations to significant applied and/or theoretical problems.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Learn fundamental concepts of ODE theories and where and how such equations arise in applications to scientific and engineering problems.
- Be competent in solving linear/non-linear 1st& higher order ODEs using analytical methods to obtain their exact solutions.
- Find power series solutions of 2nd order differential equations.

Course Outline

Module-I (T-5 hrs-P-4 hrs-P-2 hrs)

Introduction to ordinary differential equations, First order and first degree differential equation, Variable separation method, Homogeneous differential equation, Non-homogeneous equation of first degree.

Practice-1 : Solving One dimensional heat flow equations using Python

Practice-2 : Solving Predator-Prey Equations using Python

Project-1 : Study on different types of first order and first degree ordinary differential equations used in mathematical models

Module-II (T-6 hrs-P-4 hrs-P-2 hrs)

Exact differential equations, Non-exact differential equations, Integrating factors.

Practice-3 : Solving Growth model (exponential case only) using Python

Practice-4 : Solving Decay model (exponential case only) using Python

Project-2 : Study of Non-exact differential equations and their solutions

Module-III (T-4 hrs-P-4 hrs-P-2 hrs)

Linear equation, Bernoulli's equation, Introduction to Second and Higher order Linear Homogeneous and Non-homogeneous equations with constant and variable coefficients.

Practice-5 : Solving Oxygen debt model using Python

Practice-6 : Solving Mixing Concentrations problems using Python

Project -3 : Applications of first order differential equations to Decay models

Module-IV (T-4 hrs-P-4 hrs-P-0 hrs)

Complimentary function and Particular integral, Finding particular integrals for the differential equations containing the Exponential functions, Trigonometric functions (Sine and Cosine) using inverse operator method.

Practice-7 : Solving Escape velocity Problem using Python

Practice-8 : Solving Free Damped Motion of a Spring System using Python

Module-V (T-4 hrs-P-4 hrs-P-2 hrs)

Finding particular integrals for the differential equations containing Power functions, Product of exponential function with other functions, Functions in the form xV(x) using inverse operator method, Solving second order linear equations using variation of parameters method.

Practice-9 : Solving Free Undamped Motion of a Spring System using Python

Practice-10 : Solving RL circuit problems using Python

Project -4 : Study on Variation of parameter method for solving second order differential equations

Module-VI (T-4 hrs-P-2 hrs-P-2 hrs)

Solving second order linear equations using Method Of Undetermined Coefficients, Linear equations reducible to constant coefficient form, Euler-Cauchy equation, Legendre's equation.

Practice-11 : Euler Method for solving Second order differential equation using Python

Practice-12 : Solving Forced Vibration of a Spring System using Python

Project -5 : Study on Method Of Undetermined Coefficients for solving second order differential equations

Module-VII (T-3 hrs-P-0 hrs-P-2 hrs)

Power series solution, Power series solutions of second order differential equations.

Project -6 : Study on Power series solutions

Text Book:

1. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi.

Chapters: 1, 2(2.1 to 2.7), 4(4.1 to 4.8), 7(7.1 to 7.3)

Reference Books:

1. Differential Equations and their Applications: Martin Braun, Springer International.
2. Advanced Differential Equations: M. D. Raisinghania, S. Chand & Company Ltd., New Delhi.
3. A First Course in differential Equations with Modeling Applications: G. Dennis Zill, Cengage Learning India Pvt. Ltd.
4. Text Book of Differential Equations : N.M. Kapoor
5. Introductory course in Differential Equations : D.A. Murray
6. Differential Equations: S. L. Ross, John Wiley & Sons, India, 2004.

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Course outline

CUTM-1515 ANALYSIS-II

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
ANALYSIS-II	CUTM-1515	Theory	3-0-3	Nil

Objective:

- To introduce Riemann integrable and Riemann sums.
- To describe various theorems about Riemann sums and Riemann integrals and emphasize the proofs' development.
- To evaluate the definite integral, double integral and triple integral

Learning Outcome:

Upon successful completion of this course, students will be able to:

- DefineIntegrability of continuous,Piecewise Continuous and Monotone Functions.
- Be competent in solving Improper Integrals, Double integration and triple integrals over different region.
- Applychange of variables in double integrals and triple integrals

Course Outline

Module-I

Improper Integrals Definitions and Types; Convergence of Unbounded Functions with Finite Limit of Integration; Comparison Test For Convergence and Beta Function; General Test for Convergence and Absolute Convergence For Finite Range Integrals; Examining Convergence of Finite Range Integrals.

Project 1: A Report on Beta Function,its Properties and Application.

Project 2: A Report on Different types of Comparison Tests in Improper Integrals

Project 3: A Report on Convergence of Finite Range Integrals.

Module-II

Infinite Range Integrals and Convergence of Infinite Range of Integrals; Comparison Test For Convergence and Gamma Function; General Test for Convergence and Absolute Convergence For Infinite Range; Problems on Examining Convergence of Infinite Range Integrals.

Project 4: A Report on Gamma Function, its Properties and Application.

Project 5: A Report on Convergence of Infinite Range Integrals.

Module-III

Double Integrals Definition and Techniques of Evaluation; Double Integration Over a Rectangle; Condition Of Integrability and Some Theorems; Calculation Of Double Integral Over a Rectangle.

Project 6: A Report on Double Integrals with its Properties and Evaluation Techniques.

Project 7: A Report on Setting up Limits of Integration for Evaluating double Integrals

Project 8: A Report on Area calculated as A Double Integral and Finding Area of Regions.

Module-IV

Double Integral Over a Region(Closed Bounded Domain); Calculation Of Double Integral Over a Closed Domain; Calculation Of Double Integral by Changing the Order Of Integration; Change of Variable in Double Integrals; Computing Double Integrals by Change of variable Techniques.

Project 9: Test of Convergence of Improper Integral for Finite range of Integration

Project 10: Test of Convergence of Improper Integral for Infinite range of Integration

Project 11: A collection of Different Test Criteria for Convergence of Improper Integrals

Module-V

Double Integrals in Polar Co-ordinates; Computing Double Integrals in Polar Co-ordinates ; Triple Integrals Concepts and Definitions ;Triple Integrals over a Parallelepiped; Calculation of a Triple integrals Over a Parallelepiped.

Project 12: A Report on Application of Double Integrals in Polar Co-ordinates.

Project 13 :A Reports on Triple Integrals and its Applications to Solve Problems.

Project 14: A Report on Some Important Theorems on Triple Integrals.

Module-VI

Triple Integral Over Regions(Bounded Domaines); Volume Of Solids by Triple Integrals; Calculation of a Triple Integrals Over any Region on R3.

Project 15: A Report on Solving Problems on Triple integrals over a Parallelepiped .

Project 16: A Study on Volume Calculated as A triple Integral and Calculating Volume Of Solids.

Module-VII

Triple Integrals in Cylindrical and Spherical Co-ordinates; Problems on Cylindrical and Spherical Co-ordinates; Change of variable in Triple integrals ; Computing Triple Integrals by Change of variable Techniques.

Project 17: A Report on Determining Limits of Integration for Cylindrical Co-ordinates in triple Integrals.

Project 18: A Report on Change of variable in Triple Integrals with the help of Jacobians.

Text Book:

1. S.C. Mallik& S. Arora,Mathematical Anyalysis, New Age Pub. House New Delhi. Chapters: 11, 17 (2.1 to 2.8, 3.1 to 3.4, 5.1 to 5.2), 18 (7.1 to 7.7)

Reference Books:

2. Calculus Early Transcendentals 10th Ed - Howard Anton, Iril Bivens & Stephen Davis .Joh Wiley & Sons
   Chapter : 14 (Except 14.4 and 14.8).
3. Topics In Calculus By R.K Panda & P.K Satapathy, S.G Publication,Puri

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Course outline

CUTM1516 MODERN ALGEBRA

Subject Name	Code	Type of course	T-P-Pr (Credit)	Prerequisite
MODERN ALGEBRA	CUTM1516	Theory	3-0-3	Nil

Objective

- A major objective is to introduce students to the language and precision of modern algebra. This means that the course will be proof-based, in the sense that students will be expected to understand, construct, and write proofs.
- A challenge for all students of mathematics is to balance the understanding with the communication. There is a tendency to think you are finished once you see why a mathematical statement is true or false.
- In fact you are just half-way there because constructing a legitimate proof involves different skills and expertise than the discovery part of the process. In this course both angles of problem-solving will be stressed.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Effectively write abstract mathematical proofs in a clear and logical manner.
- Locate and use theorems to solve problems in number theory and theory of polynomials over a field.
- Demonstrate ability to think critically by interpreting theorems and relating results to problems in other mathematical disciplines.
- Demonstrate ability to think critically by recognizing patterns and principles of algebra and relating them to the number system.
- Work effectively with others to discuss homework problems put on the board.

Course Outline

Module-I

Definition and examples of groups, Subgroups and examples of subgroups.

Project-1 Collection of abelian groups using different properties.

Project-2 Report on multiplication modulo and addition modulo groups.

Project-3 Finding elements of $U_n(K)$

Module-II

Lagrange's Theorem and Consequences, Fermat's little theorem, Cyclic groups of Group G.

Project-4 Finding order of a subgroup using Lagrange's Theorem

Project-5 Uses of Fermat's little theorem

Module-III

Classification of Subgroups of Cyclic group, Cosets and Properties of Cosets

Project-6 List of the elements of the groups $< n >$ in Z_m

Project-7 Index of a subgroup H in G

Module-IV

Permutation Groups

Project-8 A group model of A_4

Project-9 Digit scheme based on D_5

Project-10 Rotation of Tetrahedron

Module-V

Application of cosets to permutation groups, Normal subgroups

Project-11 Collections of application of cosets to different groups

Project-12 Application to public key cryptography

Project-13 Reports on Stabilizer point and Orbit point

Module-VI

Quotient groups, Group Homomorphism, Properties of Homomorphism

Project-14 Reports on Quotient groups

Project-15 Properties of Homomorphism with examples.

Project-16 Collection on examples of group Homomorphism.

Module-VII

Isomorphism: Definition and examples, Cayleys Theorem

Project-17 First, second and third Isomorphism theorems

Project-18 Uses of Cayleys Theorem

Text Book:

1. Joseph A. Gallian, Contemporary Abstract Algebra (4th Edn.), Narosa Publishing House, New Delhi.
   Chapters: I, II, III, IV, V, VI VII, IX

Reference Books:

1. University Algebra – N.S. Gopalkrishna (Wiley Eastern)
2. Modern Algebra – Vatsa and Vatsa (New Age International)
3. Topics in algebra - I. N. Herstein (Vikas Pub. House)

CUTM1517 PARTIAL DIFFERENTIAL EQUATIONS AND SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS

Subject Name	Code	Type of course	T-P-PJ (Credit)	Prerequisite
PARTIAL DIFFERENTIAL EQUATIONS AND SYSTEM OF ORDINARY DIFFERENTIAL EQUATIONS	**CUTM1517**	**Theory + Practice**	**3-2-1**	**Nil**

Objective

- Introduce students to partial differential equations.
- Introduce students to how to solve linear and non-linear Partial Differential with different methods.
- To practice heat and wave equations in 2D and 3D..

Learning Outcome

Upon successful completion of this course, students will be able to:

- solve linear partial differential equations of both first and second order
- apply partial derivative equation techniques to predict the behavior of certain phenomena.
- apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of specialization.
- extract information from partial derivative models in order to interpret reality.

Course Outline

Module-I (4h+4h+2h)

Linear Homogeneous and Non-homogeneous system of Differential Equations with constant coefficients.

Practice-1

To find the general solution of linear homogeneoussystem of differential equations by using Matlab.

Practice-2

To find the general solution of linear non-homogeneoussystem of differential equations by using Matlab.

Project -1

To make a report of an application of linear system of differential equation

Module-II(4h+4h+2h)

Simultaneous linear first order differential equations in three variables, Pfaffian differential equations, Methods of Solutions of Pfaffian differential equations in three variables.

Practice-3

To find the solution ofsimultaneous linear first order differential equations by using Matlab.

Practice-4

To find the Solutions of system of differential equations in three Variables by using Matlab.

Project-2

Tomake a report on simultaneous Linear Differential Equations.

Module-III(4h+4h)

Introduction to first order partial differential equations, formation of first order partial differential equations, linear Partial differential equations.

Practice-5

To find the solution of first order partial differential equations by using Matlab

Practice-6

To find the solution of first order Quasi-linear partial differential equations by using Matlab

Module-IV(5 h+4h+2h)

Non-linear partial differential equations, Special types of first-order equations, Charpit Equation, solutions of partial differential equations of first order satisfying given initial conditions.

Practice-7

To find the solution of 1-d Wave equation by using Matlab

Practice-8

To find the solution of 1-d Heat equation by using Matlab

Project-3

Summary of Special types of partial Differential Equations**.**

Module-V(4h+2h+2h)

First order homogeneous PDE with constant coefficients, higher order homogeneous PDE with constant coefficients.

Practice-9

To find the solution of first order homogeneous partial differential equations by using Matlab

Project-4

Briefly describe Homogeneous Partial differential Equations with suitable examples.

Module-VI(6h+2h+2h)

Higher order linear Non-homogeneous PDE with constant coefficients, general Solution of PDE by using inverse operators.

Practice-10

To find the solution of 2-d Wave equation by using Matlab

Project-5

Make a report onNon-homogeneous Partial differential Equations with constant coefficients.

Module-VII(3h+4h+2h)

Solution of homogeneous and non-homogeneous PDE with variable coefficients,

Practice-11

To find the solution of 2-d heat equation by using Matlab

Practice-12

To find the solution of 2-d Laplace equation by using Matlab

Project-6

Summary of Non-homogeneous Partial differential Equations with variable coefficients.

Text Book:

1. J. Sinha Roy and S.Padhy, A course on ordinary and partial differential equation, KalyaniPublisers, New Delhi, Ludhiana,2012

Reference Books:

1. LoknathSahoo, Calculus and ordinary differential equations, Kalyani Publication, Reprint-2017
2. TynMyint-U and LokenathDebnath, Linear Partial differential Equations for Scientists and Engineers, 4thEdition, Springer, Indian reprint, 2006
3. S.L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, India, 2004

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CUTM1518 NUMERICAL ANALYSIS

Subject Name	Code	Type of course	T-P-PJ (Credit)	Prerequisite
NUMERICAL ANALYSIS	CUTM1518	Theory + Practice	3-2-1	Nil

Objective

- To understand the limitations of analytical methods and the need for numerical methods and the ability to apply these numerical methods to obtain the approximate solutions to engineering and mathematical problems.
- Ability to decide and to derive appropriate numerical methods for approximating the solutions of various types of problems in engineering and science and analyze the error incumbent in any such numerical approximation.
- Ability to report analysis, solution and results in a standard engineering format.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Perform error analysis to select an appropriate numerical model and to estimate errors in numerical solution of a given problem.
- Derive a variety of numerical algorithms/methods & compare the viability of different approaches to the numerical solutions of various mathematical problems arising in roots of linear and non-linear equations, interpolation and approximation, numerical differentiation and integration, system of linear algebraic equations and differential equations.
- Analyze and evaluate the accuracy of common numerical methods.

Course Outline

Module – I (5hr+6hr+0hr)

Introduction to Numerical Analysis, Concept of Number system: Binary numbers, octal numbers, hexa-decimal numbers. Floating point Arithmetic, K – digit Arithmetic, Dealing with Errors: Relative, absolute, roundoff, truncation.

Practice 1: Calculate the sum 1+1/2+1/3+1/4+ ----------+1/N. using python

Practice 2: To find the absolute value of an integer using python

Practice 3: Enter 100 integers into an array and sort them in an ascending order using python

Module – II (7hr+8hr+4hr)

Numerical Solution of non-linear equations: method of bisection, Regula-falsi method, Secant method, Newton-Rapshon method, fixed point iteration method.

Practice 4: To find the approximate value of a polynomial using Bisection method.

Practice 5: To find the approximate value of a polynomial using Newton Rapshon method

Practice 6: To find the approximate value of a polynomial using Secant method

Practice 7: To find the approximate value of a polynomial using Regula Falsi method

Project 1: Numerical Methods for Solving Systems of Nonlinear Equations

Project 2: A Study on Transcendental and Polynomial equations.

Module – III (3hr+2hr+2hr)

Polynomial Interpolation, Existence and uniqueness of interpolating polynomials, Lagrange's interpolating polynomial.

Practice 8: To find the value of a function using Lagrange interpolation

Project 3: A study on Lagrange interpolation

Module – IV (4hr+2hr+4hr)

Newtons Divided Difference Interpolating Polynomial, Forward and backward Difference operators. Newton's Forward and backward Difference Interpolation formula

Practice 9: Solving problems on Newton forward/backward difference formula using python

Project 4: A study on Newton's Divided Difference Interpolation Formula

Project 5: A study to apply Newton forward difference/backward formula on solving numerical problems with MATLAB program

Module – V (5hr+4hr+0hr)

Numerical Integration, Newton-cotes rule, Trapezoidal Rule, Simpsons 1/3 rd rule, Simpsons 3/8 th rule.

Practice 10: Solving a problem on trapezoidal rule using python

Practice 11: Solving a problem on Simpson's 1/3 rd rule using python

Module – VI (2hr+0hr+0hr)

Compound Quadrature rules, Gauss-Legendre Rules,

Module – VII (4hr+2hr+2hr)

Numerical solution of Differential Equation, Euler's method, Runge-Kutta 4^{th} order method

Practice 12: Solving Problems on 4th order Runge-Kutta method using python

Project 6: A Study on Runge-Kutta method

Text Book:

1. A Course on Numerical Analysis : B. P. Acharya & R. N. Das, Kalyani Publisher Chapters: 1, 2 (2.1 – 2.4, 2.6, 2.8, 2.9), 3 (3.1 to 3.4, 3.6 to 3.8). 6 (6.1- 6.3, 6.5, 6.10, 6.11), 7 (7.1, 7.2, 7.3, 7.4 & 7.7)

Reference Books:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods For Scientific And Engineering Computation, 6th Ed., New Age International Publisher, India, 2007.
2. John H. Mathews and Kurtis D. Fink, Numerical Methods Using MatLab, 4th Ed., Phi Learning Private Limited, 2012.

Course outline

CUTM1519 ADVANCED ANALYSIS

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
ADVANCEDANALYSIS	CUTM1519	Theory	3-0-3	Nil

Objective

- To point out that iterative processes and convergence of sequences occur in many areas of mathematics, and to develop a general context in metric spaces.
- To provide a basic course in analysis.
- To reinforce ideas of proof.

Learning Outcome

- Understand the Euclidean distance function on R^n and appreciate its properties, and state and use the Triangle and Reverse Triangle Inequalities for the Euclidean distance function on R^n
- Explain the definition of continuity for functions from R^n to R^m and determine whether a given function from R^n to R^m is continuous
- Explain the geometric meaning of each of the metric space properties and be able to verify whether a given distance function is a metric
- Distinguish between open and closed balls in a metric space and be able to determine them for given metric spaces
- Define convergence for sequences in a metric space and determine whether a given sequence in a metric space converges
- State the definition of continuity of a function between two metric spaces

Course Outline

MODULE – I (5hr+0hr+6hr)

Metric Spaces: Definition and examples, open and closed spheres,

Project-1: Write a report on applications of metric spaces.

Project-2: Show that the class denote a set of all bounded sequence of real numbers is a metric space.

Project-3: Show that the class of all sequences is a metric space.

MODULE – II (3hr+0hr+4hr)

Neighbourhoods, Interior points. Open set

Project-4: Write a report on limit points and their applications.

Project-5(Flip class): Prove theorems on Neighbourhoods, Interior points

MODULE – III (5hr+0hr+6hr)

Closed set, boundary points, limit points and isolated points, closure of a set, dense sets.

Project-6: Write a report on difference between open set closed set and limit point , interior point with appropriate examples.

Project-7: Write the difference between boundary points, limit points and isolated points explain through examples.

Project-8 (Flip class): Prove theorems on closed set and dense sets.

MODULE – IV (4hr+0hr+6hr)

Separable metric spaces, sequences in metric space, convergent sequences, Cauchy sequences

Project-9: Write a report on applications of convergent sequences and Cauchy sequences.

Project-10: Every convergent sequence is bounded. Is the reverse true? Justify your answer with suitable example.

Project-11(Flip class): Prove theorems on convergent sequences and Cauchy sequences.

MODULE – V (4hr+0hr+4hr)

Complete metric space, subspace, Cantor's theorem. Continuous functions,

Project- 12(Flip class): Prove theorems on Complete metric space, subspace.

Project-13(Flip class): : Prove that addition, subtraction, multiplication and division (with condition) of continuous functions are continuous

MODULE – VI (4hr+0hr+6hr)

Uniform continuity, Connectedness, connected subsets of separated sets.

Project-14(Flip class): Prove theorems on Uniform continuity and Connectedness.

Project- 15: Write the difference between continuity and uniform continuity and explain through a proper example..

Project-16 (Flip class): Prove theorems on connected subsets of separated sets.

MODULE – VII (5hr+0hr+4hr)

Disconnected sets, contraction mappings, Banach fixed point theorem.

Project- 17(Flip class): Geometrical interpretation of connected and disconnected sets.

Project-18: Write some applications of Banach fixed point theorem.

BOOK PRESCRIBED

1. K. Jain and K. Ahmad, Metric Spaces, Narosa Publishing House, New Delhi. Chapters :2 (2.1-2.4, 2.6-2.9), 3(3.1-3.4), 4(4.1-4.3), 6(6.1,6.2), 7(7.1)
2. Methods of Real analysis-R.G. Goldberg. Chapters: 4(4.2,and 4.3), 5,and 6 (up to 6.8)

BOOKS FOR REFERENCE

1. S.C. Malik and S. Arora – Mathematical Analysis (New Age International)
2. Principles of Mathematical Analysis – Walter Rudin, III Edition, McGRAW-Hill Book Co.

CUTM1520 COMPLEX ANALYSIS

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
COMPLEX ANALYSIS	CUTM1520	Theory	3-1-2	Nil

Objective

- To understand the application of Complex Analysis to Two-Dimensional problems in Physics including Hydrodynamics and Thermodynamics and also in Engineering fields such as; Nuclear, Aerospace, Mechanical and Civil engineering, signal processing & communications.
- To acquire the skill of evaluating contour integrals using Cauchy's integral formula and Cauchy's integral theorem.

Learning Outcome

Upon successful completion of this course, students will be able to:

- To get equipped with the understanding of the fundamental concepts of functions of a complex variable along with the concepts of analyticity, Cauchy-Riemann relations and harmonic functions.
- Evaluate complex contour integrals applying the Cauchy's integral theorem and Cauchy's integral formula.

Course Outline

Module I (T-5 hrs-P-4 hrs-P-2 hrs)

Complex numbers, Algebra of complex numbers, Modulus and argument, Roots of a complex number.

Practice-1 : Plotting complex numbers in Matlab

Practice-2 : Finding the modulus and argument of a complex number using Matlab
Project-1 : Finding roots of different complex numbers

Module II (T-3 hrs-P-2 hrs-P-2hrs)

Functions of a complex variable, Limit and continuity, Differentiation, Cauchy-Riemann equations.

Practice-3 : Plotting complex functions using Matlab

Project-2 : Verifying Cauchy-Riemann equations for complex functions in cartesian form and polar form

Module III (T-4 hrs-P-0 hrs-P-2 hrs)

Analytic functions, Laplace equation, Harmonic and Conjugate harmonic functions, Method of finding out conjugate harmonic functions and the corresponding analytic function, Entire functions.

Project-3 : Finding conjugate harmonics of different harmonic functions and the corresponding analytic functions

Module IV (T-4 hrs-P-2 hrs-P-4 hrs)

Complex exponential functions, Logarithmic functions, Trigonomertric functions, Hyperbolic functions.

Practice-4 : Generate and plot Complex Exponential Signal Graph in Matlab

Project-4 : Study on Complex Exponential and Logarithmic functions

Project-5 : Studying properties of Complex trigonometric and hyperbolic functions

Module V (T-3 hrs-P-2 hrs-P-4 hrs)

Definite integrals of complex functions, Contours, Evaluation of Contour integrals using Cauchy's Integral Theorem.

Practice-5 : Integrating complex functions using Matlab

Project-6 : Evaluation of different types of Contour integrals using Cauchy's Integral Theorem

Module VI (T-6 hrs-P-2 hrs-P-6 hrs)

Cauchy's Integral Formula for complex functions and their derivatives, Convergence of sequences and series, Taylor series, Maclaurin series.

Practice-6 : Finding out the Taylor series expansion of a function using Matlab

Project-7 : Evaluation of different types of Contour integrals using Cauchy's Integral Formula

Project-8 : Study on Radius of convergence of a Power series

Project-9 : Taylor series expansion of different complex functions

Project-10 : Maclaurin series expansion of different complex functions

Module VII (T-5 hrs-P-0 hrs-P-4 hrs)

Conformal mapping, Bilinear Transformation, Fixed points, Cross ratio.

Project-11 : Study on Bilinear Transformations

Project-12 : Study on Conformal mappings **Text**

Book:

1. James Ward Brown and Ruel V. Churchill, Complex Variables And Applications, 8th Ed., Mc-Graw Hill International Edition, 2014.

   Chapters: 1, 2(12, 13, 15 to 26), 3(29, 30, 34, 35), 4(37 to 41, 50 to 52), 5(55, 56, 57), 8(93, 94), 9(101).

Reference Book:

2. Complex Analysis – L. V. Ahlfors, Mc-Graw Hill International Editions (Vikas Publications – Second Edition)

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CUTM1521 INTEGRAL TRANSFORMS

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
INTEGRAL TRANSFORMS	CUTM1521	Theory	3-1-2	Nil

Objective

- To describe the ideas of Fourier and Laplace Transforms and indicate their applications in the fields such as application of PDE,
- Digital Signal Processing, Image Processing, Theory of wave equations, Differential Equations and many others.
- To use Fourier series for solving boundary value problems appearing in scientific& engineering problems.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Learn application of MATLAB programming.
- Solve differential & integral equations with initial conditions using Laplace transform.
- Evaluate the Fourier transform of a continuous function and be familiar with its basic properties.
- Solution of integral equation and their application.

Course Outline

Module-I(T-4 h + Pr-2 h+ Pj-4 h)

Introduction to Integral Transforms, Laplace Transforms, and Properties of Laplace transforms, unit step function, second shifting theorem.

Practice-1

Laplace Transform and Inverse Laplace Transform Using Matlab.

Project-1

Make a short draft of properties of Laplace transform from memory. Then compare your notes with the text and write a report of 2-3 pages on these operations and their significance in applications.

Project-2

Find the Laplace transform of the following functions.

Module-II(T-4 h + Pj-4 h)

Unit impulse function, Laplace transforms of Derivatives and Integrals, Derivatives and Integrals of Transforms.

Project-3

Find the inverse Laplace transform of Derivative and integral properties.

Project-4

Find the Laplace transform of unit impulse function and unit step function.

Module-III(T-4 h + Pr-2 h+ Pj-4 h)

Evaluation of integrals, convolutiontheorem, inverse Laplace transform.

Practice-2

To solve integral equations by using Matlab.

Project-5

Evaluation of integrals by using Laplace transform.

Project-6

Find the inverse Laplace transform by using convolution theorem.

Module-IV(T-4 h + Pr-2 h+ Pj-4 h)

Solution of differential equations, integral equations.

Practice-3

Find the solution of differential equations by Laplace Transform Using Matlab.

Project-7

Solve the differential equation by using Laplace transform.

Project-8

Solve the integral equation by using Laplace transform.

Module-V(T-4 h + Pr-2 h+ Pj-4 h)

Periodic function, Fourierseries, Fourier series expansion of an arbitrary period, even and odd functions, half Range Expansions of a Fourier series.

Practice-4

Find the Fourier series expansion of a periodic function by using Matlab.

Project-9

Find the Fourier series expansion of a 2-pi periodic function.

Project-10

Find the Half range expansion of Fourier cosine and sine series.

Module-VI(T-4 h + Pr-2 h+ Pj-2 h)

Complex form of Fourier series, Fourier Integrals, Different forms of Fourier Integral Theorem.

Practice-5

Find the Fourier Series Coefficients by using Matlab.

Project-11

Find the Fourier sine and cosine integral of the following functions.

Module-VII(T-4 h + Pr-2 h+ Pj-2 h)

Fourier Transforms, Infinite Fourier Transforms, Finite Fourier transform, Properties Fourier Transform.

Practice-6

First Fourier transform by using Matlab.

Project-12

Make a short draft of properties of Fourier transform from memory. Then compare your notes with the text and write a report of 2-3 pages on these operations and their significance in applications.

Text Book:

M.D. Raisinghania, H.C. Saxena and H.K. Dass: Integral Transforms, S. Chand & Company LTD.Chapters: 1(1.1-1.5,1.7 to 1.10,1.12) 2(2.2,2.4,2.5,2.6), 3(3.1 to 3.21), 4(4.1, 4.4, 4.5 to 4.13, 4.15 to 4.17), 5(5.1, 5.16), 6(6.1 to 6.3, 6.6 to 6.8, 6.11), 7(7.1 to 7.3).

Reference Text Book:

1. Higher Engineering Mathematics by B.V.Ramana.
2. An introduction to non-harmonic Fourier series,Author(s):Robert M. Young.
3. Advanced Engineering Mathematics by E.Kreyszig (10th edition).

CUTM1522 DISCRETE MATHEMATICAL STRUCTURE

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
DISCRETE MATHEMATICAL STRUCTURE	CUTM1522	Theory	3-1-2	Nil

Objective

- To understand mathematical reasoning in order to read, comprehend and construct mathematical arguments as well as to solve problems, occurred in the development of programming languages.
- To work with different types of Sets, Lattices and Boolean Algebra.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Evaluate elementary mathematical arguments and identify fallacious reasoning.
- Apply the logical structure of proofs and work symbolically with connectives and quantifiers to produce logically valid, correct and clear arguments.
- Reformulate statements from common language to formal logic. Apply truth tables and the rules of propositional and predicate calculus.

Course Outline

Module-I (T-5 hrs-P-4 hrs-P-4 hrs)

Introduction to Logic, Logical connectives, Converse, Inverse, Contrapositive, Proportional Equivalences, Propositional Calculus, Translating English sentences to Logical expressions.

Practice-1 : Finding the truth values of compound propositions using Python

Practice-2 : Writing conditional statements in Python

Project-1 : Study on equivalent statements in Logic

Project-2 : Study on Propositional Calculus

Module-II (T-5 hrs-P-0 hrs-P-4 hrs)

Predicates, Quantifiers, Bound and free variables, Rules of inference, Derivation of Valid conclusion, Nested Quantifiers.

Project-3 : Study on Universal Quantifiers and Existential Quantifiers

Project-4 : Study on Valid arguments in Logic

Module-III (T-4 hrs-P-0 hrs-P-4 hrs)

Recurrence Relation and it's solution by using Generating function, Pigeon-Hole Principle.

Project-5 : Study on different types of Recurrence relations

Project-6 : Study on Pigeon-Hole Principle

Module-IV (T-4 hrs-P-6 hrs-P-2 hrs)

The basics of counting, Generalized Permutations, Combinations and their Applications.

Practice-3 : Finding Factorial of a number using Python

Practice-4 : Finding out the value of P(n,r) using Python

Practice-5 : Finding out the value of C(n,r) using Python

Project-7 : Study on permutations and combinations

Module-V (T-4 hrs-P-2 hrs-P-2 hrs)

Relations and their operations and properties, Equivalence relation, Representation of a relation, Closure of a relation.

Practice-6 : Finding Composition of Relations using Python

Project-8 : Study on different types of Relations

Module-VI (T-3 hrs-P-0 hrs-P-4 hrs)

Partial order relation, Partially ordered set and totally ordered set, Hasse diagram, Maximal and minimal elements, Greatest and least elements, Supremum and infimum of a Poset.

Project-9 : Study on partially ordered sets and Totally ordered sets

Project-10 : Study on Hasse Diagram

Module-VII (T-5 hrs-P-0 hrs-P-4 hrs)

Lattice and it's algebraic structure, Properties of a Lattice, De-Morgan's Law, Bounded and Distributive Lattices, Boolean Algebra, Boolean Function.

Project-11 : Study on Lattices and Ordered Sets

Project-12 : Study on Boolean Algebra

Text Book:

1. Kenneth H. Rosen, Discrete Mathematics and Applications, Tata Mc-Graw Hill Publications,

Chapters: 1(1.1 To 1.5), 5(5.1, 5.2, 5.5), 6(6.1, 6.2, 6.4), 7, 10(10.1, 10.2).

Reference Book:

1. Discrete Mathematics with Graph Theory by Edgar G. Goodaire and Michael M. Parmenter

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Course Outline

CUTM1523 LINEAR PROGRAMMING

Subject Name	Code	Type of Course	T-P-Pj (Credit)	Prerequisite
LINEAR PROGRAMMING	**CUTM1523**	**T + P + Pj**	**3-2-1**	**Nil**

Course Objective

- To introduce a brief understanding about Linear Programming Problems.
- To cater the characteristics of Linear Programming Problems and its Applications.
- To demonstration of the utilization of Linear Programming Problems in industry and business.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Formulate the necessary and sufficient optimality conditions for linear programming and demonstrate the geometrical interpretation of these conditions.
- Use various techniques to solve basic transportation and network problems.
- Use the mathematical foundations learned in this course to formulate new applications as optimal decision problems and seek appropriate solutions algorithms.

Course Outline

CUTM1523 Linear Programming (3-2-1)

Module I (5 Hours)

Linear programming problems (LPP): Introduction to linear programming problems (LPP), Mathematical formulation of the linear programming problems with illustrations

Practice 1: (2 Hours)

Formulation of maximization type linear programming problem using excel solver

Practice 2: (2 Hours)

Formulation of minimization type linear programming problem using excel solver

Assignment 1: (2 Hours)

Formulation of Manufacturing/Production Problem to LPP

Module II (4 Hours)

Graphical method used for solving linear programming problem. Feasible region of LPP, unbounded solution to the LPP in graphical method, Canonical and standard form of LPP.

Practice 3: (2 Hours)

Solution of graphical method of LPP using excel solver

Practice 4: (2 Hours)

Solving manufacturing problem using excel solver

Practice 5: (2 Hours)

Solving diet problem using in excel solver

Assignment 2: (2 Hours)

Formulation of investment and diet problems to LPP and its graphical solution.

Module III (5 Hours)

Simplex Method: Basic and non basic variables, Theory of Simplex method, optimality and unboundlessness, Simplex algorithm, Simplex method in tableau format.

Practice 6: (2 Hours)

Solving Maximization problem using Simplex method in excel solver

Practice 7: (2 Hours)

Solving Minimization problem using Simplex method in excel solver

Assignment 3: (2 Hours)

Solution of linear programming problem using simplex method.

Module IV: (5 Hours)

Introduction to artificial variables, Two –phase simplex method, Big-M method, Degeneracy problem in simplex method

Practice 8: (2 Hours)

Solving linear-programming problem using Two Phase method in excel solver

Practice 9: (2 Hours)

Solving linear-programming problem using Big-M method in excel solver

Assignment 4: (2 Hours)

Solution of linear programming problem using penalty method.

Module V: (4 Hours)

Transportation Problem: Introduction to transportation problem, Initial basic feasible solution to transportation problem using North-West Corner, Least Cost Method and Vogel's approximation Method.

Practice 10: (2 Hours)

Solving Transportation problem using North West Corner method in excel solver

Practice 11: (2 Hours)

Solving Transportation problem using Least Cost method in excel solver

Assignment 5:

Initial basic feasible solution to transportation problem

Module VI: (4 Hours)

Optimal solution to transportation problem using MODI method, Unbalanced transportation problem, Degeneracy in transportation problem.

Practice 12: (2 Hours)

Solving Transportation problem using Vogel's Approximation method in excel solver

Assignment 6: (2 Hours)

Optimal solution to transportation problem using MODI method

Module VII: (4 Hours)

Assignment Problem: Introduction to assignment problem, Mathematical formulation of assignment problem, Solution to assignment problem using Hungarian method

Assignment 7: (2 Hours)

Solution to assignment problem using Hungarian method

Text Books:

Kanti Swarup, P.K. Gupta and Man Mohan-Operations Research, S. Chand and Co. Pvt.Ltd.

S. Kalavathy- Operations Research, Vikas Publishing House Pvt. Ltd.

Reference Book:
Mathematical Programming by N. S. Kambo, East West Press.

Course Outline

CUTM1524 PROBABILITY AND STATISTICS

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1524	PROBABILITY AND STATISTICS	3-1-2	NIL

Objective

- To translate real-world problems into probability

  To motivate students in an intrinsic interest in statistical

- To recognize the role and application of probability theory, descriptive and inferential statistics in many different fields of science and engineering.

- To apply probability and statistics in engineering and science like disease modeling, climate

Learning outcome

Upon successful completion of this course, students will be able to:

- Define and illustrate the concepts of sample space, events and compute the probability and conditional probability of events.
- Define, illustrate and apply the concepts of discrete and continuous random variables, the discrete and continuous probability distributions.
- Define, illustrate and apply the concept of the expectation to the mean, variance and covariance of random variables.
- Compute probabilities based on practical situations using the Binomial, Poisson and Normal distributions.

Course content

Module I: (4 hrs+2 hrs+4hrs)

Probability: Axiomatic definitions of probability, Sample Space, Probability axioms, Independent events, Mutually Exclusive Event, Equally Likely Events

Practice-1(2 hrs)

Bayes Theorem using MATLAB

Project-1 (2hrs)

Application of conditional probability analysis to the clinical diagnosis

Project-2(2hrs)

A Report on Bayes' Theorem and its Application in Different Fields

Module II :(4 hrs+2 hrs+4hrs)

Discrete random variables, Continuous random variables, Expectation of random variables, Variance and Standard Deviation

Practice-2(2hrs)

Probability Density Function using MATLAB

Project-3(2hrs)

A Report on Random Variables with Examples

Project-4 (2hrs)

A Report on Moment Generating Function of Distributions

Module III:(6 hrs+4 hrs+4hrs)

Binomial distribution, Poisson distribution, Poisson Distribution as the limiting case of Binomial Distribution

Practice-3(2 hrs)

Binomial distribution using MATLAB

Practice-4(2 hrs)

Poisson distribution - algorithm in Matlab

Project-5(2hrs)

Comparative study between Binomial distribution and Poisson distribution

Project-6(2hrs)

Report on Poisson distribution with their Business Applications in analyzing

data sets

Module IV:(4 hrs+2hrs+8hrs)

Uniform distribution, Normal distributions, Normal approximation to the Binomial distributions

Practice-5(2hrs)

Gaussian distribution – how to plot it in Matlab

Project -7(2hrs)

Flip class

A Report on Gamma, Exponential, Beta Distributions

Project-8(2hrs)

A Report on Central Limit Theorem (CLT) and its Applications in election polls

Project-9(2hrs)

Flip class

A Report on Negative binomial Distribution

Project-10(2hrs)

Flip class

A Report on Geometric distributions

Module V:(4 hrs+0 hr+0 hr)

Distribution of two random variables, Expectation of function of two random variables

Module VI:(4 hrs)

Conditional distributions and expectations.

Module VII:(4 hrs+2 hrs+4hrs)

Correlation coefficient, Co-variance independent random variables, linear regression of two

variables

Practice-6(2hrs)

Covariance & Correlation Coefficient calculation in MATLAB

Project-11 (2hrs)

Flip Class

A Report on Markov's inequality

Project -12(2hrs)

Flip Class

A Report on Chebyshev's inequality

Total Hrs=T(30hrs+P(12hrs)+Pj(24hrs)) Text

Books:

1. Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006.
2. Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007.

Reference Books:

1. Statistical Methods By S.P. Gupta (31st Edition) ; Publisher: Sultan Chand & Sons
2. Mathematical Statistics By S.C. Gupta & V.K. Kapur(10th Edition); Publisher: Sultan Chand & Sons.

Course outline Prepared by: **Dr.Banitamani Mallik**

Date:08-06-2020

B.Sc. Zoology
School of Applied Sciences

Program Objectives

1.To expand scientific temper and can prove to be more beneficial for the society as the scientific developments can make a nation or society to grow at a rapid pace.

2. To obtain a professional job as scientist ,researcher ,entrepreneur and to get jobs in marketing, business &other technical fields.

POs; Science Graduates will be able to;

POs	Outcomes
PO1	Apply mathematics, science, fundamentals and specialization on to the conceptualization of different scientific models
PO2	Identify, formulate, research literature and solve complex scientific related problems reaching substantiated conclusions using first principles of mathematics and applied sciences
PO3	Design solutions for scientific problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations
PO4	Conduct investigations of complex problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
PO5	Create, select and apply appropriate techniques, resources, and modern tools, including prediction and modelling, to complex scientific activities, with an understanding of the limitations
PO6	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
PO7	Communicate effectively on complex scientific activities with the scientific community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO8	Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to scientific application
PO9	Understand and commit to professional ethics and responsibilities and norms of scientific application
PO10	Understand the impact of scientific solutions in a societal context and demonstrate knowledge of and need for sustainable development
PO11	Recognize the need for, and have the ability to engage in independent and life-long learning
PO12	Demonstrate a knowledge and understanding of contemporary technologies, their applications and limitations, contemporary research in the broader context of relevant fields
PO13	Demonstrate the ability to succeed in national and international competitive events in the relevant fields

PSOs: Department of Zoology

PSO1: Jobs

PSO2: Higher studies

PSO3: Research

Cos:

Cos	**Skills**
CO1	Knowledge
CO2	Observe, Classify, Quantify, Interpret and Communicate
CO3	Investigation and Judgements
CO4	Problem Solving
CO5	Leadership & Management
CO6	Product/Publication/Patent

***Correlation is noted as "H" for High, "M" for Medium and "L" for Low**

Mapping PSOs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**
PSO1	**H**	**H**	**M**	**M**	**L**	**M**	**L**	**H**	**H**	**L**	**M**	**M**	**M**
PSO2	**H**	**H**	**M**	**H**	**H**	**M**	**M**	**M**	**M**	**M**	**M**	**H**	**M**
PSO3	**H**	**H**	**M**	**M**	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**	**M**

Mapping COs with POs

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**
CO1	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**
CO2	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**	**H**	**H**
CO3	**M**	**H**	**H**	**M**	**H**	**H**	**H**	**M**	**M**	**H**	**H**	**H**	**H**
CO4	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**	**H**	**H**
CO5	**H**	**H**	**H**	**M**	**H**	**H**	**H**	**M**	**M**	**H**	**H**	**H**	**H**
CO6	**M**	**M**	**H**	**M**	**H**	**M**	**H**	**L**	**M**	**H**	**H**	**H**	**H**

Course Code	*Course Title*	*Course Type*	*Credits*	*Prerequisite*	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**	**PSO1**	**PSO2**	**PSO3**
BSZO1101	Non-Chordates-I	Theory + Practice	***6***	***+2 pass***	**H**	**H**	**M**	**L**			**H**	**H**	**H**
BSZO1102	Principles of Ecology	Theory + Practice	***6***	***+2 pass***	**H**	**H**	**M**	**L**			**H**	**H**	**H**
BSZO1201	Non-Chordates-II	Theory + Practice	***6***	***+2 pass***	**H**	**H**	**M**	**L**			**H**	**H**	**H**
BSZO1202	Cell Biology	Theory + Practice	***6***	***+2 pass***	**H**	**H**	**M**	**L**			**H**	**H**	**H**
BSZO2301	Diversity of Chordates	Theory + Practice	***6***	***1st year B.Sc.***	**H**	**H**	**H**	**L**			**H**	**H**	**H**
BSZO2302	Physiology-Controlling & Coordinating Systems	Theory + Practice	***6***	***1st year B.Sc.***	**H**	**H**	**H**	**L**			**H**	**H**	**H**
BSZO2303	Fundamentals of Biochemistry	Theory + Practice	***6***	***1st year B.Sc.***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSZO2401	Comparative Anatomy of Vertebrates	Theory + Practice	***6***	***1st year B.Sc.***	**H**	**H**	**M**	**L**			**H**	**H**	**H**
BSZO2402	Physiology: Life Sustaining Systems	Theory + Practice	***6***	***1st year B.Sc.***	**H**	**H**	**H**	**L**			**H**	**H**	**H**

BSZO2403	Biochemistry of Metabolic Processes	Theory + Practice	***6***	***1st year B.Sc.***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSZO3501	Molecular Biology	Theory + Practice	***6***	***2nd year B.Sc***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSZO3502	Principles of Genetics	Theory + Practice	***6***	***2nd year B.Sc***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSZO3601	Developmental Biology	Theory + Practice	***6***	***2nd year B.Sc***	**H**	**H**	**H**	**L**			**H**	**H**	**H**
BSZO3602	Evolutionary Biology	Theory + Practice	***6***	***2nd year B.Sc***	**H**	**H**	**M**	**L**			**H**	**H**	**H**
BSFL1101 OR FCBS0101	English OR Environmental Science	Theory	***2***	***+2 pass***	**H**	**H**	**M**	**L**			**H**	**H**	**H**
BSZO3503	DSE-1: Animal Biotechnology	Theory + Practice	***6***	***2nd year B.Sc***				H				**H**	**H**
BSZO3504	DSE-2: Fish and Fisheries	Theory + Practice	***6***	***2nd year B.Sc***	**H**	**H**	**H**	**H**				**H**	**H**
BSZO3603	DSE-3: Immunology	Theory + Practice	***6***	***2nd year B.Sc***	**H**	**H**	**H**	**H**				**H**	**H**
BSZO3604	DSE-4: Parasitology	Theory + Practice	***6***	***2nd year B.Sc***	**H**	**H**	**H**	**H**				**H**	**H**
BSLS2001	Techniques in Biofertilizer (SEC-	Practice	***2***	***+2 pass***	**H**	**H**	**H**	**H**			H	**H**	**H**

	1)												
BSLS2002	Skill in Apiculture (SEC-1)	Practice	***2***	***+2 pass***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSLS2003	Herbal Technology(SEC-2)	Practice	***2***	***+2 pass***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSLS2004	Techniques in Medical Diagnostics (SEC-2)	Practice	***2***	***+2 pass***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSLS2005	Vermicomposting	Practice	***2***	***+2 pass***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSLS2011	Pisciculture	Practice	***2***	***+2 pass***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSLS2012	Sericulture	Practice	***2***	***+2 pass***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSLS2013	Ecotourism	Practice	***2***	***+2 pass***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSLS2014	Poultry Management	Practice	***2***	***+2 pass***	**H**	**H**	**H**	**H**			**H**	**H**	**H**
BSLS2015	Ornamental Fish Management	Practice	***2***	***+2 pass***	**H**	**H**	**H**	**H**			**H**	**H**	**H**

Year 2020-21

Course Code	*Course Title*	*Course Type*	*Credits*	*Prerequisite*	CO 1	CO 2	CO 3	CO 4	CO 5	CO6	PSO1	PSO2	PSO3
CUTM1497	Non-Chordates-I	Theory + Practice	*6*	+2 Sc. with Biology	H	H	M	L			H	H	H
CUTM1499	Principles of Ecology	Theory + Practice	*6*	+2 Sc. with Biology	H	H	M	L			H	H	H
CUTM1498	Non-Chordates-II	Theory + Practice	*6*	+2 Sc. with Biology	H	H	M	L			H	H	H
CUTM1500	Cell Biology	Theory + Practice	*6*	+2 Sc. with Biology	H	H	M	L			H	H	H
CUTM1501	Diversity of Chordates	Theory + Practice	*6*	+2 Sc. with Biology	H	H	H	L			H	H	H
CUTM1502	Animal Physiology-Controlling & Coordinating Systems	Theory + Practice	*6*	+2 Sc. with Biology	H	H	H	L			H	H	H
CUTM1503	Fundamentals of Biochemistry	Theory +	*6*	+2 Sc. with	H	H	H	H			H	H	H

		Practice		Biology									
CUTM1504	Comparative Anatomy of Vertebrates	Theory + Practice	***6***	+2 Sc. with Biology	**H**	**H**	**M**	**L**			**H**	**H**	**H**
CUTM1505	Animal Physiology: Life Sustaining Systems	Theory + Practice	***6***	+2 Sc. with Biology	**H**	**H**	**H**	**L**			**H**	**H**	**H**
CUTM1506	Biochemistry of Metabolic Processes	Theory + Practice	***6***	+2 Sc. with Biology	**H**	**H**	**H**	**H**			**H**	**H**	**H**
CUTM1507	Molecular Biology	Theory + Practice	***6***	+2 Sc. with Biology	**H**	**H**	**H**	**H**			**H**	**H**	**H**
CUTM1508	Principles of Genetics	Theory + Practice	***6***	+2 Sc. with Biology	**H**	**H**	**H**	**H**			**H**	**H**	**H**
CUTM1509	Developmental Biology	Theory + Practice	***6***	+2 Sc. with Biology	**H**	**H**	**H**	**L**			**H**	**H**	**H**
CUTM1510	Evolutionary Biology	Theory + Practice	***6***	+2 Sc. with Biology	**H**	**H**	**M**	**L**			**H**	**H**	**H**
CUTM1182/ **CUTM1010**	English/ Environmental Science	Theory	***3***	+2 Sc.	**H**	**H**	**M**	**L**			**H**	**H**	**H**

B.Sc. (Zoology) Syllabus

(ThreeYears Programme)

School of Applied Sciences

Centurion University of Technology & Management

2021

CHOICE BASED CREDIT SYSTEM IN B.Sc. (Honours)

Semester	Basket-1	Basket-2	Basket -3	Basket-4	Basket-5	Semester wise cumulative credits
Semester	**Core**	**Ability Enhancement**	**Domain**	**Generic Elective**	**Skill**	
I	C 1 C 2	Environmental Science	Domain Courses of Minimum	G - 1	At least 04 skill courses of 16	Minimum 24 Credits

		(02 Credit)	26 credits upto maximum of 36 credits.		credits	
II	C 3 C 4	JOB Readiness (English) (06 Credit)		G - 2		Minimum 24 Credits
III	C 5 C 6 C 7			G - 3		Minimum 24 Credits
IV	C 8 C 9 C 10			G - 4		Minimum 24 Credits
V	C 11 C 12					Minimum 24 Credits
VI	C 13 C 14					Minimum 24 Credits
					Total Credits	**Minimum 140**
* A student can opt more number of **Domain /GE courses** up to a maximum of 20 credits over the period of six semesters						**Maximum 160**

COURSE STRUCTURE

Semester – I

Sl.No.	Code	Subject Name	T-T-P	Credit
01	CUTM1016	Job Readiness	0-0-6	6
02	CUTM1010	Environmental Science	0-2-0	2
03	CUTM1497	Non-Chordates I	3-1-2	6
04	CUTM1499	Principles of Ecology	3-1-2	6
05	GE-1@	Inter Disciplinary Subject	3-1-2	6
			TOTAL	**26**

Semester – II

Sl.No.	Code	Subject Name	T-T-P	Credit
01	CUTM1016	Job Readiness	0-0-6	6
02	CUTM1010	Environmental Science	0-2-0	2
03	CUTM1498	Non-Chordates II	3-1-2	6
04	CUTM1500	Cell Biology	3-1-2	6
05	GE-2@	Inter Disciplinary Subject	3-1-2	6
			TOTAL	**26**

Note: @Generic Elective Subjects to be chosen from discipline other than Zoology

Semester – III

Sl.No.	Code	Subject Name	T-T-P	Credit
01	SEC-1#	Skill		4
02	CUTM1501	Diversity of Chordates	3-1-2	6
03	CUTM1502	Physiology: Controlling and Coordinating Systems	3-1-2	6
04	CUTM1503	Fundamentals of Biochemistry	3-1-2	6
05	GE-3@	Inter Disciplinary Subject	3-1-2	6
			TOTAL	**28**

Semester – IV

Sl.No.	Code	Subject Name	T-T-P	Credit
01	SEC -2#	Skill		4
02	CUTM1504	Comparative Anatomy of Vertebrates	3-1-2	6
03	CUTM1505	Physiology: Life Sustaining Systems	3-1-2	6
04	CUTM1506	Biochemistry of Metabolic Processes	3-1-2	6
05	GE-4@	Inter Disciplinary Subject	3-1-2	6
			TOTAL	**28**

Note: # Any two Skill Enhancement Courses to be chosen.

Semester –V

Sl.No.	Code	Subject Name	T-T-P	Credit
01	CUTM1507	Molecular Biology	3-1-2	6
02	CUTM1510	Evolutionary Biology	3-1-2	6
03	Domain			
04	Domain			
			TOTAL	**12**

Semester –VI

Sl.No.	Code	Subject Name	T-T-P	Credit

01	CUTM1509	Developmental Biology	3-1-2	6
02	CUTM1508	Principle of Genetics	3-1-2	6
03	Domain			
04	Domain			
			TOTAL	**12**

Course Outline for BSc Courses

NON CHORDATES-I:PROTISTS TO PSEUDOCOELOMATES

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1497	Non – Chordates-I-protists to pseudocoelomates	3-2-1	

Objective

Key points: *Briefly explain why the course is to be studied. Specify who should study the course and requirement of prior knowledge and skill, if any.*

- To have in depth knowledge about invertebrates of different phyla.
- To understand the taxonomic position of Protozoa to Helminthes.
- To understand the body organization and general characteristics of animals belonging to

different phylum ranging from unicellular to multicellular organization.

Learning outcome

Key points*: State clearly what knowledge and skill a student is expected to learn at the end of the course and will be able to apply.*

- Students would be able to represent invertebrates of different categories which affects the ecosystem in various ways.
- Students will be able to describe the unique character of Protozoa ,Porifera, Coelenterata and Helminthes.
- Students will understand the life functions and the ecological role of animals belonging to different phyla .
- Student will get information regarding the diversity of the animals belonging to different phylums ranging from unicellular to multicellular organization.

Course content

Module- I - General characteristics and classification of kingdom Protista (06H)

Protista, Parazoa and Metazoa :General characteristics and Classification up to classes, Study of Euglena, Amoeba and Paramecium,Life cycle and pathogenicity of Plasmodium vivax and Entamoeba histolytica.

Module- II- General characteristics ofMetazoa (05H)

Locomotion and Reproduction in Protista , Evolution of symmetry and segmentation of Metazoa.

Module- III- Porifera (6 H)

Porifera: General characteristics and Classification up to classes, Canal system and spicules in sponges.

Module- IV - Coelenterates (6 H)

Cnidaria: General characteristics and Classification up to classes, Metagenesis in Obelia Polymorphism in Cnidaria, Corals and coral reefs.

Module- V- Ctenophora (5 H)

Ctenophora: General characteristics and Evolutionary significance, General characteristics and Evolutionary significance.

Module- VI- Platyhelminthes (6H)

Platyhelminthes: General characteristics and Classification up to classes, Life cycle and pathogenicity of *Fasciola hepatica* and *Taenia solium.*

Module-VII - Nemathelminthes (6H)

Nemathelminthes: General characteristics and Classification up to classes,Life cycle, and pathogenicity of Ascaris lumbricoides and Wuchereriabancrofti, Parasitic adaptations in helminthes

PRACTICE :

1. Study of whole mount of Euglena, Amoeba and Paramecium.
2. Study of Permanent slides of Binary fission and Conjugation in Paramecium
3. Study of Obelia, Physalia, Millepora, Aurelia, Tubipora
4. Study of Corallium, Alcyonium, Gorgonia, Metridium
5. Study of Museum specimen of Pennatula, Fungia, Meandrina, Madrepora and ctenophore.
6. Study of adult Fasciola hepatica, Taenia solium and their life cycles (Slides/microphotographs)
7. Study of adult *Ascaris lumbricoides* and its life stages (Slides/micro-photographs).
8. Study of adult *Wuchereriabancroftii* and its life stages (Slides/micro-photographs).
9. To submit a Project Report on any related topic on life cycles/coral/ coral reefs**.**

10. Study of Sycon (T.S. and L.S.), Hyalonema, Euplectella, Spongilla
11. Examination of pond water collected from different places for diversity in protest.

Text Books:

- Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders

Reference Books:

- International Edition. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
- Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson.

Non Chordates-II :Coelomates

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1498	Non – Chordates-II: Coelomates	3-2-1	

Objective

Key points:*Briefly explain why the course is to be studied. Specify who should study the course and requirement of prior knowledge and skill, if any.*

- To have in depth knowledge about invertebrates of different phyla.
- To understand the taxonomic position of Annelida to Echinodermata.
- To understand the body organization and general characteristics of animals belonging to different phylums .

Learning outcome

Key points*: State clearly what knowledge and skill a student is expected tolearn at the end of the course and will be able to apply.*

- Students would be able to represent invertebrates of different categories which affect the ecosystem in various ways.
- Students will be able to describe the unique characters of Annelida , Arthropoda, Mollusca and Echinodermata.
- Students will be able to recognize the life functions and the ecological role of the animals belonging to different phylum.
- Students will get information regarding the diversity of the animals belonging to different phylums on the basis of their habit and habitat and body organization.

Course content

Module-I- Introduction to Coelomates- (3h)
Evolution of coelom and metamerism

Module-II- Annelida: (5h)
General characteristics and Classification up to classes, Excretion in Annelida

Module-III- Arthropoda: (4h)
General characteristics and Classification up to classes, Vision and Respiration in Arthropoda, Metamorphosis in Insects, Social life in bees and termites.

Module-IV- Onychophora:(3h)
General characteristics and Evolutionary significance of Onychophora.

Module-V - Mollusca:- (8 h)
General characteristics and Classification up to classes, Respiration in Mollusca,Torsion and detorsion in Gastropoda, Pearl formation in bivalves, Evolutionary significance of trochophore larva.

Module- VI-Echinodermata (4h)
General characteristics and Classification up to classes, Water-vascular system in Asteroidea

Module-VII -Developmental aspects of Echinoderms (4h)
Larval forms in Echinodermata, Affinities with Chordates.

Practice

1. Study of museum specimen belonging to phylum Annelida Earthworm, Nereis, Sabella , Leech and Aphrodite.
2. Study of digestive system of Earthworm.
3. Study of septal nephridia and pharyngeal nephridia of Earthworm
4. Study of museum specimen belonging to phylum Arthropoda Cockroach, Honeybee, Prawn Peripatus, Balanus
5. Study of mouth parts of Cockroach.
6. Study of digestive system of Cockroach (Dissection)
7. Study of nervous system of Cockroach (Dissection)

8. Study of whole mount of mouth parts of Cockroach
9. Study of museum specimen belonging to phylum Mollusca Snail , Octopus, Sepia , Chiton, Helix, Pila
10. Study of museum specimen belonging to phylum Echinodermata : Starfish, Antedon, Echinus, Ophiura

Text Books:

Ruppert and Barnes, R.D. (2006). Invertebrate Zoology, VIII Edition. Holt Saunders International Edition

Reference Books:

1. Barnes, R.S.K., Calow, P., Olive, P. J. W., Golding, D.W. and Spicer, J.I. (2002). TheInvertebrates: A New Synthesis, III Edition, Blackwell Science
2. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson

Developmental Biology

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1509	Developmental Biology	3-2-1	

Objective

Key points:*Briefly explain why the course is to be studied. Specify who should study the course and requirement of prior knowledge and skill, if any.*

- The course is so designed for acquiring knowledge to know the process of reproduction and the development of embryo.
- The objective of this course is to provide a comprehensive understanding of the concepts of early animal development.
- Students taking this course must develop a critical appreciation of methodologies specifically used to study the process of embryonic development in animals.

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Learning outcome

Key points*: State clearly what knowledge and skill a student is expected tolearn at the end of the course and will be able to apply.*

- Students will get the knowledge about the reproductive and development processes and can apply the acquired knowledge for higher study.
- This course will provide a comprehensive understanding of the concepts of early animal development.

- Students will be able to predict the lineage outcome of transplanting mesodermal cell populations from anterior heart fields to posterior to presomitic tail bud.

Course Outline

Module -I- Historical perspective and basic concepts (4h)

Historical perspective and basic concepts: Phases of development, Cell-Cell interaction, Pattern development, Differentiation and growth, Differential gene expression, Cytoplasmic determinants and asymmetric cell division.

Module-II- Various Developmental aspects (4h)

Early Embryonic Development, Gametogenesis, Spermatogenesis, Oogenesis and Types of egg, Egg Membranes.

Module-III- Fertilization (5 h)

Fertilization (External and Internal), Changes in gametes, Blocks to polyspermy, Planes and patterns of cleavage.

Module - IV- Fate Maps (4h)

Fate maps (including Techniques), Early development of frog up to gastrulation, Early development of chick up to gastrulation, Embryonic induction and Organisers.

Module -V- Embryonic development (5h)

Late Embryonic Development: Fate of Germ Layers, Extra-embryonic membranes in birds, Implantation of embryo in humans, Placenta (Structure, types and functions of placenta), Post Embryonic Development. Metamorphosis: Changes, hormonal regulations in amphibians and insects.

Module-VI- Regeneration (3h)

Regeneration: Modes of regeneration, epimorphosis, morphallaxis and compensatory regeneration (with one example each).

Module- VII- Ageing (5h)

Ageing: Concepts and Theories, Implications of Developmental Biology Teratogenesis: Teratogenic agents and their effects on embryonic, development, In vitro fertilization ,Concept of Stem cell, Amniocentesis

PRACTICE

1. Study of whole mounts and sections of developmental stages of frog through permanent slides: Cleavage stages, blastula, gastrula
2. Study of whole mounts and sections of developmental stages of frog through permanent slides: neurula, tail-bud stage,tadpole (external and internal gill stages).
3. Study of T.S of Testis , Semen sample , Graffian follicle(Mature follicle about to release an ovum) and corpus luteum through permanent slides.
4. Study of whole mounts of developmental stages of chick through permanent slides: Primitive streak (13 and 18 hours).
5. Study of Whole mounts of chick embryo 21, 24, 28, 33, 36, 48, 72, and 96 hours of incubation.
6. Study of the developmental stages and life cycle of Drosophila from stock culture.
7. Study of different sections of placenta (photomicropgraph/ slides)

8. Project report on Drosophila culture/chick embryo development

Text Books:

Verma, Agrawal, 2007,Embryology,Rostogi Publication

Reference Books:

- Gilbert, S. F. (2010). Developmental Biology, IX Edition, Sinauer Associates,Inc., Publishers, Sunderland, Massachusetts, USA
- Balinsky B. I. and Fabian B. C. (1981). An Introduction to Embryology, V Edition, International Thompson Computer Press
- Carlson, R. F. Patten's Foundations of Embryology Kalthoff (2008). Analysis of Biological Development, II Edition, McGraw-Hill Publishers
- Lewis Wolpert (2002). Principles of Development. II Edition, Oxford University Press CBCS

Principles of Genetics

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1508	Principles of Genetics	3-2-1	

Objective

- Genetics is offered as a core course that provides fundamental knowledge of inheritance and evolution of the concept of gene with study of genetic diseases.
- This course provides an overview of genetics starting from the work of Mendel to the current understanding of various phenomena like recombination, transposition, sex determination and mutations.
- Describe the mechanisms governing Mendelian inheritance, gene interactions and gene expression.

Learning outcome

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- The primary outcome of studying this course will be the gaining of knowledge of the basic principles of inheritance and knowledge of the principles of genetics is essential for a deeper understanding of the varied branches of the biological.
- Knowledge of the mechanisms of mutations and the causative agents will lead to an increase in an awareness of the students about the harmful impact of various chemicals and drugs being used in day to day life.
- Student Will be able to make a strategy to manipulate genetic structure of an organism for the improvement in any trait or its well being based on the techniques learned during this course.

Course Outline

Module-I

Mendelian Genetics and its Extension: Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Sex-linked, sex-influenced and sex-limited characters inheritance.

Module-II

Linkage, Crossing Over and Chromosomal Mapping: Linkage, Crossing Over and Chromosomal Mapping, Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing over including models of recombination. Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and coincidence, Somatic cell hybridization.

Module- III

Mutations: Types of chromosomal aberrations (Classification, figures and with one suitable example of each), Molecular basis of mutations in relation to UV light and chemical mutagens; Detection of mutations: CLB method, attached X method.

Module-IV

Sex Determination: Genetic and environmental basis of sex determination; Chromosomal mechanisms of sex determination in *Drosophila* and Man.

Module-V

Extra-chromosomal Inheritance. Criteria for extra-chromosomal inheritance, Antibiotic resistance in Chlamydomonas, Mitochondrial mutations in Saccharomyces, Infective heredity in Paramecium and Maternal effects.

Module-VI

Polygenic Inheritance: Polygenic inheritance with suitable examples; simple numericals based on it. Recombination in Bacteria and Viruses, Conjugation, Transformation, Bacteriophage, Transduction.

Module-VII

Transposons: Complementation Test in Transposable Genetic Elements: Transposons in bacteria, Ac-Ds elements in maize and P elements In Drosophila, Transposons in humans.

Principles of Genetics Lab Practice

Experiments:

1. To study the collection of*Drosophilla*.
2. Study of *Drosophilla*under compoundmicroscope.
3. Chi-square analyses usingseeds/beads/*Drosophila*.
4. Linkage maps based on data from conjugation, transformation andtransduction.
5. Linkage maps based on data from *Drosophila*crosses.
6. Study of karyotype (*Human orDrosophilla*).
7. Pedigree analysis of some human inheritedtraits.
8. **Study of genetics of mice.**
9. **Study of genetics of chicken**
10. **Linkage maps based on data from Trihybrid cross.**
11. Morphological study of chromosome by squashing method.
12. Sex Determination: Genetic and environmental basis of sex determination

Text Books andReference Books:

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. WileyIndia
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and SonsInc
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics. X Edition. Benjamin Cummings
- Russell, P. J. (2009). Genetics- A Molecular Approach. IIIEdition.
- BenjaminCummings
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll,S.B.
- Introduction to Genetic Analysis. IX Edition. W. H. Freeman andCo
- Fletcher H. and Hickey I. (2015). Genetics. IV Edition. GS, Taylor andFrancis Group, New York and London. CBCS Undergraduate Program in Zoology2015
- Pierce B. A. (2012). *Genetics-A conceptual approach.* IV Edition. W. H. Freeman and Company
- Russell, P. J. (2009). *Genetics- A Molecular Approach.*III Edition. Benjamin Cummings
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. (2007) *Introduction to Genetic Analysis*. IX Edition. W. H. Freeman and Co.

Animal Physiology- Life sustaining system

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1505	Animal Physiology- Life sustaining system	3-2-1	

Objective

- To know the functioning of various organs and their inter relationship
- To facilitate students about the various metabolic processes

Learning outcome

- Students would be able to know and compare the different anatomical aspect of various organisms
- Students will acquire the knowledge of functioning of different body parts
- The students can apply the acquired knowledge for higher study

Course Outline

Module- I

Physiology of Digestion: Structural organization of gastrointestinal tract and associated glands, Mechanical and chemical digestion of food, Absorptions of carbohydrates, lipids, proteins, water, minerals and vitamins, Hormonal control of secretion of enzymes in Gastrointestinal tract

Module- II

Physiology of Respiration: Mechanism of respiration & Pulmonary ventilation, Respiratory volumes and capacities, Transport of oxygen and carbon dioxide in blood, Respiratory pigments and Control of respiration, Dissociation curves and the factors influencing it, Carbon monoxide poisoning

Module- III

Physiology of Heart: Structure of mammalian heart, Coronary circulation, Structure and working of conducting myocardial fibers, Origin and conduction of cardiac impulses

Module- IV

Physiology of Heart: Cardiac cycle, Cardiac output and its regulation, Frank-Starling Law of the heart, Nervous and chemical regulation of heart rate, Electrocardiogrm-Blood pressure and its regulation

Module- V

Renal Physiology: Structure of kidney and its function, Structure and function of Nephron, Mechanism of urine formation, Regulation of water balance, Regulation of acid-base balance, Counter-Current theory

Module-VI

Adaptive physiology: Adaptive physiology, Adaptation of reptile and aves to water, space, land, Adaptation of other species to water, space, land

Module-VII

Reproductive System: Physiology of male reproduction, Physiology of female reproduction, Puberty and Methods of contraception in male and female

Physiology: Life sustaining system Lab (Practice)

Experiments

1. Histological study of gastrointestinal tract
2. Study of Histology of trachea and lung
3. Estimation of haemoglobin using Sahli's haemoglobinometer
4. Enumeration of R.B.C.&W.B.C. using haemocytometer
5. Determination of ABO Blood group
6. Preparation of haemin and haemochromogen crystals
7. Recording of blood pressure using sphygmomanometer
8. Histological study of kidney(Human)
9. Histological study of nephron
10. Histological study of testis(mammal)
11. Histological study of ovary(mammal)
12. Histological study of artery & vein

E-materials:

Online Source:
https://www.udemy.com/course/humanphysiology/, https://www.coursera.org/specializations/anatomy , https://www.edx.org/course/anatomy-cardiovascular-urinary-and-respiratory-sys

Text Books:

1. Guyton's Physiology

Reference Books:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,
3. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
4. Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills

Diversity of Chordates

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1501	**Diversity of Chordates**	**3-2-1**	

Objective

- To understand about aware of higher organisms and their taxonomy to correlate the evolutionary trend in organisms.
- To know students about identify the diversification of species of chordate world

Learning outcome

- An in depth study for better application of mind to further approach towards biology.
- Students will be able to conduct research work efficiently.

Course Outline

Module- I

Introduction to Chordates: General characteristics and classification of chordates, General characteristics of Protochordates and Hemichordata, General characteristics of Urochordata and Cephalochordata, Study of larval forms in Protochordates, Retrogressive metamorphosis in Urochordata

Module- II

Origin of Chordata: Origin of chordates-Dipleurula concept & Echinoderm theory, Advanced features of vertebrates over Protochordata

Agnantha: General characteristics and classification of cyclostomes, Classification of cyclostomes up to class, Characteristics of Petromyzon, Myxin

Module- III

Pisces: General characteristics of Chondrichthyes and Osteichthyes, Classification up to order Migration, Osmoregulation in fishes, Parental care in fishes

Module- IV

Amphibia: Origin of Tetrapoda (Evolution of terrestrial ectotherms), General characteristics and classification of amphibia up to order, Parental care in Amphibians & Neoteny

Module- V

Reptilia: General characteristics and Classification of Reptilia, Affinities of *Sphenodon*, Poison apparatus and biting mechanismin snakes, **A**daptive charactecteristics of crocodile

Module-VI

Aves:General characteristics and classification (up to order Archaeopteryx), Principles and aerodynamics of flight, Flight adaptations, Migration in birds

Module-VII

Mammals: Affinities of Prototheria, Adaptive radiate: Zoogeographical realm, Theories pertaining to distribution of animals, Plate tectonic and Continental drift theory, Distribution of vertebrates in different realms

Diversity of Chordates Lab (Practice)

Experiments:

1. Museum specimen on Protochordata- Balanoglossus, Herdmania, Branchiostoma
2. Sections of Balanoglossus through proboscis and branchio-genital regions
3. Museum specimen on Petromyzon, Myxine
4. Museum specimen on : Fishes-Scoliodon, Pristis, Torpedo, Chimaera
5. Museum specimen on Labeo, Exocoetus, Echeneis, Anguilla, Hippocampus, Tetrodon/ Diodon, Anabas
6. Museum specimen on-Amphibia: Ichthyophis/Ureotyphlus, Necturus
7. Bufo, Hyla, Alytes, Salamandra
8. Museum specimen on Reptilia Hemidactylus, Varanus, Uromastix, Chamaeleon, Draco
9. Draco, Vipera, Naja, Hydrophis (Identification of poisonous and non-poisonous snakes)
10. Aves :Study of two common birds from different orders
11. Aves :Study of types beaks and claws
12. Mammalia Sorex, Bat (Insectivorous and Frugivorous), Funambulus, Loris, Herpestes, Erinaceous

References

Text Books:

- Kotpal.R.L, (2007)Modern Text Book of Zoology,Rastogi Publication

Reference Books:

- Young, J. Z.(2004). The Life of Vertebrates. III Edition. Oxford University press. Pough H. Vertebrate life, VIII Edition, Pearson International.
- Darlington P.J. The Geographical Distribution of Animals, R.E. Krieger Pub Co.Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers Inc.

Biochemistry of Metabolic Processes

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1506	**Biochemistry of Metabolic Processes**	**3-2-1**	

Objective

- To know the functioning of various organs and their inter relationship
- To understand about the various metabolic processes

Learning outcome

- Students will acquire the knowledge of functioning of different body parts
- The students can apply the acquired knowledge for higher study

Module- I

Overview of Metabolism: Stages of Metabolism (Catabolism *vs* Anabolism), Compartmentalization of metabolic pathways, ATP as "Energy Currency of cell" & use of reducing equivalents and cofactors, Intermediary metabolism and regulatory mechanisms.

Module- II

Carbohydrate Metabolism: Sequence of reactions and regulation of glycolysis & Gluconeogenesis, Citric acid cycle and significance, Phosphate Pentose Pathway (Role and significance), Glycogenesis, Glycogenolysis.

Module- III

Lipid Metabolism: β-oxidation of saturated fatty acids with even & odd number of carbon atoms, Omega -oxidation of even & odd number of saturated fatty acids, Biosynthesis of palmitic acid, Metaboliosm of unsaturated fatty acid, Ketogensis, Metabolic Fuel Utilization & Regulation of fatty acid

Module- IV

Protein Metabolism: Catabolism of amino acids, Transamination, Deamination, Protein Metabolism

Module- V

Fate of carbon skeleton: Urea cycle, Fate of C-skeleton of Glucogenic & Ketogenic amino acids, Regulation of Urea cycle, Role of mitochondria

Module- VI

Oxidative Phosphorylation: Oxidative Phosphorylation, Redox systems & Coupled reactions, Review of mitochondrial respiratory chain, Shuttle systems & Membrane transporters

Module- VII

Inhibitors and Uncouplers: Inhibitors of Electron Transport System, Uncouplers of Electron Transport System, Activity of Enzyme

Biochemistry of Metabolic Process Lab (Practice)

Experiments:

1. To demonstrate the effect of temperature on enzyme activity
2. To estimate the carbohydrate content of supplied tissue by Spectrophotometry method
3. To estimate the glycogen content of supplied tissue by colorimeter method
4. To estimate the lipid content from the given sample
5. To estimate the protein content of supplied tissue by colorimeter method
6. Estimation of total protein content in the given sample by Lowry's /Barfoed's Method
7. To estimate amino acids from a mixture by using chromatography (paper/Thin layer)
8. To estimate amino acids from a mixture by using chromatography (paper/Thin layer)
9. Determination of SGPT in given sample by using available kit.(Chick/Goat Serum)
10. Estimation of known and unknown protein
11. Preparation of Standard Curve of Bovine serum Albumin
12. Study the enzymatic activity of Trypsin and Lipase

1. Reference

Text Books:

1. Cox, M.M and NelsoEXT n, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.

Reference Books:

1. Cox, M.M and NelsoEXT n, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition,

2. W.H. Freeman and Co., New York.

3. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.rs

4. Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

Principles of Ecology

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1499	**Principles of Ecology**	**3-2-1**	

2. Objective

Obtain knowledge about the Ecosystem and their functioning, so that they will be crusader of environmental sustainability.

3. Learning outcome

Students will acquire knowledge of intricate relationship of main and environment.

Course Outline

Module- I(10Hrs)

Introduction to Ecology: History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors.

Module- II (7Hrs)

Population: Unitary and Modular populations Unique and group attributes of population: Density, nasality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion. Exponential and logistic growth, equation and patterns, r and K strategies .

Module-III (8Hrs)

Population regulation - density-dependent and independent factors Population interactions, Gause's Principle with laboratory and field examples, Lotka-Volterra equation for competition and Predation, functional and numerical Responses.

Module-IV (8Hrs)

Community: Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Ecotone and edge effect; Ecological succession with one Example, Theories pertaining to climax community.

Module- V (5Hrs)

Ecosystem: Types of ecosystems with one example in detail, Food chain: Detritus and Grazing food chains, Linear and Y-shaped food chains, Food web. B.Sc. (Zoology) Curriculum School of Applied Sciences

Module- VI (5Hrs)

Energy flow through the ecosystem, Ecological pyramids and Ecological efficiencies .

Module- VII (5Hrs)

Nutrient and biogeochemical cycle with one example of Nitrogen cycle, Human modified ecosystem Applied Ecology: Ecology in Wildlife Conservation and Management Principles of Ecology

PRACTICE

1. Study of life tables and plotting of survivorship curves of different types from the hypothetical/real data provided.

2. Determination of population density in a natural/hypothetical community by quadrate method and calculation of Shannon-Weiner diversity index for the same community

3.Study of an aquatic ecosystem: Phytoplankton and zooplankton, Measurement of area, temperature, turbidity/penetration of light, determination of pH, and Dissolved Oxygen content.

4. (Winkler's method), Chemical Oxygen Demand and free CO2.

5. Report on a visit to National Park/Biodiversity Park/Wild life sanctuary.

Text Books :

Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole

Reference Books:

- Colinvaux, P. A. (1993). Ecology. II Edition.
- Wiley, John and Sons, Inc. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
- Robert Leo Smith Ecology and field biology(2000) Harper and Row publisher Ricklefs, R.E.

Cell Biology

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1500	**Cell Biology**	**3-2-1**	

Objective

- To make the student understand all type of cells and cellular components, and how cell works in healthy and diseased states

Learning outcome

Students will understand

- the structures and purposes of basic components of prokaryotic and eukaryotic cells.
- how the cellular components are organized and perform specific functions.
- the cellular components underlying mitotic and meiotic cell division.
- the cellular communication and signal transduction takes place in cells

Course outline

Module- 1 (11 Hrs)

Overview of Cells; Cell theory; Prokaryotic and Eukaryotic cells; Virus; Viroids; Mycoplasma; Prions
Assignment 1: Prions and associated diseases

Module- 2 (10 Hrs)

Plasma Membrane: Various models of plasma membrane structure; Transport across membranes: Active and Passive transport, Facilitated Transport; Cell junctions: Tight junctions, Gap junctions, Desmosomes, Hemidesmosomes

Module- 3 (6 Hrs)

Endomembrane System: Structure and Functions of Endoplasmic Reticulum, Golgi Apparatus, Lysosomes

Module- 4 (8 Hrs)

Mitochondria: Structure and function, Semi-autonomous nature, Endosymbiotic hypothesis, Chemi-osmotic hypothesis, Mitochondrial electron transport chain; Peroxisomes: structure and function.

Module- 5 (10 Hrs)

Cytoskeleton: Structure and Functions: Microtubules, Microfilaments and Intermediate filaments; Nucleus: Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleolus, Chromatin: Euchromatin and Hetrochromatin and packaging (nucleosome)

Module- 6 (10 Hrs)
Cell Division and Cell cycle: Mitosis, Meiosis; Regulation of cell cycle

Module- 7 (10 Hrs)
Cell Signaling: Overview of cell signaling, signaling molecules and receptors, GPCR, Second messengers, Role of second messenger (cAMP) in cell signaling, Activation of gene transcription by GPCR

PRACTICE

1. Cell Organization and Sub Cellular Structure Studies
2. Gram's staining technique for visualization of prokaryotic cells
3. Counting of cells using Hemocytometer
4. Study of cell attachment
5. Study of cell proliferation
6. Isolation of Endoplasmic Reticulum
7. Isolation and microscopic study of mitochondria
8. Study the presence of Barr body in human female blood cells/cheek cell
9. Study of Actin Assembly
10. Study various stages of mitosis using permanent slides
11. Study various stages of meiosis using permanent slides
12. Maintenance of mammalian cell lines.

Text Books:

1. Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments. VI John Wiley and Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins

Reference Books:

1. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. V ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.

2. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San

3. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). Molecular Biology of the Cell, V Edition, Garland publishing Inc., New York and London

Fundamentals of Biochemistry

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1503	**Fundamentals of Biochemistry**	**3-2-1**	

Objective

This course will make students to know about the biochemical features in organisms and self.

Learning outcome

- An in depth study for better application of mind to further approach towards biology.
- This course would make students well equipped with the process of body and its functioning.

Course outline

Module-I

Carbohydrates: Structure and Biological importance of :Monosaccharides,Disaccharides,Polysaccharides and Glycoconjugates

Module-II

Lipids**:** Structure and Significance: Physiologically important saturated and unsaturated fatty acids,Tri-acylglycerols,Phospholipids,Glycolipids,Steroids

Module-III

Proteins: Amino acids: Structure, Classification and General properties of α-amino acids;Physiological importance of essential and non-essential α-amino acidsProteins:Bonds stabilizing protein structure and Denaturation;Levels of organization in proteins;Introduction to simple and conjugate proteins

Module-IV

Immunoglobulins: Basic Structure, Classes and Function, Antigenic Determinants.

Nucleic Acids: Structure: Purines and pyrimidines, Nucleosides, Nucleotides, Nucleic acids;Cot Curves: Base pairing, Denaturation and Renaturation of DNA;Types of DNA and RNA;Complementarity of DNA;Hpyo-Hyperchromaticity of DNA.

Module-V

Enzymes: Nomenclature and classification;Cofactors;Specificity of enzyme action;Isozymes;Mechanism of enzyme action.

Module-VI

Enzyme kinetics;Factors affecting rate of enzyme-catalyzed reactions;Derivation of Michaelis-Menten equation;Concept of Km and Vmax, and Lineweaver-Burk plot;Multi- substrate reactions.

Module-VII

Enzyme inhibition;Allosteric enzymes and their kinetics;Regulation of enzyme action.

PRACTICE

1. Qualitative tests of functional groups in carbohydrates
2. Qualitative tests of functional groups in lipids.
3. Qualitative tests of functional groups in protein
4. Separation of amino acid using Paper Chromatography.
5. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter(Diphenylamine reagent) or spectrophotometer (A260 measurement)
6. Action of salivary amylase under optimum conditions.
7. Effect of different pH on salivary amylase activity.
8. Demonstration of proteins separation by SDS-PAGE.
9. Effect of different Temperature on salivary amylase activity.
10. Effect of inhibitor on salivary amylase activity

Text Books:

Cox, M.M and NelsoEXT n, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition, W.H. Freeman and Co., New York.

Reference Books:

1. Cox, M.M and NelsoEXT n, D.L. (2008). *Lehninger's Principles of Biochemistry*, V Edition,
2. W.H. Freeman and Co., New York.
3. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2007). *Biochemistry*, VI Edition, W.H. Freeman and Co., New York.rs
4. Sources of Environmental hazards, hazard identification and accounting, fate of toxic and persistent substances in the environment, dose Response Evaluation, exposure Assessment.

Animal Physiology: Controlling and Coordinating System

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1502	**Animal Physiology : Controlling and Coordinating System**	**3-2-1**	

Objective

To obtain Knowledge about the functioning of various system of organisms and their interrelationship for well-coordinated function.

Learning outcome

- An in depth study for better application of mind to further approach towards biology.
- This course would make students well equipped with the process of body and its functioning.

Course outline

Module-I Tissues

Structure, location, classification and functions of epithelial tissue, Structure, location, classification and functions of connective tissue ,Structure, location, classification and functions of muscular tissue,Structure, location, classification and functions of nervous tissue & Structure and types of bones and cartilages.

Module-II Bone and Cartilage & Muscle:

Ossification, bone growth and resorption ,Histology of different types of muscle, Ultra structure of skeletal muscle, Chemical basis of muscle contraction;

Module-III Blood:

Components of blood and their functions,Structure and functions of haemoglobin, Haemostasis,Blood clotting system,Kallikrein-Kinninogen system,HaemopoiesisBlood groups: Rh factor, ABO and MN.

Module-IV Nervous System :

Organization of the Brain,Structure of neuron,Resting membrane potential,Origin of action potential and its propagation across the myelinated and unmyelinated nerve fibers,Types of synapse. Synaptic transmission and, Neuromuscular junction,Reflex action and its types - reflex arc, Physiology of hearing and vision.

Module-V Endocrine System I:

Classification of hormones,Histology& mechanism of action of pituitary gland,Histology& mechanism of action of thyroid gland,Histology& mechanism of action of parathyroid gland.

Module-VI Endocrine System II:

Histology & mechanism of action of pancrease**,**Histology& mechanism of action of pineal gland,

Histology & mechanism of action of gonadal hormone,Regulation of their secretion; Mode of hormone action.

Module-VII Neuroendocrine gland

Hypothalamus (neuroendocrine gland), Principal nuclei involved in neuroendocrine control of anterior pituitary and endocrine system, Role of hormone in growth.

PRACTICE

1. Preparation of temporary mounts: Squamous epithelium, Striated muscle fibres and nerve cells
2. Preparation of permanent slide of liver/skeletal muscle/any other tissue of given specimen.
3. Determination of blood groups
4. Preparation of blood smear from blood cells.
5. Estimation of haemoglobin using Sahli's haemoglobinometer
6. Demonstration of the unconditioned reflex action (Deep tendon reflex such as knee jerk reflex)
7. Anatomical model of eye .

8. Anatomical model of ear .
9. Study of permanent slides of various Mammalian tissues
10. Study of slides of endocrine glands
11. Identification of histological slides of lymphoid tissue
12. Preparation of permanent slide of any five mammalian (goat/chick) tissues by microtomy

.Text Books:

1. Agrawal,V.K,Textbook of Animal Physiology,S.Chand Publication
2. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition.
3. Hercourt Asia PTE Ltd. /W.B. Saunders Company.

Reference Books:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.

Comparative Anatomy of Vertebrates

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1504	**Comparative Anatomy of Vertebrates**	**3-2-1**	

Objective

- To make a comparative study of the anatomy of an organ in different groups of vertebrates
- To derive the evolutionary significance from it
- Tto understand as to why an organ evolved the way it is present now.

Learning outcome

- Students recognize vertebrate structural principles by studying all body systems of vertebrates in an evolutionary perspective.
- Compare and contrast the anatomical systems of different vertebrates and identifycommon traits across species and groups.

Course outline

Module-I :Integumentary System

Introduction to integuments, General features of integuments Dermis and Epidermis, Derivatives of integuments scales nails hooves , Horn antles baleen dermal armour , Dermal derivatives

Module-IISkeletal System

Introduction to skeletolsystem, Axial Skeleton, Appendicular skeleton, Jaw suspensorium , Visceral arches

Module-III: Digestive System

Introduction to digestive system, Alimentary canal, Associate glands , Dentition

Module-IV Respiratory System

Introduction to Respiratory system, Brief account of Gills , Brief account of lungs , Brief account of air sac , Brief account of swim bladders

Module-V Circulatory System

Introduction to Circulatory system, General plan of circulation, Evolution of heart , aortic arches

Module-VI: Urinogenital System

Introduction to Urinogenital system , Succession of kidney , Evolution of urinogenital duct , Types of mammalian urinogenital system

Module-VII Nervous System

Introduction to Nervous system ,Comparative account of brain, Autonomic nervous system, Spinal cord, Types of receptors

PRACTICE

1. Temporary mount of external scales in fishes (cycloid, placoid, ganoid, ctenoid)
2. Study of disarticulated skeleton of Amphibia/Reptilia/Aves/Mammal
3. Demonstration of Chick to study arterial system
4. Demonstration of Specimen
5. Demonstration of heart through video
6. Mini project&Powerpoint presentation

Text Books:

- Jordan, E. L. and Verma, P. S. (2013) Chordate Zoology (14th edition).
- Saxena, R. K. and Saxena, S. (2015) Comparative Anatomy of Vertebrates (2nd edition).

Reference Books:

- Kardong, K.V. (2005) *Vertebrates' Comparative Anatomy, Function and Evolution*. IV Edition. McGraw-Hill Higher Education.
- Kent, G.C. and Carr R.K. (2000). *Comparative Anatomy of the Vertebrates*. IX Edition. The McGraw-Hill Companies.

Online Source: https://www.youtube.com/playlist?list=PLdNTrjqdXm_T7DzT1AO_b5_6G8zEF2al_

Evolutionary Biology

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1510	**Evolutionary Biology**	**3-2-1**	

Objective

- To provide comprehensive overview of Concept of Evolution.
- To explain Origin of Life especially Prokaryotes as well as Eukaryotes in detail.
- To provide adequate information about Geological Time Scale
- To give detailed outline of Extinctions and its types.
- To impart descriptive knowledge regarding Origin and Evolution of Man.

Learning outcome

- Students understand and explain the main forces of evolution (natural selection, sexual selection, genetic drift). and the interplay among them, both over ecological and evotionary time.
- Students understand the history of life; the evolution of humans

Course outline

Module-I :Major Events in History of Life

Major Events in History of Life ,Lamarckism , Darwinism , Neo-Darwinism

Module II : Fossils
Types of fossils, Incompleteness of fossil record, Dating of fossils, Phylogeny of horse

Module III :Organic variations

Isolating Mechanisms ,Natural selection (Example: Industrial melanism) , Types of natural selection(Directional, Stabilizing, Disruptive) , 3.5Artificial selection

Module IV

Genetic Drift , Micro evolution , Biological species concept (Advantages and Limitations) , Modes of speciation (Allopatric, Sympatric)

Module V

Macro-evolutionary Principle , Darwin's Finches , Causes and effects of extinction , Biological species concept (Advantages and Limitations) , Modes of speciation (Allopatric, Sympatric)

ModuleVI : Extinction

Mass extinction , K-T extinction , Role of extinction in evolution , Origin and evolution of man, Homonid characteristics

Module VII

Phylogenetic trees **,** Multiple sequence alignment **,** constructions of phylogenetic trees

PRACTICE

1. Study of homology and analogy from suitable specimens/ pictures
2. Study of fossil evidences from plaster cast models and pictures
3. Demonstration of video
4. Mini project : Study and verification of Hardy-Weinberg Law by chi square analysis
5. Demonstration of video: Graphical representation and interpretation of data of height/ weight of a sample of 100 humans in relation to their age and sex.
6. Demonstration of role of natural selection and genetic drift in changing allele frequencies using simulation studies

Reference and Text books

- B.S. Tomar& S.P. Singh, 2000. Evolutionary biology. (Rastogi Publ.).
- Ridley, M. (2004). *Evolution*. III Edition. Blackwell Publishing
- Campbell, N. A. and Reece J. B. (2011). *Biology*. IX Edition, Pearson, Benjamin, Cummings.Douglas,
- J. Futuyma (1997). *Evolutionary Biology*. Sinauer Associates.

Molecular Biology

	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1507	**Molecular Biology**	**3-2-1**	

Objective

- This course covers the structure function, and makeup of the molecular building blocks of

prokaryotic and eukaryotic organisms.

- It focuses on the interactions and interrelationship of DNA, RNA and protein synthesis and how these interactions are regulated.

Learning outcome

- Student would understand and apply general concepts of molecular biology to specific problems
- Student would understand the biological processes such as DNA replication, transcription and translation.
- Student would understand the consequences of dysfunctioning of these processes and develop ideas for possible solutions.

Course outline

Module-I: Nucleic acids

Introduction to nucleic acids: Nucleotide and Nucleoside, Types of nucleic acids: DNA & RNA

DNA: Watson & Crick model of DNA, Different forms of DNA (A, B and Z forms). RNA: Different forms of RNA, Protein coding RNA (mRNA), Functional RNA (rRNA and tRNA), Regulatory RNA (si RNA, mi RNA, sn RNA)

Module II: DNA replication

Overview of DNA replication: Different models of DNA replication, Semi-conservative mode of DNA replication, rolling circle mode of DNA replication, Theta mode of DNA replication. Enzymes involved in DNA replication and their roles: DNA polymerases, DNA gyrase, DNA helicase, DNA ligase, Primase. Replication process: DNA replication in prokaryotes and eukaryotes

Module III: DNA mutation

Mutation: Causes of mutation and effects of mutation. Types of mutation: missense mutation, Nonsense mutation, Insertion or Deletion, Duplication, Frameshift mutation, Repeat expansion

Module IV: DNA Repair

DNA Repair: Direct repair, Excision repair, Mismatch repair, Nonhomologous end-joining, SOS response. DNA repair errors: Defects in DNA repair and its consequences.

Module V: Transcription and post transcriptional processing

Transcriptional machinery: The transcription Unit, Enzymes and transcription factors. Transcription process: Process of transcription in prokaryotes and eukaryotes. Post transcriptional processing: Processing of mRNA, Synthesis and processing of functional RNA (rRNA & tRNA). Reverse transcription: The process of synthesis of cDNA.

Module VI: Regulation of gene transcription

Transcription regulation in prokaryotes: The operon concept: The lac operon, The trp operon. Transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements. Gene silencing: Transcriptional and post-transcriptional gene silencing

Module VII: Translation and post translational processing

Component of translation and their roles: mRNA: The precursor of molecule of translation, Ribosomes: The site of protein synthesis, tRNA: the carrier molecule of translation. Translation: Process of translation in prokaryotes and eukaryotes. Post translational modifications: Co- and post-translational modifications of proteins

Molecular Biology Lab (Practice)

Experiments:

1. Isolation and spectrophotometric estimation of DNA
2. Isolation and spectrophotometric estimation of RNA
3. Visualization of DNA/RNA using agarose gel electrophoresis
4. Preparation of equilibrated phenol

5. Quantitative estimation of RNA using Orcinol reaction
6. Demonstration of DNA & RNA by MGP
7. Preparation of liquid culture medium (LB) and raise culture of E. coli
8. Preparation of solid agarose medium (LB) and raise colonies of E. coli
9. Demonstration of DNA replication, transcription and translation using Photograph, slides and/or videos.
10. Application of *in silico* tools (BIOVIA's DISCOVERY STUDIO) to study the three dimensional structure of proteins.

Text Books*:*

1. Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., &Losick, R. (2004). Molecular Biology of the Gene (International Ed.).

Reference Books:

1. Brown, T. A. (2006). *Genomes 3.* Garland Science
1. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter: Molecular Biology of the Cell, IV Edition.
2. Cooper G. M. and Robert E. Hausman R. E. The Cell: A Molecular Approach, V Edition, ASM Press and Sinauer Associates.
3. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). Cell and Molecular Biology. VIII Edition. Lippincott Williams and Wilkins, Philadelphia.
4. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
5. Lewin B. (2008). Gene XI, Jones and Bartlett

Online Source:

- *ePathsala*
- *NPTEL*

Centurion University of Technology and Management Odisha

CHOICE BASED CREDIT SYSTEM

COURSE STRUCTURE & SYLLABUS

BASKET - III

Centurion
UNIVERSITY

School of Engineering & Technology

2020

Course Structure
Basket - III

Course Code	Course Title	Credits	Course Type T+P+PJ
CUTM1017	Industrial IOT and Automation	6	3-2-1
CUTM1018	Data Analysis and Visualisation using Python	4	0-1-3
CUTM1019	Machine Learning using Python	4	1-2-1
CUTM1020	Robotic automation with ROS and C++	4	1-2-1
CUTM1021	Basics of Design Thinking	2	0-0-2
CUTM1022	System Integration with DYMOLA	2	0-0-2
CUTM1023	Smart Engineering Project (G2M)	3	0-0-3

Industrial IoT and Automation

Code	Course Title	Credit	T-P-PJ
CUTM1017	Industrial IoT and Automation	6	3-2-1

Objective

- Students will learn the new evolution in hardware, software, and data.
- While the promise of the Industrial Internet of Things (IIoT) brings many new business prospects, it also presents significant challenges ranging from technology architectural choices to security concerns.
- Students acquire upcoming Industrial Internet of Things: Roadmap to the Connected World Course offers important insights on how to overcome these challenges and thrive in this exciting space.

Learning outcome

- Discover key IIoT concepts including identification, sensors, localization, wireless protocols, data storage and security
- Explore IoT technologies, architectures, standards, and regulation
- Realize the value created by collecting, communicating, coordinating, and leveraging the data from connected devices
- Examine technological developments that will likely shape the industrial landscape in the future
- Understand how to develop and implement own IoT technologies, solutions, and applications
- At the end of the program, students will be able to understand how to develop and implement their own IoT technologies, solutions, and applications.

Course content

Module I: Introduction and Architecture (6 hours)

Theory

What is IIoT and connected world? the difference between IoT and IIoT, the web of things, architecture of IIoT.

Practice: Hardware/MATLAB

1. Simulation of RFID using Matlab/Dymola.

Module II: Communication Technologies of IIoT (10 hours)

Theory

Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus technology, wireless network communication, security issues in IIoT.

Practice:
1. Demonstration of MQTT communication using Matlab/Dymola.
2. Site visit to Apparel factory in the Bhubaneswar campus.
3. Wireless communication demonstration using Matlab/Dymola.

Module III: Visualization and Data Types of IIoT (8Hours)
Theory
HMI in an Industrial IoT world, front end EDGE devices, enterprise data for IIoT, emerging descriptive data standards for IIoT, cloud data base.

Practice:
1. Assembling the HMI for IIoT environment using Matlab/Dymola.
2. Measurement of temperature & pressure values of the process using sensors.

Module IV: Automation (8 Hours)
Theory
Automation definition, automation pyramid, field level sensors, Embedded sensors, HMI in an automation process.

Practice:
1. Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')
2. Wearable sensing for IoT (future user interfaces for IoT - new ways to control and interact with your environment)

Module V:Control & Supervisory Level of Automation (8 Hours)
Theory
Programmable logic controller (PLC), real-time control system, Supervisory Control & Data Acquisition (SCADA).

Practice:
1. Simulation of PLC to understand the control concept.
2. SCADA HMI demonstration using Matlab.
3. SCADA simulation using Matlab/Dymola.

Module VI: Planning Level & Management Level (4Hours)
Theory
Manufacturing execution system (MES), enterprise resource planning(ERP), production control.

Practice:
1. Designing MES system by using Adobe.

Projects:
1.A smart meter is an internet-capable device that measures energy.
2.Building connectioninto existing Modbus & Profibus networks.
3.Monitoring environmental conditions in an apparel factory space.
4. Predictive monitoring of CNC machine operation.

Text Books:

- The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.)(Springer Publication)
- Industrial Internet of Things: Cybermanufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat(Springer Publication)

Note: 1 credit theory=10 hrs lecture, 1 credit practice/project=12.5 hrs lab/workshop/field work in a semester

Data Analysis and Visualisation Using Python

Code	Course Title	Credit	T-P-PJ
CUTM1018	Data Analysis and Visualisation Using Python	4	0-1-3

Objective

- How to tell a story from data
- How to marshal the data for storyline
- The ability to develop visualisation to tell the story
- The focus is on analysis of data using visualisation as a tool

Learning outcome

- To create impactful visualization with good story line.

Course content

Module-I

STORY BOARD DEVELOPMENT

The objective and flow of the story to be understood through cases

Module-II

DATA READING USING PYTHON FUNCTIONS

Python libraries: Pandas, NumPy, Plotly, Matplotlib, Seaborn, Dash

Data collection from online data sources, Web scrap, data formats such as HTML, CSV, MS Excel, data compilation, arranging and reading data, data munging

Module-III

DATA VISUALSATION USING PYTHON LIBRARIES

Different graphs such as Scatterplot, Line chart, Histogram, Bar chart, Bubble chart, Heatmaps etc.

Dashboard Basics – Layout, Reporting, Infographics, Interactive components, live updating

Projects List

1. COVID 19
2. World Development Indicators

3. ERP dashboarding

4. Details of Social/ Empowerment schemes of Govt. etc.

References:

https://www.programmer-books.com/wp-content/uploads/2019/04/Python-for-Data-Analysis-2nd-Edition.pdf

https://towardsdatascience.com/data-visualization/home

Reading materials and videos available on internet on how to use ANACONDA, JUPYTER NOTEBOOK and Python Libraries

Machine Learning using Python

Code	Course Title	Credit	T-P-PJ
CUTM1019	Machine Learning using Python	4	1-2-1

Objective

- Understand the meaning, purpose, scope, stages, applications, and effects of ML.
- Explore important packages of python, such as numpy, scipy, OpenCV and scikit-learn.

Learning outcome

- Students will able to Create and incorporate ML solutions in their respective fields of study.

Course content

Module 1 – Application and Environmental-setup (12 hrs)

- Applications of Machine Learning In different fields (Medical science, Agriculture, Automobile, mining and many more).
- Supervised vs Unsupervised Learning based on problem Definition.
- Understanding the problem and its possible solutions using IRIS datasets.
- Python libraries suitable for Machine Learning(numpy, scipy, scikit-learn, opencv)
- Environmental setup and Installation of important libraries.

Module 2 - Regression (8 hrs)

- Linear Regression
- Non-linear Regression
- Model Evaluation in Regression
- Evaluation Metrics in Regression Models
- Multiple Linear Regression
- Feature Reduction using PCA
- Implementation of regression model on IRIS datasets.

Module 3 - Classification (24 hrs)

- Defining Classification Problem with IRIS datasets.
- Mathematical formulation of K-Nearest Neighbour Algorithm for binary classification.
- Implementation of K-Nearest Neighbour Algorithm using sci-kit learn.
- Classification using Decision tree.
- Construction of decision trees based on entropy.
- Implementation of Decision Trees for Iris datasets .
- Classification using Support Vector Machines.
- SVM for Binary classification
- Regulating different functional parameters of SVM using sci-kit learn.
- SVM for multi class classification.
- Implementation of SVM using Iris datasets .

- Implementation of Model Evaluation Metrics using sci-kit learn and IRIS datasets.

Module 4 - Unsupervised Learning (12 hrs)

- Defining clustering and its application in ML .
- Mathematical formulation of K-Means Clustering.
- Defining K value and its importance in K-Means Clustering.
- Finding appropriate K value using elbow technique for a particular problem.
- Implementation of K-Means clustering for IRIS datasets

Projects

- To be defined based on respective study area of student.

References:

Text Book:

1. EthemAlpaydin, Introduction to Machine Learning, Second Edition, http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12012.

Web Resource:

1. https://towardsdatascience.com/beginners-guide-to-machine-learning-with-python-b9ff35bc9c51

Robotic automation with ROS and C++

Code	Course Title	Credit	T-P-PJ
CUTM1020	Robotic automation with ROS and C++	4	1-2-1

Objectives:

- To upgrade knowledge levels of robotic application in modern industries
- Project based training

Learning Outcomes:

- Advanced knowledge on robotic automation
- Understand different types of devices to which robotic modules are connected
- Provide the knowledge about understand various types of robotic applications.
- Industry based project & advanced learning.

Syllabus

Course – 1

Robotic Automation Introduction

1.1 Basic's of automation

1.2 Use of robots in industry.

Course - 2

Sensor's requirement in robots.

2.1 Selecting sensors as per the project.

2.2 Specification checking of sensors.

2.3 Interfacing of sensor to controllers.

Practice

P2.1 TILT, PROXIMITY, TEMPERATURE, HUMIDITY, SMOKE, FINGERPRINT

P2.2BLUETOOTH, ESP8266, GPS, GSM

Course - 3

Controllers and output port handling.

3.1 Concept of 8951 controller

3.2 Concept of Arduino and concept of Raspberry Pi.

Practice

P3.1 Port handling of 8951

P3.2 Port handling of Arduino

P3.3 Port handling of Raspberry Pi

Course - 4

Sequential robot control

4.1 Designing of sequential robot control system.

4.2 Writing of programs in different programming languages.

4.3 Controlling of input/output devices.

Practice

P4.1 Programming of controllers with different programming languages

P4.2 Designing of sequential control robot.

Course5

ROS & C++

5.1 What is Ubuntu & ROS.

5.2 Requirement and application of ROS.

5.3 ROS based simulation of Turtlbot.

5.4 Adding of robot with wheel & sensor. Placing robot inside Gazebo.

Practice:

P5.1 Ubuntu basic command.

P5.2 Installation of Ubuntu, ROS & Gazebo

P5.3 Turtlbot control application

P5.4 Gazebo based robot control and simulation.

P5.5 Python and C++ based programming to control robot.

Virtual LAB : Using ROBOMASTER (AWS)

Projects

1. Mobile controlled robot

2. Autonomous operated robot.

3. Location targeted robot

Session plan for the entire course

Module – 1

Robotic Automation Introduction

Session 1 Basic's of automation

Session 2 Use of robots in industry.

Video : https://www.youtube.com/watch?v=b9HU-_XyUw0&t=2s

Video : https://www.youtube.com/watch?v=H5GyL7nmnEY&feature=emb_rel_end

Module - 2

Sensor's requirement in robots.
Session 3 Selecting sensors as per the project.
Session 4 Specification checking of sensors.
Session 5 Interfacing of sensor to controllers.
Videos : https://www.youtube.com/watch?v=J_KoRp8SnoE&t=300s
Virtual LAB : Using Proteus https://www.youtube.com/watch?v=1S7vQubTgQg

Module - 2

Controllers and output port handling.

Session 6 Concept of 8951 controller

Session 7 Concept of Arduino and concept of Raspberry Pi.

Video : https://www.youtube.com/watch?v=aArpCMXOn0A

Virtual LAB : Using Proteus https://www.youtube.com/watch?v=j9Ur8PautVI

Module - 3

Sequential robot control

Session 8 Designing of sequential robot control system.

Session 9 Writing of programs in different programming languages.

Session 10 Controlling of input/output devices.

Video : https://www.youtube.com/watch?v=0dx9xsvanNA&t=10s

Module 4

ROS & C++

Session 11 What is Ubuntu & ROS.

Session 12 Requirement and application of ROS.

Session 13 ROS based simulation of Turtlbot.

Session 14 Adding of robot with wheel & sensor. Placing robot inside Gazebo.

Practice:

1. Ubuntu basic command.
2. Installation of Ubuntu, ROS & Gazebo
3. Turtlbot control application
4. Gazebo based robot control and simulation.
5. Python and C++ based programming to control robot.

Virtual LAB : Using ROBOMASTER (AWS)

Projects

1. Mobile controlled robot

2. Autonomous operated robot.

3. Location targeted robot

Basics of Design Thinking

Code	Course Title	Credit	T-P-PJ
CUTM1021	Basics of Design Thinking	2	0-0-2

Course Rationale:

Steve Jobs famously said "Design is just not what is looks or feels like. Design it how it works". Design Thinking is described as a discipline where designer's sensibility and methods match with the needs of users. It draws on logic, imagination, intuition and systemic reasoning to explore the possibilities of a solution to a challenge and to create desired outcomes that benefit the end user. So, if you are among the one who is constantly thinking of solving a problem of business or society, it is ideal for you. This course will help you with the basics of design thinking and through an action centric learning approach, lead to creatively explore the challenges and by using the design thinking tool propose innovative solutions.

Course Objectives:

The course aims to

- To orient the participants with the basics of the design thinking process
- To familiarize participants with the elements of Design thinking

Learning Outcome:

After completion of the course the students

- will be able to apply the design thinking process to innovative problem solving

Course contents

Module: I

Basics of Design Thinking, Why Design Thinking, Design Thinking Mindset (Inspiration, Ideation and Implementation) Design thinking process, (Empathy, Define, Ideate, Prototype, Test). Cases of application of Design thinking approach (Intuit, IDEO, Infosys, IBM, Google, Apple, Jubilant Foods)

Module: II

Executing a Design Thinking Project- Apply Interviewing and empathy building technique, Drawing inferences from the observations, Defining a point of view, Ideation process, developing and testing prototypes and writing a story of a minimum viable solution.

Projects-

- Develop a customer friendly insulin pump design
- Develop a new customer experience for buying a diamond ring online
- Develop a new disease monitoring device for health workers working in remote areas.
- Designing an integrated machinery for end to end farm activities for small and marginal farmers.
- Design a Fund raising campaign

Recommended References:

Books: Tom Kelly & Jonathan Littman (2001). "The Art of Innovation" Broadway Publication.

System Integration with DYMOLA

Code	Course Title	Credit	T-P-PJ
CUTM1022	System Integration with DYMOLA	2	0-0-2

Course Objectives

- To provide powerful multi-disciplinary systems engineering through compatible model libraries for a large number of engineering domains.
- To design high-fidelity modeling of complex integrated systems.
- To design intuitive modeling i.e. advanced, formally defined object-oriented modeling language.
- To enable users to easily build their own components or adapt existing ones to match their unique needs.
- To provide hardware-in-the-loop simulations (HILS) i.e. real-time simulation with AurdinoUno, Python, Matlab, 3D real-time animation, CAD files import capability.
- To increase the ability to integrate with complex 3D geometry for integrated simulation.
- To increase powerful model management, calibration & optimization capabilities.

Learning Outcomes

- The use of open standards such as DYMOLA (Modelica and FMI) is a key enabler to better understand the behavior of systems and to work and communicate accurately with partners and suppliers.
- DYMOLA is not only capable to support an ad-hoc modeling level, such as functional behavior or detailed design, but is also able to convert these predictive models into real-time models.
- The user can able to create new elements in an easy and intuitive way, to answer to its own modeling requirements.
- Future Centurions are ready for operating in many industries including automotive, aerospace, architecture, Motorsport, energy, and high tech.

Course Syllabus

Module 1 - Introduction Dymola and Modelica library

Package Browser, Component Browser, Parameter and Variable Editor Simulation Window,

Modeling, and Simulation.

The Modeling window is used to compose models and model components.

The Simulation experiment on the model, plot results and animate the behavior.

Creating user-defined models and scripting using Modelica language.

Role Play – Explore the pre-defined libraries and Models, Creating a Package

Practice Project - Preparation of animated projects

https://www.youtube.com/watch?v=39xyI0k

https://www.youtube.com/watch?v=FN8LlnTwzVE&t=314s

Module 2 – Physical Modeling using DYMOLA

Import of user-defined libraries and packages, interfacing with physical models using ArduinoUno.

The Simulation experiment on the model using multi-domain libraries such as mechanical, electrical, control, thermal, pneumatic, hydraulic, powertrain, thermodynamics, vehicle dynamics, air-conditioning domains

Dymola interface that is stored in the Python package

Role Play – Explore the pre-defined libraries and Models, Creating a Package

Practice Project - Preparation of projects using user-defined packages,

Systems Physics with Modelica/Dymola

https://www.youtube.com/watch?v=xlpHwX-W3Ns

Module 3 – Animation and 3D view Using DYMOLA

MultiBody Frame Connector, Building a Mechanical Model, Concept of Furuta

Role Play - Practical session by students for students

Practice Project - Modeling of animated projects using the MultiBody library.

https://www.youtube.com/watch?v=c9Ar2b4X5rQ

https://www.youtube.com/watch?v=k7lLBASaEJg

Session Plan

Session 1

Project 1

Simulating a model – Modeling of Integrated circuits

Description: Use of Electrical and Electronics components.

Workbench Use: Behavior Modelling, Functional and Logical Design.

Session 2

Project 2

Simulating a model -Creating a model for Electric DC Motor

Description: Design a DC Motor Model, Test, and Simulation, Creating a library for components, Creating a model for motor drive, Scripting.

Workbench Use: Behavior Modelling, Modelica Standard Library.

Session 3

Project 3

Simulating a model -Simple Pendulum with Frictionless joint Using Multi-Body Library

Description: Design the Simple pendulum and the Furuta joint using Dymola and Modelica language. Friction joint for the Mechanical equipment.

Workbench Use: Behavior Modelling.

Session 4

Project 4

Simulating a model – Pick and Place Robot

Description: 5 Axis Pick and Place Robot Design, Validation, and Optimization in the 3DS platform.

Workbench Use: Behavior Modelling, Functional and Logical Design. Part design and Assembly Design.

https://www.youtube.com/watch?v=9RgdZUvEjPw

Session 5

Project 5

Simulating a model – 3D Printer Design

Description: Design All System and Sub System of the 3D Printer, Validation and Simulation using 3Ds Platform.

Workbench Use: Behavior Modelling, Functional and Logical Design. Part design and Assembly Design.

Session 6

Project 6

Simulating a model – Bicycle Behavior Modeling

Description: Design Power Train, Driving Cycle, part design, and Simulation.

Workbench Use: Behavior Modelling, Functional and Logical Design. Part design and Assembly Design.

Session 7

Project 7

Simulating a model – Refrigerator Compartment Door Design using Thermal Library

Description: This component model the airflow through the door of a refrigerator or freezer compartment.

Workbench Use: Behavior Modelling, Functional and Logical Design. Part design and Assembly Design.

Session 8

Project 8

Simulating a Model – Engine Analytic Using MultBody Library.

Description: Engine analytic, an engine with 6 cylinders, 6 planar loops, 1 degree of freedom, and analytic handling of kinematic loops.

Workbench Use: Behavior Modeling.

Session 9

Project 9

Simulating a model – Control the real and Digital servo motor ArduinoUno Library

Description: Control the Real and Digital Servo motor with simulation.

Workbench Use: Behavior Modelling, Arduino based System Design, and Functional and logical design.

Session 10

Project 10

Simulating a model – Virtual Universes with Poppy Humanoid Using ArduinoUno Library

Description: Virtual universes with a human assistant robot with simulation.

Workbench Use: Behavior Modelling, Arduino based System Design, Functional, and logical design.

Session 11

Project 11

Simulating a model – Implementation of Model using Python Library

Description: Modeling using python library, validation and optimization in the 3Ds platform.

Workbench Use: Behavior Modelling, Functional and Logical Design. Part design and Assembly Design.

Session 12

Project 12

Simulating a model – Industrial Robot Design

Description: 6 Axis industrial robot design, validation, and optimization in the 3Ds platform.

Workbench Use: Behavior Modelling, Functional and Logical Design. Part design and Assembly Design.

Session 13

Project 13

Simulating a model – Temperature Control System Using State Graph

Description: The model contains an electric circuit with a heating resistor and a switch.

Workbench Use: Behavior Modelling.

https://www.youtube.com/watch?v=zz-_crJOGo0&t=26s

https://www.youtube.com/watch?v=Zl592ARjnpU

Session 14

Project 14

Simulating a model – Magnetic Ball System using Magnetic Library

Description: The electronic circuit consists of a voltage source, a resistor, and an inductor in the form of a tightly wound coil. An iron ball beneath the inductor experiences a gravitational force as well as an induced magnetic force (from the inductor) that opposes the gravitational force.

Workbench Use: Behavior Modelling.

Session 15

Project 15

Simulating a Model – Design of Water to Steam Converter Using Fluid Library

Description: Create a package under Fluid_Package called Water_To_Steam using temperature sensors.

Workbench Use: Behavior Modelling.

Session 16

Project 16

Simulating a Model – Design of Liquid Valve Control Using Fluid Library

Description: Building a simple circuit with two valves and a volume block.

Workbench Use: Behavior Modelling.

https://www.youtube.com/watch?v=P_YI3RiTI14

CBCS Structure

Basket	Basket Category	Minimum Credits to be acquired by Regular students	Minimum Credits to be acquired by Lateral Entry students
I	Foundation Courses in Sciences	17	06
II	Foundation Courses in Humanities & Management [A: 6 credit (choice), B: 6 credit (Compulsory)]	12	6(Job readyness) + 3
III	Smart Stack	25	25
IV	Foundation and Core Engineering Courses	58*	48
V	Domain/Skill/Internship/Minor Project/MOOC	48	32
	Total Credits	**160**	**120**

Course Structure

Basket I	**Foundation Courses in Sciences**		
Course Code	**Course Title**	**Credit**	**Type (Theory+Practice+Project**
CUTM1001	Differential Equations and Linear Algebra	3	2+0+1
CUTM1002	Laplace & Fourier Transforms	3	2+0+1
CUTM1003	Complex Analysis & Numerical Methods	3	2+0+1
CUTM1004	Discrete Mathematics	3	2+0+1
CUTM1005	Probability & Statistics	3	2+0+1
CUTM1925	Calculus	3	2+0+1
CUTM1006	Mechanics for Engineers	3	2+1+0

CUTM1007	Optics and Optical Fibres	3	2+1+0
CUTM1008	Applied Analytical Chemistry	3	2+1+0
CUTM1009	Applied Engineering Materials	3	2+0+1
CUTM1010	Environmental Studies	2	0+0+2

Basket II	**Foundation Courses in Humanities & Management [A: 6 credit (choice), B: 6 credit (Compulsory)]**		
Course Code	**Course Title**	**Credit**	**Type (Theory+Practice+Project**
CUTM1011	Optimisation Techniques	2	0-2-0
CUTM1012	Engineering Economics and Costing	3	2-0-1
CUTM1013	Project Management	3	2-0-1
CUTM1014	Gender, Human Rights and Ethics	3	1.5-0-1.5
CUTM1015	Climate Change, Sustainability and Organisation	3	1.5-0-1.5
CUTM1016	Job Readiness	6	0-6-0

Basket III	**Smart Stack**		
Course Code	**Course Title**	**Credit**	**Type (Theory+Practice+Project**
CUTM1017	Industrial IOT and Automation	6	3-2-1
CUTM1018	Data Analysis and Visualisation using Python	4	0-1-
CUTM1019	Machine Learning using Python	4	1-2-1
CUTM1020	Robotic automation with ROS and C++	4	1-2-1
CUTM1021	Basics of Design Thinking	2	0-0-2
CUTM1022	System Integration with DYMOLA	2	0-0-2
CUTM1023	Smart Engineering Project (G2M)	3	0-0-3

Basket IV	Core Course_ Electrical and Electronics Engineering		
Course Code	**Course Title**	**Credit**	**Type (Theory+Practice+Project**
CUTM1028	OOPs with C ++ Programming	4	1-2-1
CUTM1029	Data Structures using C++	4	1-2-1
CUTM1030	Advanced Web Programming	4	1-2-1
CUTM1031	Java Technologies	4	2-1-1
CUTM1039	Embedded System Design Using ARM Cortex	6	3-2-1
CUTM1040	VLSI Design	6	3-2-1
CUTM1042	Electromagnetic Field Theory and Transmission Line	3	2-1-0
CUTM1043	Network Analysis	3	2-1-0
CUTM1051	Energy Production & Transmission	3	2-1-0
CUTM1052	Substation Switch gear & Protection	4	2-1-1
CUTM1053	System Modeling and Control	4	3-1-0
CUTM1054	Electrical Machines Operation and Control	4	2-2-0
CUTM1055	Industrial Power Electronics	4	2-1-1
CUTM1056	Digital Measurement and Instrumentation	3	2-1-0
CUTM1057	Basic Electrical Engineering	2	1-1-0
	Total Credits	**58**	

Basket V: Domain/Skill/MOOC/Minor Project/Internship/Applied Courses

Domain:

- Industrial Automation

- Operation and Maintenance of Electrical Grid System & Transformers
- Embedded System Design
- Renewable Energy Applications
- GO-TO MARKET (Digital Manufacturing)

Basket IV: Core Courses Syllabus

OOPs with C++ Programming

Code	Course Title	Credit	T-P-PJ
CUTM1028	OOPs with C++ Programming	4	1-2-1

Objective

- To understand how C++ improves C with object-oriented features
- To learn how to design C++ classes for code reuse
- To learn how inheritance and virtual functions implement dynamic binding with polymorphism
- To learn how to use exception handling in C++ programs

Learning outcome

- Apply the object-oriented programming approach in connection with C++
- Illustrate the process of data file manipulations using C++
- Apply virtual and pure virtual function & complex programming situations
- Write an error free program of minimum 200 lines of code

Course content

Module I: Revision of C programming (8 hrs)

Revision of C Programming, Pointers, Functions (Call by value and reference), Recursion, Arrays using Pointers, Structures, Union, Enumeration and Typedef, File handling.

Programs:

1. Write a Program to perform Parameter passing.
2. Write a program to create a scientific calculator.
3. Write a program to convert a decimal to binary number using recursion.
4. Write a program to Read 'n' employee details and display the top 10 employees as per the salary.
5. Write a program to evaluate MCQ questions of an examination and generate the results using files.

Module II: Basics of Object oriented concepts **(8 hrs)**

Object oriented concepts Classes and Objects, Encapsulation, Abstraction, Overloading, Inheritance, Polymorphism.

Beginning with C++, Tokens, Static Members, Constant Members, Expressions, Control Structure, Functions: parameter passing, inline function, function overloading.

Programs:

1.Write a program to read a number and check whether the number is Prime number , Palindrome number , Magic number , Armstrong number , Strong number or not.

2. Write definitions for two versions of an overloaded function. This function's 1st version sum() takes an argument, int array, and returns the sum of all the elements of the passed array. The 2nd version of sum() takes two arguments, an int array and a character ('E' or 'O'). If the passed character is 'E', it returns the sum of even elements of the passed array and is the passed character is 'O', it returns the sum of odd elements. In case of any other character, it returns 0 (zero).

Module III: Class-Object-Constructor **(10 hrs)**

Classes: data members, member function, array of objects, static data members, constant members function, and friend function.

Constructors, Encapsulating into an object, Destructors.

Programs:

1. Define a class to represent a book in a library. Include the following members:

Data Members

Book Number, Book Name, Author, Publisher, Price, No. of copies issued, No. of copies

Member Functions

(i) To assign initial values

(ii) To issue a book after checking for its availability

(iii) To return a book

(iv) To display book information.

2. A bank maintains two kinds of accounts for customers, one called as savings and the other as current account. The savings account provides compound interest and withdrawal facilities but no cheque book facility. The current account provides cheque book facility but no interest. Current account holders should also maintain a minimum balance and if the balance falls below this level a service charge is imposed.

Define a class to represent a bank account. Include the following members: Data members: 1. Name of the depositor. 2. Account number. 3. Type of account. 4. Balance amount in the account. Member functions: 1. To assign initial values. 2. To deposit an amount. 3. To withdraw an amount after checking the balance. 4. To display the name and balance. Write a main program to test the program

3. Declare a class to represent fixed-deposit account of 10 customers with the following data members:

Name of the depositor, Account Number, Time Period (1 or 3 or 5 years), Amount.

The class also contains following member functions:

(a) To initialize data members.

(b) For withdrawal of money (after alf of the time period has passed).

(c) To display the data members.

4. Create two classes DM and DB which store the value of distances. DM stores distances in meters and centimeters and DB in feet and inches. Write a program that can read values for the class objects and add one object of DM with another object of DB. Use a friend function to carry out the addition operation. The object that stores the results may be a DM object or DB object, depending on the units in which the results are required. The display should be in the format of feet and inches or meters and centimeters depending on the object on display.

Module IV: Inheritance **(8 hrs)**

Associations, Inner Classes, Memory Management and pointers

Inheritance: Derived classes, member accessibility, forms of inheritance, virtual base classes.

Programs:

1. Write a Program to describe about all types of inheritance.

2. Create a base class called shape. Use this class to store two double type values that could be used to compute the area of figures. Derive two specific classes called triangle and rectangle from the base shape. Add to the base class, a member function get_data() to initialize base class data members and another member function display_area() to compute and display the area of figures. Make display_area() as a virtual function and redefine this function in the derived classes to suit their requirements. Using these three classes, design a program that will accept dimensions of a triangle or a rectangle interactively, and display the area.

3. An educational institution wishes to maintain a database of its employees. The database is divided into a number of classes whose hierarchical relationships are shown in following figure.

The figure also shows the minimum information required for each class. Specify all classes and define functions to create the database and retrieve individual information as and when required.

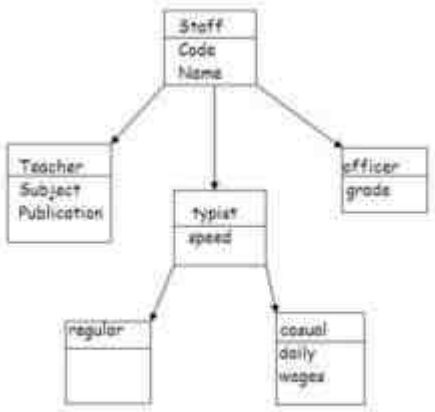

fig: class relationships (for exercise 8.3)

Module V: Polymorphism (8 hrs)

Polymorphism (Compile time Polymorphism, Run time Polymorphism), Virtual Functions, Abstract class, virtual destructors, Interfaces.

Programs:

1. Write a Program to overload ++ operator.
2. Write a program to overload + operator by concatenating strings.
3. Write a program to describe about virtual function.

Module VI: Exception Handling **(8 hrs)**

Exception Handling, Managing Console I/O Operations, Streams & Files: streams, hierarchy of stream classes, working with files

Programs:

1. Write a Program to describe about exception handling mechanism.
2. Write a Program to describe multi catch statement.
3. Write a program to read a list containing item name, item code, and cost interactively and produce a three column output as shown below.

Name	Code	Cost
Turbo C++	1001	250.95
C primer	905	95.70

Note that the name and code are left-justified and the cost is right justified with a precision of two digits. Trailing zeros are shown.

4. Write a program that reads a text file and creates another file that is identical except that every sequence of consecutive blank spaces is replaced by a single space.

5. Write a program that reads character from the keyboard one by one. All lower case characters get store inside the file LOWER, all upper case characters get stored inside the file UPPER and all other characters get stored inside OTHERS.

Module VII: Templates **(8 hrs)**

Advance Topics in C++ Object Design and Templates STL (Standard Type Libraries)RTTI (Run Time Type Identification) Advanced Typecasting ,new data types, new operators, class implementation, namespace scope , operator keywords, new headers , C++ Containers

Programs:

1. Write a function template for finding the minimum value contained in an array.

2. Imagine a publishing company that markets both books and audio-cassette versions of its works. Create a class called Publication that stores the title (a string) and price of a publication. From this class derive two classes: Book, which adds a page count (type int); and Tape, which adds a playing time in minutes (type float). Each of the three class should have a getdata() function to get its data from the user at the keyboard, and a putdata() function to display the data. Write a main() program that creates an array of pointers to Publication. In a loop, ask the user for data about a particular book or Tape, and use new to create a object of type Book or Tape to hold the data. Put the pointer to the object in the data for all books and tapes, display the resulting data for all the books and taps entered, using a for loop and a single statement such as pubarr[i]->putdata();to display the data from each object in the array.

Text Books:

1. E Balagurusamy, “Object Oriented Programming with C++”, Tata McGraw Hill, Sixth Edition.

2. Herbert Schlitz, “The Compete Reference C++”, Tata McGraw Hill, Fourth Edition.

Reference Books:

1. Ashok Kamthane, “Object Oriented Programming with ANSI and Turbo C++”, Pearson.
2. Behrouz A. Forouzan & Richard F. Gilberg “A Structured approach using C++” Cengage Learning Indian Edition.

Data Structures using C++

Code	Course Title	Credit	T-P-PJ
CUTM1029	Data Structures using C++	3	1-2-1

Objective

- Be familiar with techniques of algorithm analysis and Recursive method
- Be familiar with implementation of linked data structures such as linked lists and binary trees
- Be familiar with several sub-quadratic sorting algorithms including quick sort, merge sort and heap sort
- Be familiar with some graph algorithms such as shortest path and minimum spanning tree

Learning outcome

- Evaluate algorithms and data structures in terms of time and memory complexity of basic operations
- Define basic static and dynamic data structures and relevant standard algorithms for them: stack, queue, dynamically linked lists, trees, graphs, heap, priority queue, hash tables, sorting algorithms, min-max algorithm
- Determine and demonstrate bugs in program, recognize needed basic operations with data structures
- Formulate new solutions for programming problems or improve existing code using learned algorithms and data structures

Course content

Module I: Problem Solving Analysis (6 hrs)

Define the problem, Identify the problem, Introduction to Problem Solving, Problem solving basics, Defining creativity v/s innovation

Find Creative Solutions using creativity tools

Effective problem solving approaches , Critical thinking and information analysis , Brainstorming, Reverse Brainstorming, Imagineering, Mind Mapping, Six Thinking Hats: A

Tool to Strengthen Critical Thinking, Collaboration, Communication, and Creativity Skills , Analyzing the situation, Gathering information, Identifying solution criteria , Decision Making Methods , Charts and Diagrams , Applying outcome-based thinking

Evaluate and Select solution

Pro's and Con's, Force field analysis, Feasibility/Capability Analysis, Decision analysis, evaluating problems , Choosing among alternatives , Qualitative analysis, discussing qualitative analysis techniques , Establishing objectives , Assigning weight to objectives in order to make the best decision , Creating a satisfaction scale to choose between alternatives

Implementing Decisions

Create an action plan, Break solution into action steps, Prioritize actions and assign roles (setting priorities for taking action) ,Follow-up at milestones

Programs:

1. Problem solving (Control structures, Arrays) using Raptor Tool.

Module II: Array & Stack **(9 hrs)**

Analysis of different Algorithms, Asymptotic analysis, Algorithm analysis, Complexity Analysis, Application of Data structures

Basic Data Structures, Arrays, Stacks and its applications (Recursion, Infix to Postfix Conversion and Postfix Evolution

Programs:

1. Write a program to perform the following menu driven program on the input array.

a. Insertion

b. Deletion

c. Searching

d. Sorting

e. Merging

f. Display

g. Exit

2. Write a program to perform the following menu driven program on the STACK.

a. Push

b. Pop

c. Display

d. Exit

Module III: Queue & Linked List **(9 hrs)**

Queues, Priority Queues, Dequees.

Linked lists: Single Linked List and Operations on Single Linked List (Creation Insertion , Deletion , Sorting and Reverse).

Programs:

1. Write a program to perform the following menu driven program on the Queue.
    a. Insertion
    b. Deletion
    c. Display
    d. Exit
2. Write a program to create a single linked list performs the following menu driven program.
    a. Insertion at front
    b. Insertion at end
    c. Insertion at particular position
    d. Deletion at front
    e. Deletion at end
    f. Deletion at particular position
    g. Display

Module IV: Stack & Queue Using Linked List **(8 hrs)**

Circular linked list and Double linked list, Stack implementation using Linked List and Queue implementation using Linked List

Programs:

1. Write a program to create a Double linked list performs the following menu driven program.
    a. Insertion at front
    b. Insertion at end
    c. Insertion at particular position
    d. Deletion at front
    e. Deletion at end
    f. Deletion at particular position
    g. Display
2. Write a program to create a circular linked list and display it.
3. Write a program to implement Stack Using Linked List.
4. Write a program to implement Queue Using Linked List.

Module V: Trees **(10 hrs)**

Trees and hierarchical orders ,Introduction to trees , Abstract trees , Tree traversals , Forests , Ordered trees , Binary trees , Perfect binary trees , Complete binary trees , Search trees , Binary search trees , AVL trees

Programs:

1. Write a program to create Binary tree and display it.
2. Write a program to create a BST and display it.
3. Write a program to print all pairs from two BSTs whose sum is greater than the given value.
4. Write a program to remove duplicate entries from the BST.
5. Write a program to create a AVL tree and display it.

Module VI: Searching & Sorting **(8 hrs)**

Searching & Sorting algorithms , Objectives of Searching , The Sequential Search , Analysis of Sequential Search , The Binary Search , Analysis of Binary Search , Introduction to sorting , Insertion sort , Bubble sort , Heap sort ,Merge sort ,Quick sort

Programs:

1. Write a program to perform linear and binary search.
2. Write a program to perform selection sort, Bubble sort and Insertion sort.
3. Write a program to perform merge and quick sort.
4. Write a program to perform Heap sort.

Module VII: Hashing **(8 hrs)**

Hash functions and hash tables ,Hashing & Introduction to hash tables ,Hash functions , Mapping down to 0 ... M – 1 , Chained hash tables , Scatter tables , Open addressing , Linear probing , Quadratic probing , Double hashing, Poisson distribution , Collision Resolution
Graph Terminology and Traversals.

Programs:

1. Write a program to perform Linear Probing.
2. Write a program to perform Double Hashing

Text Books:

1. Data Structures, Algorithms and Applications in C++, Sartaj Sahani, 2nd Edition.
2. Data Structures and Algorithms in C++, Michael T.Goodrich, R, Tamassia and D.Mount, wiley Student Edition, 7th edition, John Wiley and Sons.

Reference Books:

1. Data Structures and Algorithms Analysis in C++ by Mark Allen Weiss.
2. Data Structures and Algorithms in C++, 3rd edition, Adam Drozdek, Cengage Learning.

Source of reference;http://courseware.cutm.ac.in/courses/data-structures-using-c/

Advanced Web Programming

Code	Course Title	Credit	T-P-PJ
CUTM1030	Advanced Web Programming	4	1-2-1

Objective

- Understand client server architecture and able to use the skills for web project development.
- Create job opportunities as a web developer

Learning outcome

- Develop a static, interactive and well-formed webpage using JavaScript, CSS3 and HTML5.
- Use PHP7 to improve accessibility of a web document.
- Gain necessary skills for designing and developing web applications.

Course content

Module I: Web Programming Concepts(7hrs)
Architecture of the Web (1)
HTTP Protocols(1)
Difference HTTP1.0 and HTTP 1.1,Stateless nature of the protocol,Methods (GET, POST, HEAD, PUT, DELETE),HTTP session,Statuscodes,Persistentconnections,HTTPS
HTML(1)
Document Object Model (DOM),Elements,Events
HTML 5(2)
Elements,Objects,Events,Canvas,Audio& Video Support,Geo-location Support
CSS(2)
Styling HTML with CSS,Inline Styling (Inline CSS),External Styling (External CSS),CSS Fonts,The CSS Box Model,The id Attribute,The class Attribute,HTML Style Tags
Practice
1. Write an HTML code to display your CV on a web page.
2. Write an HTML code to create a Home page having three links: About Us, Our Services and Contact Us. Create separate web pages for the three links.
3. Write an HTML code to create a Registration Form. On submitting the form, the user should be asked to login with this new credentials.
4. Write an HTML code to create your Institute website, Department Website and Tutorial website for specific subject.
5. Write an HTML code to create a frameset having header, navigation and content sections.

6.Write an HTML code to demonstrate the usage of inline CSS.
7. Write an HTML code to demonstrate the usage of internal CSS.
8. Write an HTML code to demonstrate the usage of external CSS.
9: Design your own website using HTML CSS
10: Design form using HTML and apply CCS

Module II: JavaScript & jQuery(14 hrs)

JavaScript (10)

Introduction to JavaScript:Variable, statements, Operators, Comments, constructs, Functions, expressions,Javascriptconsole,Scope, Events, Strings, String Methods, Numbers, Number Methods, Dates, Date Formats, Date,Methods,Arrays, Array Methods,Booleans, Comparisons Control Structures:Conditions, Switch,Loop For, Loop While, Break

Functions: Function Definitions, Function Parameters, Function Invocation, Function Closures

Objects: Object Definitions, Object Properties, Object Methods, Object Prototypes

Object Oriented Programming:

Method,Constructor,Inheritance,Encapsulation,Abstraction,Polymorphism,JavascriptValidations, Document Object Model, Document and Events (DOM Manipulation)

HTML DOM: DOM Intro, DOM Methods, DOM Document, DOM Elements, DOM HTML, DOM CSS,DOM Animations, DOM Events, DOM EventListener, DOM Navigation, DOM Nodes, DOM Nodelist,Debugging,Type Conversion, Regular expressions, Errors, Debugging

Forms: Forms Validation, Forms API,JS Browser BOM, Window, Screen, Location, History, Navigator, Popup Alert, Timing, Cookies,JavascriptWindows,Pushing code quality via JSLinttool,Security in Java Script

jQuery(4)

Basics of jQuery,jQuery selection and events, jQuery Effects,jquery traversal and manipulation,Data attributes and templates, jQuery Plugins,Jquery / Google Web Toolkit

Practice:

1.Write a Java script to prompt for users name and display it on the screen.

2. Design HTML form for keeping student record and validate it using Java script.

3. Write programs using Java script for Web Page to display browsers information.

4: Validate form page using JavaScript

5: use JQuery effect in page

6. Write a jQuery Code to Find the data passed with the on() method for each element.

7.Find the position of the mouse pointer relative to the left and top edges of the document.

8.Count the number of milliseconds between the two click events on a paragraph

9.Find all the text nodes inside a paragraph and wrap them with an italic tag

Module III: AJAX& JSON(8 hrs)

AJAX(3)

Design Introduction to Ajax,Web services and Ajax,Ajax using HTML, CSS, JavaScript,Ajax Framework and DOM,XMLHttpRequest,Ajax Architecture

Working with JSON (5)

JSON – Introduction,Need of JSON,JSON Syntax Rules,JSON Data - a Name and a Value,JSONObjects,JSONArrays,JSON Uses JavaScript Syntax,JSONFiles,JSON& Security Concerns, Cross Site Request Forgery (CSRF), Injection Attacks,JSXMLHttpRequestfunctions,JavaScriptXMLHttpRequest& Web APIs,JSON& Client Side Frameworks,JSON& Server Side Frameworks,Replacing XML with JSON,JSON parsing,AJAX using JSON and jQuery

Practice:

1.Create an simple application using AJAX to show the table of numbers given by user at runtime.

2.Access web service using Ajax and handle using JSON

Module IV: Responsive Web Design (5 hrs)

Introduction

The Best Experience for All Users

• Desktop

• Tablet

• Mobile

Bootstrap

Overview of Bootstrap

Need to use Bootstrap

Bootstrap Grid System, Grid Classes, Basic Structure of a Bootstrap Grid

Typography

Tables, Images, Jumbotron, Wells, Alerts, Buttons, Button Groups, Badges/Labels, Progress

Bars,Pagination, List Groups, Panels, Dropdowns, Collapse, Tabs/Pills, Navbar, Forms, Inputs

Bootstrap Grids, Grid System, Stacked/Horizontal

Bootstrap Themes, Templates

Practice:

1.Create a responsive website using bootstap

Module V: PHP(10 hrs)

PHP(10):

Introduction to PHP,Working with arrays,Functions,Forms,Handling date and Times,Working with Files,Session and state management,Database operations from PHP

Practice:

1.Develop student registration web application using PHP

2.Write a PHP database application that collects comments from users and makes it possible for users to view all the comments that have been submitted. You will need three files: an HTML page with a form where the user can enter a comment; a PHP program to process the input from this form by adding the comment to the database; and a PHP program that displays all the comments.

Module VI: Introduction to Drupal(5 hrs)

Drupal Basics, Content Management System, Content Management Framework, Web Application,Framework,Drupal Workflow, Bootstrap, hooks, callbacks, output,Modules (Core and Contributed), Nodes, Blocks, Regions,The Admin Interface (Overview),Content Management, Site Building, Site Configuration, User Management, Reports, Help,ContentTranslation,User Contributed Modules,Layouts in Drupal, File Systems

Practice:

1.Setup Drupal server and develop a site on it

Module VII: XML & Web Security (6 hrs)

XML (2)

Introduction to XML,XML Validation,Reason for XML,XML Tree Structure, XML DOM,XML DTD,XML Schema

XML style language(2)

XML and XSLT, XML Parsing,XML parsers (DOM & SAX),XML WSDL,RSS Feed

Web Security(2)

SQL Injection,Cross-Site Scripting (XSS),Security standards (OWASP)

Practice:

1. Creating XML Document

2.DTD creation

3.Test SQL Injection for student resgistration application

Text/Reference Books

1.Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Black Book Kindle Edition,byKogent Learning Solutions Inc.

2.HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, AJAX, PHP and jQuery, 2ed Kindle Edition,by DT Editorial Services

3.Programming PHP: Creating Dynamic Web Pages, Third Edition, by Kevin Tatroe, O'REILLY

4.Introduction to JavaScript Object Notation: A To-the-Point Guide to JSON kindle Edition by Lindsay Bassett,O'REILLY

5.Bootstrap: Responsive Web Development by Jake Spurlock, Paperback

Project Work

1.Online Quiz System

2.Online Student feedback System

3.. Online Tutorial System

4.Restaurant Billing System

5.Online MCQ Database Bank System

Source of reference:https://nqr.gov.in/qualification-title?nid=3002

Courseware Link: http://courseware.cutm.ac.in/courses/advanced-web-programming/**Course**

Java Technologies

ode	Course Title	Credit	T-P-PJ
CUTM1031	**Java Technologies**	4	2-1-1

Objective

- Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
- Be aware of the important topics and principles of software development
- Have the ability to write a computer program to solve specified problems
- Have the ability to write a computer program to solve specified problems
- Be able to use the Java SDK environment to create, debug and run simple Java programs

Learning outcome

- Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs
- Read and make elementary modifications to Java programs that solve real-world problems
- Identify and fix defects the common safety issues in code
- Document a Java program using Javadoc
- Use a version control system to track source code in a project
- Qualify confidently any interview process where Java is the requirement

Course content

Module I: Introduction to Java (8 hrs)

Features and Installation, Java Programming Basics, Decision Making and Looping, Class and Object, Inheritance
Practice 1 (1 Hr)
Practice 2 (1 Hr)

Module II: Package and Safe Code (5 Hr)

Interfaces, Packages and Access Protection, Exception Handling (Fault Tolerant Programming)
Practice 3 (1 Hr)

Module III: Collection and Threads (5 Hr)
ArrayList, Vector, Set, Map, Multi-threaded Programming, Synchronization
Practice 4 (1 Hr)

Module IV: Language and Utility Packages (5 Hr)
String Handling, Wrappers, Runtime Memory Management, Cloning, Calendar, Date and Time Facilities, Scanner, Internationalization
Practice 5 (1 Hr)
Practice 6 (1 Hr)
Module V: Input/ Output and Applets (5 Hr)
Byte and Character Stream I/O, Persistence, Applet: Architecture, Skeleton, and Implementation
Practice 7 (1 Hr)
Practice 8 (1 Hr)
Module VI: GUI Programming (5 Hr)
AWT: Container, Components, Layout Managers, Event Handling
Practice 9 (1 Hr)
Practice 10 (1 Hr)
Module VII: Networking and Advanced (5 Hr)
Networking Fundamental, Client-Server Communication, Remote Method Invocation (RMI), Java Virtual Machine (JVM) Tuning, Java Profiler
Practice 11 (1 Hr)
Practice 12 (1 Hr)

Text Book(s):

1. Java The Complete Reference, Fifth Edition, C25 Herbert Schildt, McGraw-Hills

Reference Book(s):

1. Murach's Java Programming, 5th Edition, Joel Murach, Mike Murach & Associates, 2011, ISBN-78-1-943872-07-7
2. Introduction to Java Programming, Comprehensive, 10th ed., Y. Daniel Liang, 2014. ISBN-10: 0133813460, ISBN-13: 9780133813463

Source of reference;

https://nqr.gov.in/qualification-title?nid=3002
https://www.cdac.in/index.aspx?id=DAC&courseid=0#
https://canvas.harvard.edu/courses/63117/assignments/syllabus
https://canvas.harvard.edu/courses/69911/assignments/syllabus
https://xid.harvard.edu/xid-apps/submitAccountForm.do

YouTube Resources:	freeCodeCamp.org
	Codearchery
	Edureka
	free project
	Jenkov

Online Source(s):

1. https://docs.oracle.com/javase/tutorial/java/index.html

2. https://www.programiz.com/java-programming

3. https://marcus-biel.com/

Software/Tool(s): Java 8, Eclipse IDE

Online Compiler: https://ideone.com/

Online Coding Practice: https://www.hackerrank.com/

List of Practices:

Practice 1 (Module-I)

Program-1:

Write a program that computes the standard deviation of a set of floating point numbers that the user enters. First the user says how many numbers N are to follow. Then the program asks for and reads in each floating point number. Finally it writes out the standard deviation. The standard deviation of a set of numbers Xi is:

SD = Math.sqrt(avgSquare - avg2)

Here, avg is the average of the N numbers, and avg2 is its square.

avgSquare is the average of Xi * Xi. In other words, this is the average of the squared value of each floating point number.

For example, if N = 4, say the numbers were:

Xi Xi * Xi

2.0 4.0

3.0 9.0

1.0 1.0

2.0 4.0

sum 8.0 18.0

Now:

avg = 8.0/4 = 2.0

avg2 = 4.0

avgSquare = 18.0/4 = 4.5

SD = Math.sqrt(4.5 - 4.0) = Math.sqrt(.5) = 0.7071067812

To do this you will need to do several things inside the loop body for each floating point value as

it comes in: add it to a sum, square it and add it to a sum of squares. Then after the loop is finished apply the formula.

Program-2 and Program-3:

Two suggested competitive programs to solve on HackerRank

https://www.hackerrank.com/domains/java

Practice 2 (Module-I)

Program-1:

Better encapsulation of the Goods class would call making instance variables private and using getter and setter methods to access them. A further refinement would be to make the class abstract and to define additional child classes. Here is a revised Goods class:

```
public abstract class GoodsSGA
{private String description;
private double price;
private int quantity;
public GoodsSGA( String des, double pr, int quant )
{description = des;price = pr;
quantity = quant;}
double getPrice()
{return price;}
void setPrice( double newPrice)
{price = newPrice;}
int getQuantity()
{return quantity;}
void setQuantity ( int newQuantity )
{quantity = newQuantity;}
public String toString()
{return "item: " + description + " quantity: " + quantity + " price: " + price ;}}
```

Revise the source code for the classes Food, Toy, and Book. (Perhaps call the revised classes

FoodSG, ToySG, and BookSG.) create a new class ToiletrySG for things like bubble bath. Create a new testing class, StoreSG to test your revised classes.

Note: the child classes will need to use the getter and setter methods to access the instance variables that are declared as private in GoodsSG.

Program-2 and Program-3:

Two suggested competitive programs to solve on HackerRank

https://www.hackerrank.com/domains/java

Practice 3 (Module-II)

Program-1:

User-Friendly Division Practice:

Put in a loop so that the user is repeatedly asked for the numerator and the divisor. For each set of data, the program prints out the result, or an informative error message if there is a problem (division by zero or poor input data).

The program continues looping, even if there is a problem Exit the loop when data entered for the numerator start with characters "q" or "Q". Don't print out an error message in this case. Don't ask for the divisor if the user just asked to quit.

Here is sample output from one run:

Enter the numerator: 12

Enter the divisor: 4

12 / 4 is 3

Enter the numerator: 12

Enter the divisor : 0

You can't divide 12 by 0

Enter the numerator: glarch

You entered bad data.

Please try again.

Enter the numerator: quit

You will need to use the method charAt() from the String class.

Program-2 and Program-3:

Two suggested competitive programs to solve on HackerRank

https://www.hackerrank.com/domains/java

Practice 4 (Module-III)

Program-1:

In mathematics, several operations are defined on sets. The union of two sets A and B is a set that contains all the elements that are in A together with all the elements that are in B. The intersection of A and B is the set that contains elements that are in both A and B. The difference of A and B is the set that contains all the elements of A except for those elements that are also in B.

Suppose that A and B are variables of type set in Java. The mathematical operations on A and B can be computed using methods from the Set interface. In particular:

A.addAll(B) computes the union of A and B; A.retainAll(B) computes the intersection of A and B; and A.removeAll(B) computes the difference of A and B. (These operations change the contents of the set A, while the mathematical operations create a new set without changing A, but that difference is not relevant to this exercise.)

For this exercise, you should write a program that can be used as a "set calculator" for simple operations on sets of non-negative integers. (Negative integers are not allowed.) A set of such integers will be represented as a list of integers, separated by commas and, optionally, spaces and enclosed in square brackets. For example: [1,2,3] or [17, 42, 9, 53,108]. The characters +, *, and - will be used for the union, intersection, and difference operations. The user of the program will type in lines of input containing two sets, separated by an operator. The program should perform the operation and print the resulting set.

Here are some examples:

Input	Output
[1, 2, 3] + [3, 5, 7]	[1, 2, 3, 5, 7]
[10,9,8,7] * [2,4,6,8]	[8]

[5, 10, 15, 20] - [0, 10, 20] [5, 15]

To represent sets of non-negative integers, use sets of type TreeSet<Integer>. Read the user's input, create two TreeSets, and use the appropriate TreeSet method to perform the requested operation on the two sets. Your program should be able to read and process any number of lines of input. If a line contains a syntax error, your program should not crash. It should report the error and move on to the next line of input. (Note: To print out a Set, A, of Integers, you can just say System.out.println(A). We've chosen the syntax for sets to be the same as that used by the system for outputting a set.)

Program-2 and Program-3:

Two suggested competitive programs to solve on HackerRank

https://www.hackerrank.com/domains/java

Practice 5 (Module-IV)

Program-1:

Password Checker:

Write a program that repeatedly asks the user for a proposed password until the user enters an acceptable password. When the user enters an acceptable password, the program writes a message and exits.

Acceptable passwords:

Are at least 7 characters long.

Contain both upper and lower case alphabetic characters. Contain at least 1 digit. The logic of this program can be quite tricky. Hint: use toUpperCase(), toLowerCase, and equals(). You will also need nested ifs.

Here is a run of the program:

Enter your password:

snowflake

That password is not acceptable.

Enter your password:

SnowFlake

That password is not acceptable.

Enter your password:

snowflake47

That password is not acceptable.

Enter your password:

Snowflake47

Acceptable password.

Program-2 and Program-3:

Two suggested competitive programs to solve on HackerRank

https://www.hackerrank.com/domains/java

Practice 6 (Module-IV)

Program-1:

Secret Code:

A text message has been encoded by replacing each character of the message with an integer. Each integer is an index into a key-phrase that contains all the lower case letters of the alphabet as well as the space character. The key-phrase may contain the same character in several locations. The encoded text is series of integers, like this:

35 10 10 33 9 24 3 17 41 8 3 20 51 16 38 44 47 32 33 10 19 38 35 28 49

To decode the message, look up each integer in the key-phrase and output the corresponding character. For example, say that the key-phrase is this (the index of each character has been written above it):

1111111111222222222233333333334444444445 5

01234567890123456789012345678901234567890123456789012345678901

six perfect quality black jewels amazed the governor

using each integer from the encoded text as an index into the phrase results in the decoded message:

attack the bridge at dawn

Write a program that decodes a secret message contained in a text file. The first line of the text file contains the key-phrase. Then the file contains a sequence of integers, each of which indexes the key-phrase. Find the character corresponding to each integer and output the secret message. Note if a character character such as 'e' occurs several places in the key-phrase it may be encoded as different integers in different parts of the secret message.

(The recipient of the secret message gets only the file of integers and must put the key-phrase at the top of the file.) For example, here is the contents of a secret message file ready for the program:

six perfect quality black jewels amazed the governor

35 10 10 33 9 24 3 17 41 8 3 20 51 16 38 44 47 32 33 10 19 38 35 28 49

Here is a sample run of the program:

C:\> java Decode < secretFile.txt

attack the bridge at dawn

You will need the charAt() method of String.

Here is another secret message file, with key-phrase inserted, that you can use to test your program:

six perfect quality black jewels amazed the governor

31 16 2 3 4 42 48 7 27 9 10 43 12 13 35 15 1 40 18 3

20 15 33 23 24 32 26 29 28 27 21 31 25 14 34 14 36

42 38 19 40 41 27 3 44 50 46 42 48 49 50 6

Program-2 and Program-3:

Two suggested competitive programs to solve on HackerRank

https://www.hackerrank.com/domains/java

Practice 7 (Module-V)

Program-1:

Stop Word Remover:

Write a program that reads in a file of text, perhaps the text of a novel. The program copies the same text to an output file, except that all the useless words such as "the", "a", and "an" are removed. (Decide on what other words you with to remove. The list of words removed is called a stop list.) Do this by reading the text file token by token using hasNext() and next(), but only writing out tokens not on the stop list.

Prompt the user for the names of the input and output files.

Fairly Easy: The output file will have only N tokens per line. Do this by counting tokens as you output them. N will be something like 10 or 12.

Improved Program: Preserve the line structure of the input file. Do this by reading each line using nextLine() and then creating a new Scanner for that line. (Look at the on-line documentation for Scanner.) With each line's Scanner, use hasNext() and next() to scan through its tokens.

Harder: Write out no more than N characters per line. N will be something like 50. Do this by keeping count of the number of characters written out per line. The length() method of String will be useful. If X characters has already been written to the current line, and if X plus the length of the current token exceeds N, then start a new line.

Program-2 and Program-3:

Two suggested competitive programs to solve on HackerRank

https://www.hackerrank.com/domains/java

Practice 8 (Module-V)

Program-1:

E-Mail Address Extractor:

Write a program that scans a text file for possible e-mail addresses. Addresses look like this: someone@somewhere.net

Read tokens from the input file one by one using hasNext() and next(). With the default delimiters of Scanner, an entire e-mail address will be returned as one token. Examine each token using the indexOf() method of String. If a token contains an at sign @ followed some characters later by a period, regard it as a possible e-mail address and write it to the output file.

Programs such as this scan through web pages looking for e-mail addresses that become the targets of spam. Because of this, many web pages contain disguised e-mail addresses that can't easily be automatically extracted.

Program-2 and Program-3:

Two suggested competitive programs to solve on HackerRank

https://www.hackerrank.com/domains/java

Practice 9 (Module-VI)

Program-1:

User-friendly Fat Calculator, with Advice:

Further modify the calories from fat calculator so that it includes another TextField that will be set with the text "Too many fat calories" if the percentage of calories from fat is equal or greater than 30 percent, or to "Healthy amount of fat" if the percentage is less than that.

Program-2 and Program-3:

Two suggested competitive programs to solve on HackerRank

https://www.hackerrank.com/domains/java

Practice 10 (Module-VI)

Program-1:

Three Button Monte:

Write a program to implement a game:

There are three buttons in the frame. Two of the buttons cause the program to quit using System.exit(0); the remaining button changes the frame to green (a win!) The winning button is different each time the game is played.

The easy way to do this (although it seems unfair to the user) treats each button the same way. The actionPerformed() method does not check which button was clicked. When any button is clicked, the method picks a random integer from 0 to 2 and performs the "winning" action if the integer happens to be 0. Otherwise, it performs the "losing" action. To the user, it seems like there is a "winning" button and two "losing" buttons. But, in fact, it does not matter which button was clicked.

This is similar to some electronic gambling devices in casinos, where it appears to the user that there are "winning moves" and "losing moves" but in fact the machine actually ignores what the user has done and just declares a "win" every now and then, according to predetermined odds.

You will need the Random class:

```
Random randNum = new Random(); // create a Random number object
int someInt = randNum.nextInt(3); // someInt gets a number from 0 to 2
```

Program-2 and Program-3:

Two suggested competitive programs to solve on HackerRank

https://www.hackerrank.com/domains/java

Practice 11 (Module-VII)

Content Delivery with Networking:

Write a Client-Server program where the client queries with a name of file and the server delivers the content of requested files to the client over the network.

(Improve the program by making the server multi-threaded)

Practice 12 (Module-VII)

Greet the user with Remote Method Invocation:

Write a program using RMI, where the user invokes a method on remote object with username as parameter and receives a greeting message based on time of the day along with username.

Projects

However, not limited to:

1. Chat application
2. Text Editor application
3. GUI based Scientific Calculator
4. Paint application
5. Slam book

(*PROJECT REVIEWS WILL COMMENCE BEYOND CLASS HOURS)

Monitoring: Credit will be received only on making an honest effort. It

is expected that students will finish watching all lecture video and complete all challenge problems by the end of each lecture week.
Borrowing code from other sources is allowed only with proper attribution and credit given to the original author(s).

List of Common Programs to solve using Java:

1.Program to calculate area of a triangle

3. Program to solve quadratic equation

3.Program to swap two zariables (with and without using third variable)

4.Program to generate random numbers in various ways

5.Program to convert miles to kilometers and vice-versa

6.Program to convert celsius to fahrenheit and vice-versa

7.Program to check if a number is odd or even

8.Program to check if input year is leap year

9.Program to test primality

10.Program to print all prime numbers in an interval using "Sieve of Eratosthenes"

11.Program to generate factorial of all elements in an array

12.Program to display the multiplication table up to 20

13.Program to print the fibonacci sequence

14.Program to check armstrong number, perfect number, Harshad number

15.Program to generate armstrong numbers in an Interval

16.Program to find the sum of Harshad numbers in an interval

17.Program to display powers of two Using lambda

18.Program to perform conversions among decimal to binary, octal and hexadecimal

19.Program to display ASCII table

20.Program to find HCF/GCD and LCM

21.Program to find factors of given natural number

22.Program to make a simple calculator

23.Program to shuffle deck of cards

24.Program to generate fibonacci sequence using recursion

25.Program to find sum of natural numbers using recursion

26.Program to find factorial of number using recursion

27.Program to convert decimal to binary using recursion

28.Program to add two matrices

29.Program to obtain transpose of a matrix

30.Program to multiply two matrices

31.Program to check if a string is palindrome

32.Program to remove punctuations from a string

33.Program to sort words lexicographically
34.Program to illustrate different set operations
35.Program to count frequency of each vowel in a string
36.Program to find hash value of a file

This course on courseware:http://courseware.cutm.ac.in/courses/java-technologies/

Embedded System Programming with ARM-Cortex

Code	Course Title	Credit	T-P-PJ
CUTM1039	Embedded System Programming with ARM-Cortex	6	3-2-1

Objective

- To allow students in Embedded System sectors to learn programming / Interfacing peripherals to ARM Cortex based Microcontroller

Learning outcome

- Describe the architectural features and instructions of 32 bit ARM Cortex M3 microcontroller.
- Understand the basic hardware components and their selection method based on the

characteristics and attributes of an Embedded System.
- Understand various Sensors, Actuators & Interfacing Modules.

Course content

Module I: EMBEDDED C (4 Hrs)

Embedded System, Programming Embedded system, Factor for selecting the Programing language, Embedded C programming Language, Embedded C vs C.

Practice:

1. Familiarization with tools (STM32CubeMX, KeiluVision IDE, Flash Magic & Proteus Simulator).
2. Programming STM32 using KeiluVision& STM32CubeMX.

Module II: ARM-32 bit MICROCONTROLLER (6 Hrs)

ARM Design Philosophy & RISC Architecture, Programmer's Model. ARM Cortex M, Cortex M Architecture, ARM Cortex-M Internals & Debugging.

Practice:

1. Familiarization with Different Processors and Controllers Boards (8, 16, 32, 64 bits)

Module III: STM32 GPIO MANAGEMENT (14 Hrs)

GPIO Configuration, Driving De-initialization, Interfacing IO devices and its type – LEDs, Switches, Buzzer, Seven Segment Display, LCD (4 bit, 8 bit Mode), Keypad (4*4), DC Motor, Stepper Motor, Servo motor, Relay.

Practice:

1. Write an Embedded C program to interface LEDs with STM32.
2. Write an Embedded C program to interface Switch with STM32.
3. Write an Embedded C Program to design up counter & down counter using Seven Segment Display. (1 digit, 2 digit)
4. Write an Embedded C program to interface buzzer to control with the help of Switch.
5. Write an Embedded C program to display characters on Alphanumeric LCD.
6. Write an Embedded C program to interface Keypad and LCD with STM32.
7. Write an Embedded C program to interface DC Motors, Stepper Motor, and Servo Motor rotate clockwise, anticlockwise and in angle (45^o, 90^o, 180^o).
8. Write an Embedded C program to interface relay to control the AC Appliances.

Module IV: STM32 INTERRUPT MANAGEMENT & UART (14 Hrs)

NVIC Controller, Enabling Interrupt, Interrupt Priority Levels, UART Initialization, UART communication in polling Mode & in Interrupt Mode. Wireless Technologies- Bluetooth, Wi-Fi, RF.

Practice:

1. Write an embedded C program to generate an Interrupt process using STM32.
2. Write an Embedded C program to interface STM32 to Bluetooth Module to send & receive Data.
3. Write an Embedded C program to interface STM32 to GPS module to get a Location Coordinate.
4. Write an Embedded C program to interface STM32 to GSM module to Send & Receive SMS.
5. Write an Embedded C program RF module with STM32 to send and receive the data wirelessly.
6. Write and Embedded C program to design a system to read the RFID cards using STM32.
7. Write and Embedded C program to connect ESP8266 with STM32 to create a Webserver.

Module V: STM32 TIMERS , ADC, & DAC (10 Hrs)

Timers Basics, General Purpose Timer, SysTick Timer, ADC & DAC Basics, Initialization, DAC Peripherals & Modules. Analog Sensors and its Types(Ultrasonic Sensor, Temperature, Humidity, Soil Moisture Sensor, PIR sensor)

Practice:

1. Write an Embedded C Programs to generate Delay using Timer.
2. Write an Embedded C program to display output for given analog input using internal ADC. (Use of Analog Sensors like Ultrasonic Sensor, Temperature, Humidity, Soil Moisture Sensor, PIR sensor)
3. Write an embedded C program to generate Triangular and Square waves using DAC.

Module VI: STM32 I2C & SPI (10 Hrs)

I2C specification, Protocol configuration, I2C Peripherals. SPI Specification, Protocol configuration, it's Peripheral and Modules.

Practice:

1. Write an Embedded C program to build I2C communication between STM32 and Arduino
2. Write an Embedded C program to build SPI communication STM32 to the Arduino board.

Module VII: PWM & CAN (8 Hrs)

RTC feature and its Module, CAN Protocols Overview, Application, Architecture, Data Transmission & Data Frames.

Practice:

1. Write an Embedded C program to implement a Real-Time Clock.
2. Write an Embedded C program to Speed Control of DC motor using PWM.
3. Write an Embedded C program to change the intensity of Light using PWM.

Text Books:

1. Shibu K V, ―Introduction to Embedded Systems‖, Tata McGraw Hill Education Private Limited, 2nd Edition
2. Noviello, Carmine. "Mastering STM32." Obtenido de http://www2. keil. com/mdk5/uvision,2017.
3. Norris, Donald. Programming with STM32: Getting Started with the Nucleo Board and C/C++. McGraw Hill Professional, 2018.

Reference Books:

1. STM32F10xx User Manual
2. https://www.udemy.com/course/stm32cubemx-complete-training/learn/lecture/9606338#overview

1. **https://www.udemy.com/course/embedded-c-programming-for-embedded-systems/**

VLSI Design

Code	Course Title	Credit	T-P-PJ
CUTM1040	VLSI Design	6	3-2-1

Objective

- The objective of the course is to provide understanding of the entire logic design process with the analysis from combinational and sequential digital circuit design.
- Provide understanding of the techniques essential to the Verilog programming for Verification and Testing.
- To learn the architecture of most prominent vendor in the FPGA market, Xilinx FPGAs and Altera FPGAs.

Learning Outcome

- Analyze combinational and sequential circuit design concepts.
- Develop FSMs & ASMs for the given problems.
- Write Verilog code, compile, simulate and execute on any VLSI design platform.
- Apply Verilog HDL for FPGA Programming.
- Implement Digital Circuits on Xilinx FPGAs and Altera FPGAs using Verilog HDL.

Course content

ModuleI: Introduction to VERILOG (10 hrs)

Introduction to Verilog HDL & Hierarchical Modeling Concepts,Lexical Conventions &DataTypes,System Tasks & Compiler Directives,Modules, Ports and Module Instantiation Methods,Modeling methods,Design Verification using Test benches

Practice

1. Introduction to Xilinx EDA Tool.
2. Introduction to XST Tool and ISIM Tool
3. Xilinx Tool Flow: Simulation and Synthesis
4. Module and Ports in Verilog
5. Data Types in Verilog Programing.

Module II: Boolean Algebra and Logic Minimization (8hrs)

Binary Arithmetic and 1's and 2's Complementation, Basic Theorems and Properties, Canonical and Standard Form, AlgebraicSimplification of Digital Logic Gates,The Karnaugh Map Method, Prime and Essential Implications, Don't Care Map Entries.

Practice

1. Gate level Modelling in Verilog.
2. Data flow Modelling in Verilog.
3. Behavioral Modelling in Verilog.

Module III: Combinational Circuit Design (12hrs)

Arithmetic Circuits: Adder/Subtractor Circuits, Ripple Carry Adder, Universal Ripple carry Adder, BCD Adder, MultipliersComparators, Multiplexer, Demultiplexer, Decoder, Encoder and Priority Encoder, Code Converters: Binary to Gray, Binary to BCD.

1. Design of Arithmetic Circuits using Verilog.
2. Design of Encoder and Decoder using Verilog.
3. Design of Data selector and Data Distributor using Verilog.
4. Design of comparator and Code converters using Verilog.

Module IV: Sequential Circuit Design (14hrs)

Latch, Flip-Flop: S-R,D,J-K,T, Flip-Flop Conversion and Excitations Counter: Asynchronous and Synchronous counter Design, Register: SISO, SIPO,PISO and PIPO, Universal Shift Register, Johnson counter and Ring Counter.

Practice

1. Design SR and D-Flip Flop Using Continuous and Procedural Assignments.
2. Design JK-Flip Flop And T-Flip Flop Using Verilog.
3. Design Shift Registers (SISO, SIPO, PISO, PIPO) using Verilog.
4. Design Ripple Counter and Up/Down Synchronous Binary Counter Using Verilog.

Module V: State Machines (10 hrs)

Basic Finite state machines (FSM) structures, Mealy and Moore type FSM,Design of controller and Data path units,Controller Design using FSMs & ASMs

Practice

1. Design of Sequence Detectors allowing overlapping as well as non-overlapping.
2. Design of Mealy and Moore type FSM using Verilog.
3. Design of data controller using ASM.

Module VI: FPGA Architecture and Prototyping (5 hrs)

Introduction to Programmable Logic and FPGAs, Popular CPLD & FPGA Families, Architecture of Xilinx and Altera FPGAs

Practice

1. Proto-typing of a design using FPGA Design Kit

Module VII: Synthesis and Timing **(6hrs)**

FPGA Design Flow,Implementation Details Advanced FPGA Design tips, Logic Synthesis for FPGA, Static Timing Analysis

Practice

1. Design mapping and optimization
2. Analyze and resolve design problems
3. Report generation
4. Verilog gate-level netlist generation and post-synthesis timing data (SDF) extraction
5. Design constraints generation for placement and routing

Text Books:

1. M.Morris Mano., "Digital Design", Pearson Education, 4th Edition.
2. Palnitkar, S. (2003). Verilog HDL: a guide to digital design and synthesis (Vol. 1). Prentice Hall Professional.

Reference Books:

1. Kohavi, Z., & Jha, N. K. (2009). Switching and finite automata theory. Cambridge University Press.
2. Jain, R. P. (2003). Modern digital electronics. Tata McGraw-Hill Education.

Electromagnetic Field Theory & Transmission Lines

Code	Course Title	Credit	T-P-PJ
CUTM1042	Electromagnetic Field Theory & Transmission Lines	3	2-1-0

Objective

- To introduce the fundamental theory and concepts of electromagnetic waves and transmission lines
- To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
- To impart knowledge on the concepts of magnetostatics, magnetic flux density, scalar and vector potential and its applications.
- To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations.
- Model and design the transmission lines at high frequencies.
- To apply Smith chart use for solution of transmission line problems and impedance matching.

Learning outcome

- Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential.
- Apply the principles of electrostatics to the solutions of problems relating to boundary conditions and electric energy density.
- Apply the principles of magnetostatics to the solutions of problems relating to magnetic field and magnetic potential,
- Apply the principles of magnetostatics to the solutions of problems relating to boundary conditions and magnetic energy density.
- Understand the concepts related to Faraday‘s law, induced emf and Maxwell‘s equations.
- Apply Maxwell‘s equations to solutions of problems relating to transmission lines and uniform plane wave propagation.

Course content

Module I: Electrostatics (3hrs Theory + 2hrs Practice)

Introduction to Electrostatic Fields, Gauss's Law and Applications, Electric Potential, Maxwell’s Two Equations for Electrostatic Fields,Electric Current and Current Density, Continuity Equation, Relaxation Time, Laplace’s and Poisson’s Equations.

Practice:

1. To Calculate the Electric field of a dipole using Coulomb's law in Matlab

2. Simulation of Electric Potential and Electric Field in Matlab

Module II: Magnetostatics (3hrs Theory + 2hrs Practice)

Biot-Savart Law: Current Flow – which path does it take, Ampere's Circuital Law, Magnetic Flux Density: Closed Loop Circuits, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Inductances and Magnetic Energy.

Practice:

1. Magnetic field by an infinitely long line current using matlab
2. Magnetic field of a Circular current loop using Biot Savart's Law

Module III: Maxwell's Equations (3hrs Theory + 1hr Practice)

Maxwell's Equations and Boundary Conditions.

Practice:

1. Maxwell's Equation using matlab

Module IV: Electromagnetic Waves (3hrs Theory + 4hrs Practice)

Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves, Wave Propagation in Lossless and Conducting Media, Polarization, Reflection and Refraction of Plane Waves – Normal and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Surface Impedance. Poynting Vector and Poynting Theorem.

Practice:

1. Linear and Circular Polarization of waves using matlab
2. 1-D standing wave using matlab
3. 2-D standing wave (TE) using matlab
4. 2-D standing wave (TM) using matlab
5. Design of Wireless Power Transfer using matlab

Module V: Introduction to Transmission Line Modelling (3hrs Theory + 3hrs Practice)

Introduction to Transmission line equations, Primary & Secondary constants Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Losslessness/Low Loss Characterization, Distortion , Loading, Transmission Line Effects, SC and OC Lines,

Reflection Coefficient, VSWR, λ/8, λ/4, λ/2 line impedance Transformations, Smith Chart – Configuration and Applications, Impedance Control.

Practice:

1. Reflection and transmission of a plane wave (S-wave)
2. Reflection and transmission of a plane wave (P-wave)
3. Radiation by an infinitesimal dipole

Module VI: Waveguides (3hrs Theory)

Introduction, Rectangular Waveguides, electric and magnetic field patterns in TE10 and TE11 mode configuration, modes of TE wave in rectangular waveguide, field equations, impossibility of TEM wave propagation in waveguides, cutoff frequency of rectangular waveguide, propagation constant, wave impedance, phase velocity, group velocity, dominant mode and degenerate modes, related problems.

Module VII: Electromagnetic Computational Techniques (3hrs Theory)

Introduction, Finite Difference Method (FDM), Finite Element Method (FEM) and Method of moments (MOM) technique.

Text Books:

1. Matthew N.O. Sadiku, “Elements of Electromagnetics”, Oxford Univ. Press.
2. G.S.N.Raju, “Electromagnetic Field Theory and Transmission Lines”, Pearson Education (Singapore) Pvt., Ltd.

Reference:

1.E.C. Jordan and K.G. Balmain, “Electromagnetic Waves and Radiating Systems”, PHI.
2.Seungbum Hong, "Electrodynamics: An Introduction", Coursera.
3.Seungbum Hong, "Electrodynamics: Electric and Magnetic Field", Coursera.
4.Seungbum Hong, "Electrodynamics: In-depth Solutions for Maxwell’s Equations", Coursera.
5.Husain Habib, "Electromagnetic Tutorials part 1 with MATLAB & GeoGebra", Udemy.

Network Analysis

Code	Course Title	Credit	T-P-PJ
CUTM1043	Network Analysis	3	2-1-0

Objective

- **To learn techniques of solving circuits involving different active and passive elements.**
- To deliver problem solving skills on circuits through the application of simulation & programming techniques and principles to common circuit problems.
- **To analyze the behavior of the circuit's response in time domain.**

Learning outcome

- Apply the knowledge of basic circuital law and simplify the network using different techniques.
- Analyze the circuit using graphical method and network theorems.
- Infer and evaluate transient response, Steady state response
- Obtain the maximum power transfer to the load , and Analyze the series resonant and parallel resonant circuit.
- Evaluate two-port network parameters.

Course Content

Module I **(4 hrs)**

Network Topology

Graph of a network, Concept of tree, Incidence matrix, Tie-set matrix, Cut-set matrix, Formulation and solution of network equilibrium equations on loop and node basis

Practice

- Incidence Matrix Formulation
- Tie-set Matrix Formulation
- Cut-set Matrix Formulation

Module II **(5 hrs)**

Network Theorems

Substitution theorem, Reciprocity theorem, Maximum power transfer theorem, Tellegen's theorem, Millman's theorem, Compensation theorem

Practice

- Verification of Reciprocity theorem
- Verification of Tellegen's theorem
- Verification of Milliman's theorem
- Verification of Maximum power transfer theorem
- Verification of Compensation theorem

Module III
Coupled Circuits **(5 hrs)**
Theory
Coupled Circuits, Dot Convention for representing coupled circuits, Coefficient of coupling, Series and parallel resonant circuits: Band Width and Q-factor

Practice
1. Self-inductance, mutual inductance and coefficient of coupling to be determined for a 1-Ø transformer representing coupled circuit.
2. Frequency response of a series and parallel resonant circuit by laboratory set up.

Module IV **(5 hrs)**
Network Laplace Transform
Application of Laplace transform: Circuit Analysis (Steady State and Transient)
Practice:
- Analysis of transient characteristics using Matlab
- AC and DC transient response analysis for RL,RC and RLC circuits

Module V **(5 hrs)**
Two Port Network
Z, Y, ABCD and h-parameters, Reciprocity and Symmetry, Interrelation of two-port parameters, Interconnection of two-port networks
Practice:
- Determination of Z parameters
- Determination of Y parameters
- Determination of h parameters
- Determination of ABCD parameters

Module VI **(4 hrs)**
Filters
Brief idea about network filters (Low pass, High pass, Band pass and Band elimination) and their frequency response

Practice:
- Design and frequency response analysis of Low Pass filter
- Design and frequency response analysis of High Pass filter
- Design and frequency response analysis of Band Pass filter
- Design and frequency response analysis of Band elimination filter

Module VII
Fourier Series **(5 hrs)**
Theory

Fourier series, Fourier analysis and evaluation of coefficients, Steady state response of network to periodic signals, Fourier transform and convergence, Fourier transform of some functions

Practice:

- Fourier series expansion of Square wave
- Fourier series expansion of Sine wave

Text Books:

1. *M. E. VAN VALKENBURG- Network Analysis, PHI Publications*
2. *A K Chakraborty, "Network Theory," DhanpatRai Publication*
3. *MAHMOOD NAHVI – Electric Circuits, SCHAUM'S Outlines Fifth Edition*

Reference Books:

1. *Smarajit Ghosh- Network Theory Analysis & Synthesis, MC Graw Hill Publishers*
2. *Dr. B.R.GUPTA-Network Analysis & Synthesis, S.Chand*

Energy Production & Transmission

Code	Course Title	Credit	T-P-PJ
CUTM1051	Energy Production & Transmission	3	2-1-0

Course Objective

- To understand power generation and economics
- To design the transmission line parameters
- To understand the mechanical design of transmission lines

Learning outcome

- Able to understand the different functions of major equipment of the power plants and layout designing of the plants

- Able to understand the economic aspects of power system generation
- Able to design transmission line cables

Course content

Module I: Thermal & Nuclear Power Plants (6Hours)

Introduction: Statistics of generation of electric power from Conventional and non conventional sources of energy, Thermal & Nuclear power station: Schematic arrangement, Types of prime movers, types of reactors, speed control & auxiliaries, Environmental aspects for selecting the sites and locations, Hazards.

Practice:

1. Schematic Layout design Thermal Plant using AutoCad
2. Schematic Layout design Nuclear Plant using AutoCad

Module II: Hydro & Wind power plants (4Hours)

Hydro power station: Schematic arrangement, Hydro turbines, Environmental aspects for selecting the sites and locations of hydro power stations, small hydro for irrigation, Wind power generation.

Practice:

3. Schematic Layout design of Hydro Plant using AutoCad

Module III: Power Generation Tariffs (5Hours)

Tariff and Economic aspects in power Generation: Terms commonly used in system operation, various factors affecting cost of generation: Load curves, load duration curves, Connected load, maximum load, Peak load, base load and peak load power plants, load factor, Plant capacity factor, Plant use factor, Demand factor, diversity factor, Cost of power plant.

Practice: MATLAB

4. Preparation of Load calculator using MATLAB

Module IV: Transmission systems (4 Hours)

Supply System: Different kinds of supply system and their comparison, choice of transmission voltage.TransmissionLines:Configurations, types of conductors, resistance of line, skin effect, Kelvin's law, Proximity effect,

Module V: Transmission line Parameters (5 Hours)

Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuittransmission lines, Representation and performance of short, medium and long transmission lines, T & Pi networks, ABCD parameters, Ferranti effect, Surgeimpedance loading.

Practice:

5. Designing of transmission line parameters using MATLAB

Module VI: Transmission line operation & Insulators (5Hours)

Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affectingcorona, methods of reducing corona and interferenceElectrostatic and electromagnetic interference with communication lines.

Overhead line Insulators:

Type of insulators and their applications, potential distribution over a string of insulators, methods ofequalizing the potential, string efficiency.

Practice:

6. Designing of Insulators and calculation of voltages using MATLAB

Module VII: Design of cables (4 Hours)

Calculation of sag & tension, affects of wind and ice loading, sag template, vibrationdampers.Under Ground Insulated cables:Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance ofsingle phase and three phase cables, dielectric loss, heating of cables, Transmission line tower designs

Practice:

7. Designing of Cables

Text Books:

1. Electrical power Generation, Transmission and Distribution S.N. Singh PHI 2nd Edition, 2009

Reference Books:

1. A Text Book on Power System Engineering A.Chakrabarti, DhanpathRai 2nd Edition

Substation Switch Gear &Protection

Code	Course Title	(Credit)	T-P-PJ
CUTM1052	Substation Switch Gear &Protection	4	2-1-1

Objective

- To understand the different components of substation.
- To understand the protection of different equipment in power system.

Learning outcome

- Able to understand the performance of different protection methods of different equipments.

- Able to understand the different components of substation and their operation.
- Able to design the power system switchgear.

Course content

Module I: Substation Systems (6 Hours)

Introduction to Substation System:Definition of substation, necessity of substation, essential features, types of substation, single line diagram of substation, List and functions of each component of substation. Auxiliary systems, Over head earthing screen, Sub-station earthing system.

Practice:

1. Layout Designof 220KV substation using MATLAB
2. Layout Design of 400KV & 750KV substation using MATLAB as per IEEE standards

Module II: Operation & Maintenance of Substations (10 Hours)

Testing and maintenance of Bus Bars, and Isolators:Types and ratings – Bus bar configuration, Tests on Bus bars. Types of isolators and ratings,Load Break switches, Maintenance of isolators,testing and maintenance of Power Transformers, Current and Voltage Transformers and Insulators:Preliminary tests, Final tests, Impulse test, Partial discharge test, Transformer maintenance. Current Transformer tests, Potential Transformer tests. CT and PT maintenance, Tests and maintenance of insulator

Practice:

3. Maintenance tests of CT & PT of substation as per manufacturers Hand book
4. Maintenance tests of Lightening Arrestor & Circuit Breaker of substation as per manufacturers Hand book
5. Maintenance tests of transformer as per manufacturers Hand book

Module III: Protection& System components (5 Hours)

Need for protective schemes, Nature and Cause of Faults, Types of Fault, Effects of Faults, Zones of Protection, Primary and Backup Protection, Essential Qualities of Protection, Classification of Protective Relays, Automatic Reclosing, Current Transformers for protection, Voltage Transformers for Protection.

Module IV: Relays (4 Hours)

Introduction,-Electromechanical Relays,Static Relays – Merits and Demerits of Static Relays, Numerical Relays, Comparison between Electromechanical Relays and Numerical Relays.

Practice:

6. Designing of a Digital Relay

Module V: Relay Operations (7 Hours)

Introduction, Time – current Characteristics, Current Setting, Time Setting, Overcurrent Protective Schemes, Reverse Power or Directional Relay, Protection of Parallel Feeders, Protection of Ring Mains, Earth Fault and Phase Fault Protection, Combined Earth Fault and Phase Fault Protective Scheme, Phase Fault Protective Scheme, Directional Earth Fault Relay, Static Overcurrent Relays, Numerical Overcurrent Relays.

Module VI: Protection control systems (5Hours)

Pilot Relaying Schemes:Introduction, Wire Pilot Protection, Carrier Current Protection
Numerical Differential Relays: Simple Differential Protection, Percentage or Biased Differential Relay, Differential Protection of 3 Phase Circuits, Balanced (Opposed) Voltage Differential Protection.
Rotating Machines Protection:Introduction, Protection of Generators
Transformer and Buszone Protection:Introduction, Transformer Protection, Buszone Protection, Frame Leakage Protection

Practice:

7. Design of Protection Scheme using MATLAB

Module VII: Circuit Breakers (8 Hours)

Introduction, Fault Clearing Time of a Circuit Breaker, Arc Voltage, Arc Interruption, Restriking Voltage and Recovery Voltage, Current Chopping, Interruption of Capacitive Current, Classification of Circuit Breakers, Air – Break Circuit Breakers, Oil Circuit Breakers, Air – Blast Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers, High Voltage Direct Current Circuit Breakers, Rating of Circuit Breakers, Testing of Circuit Breakers.

Practice:

8. Design & simulation of Circuit breaker using 3DS Tools

Project:

1. Analysis of critically operating power system using MATLAB/DYMOLA

Text Books:

1. Fundamentals of Power System Protection Y.G.Paithankar S.R. Bhide PHI 1 st Edition, 2009

Reference Books:

1. Power System Protection and Switchgear, BhuvaneshOza et al McGraw Hill 1 st Edition, 2010

System Modeling & Control

Code	Course Title	(Credit)	T-P-PJ
CUTM1053	System Modeling and Control	4	3-1-0

Objective

- To teach how to convert a physical systems consist of mechanical and electrical system into a mathematical model.
- Analysis of a live system in time domain and frequency domain and application of controllers to get the desired response.

Learning outcome

- Students will understand the basics of a system.
- Student gain knowledge on stability of a system.
- Student will analyze the system and controller.
- Students will develop skill of designing automatic control system and controller for a particular application.

Course content

Module I: Introduction (6 Hours)

Theory

Introduction to Control Systems: Basic Concepts of Control Systems, Open loop and closed loop systems; Servomechanisms,Laplace transform, Transfer functions, Concept of Pole and Zero.

Practice: Hardware/MATLAB

1. Study of Temperature control system
2. Using MATLAB, find the poles, zeros, gain and draw the pole-zero plot of the transfer function.

Module II: System Dynamics (10 Hours)

Theory

Mathematical Models of Physical Systems: Differential Equations of Physical Systems, Mechanical Translational Systems, Rotational systems, Electrical Systems, Analogy between Mechanical and electrical quantities, Derivation of Transfer functions, Block Diagram Algebra, Signal Flow Graphs and Mason's Gain Formula.

Practice: MATLAB

3. Using MATLAB, find the transfer function from given block diagram.

Module III: Time Response Analysis (8Hours)

Theory

Time Response Analysis: Type Test Signals, Time response of first order systems to unit step and unit ramp inputs, Time Response of Second order systems to unit step input, Time Response specifications, Steady State Errors and Static Error Constants of different types of systems.

Practice: MATLAB/DYMOLA

4. Standard Test Signals
5. Time response of first order systems to unit step and unit ramp inputs
6. Time Response of Second order systems to unit step input
7. Using MATLAB, determine the steady state error of the given system.

Module IV: Stability in Time Domain **(4 Hours)**

Theory

Stability in Time Domain: Stability and Algebraic Criteria, concept of stability, Necessary conditions of stability, Hurwitz stability criterion, Routh stability criterion and Application of the Routh stability criterion to linear feedback system

Module V:Root Locus Technique **(5 Hours)**

Theory

Root Locus Technique: Root locus concepts, Rules of Construction of Root locus and Determination of Roots from Root locus for a specified open loop gain.

Practice: MATLAB

8. Construct the root locus for 2^{nd}&3^{rd} order system and analyze its stability (Gain)

Module VI: Frequency Response Analysis **(6Hours)**

Theory

Frequency Response Analysis: Frequency domain specifications, correlation between Time and Frequency Response with respect to second order system, Bode plot, Determination of Gain Margin and Phase Margin from Bode plot.

Practice: MATLAB

9. Construct the bode plot for 2^{nd} and 3^{rd}order system and analyze its stability (PM & GM)

Module VII: Controllers **(4 Hours)**

Theory

Controllers: Concept of Proportional, Derivative and Integral Control actions, P, PD, PI and PID controllers.

Practice: MATLAB/DYMOLA

10. Design of P,PD, PI and PID Controller for 2^{nd}or 3^{rd}order system

Text Books:

1. Saeed S. Hasan, "Automatic Control Systems,"Kataria Publication, 9th Edition-2017.

Reference Books:

2. Nagrath J. and Gopal M., "Control Systems Engineering," New Age International Publishers, 6th Edition-2017.

Electrical Machines Operation and Control

Code	Course Title	T-P-PJ	Prerequisite
CUTM1054	Electrical Machines Operation and Control	3-1-0	Basic Electrical Engineering

Objective

- To introduce the students about principles of electromagnetism applied to alternating machines.
- To familiarize the students about the fundamental laws that governs the operation of machines and to extend its application to synchronous generator and motors.
- To introduce the students about the constraints associated with starting of Induction motors.
- Develop selection skill to identify the type of generators or motors required for particular application.
- Highlight the importance of transformers in transmission and distribution of electric power.

Learning Outcome

- Distinguish the constructional similarity and dissimilarity between various machines.
- Perform different tests on various machines.
- Understand electromagnetic and electromagnetic induction
- Understand DC Machines
- Understand single and three phase A.C circuits, and Understand AC machines

Course content

Module-I: D.C. Machines (5 Hrs)

Theory

Construction, Classification and Principle of operation of DC machines.
Theory & testing:-EMF equation of DC generator, DC Motor Characteristics, Speed Equation of DC Motor. Characteristic for Speed Armature Current, Torque Armature Current and Speed Torque of (i) Separately Excited DC Motor, (ii) DC Shunt Motor, (iii) DC Series Motor, and (iv) DC Compound Motor, Comparison between Different types of DC Motors
Application- DC Generator, DC Motor-Types

Practice:

1) Determination of OCC (Open Circuit Characteristics) of D.C Shunt Generator.
2) Starting & Speed Control of D.C Shunt motor by (i) Field flux control method & (ii) armature voltage control method.
3) Starting & Speed Control of D.C Series motor by (i) Field flux control method & (ii) armature voltage control method.

MODULE II: Stepper Motors (Precision Machines) (6 Hrs)

Theory

Stepper motor drive, basic principles involved in stepper motor control, stepper motor specification, operation and commercial driver chips and packages, Brushless DC Motors, Reluctance Motor, Hysteresis Motor

Application in Medical, Automobile, Civil, Electrical etc

Practice:

4) Motor Voltage and Current Measurement.

5) ON-Load Tap changer

Module-III: Induction Motors (8 Hrs)

Theory

Principles of operation of induction motors, both single and 3-phase types. Torque-speed curves, Different types of single phase motors

Three Phase Induction Motor

Equivalent Circuit and Phasor Diagram, No-Load and Blocked Rotor tests, Determination of Parameters, Slip-Torque Characteristics Losses and Efficiency, Effect of rotor resistance, Starting and speed control methods, Cogging, Crawling and Electrical Braking of Induction Motors.

Applications of three & single phase motors which will assist in picking the right one for an application.

Practice:

5) Determination of parameter of a single phase induction motor and study of (a) Capacitor start induction motor (b) Capacitor start and capacitor run induction motor

6) Determination of Efficiency, Plotting of Torque-Slip Characteristics of Three Phase Induction motor by Brake Test.

7) Load test of a 3 phase slip ring induction motor.

Module-IV: Three Phase Synchronous Generators (7 Hrs)

Theory

Construction, Principle, Coil Pitch, Distributed Windings in A.C. Machines, The Equivalent Circuit of a Synchronous Generator (Armature Reaction Reactance, Synchronous Reactance and Impedance). The Phasor Diagram of a Synchronous Generator, Power and Torque in Synchronous Generators (Power Angle Equation and Power Angle Characteristic)

Practice:

8) Plotting the open circuit and short circuit characteristics of alternator.

9) Calculating the voltage regulation by synchronous impedance method.

10) Calculating the voltage regulation by zero power factor method.

Module-V: Parallel Operation Of Three Phase AC Synchronous Generators (4 Hrs)

Theory

Synchronous condenser, Hunting, Paralleling-Conditions, Procedure, Operation of Generators in Parallel with Infinite bus bar, Effect of excitation, effect of unequal voltage and steam power supply.

Practice:

11) Connection & verifying the conditions of parallel operation of alternators.

12) Verification of direct axis reactance, quadrature axis reactance

13) Load Sharing during parallel operation using Dymola.

Module-VI: Three Phase Synchronous Motors (6 Hrs)

Theory

Basic Principles of Motor operation, Construction, Starting Synchronous Motors, Synchronous Motor Ratings, Equivalent circuit & phasor diagram, Effect of excitation on varying load, power developed in a synchronous motor.

Applications of synchronous motors

Practice:

14) Study of universal motor and shaded pole motor.

15) Use of synchronous motor as a synchronous condenser for p.f improvement.

Module-VII: Single-Phase Transformers (9 Hrs):

Theory

Construction and principle of operation, EMF Equation, Transformation ratio, Practical and Ideal transformers

Three Phase Transformers: Three-phase transformer connections- Star-star, Two Single-Phase Transformers connected in Open Delta (V-Connection) and their rating, Delta-star, Zig-zag connections. Scott connection, Open delta connection. Auto Transformers, Welding Transformer.

Application of Single & Three Phase transformer

Practice:

16) Prescribed tests of single phase and three phase Transformer.

17) Load balancing in a three phase distribution Transformer.

18) Simulation of open delta condition of Transformer.

TEXT BOOK:

1. Electrical Machines – D P Kothari and I J Nagrath, Fourth Edition – Tata McGraw Hill.

REFERENCE BOOKS:

1. Electrical Machinery – P S Bimbhra – Khanna Publishers.
2. Electrical Machines - P. K. Mukherjee, S. Chakravarti, Dhanpat Rai & Sons

Industrial Power Electronics

Code	Course Title	Credit	T-P-PJ
CUTM1055	Industrial Power Electronics	4	2-1-1

Course Objective

- Theymust meet industrial requirement for power electronic engineers.
- They must be gaining adequate practical knowledge on power semiconductor devices, converters and their control techniques.
- They should know the typical applications to motor drives.

Learning outcome

- They will apply their knowledge of the electrical characteristics of power semiconductor devices.
- They will know how to select power semiconductor devices for a range of applications.
- They will understand the basic topology of converters, inverters and power supplies and design calculations for drive
- They will learn the power converter applications, and understand the approximations used.

Course content

Module I (6hrs.)

Power Semiconductor Devices

Introduction to power electronics, uncontrolled switches, semi-controlled switches,fully controlled switches, constructional features, operating principle, characteristics and specification of power semiconductor devices,hard and soft switching of power semiconductors switches.

Practice

1. Simulation of V-I characteristics of power diode&power transistor.
2. Simulation of V-I characteristics of MOSFET& IGBT.
3. Simulation of V-I characteristics of silicon-controlled rectifier.

Module II (3 hrs.)

Triggering Circuits

R- Triggering, R-C triggering, UJT triggering, design of UJT triggering circuit.

Practice

4. Simulation of R and RC triggering.
5. Simulation of UJT triggering

Module III **(8 hrs)**

AC to DC Converter

Overview of rectifiers, half wave uncontrolled rectifier with R load and R-L load, use of freewheeling diode, half wave rectifier R-L load with FWD, full wave bridge uncontrolled rectifier, half wave controlled rectifier with R load,R-L load and R-L load with free-wheeling diode, half controlled bridge rectifier, fully controlled bridge rectifier, effect of source inductance on the performance of ac to dc converters, power factor improvement,harmonic reduction, filter design.

Practice

6. Simulation of single phase half-wave and full-wave diode rectifier using R & L load.
7. Simulation of single phase fully controlled converter using R & L load.
8. Simulation of single phase semi converter using R-L load.
9. Simulation of 3-phase semi converter with R, R-L and dc motor load with/without freewheeling diode.
10. Simulation of 3-phase bridge converter with R, R-L and dc motor load with/without freewheeling diode.

Module IV: **(10 hrs.)**

DC to DC Converter

Introduction to chopper (Type A,B, C, D, E), switching techniques, step down dcchopper with R load, R-L-E load, step up dc chopper with R, R-L, R-L-E load, buck regulator, boost regulator, Buck-boost regulator, CUK and SEPIC converter, commutation of thyristor based circuits part-I, commutation of thyristor based circuits part-II, introduction to SMPS circuits, fly back type SMPS, forward type SMPS, design of transformer for SMPS circuits.

Practice

11. Simulation of buck converter.
12. Simulation of boost converter.
13. Simulation of buck boost converter.

Module V **(6 hrs.)**

DC to AC Converter

Introduction to inverters, importance and application of inverters, single phase half bridge inverter with R and R-L load, single phase bridge inverter with R and R-L load, three phase inverters, control techniques of inverter, single/multiple pulse width modulation, sinusoidal pulse width modulation and its realization, CSI, load-commutated CSI, industrial inverter.

Practice

14. Simulation of single-phase inverter&three phase inverter.

Module VI **(3 hrs.)**

AC to AC Converter

AC voltage controller: Single phase bi-directional controllers with R and R-L load, single phase cyclo-converters.

Practice

15. Simulation of single phase AC voltage controller&cyclo-converter.

Module VII **(9 hrs)**

Application of Power Electronics Converters

Analysis of converter fed dc drives, analysis of chopper fed dcdrives,analysis of VSI,CSI fed induction motor drives, automotive & traction system, industries as rolling mills, pumps, elevators, utility systems as FACTs, smart grid, and renewable energy as wind turbine.

Practice

16.Simulation of converter fed dc drives (Wind Turbines).

17. Simulation ofchopper fed dcdrives (PV Systems).

18. Simulation of induction motor drives (e-Vehicle).

19.Simulation of railway electrification system using Dymola

Project

1. 500 VA Sine wave Inverter
2. Industrial Battery Charger using SCR
3. Precision Illumination control of Lamp
4. Dual Converter using Thyristors

Text Books:

1. *M. H. Rashid,"Power Electronics: Circuits, Devices and Applications," 4th Edition, Pearson,2017*
2. *M. D. Singh & K. B. Khanchandani, "Power electronics", 2nd Edition, Tata McGraw-Hill,2008*

Reference Books:

1. *J. Vithayathil,"Power Electronics: Principles and Applications",2nd Edition TMH Edition,1995*

2. *Mohan, Undeland and Robbins,"Power Electronics: Converters, Applications and Design" 3rd Edition Edition, 2007*

Digital Measurement and Instrumentation

Code	Course Title	Credit	T-P-PJ
CUTM1056	Digital Measurement and Instrumentation	3	2-1-0

Objective

- The main objective of this course is to explain the operation, performance and application of Digital Measuring Instruments to the students.

Learning Outcome

- Understand the construction, principle and characteristics of different types of digital measuring instruments
- Apply the knowledge about different instruments and can identify the best suitable instrument for a required typical measurement

Course Content

Module I **(6 hrs)**

Philosophy of digital measurements

Time Measurement Techniques: Error analysis in digital measurement, Measurement of time interval between two events, Error in time interval measurement, Vernier technique for small time measurement, Measurement of time interval with constraints, Measurement of periodic time, phase, Quality factor of ringing circuit, Decibel meter, Software controlled measurement.

Practice

- Error analysis of digital measurement using Matlab
- Simulation of Quality Factor of ringing circuit

Module II **(5 hrs)**

Digital frequency measurement techniques

Measurement of frequency, Ratio of two frequencies, Product of two frequencies, High frequency, average Frequency difference, Deviation of power frequency, Peak frequency. Fast low-frequency measurement, Digital Tachometer.

Practice

- Addition and product of different frequencies using Matlab
- Simulation of digital tachometer using Matlab

Module III **(5 hrs)**

Digitally Programmable Circuits

Single mode switching, Group mode switching, Resistors, Potentiometers, Amplifiers, Schmitt trigger, Dual polarity gain amplifiers. Programmable gain amplifier with dual output, Two stage programming, Programmable Biquads.

Practice:

- Analysis of switching using Matlab
- Simulation of programmable biquads using Matlab

Module IV **(4 hrs)**

Digital to Analog Converters

Output Input relation, DACs derived from programmable gain amplifiers, Weighted-resistor DAC, Weighted current DAC, Weighted reference voltage DAC, Ladder DAC, Switches.

Practice:

- Simulation of programmable gain amplifier using Matlab
- Simulation of DAC using Matlab

Module V **(5 hrs)**

Digital Voltage Measurement Techniques

Sampling theorem, Time-division multiplexing, Quantization, Indirect type A/D converters, Direct type A/D converters, Input circuitry of a digital voltmeter.

Practice:

- Simulation of Digital voltmeter using Matlab
- Analysis and simulation of digital multi-meter.

Module VI **(4 hrs)**

Digital Instrument

Need for digital instruments, Advantages of digital instruments, Essentials of digital instrument, Performance characteristics of digital instrument.

Digital Recording Systems

Input Conditioning Equipment, Digitizer, Multiplexer, Programme Pinboard, Linearizer, Digital Clock, Limit Detectors, Output Devices

Practice:

- Data fetching using controllers
- Simulation of digital clock using Matlab

Module VII: **(4 hrs)**

Signal Generator, Analyzersand Oscilloscopes:

Function Generator, Pulse Generator, RF Signal Generator, Harmonic Distortion Analyzer, Spectrum Analyzer, Digital Storage CROs

Practice:

- To study block wise Construction of a Function Generator
- Measure Voltage, Frequency, Phase and Modulation Index (Trapezoidal Method) using CRO
- Demonstrate features of Digital Storage Oscilloscope
- Measure unknown Frequency using Lissajous Patterns

Text Books:

1. T. S. Rathore- Digital Measurement Techniques, Alpha Science International Ltd
2. David A. Bell - Electronic Instrumentation and Measurements, Oxford Univ. Press, 1997
3. A. K. Sawhney – A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Co

Reference Books:

1. PrithwirajPurkait- Electrical and Electronics Measurement and Instrumentation, MC Graw Hill Publishers
2. H.S. Kalsi-Electronic Instrumentation, Tata McGraw-Hill, New Delhi, 2010
3. R. K. Rajput- Electrical & Electronic measurement and Instrumentation, S. Chand Publication
4. K. Lal Kishore- Electronic Measurements and Instrumentation, Pearson Education 2010

Basic Electrical Engineering

Code	Course Title	(Credit)	T-P-PJ
CUTM1057	Basic Electrical Engineering	2	1-1-0

Objective

- In this course, student will come to know about the Basics of Electrical Engineering, Currents and Voltages across various Electrical elements.
- Their behavior in both Alternating Current and Direct Current circuits.
- Analysis of 1-phase and 3-phase AC wave forms.

Learning outcome

- Student will be exposed to the breadth of electrical engineering, able to gain knowledge in Electrical Circuits (AC and DC).
- Acquire knowledge on various parameters of electrical engineering and their properties with hands-on-practice of basic electrical experiments.

Course content

Module I: Basic Concepts and Basic Laws
(4hrs)

Theory

Essence of Electricity, Electric Field; Electric Current, Potential and Potential Difference, E.M.F., Electric Power, Ohm's Law, Basic Circuit Components, Ideal and Practical Sources, Source Conversion.

Practice:

1. Design and Analysis of Basic electrical circuits using Dymola. Plotting the V-I Characteristics of Incandescent lamp using Dymola.

Module II: Methods of Analysis (4hrs)

Theory

Network Analysis using Series and Parallel Equivalents, Voltage and Current Divider Circuits, Nodal Analysis, Mesh Analysis, Delta-Star & Star-Delta conversion.

Practice :

2. Verification of KCL and KVL in series and parallel circuits using Dymola.

Module III: DC Network Theorems (3hrs)

Theory

Analysis of Superposition, Thevenin's and Norton's theorem.

Practice:

3. Verification of Superposition, Thevenin's and Norton's theorem using Dymola.

Module IV: Introduction to Electromagnetism (4hrs)

Theory

Magnetic Circuits, B-H curve, Permeability, Reluctance, Solution of simple magnetic circuits, Hysteresis and Eddy current loss. Methods of preventing such losses. Solenoids and field coils. Application of solenoids in different circuits in Automobiles and in electrical circuit.

Practice (Hardware):

4. Observation of generation of magnetic flux for different input current in a coil and plotting B-H Curve.

Module V: Single-Phase Transformer (2hrs)

Practice (Hardware):

5. Study of Transformers, Linear Transformer Model, Ideal Transformer Model, No-load Loss and Load-loss Calculation.

Module VI: AC Circuit Analysis (3hrs)

Theory

Single-phase EMF Generation, Waveform and Phasor Representation, Average and Effective value of sinusoids, Peak factor & Form factor, Complex Impedance and Power using j-operator, Power factor.

Practice:

6. Calculation of current, voltage, power & power factor of series RLC circuit excited by 1-Ø A.C Supply using Dymola.

Module VII: Phasor Analysis (3hrs)

Theory

Three-Phase AC Circuits: Comparison between single-phase and three-phase systems, Three-phase EMF Generation, Line and Phase quantities in star and delta networks, Power and its measurement in three-phase balanced circuits.

Practice

7. Measurement of power and power factor in a 3-Ø AC circuit by (one, two and three) wattmeter using Dymola.

Recommended Books:

1. P. K. Sathpathy, “Basic Electrical Engineering,” 3rd Edition, Oxford.
2. B. L. Thereja, “Electrical Technology”, Volume-I,2005 Edition(24th Revised Edition)
3. Hughes, “Electrical & Electronic Technology”, Ninth Edition (Revised by J Hiley, K Brown, and I Smith), Pearson Education

Industrial Automation

Code	Course Title	(Credit)	T-P-PJ
IACU2100	Industrial Automation	24	5-9-10

Course Code	Course Title	Credits	Type T-P-PJ
CUIA2100	Introduction to Industrial Automation	1	1-0-0
CUIA2101	Advanced Programming & Control Blocks of PLC	3	1-2-0
CUIA2102	Control & Signal Wiring of PLC	2	0-2-0
CUIA2103	SCADA based advanced features	2	1-1-0
CUIA2104	SCADA & PLC based sequential control	1	0-1-0
CUIA2105	Human Machine Interface	3	1-2-0
CUIA2106	OPC server base data fetching & control	2	1-1-0
CUIA2107	Project	6	0-0-6
CUIA2108	Internship	4	0-0-4
	Total Credits	**24**	

Domain Track Objectives

- To upgrade knowledge levels needed for modern industries.
- Process & sequential control logic of industry.
- Project based training.

Domain Track Learning Outcomes

- Gain knowledge on advanced industrial automation.
- Understand different types of Devices to which PLC input and output modules are connected.
- Provide the knowledge about understand various types of mobile applications.
- Industry based project & advanced learning.
- Students will develop skill of designing automatic control system and controller for a particular application.

Domain Syllabus

Course – 1: INTRODUCTION TO INDUSTRIAL AUTOMATION

1.1 Automation Uses

1.2 Automation - PLC Basics

1.3 Mechanical relays versus PLC

1.4 Functions of various blocks and working principle of advanced blocks.

Course – 2: ADVANCED PROGRAMMING & CONTROL BLOCKS OF PLC

2.1 CPT, ADD, SUB, MUL, DIV, SQR, NEG, TOD, FRD

2.2 MOV, MVM, AND, OR, XOR, NOT. CLR.

2.3 BSL, BSR, SQC, SQL, SQO, FFL, FFU, LFL, LFU

2.4 JMP, LBL, JSR, MCR

2.5 Connecting PLC software with SCADA software

Practice:

P2.1 - Comparison of industry based analog signals.

P2,2 - Detecting different product output of an industry

P2.3 - Sequential control of an industry by using advanced blocks.

P2.4 - Emergency control system of an industry

P2.5 - Connecting PLC software with SCADA software

Course – 3: CONTROL & SIGNAL WIRING OF PLC

3.1 Control wiring of PLC.

3.2 PLC, Sensor and field instruments signal flow wiring.

3.3 Device connectivity

Practice:

P3.1 PLC input/output wiring concept.

P3.2 Connecting relay, contactor, sensors and other field instruments.

P3.3 Controlling an industry motor using STAR-DELTA connection

Course – 4: SCADA BASED ADVANCED FEATURES

4.1 Alarms

4.2 Trends, Data base connectivity & Report generation

4.3 Recipe management

4.4 Security

Practice:

P4.1 - Data fetching and representing on graph and excel

P4.2 - Advanced controlling of industry by using SCADA

Course – 5: SCADA & PLC BASED SEQUENTIAL CONTROL

5.1 Script

5.2 Networking

5.3 Device connectivity.

Practice:

P5.1 Script

P5.2 Networking

P5.3 Device connectivity

Course – 6: HUMAN MACHINE INTERFACE

6.1 What is HMI. Use of HMI

6.2 Concept of different operational features

6.3 Connectivity of HMI and PLC.

Practice:

P6.1 Alarms

P6.2 Security

P6.3 Recipe manager

Course – 7: OPC SERVER BASE DATA FETCHING & CONTROL

7.1 Study of Open Platform Communications

7.2 OPC to control PLC, SCADA.

7.3 OPC based different protocol concept.

7.4 Data handling using OPC.

Practice:

P7.1 Installation of OPC

P7.2 OPC protocols

P7.3 Connectivity of PLC, SCADA & ARDUINO to OPC.

Industrial Automation

Code	Course Title	(Credit)	T-P-PJ
IACU2100	Industrial Automation	24	5-9-10

Course Code	Course Title	Credits	Type T-P-PJ
CUIA2100	Introduction to Industrial Automation	1	1-0-0
CUIA2101	Advanced Programming & Control Blocks of PLC	3	1-2-0
CUIA2102	Control & Signal Wiring of PLC	2	0-2-0
CUIA2103	SCADA based advanced features	2	1-1-0
CUIA2104	SCADA & PLC based sequential control	1	0-1-0
CUIA2105	Human Machine Interface	3	1-2-0

CUIA2106	OPC server base data fetching & control	2	1-1-0
CUIA2107	Project	6	0-0-6
CUIA2108	Internship	4	0-0-4
	Total Credits	**24**	

Domain Track Objectives

- To upgrade knowledge levels needed for modern industries.
- Process & sequential control logic of industry.
- Project based training.

Domain Track Learning Outcomes

- Gain knowledge on advanced industrial automation.
- Understand different types of Devices to which PLC input and output modules are connected.
- Provide the knowledge about understand various types of mobile applications.
- Industry based project & advanced learning.
- Students will develop skill of designing automatic control system and controller for a particular application.

Domain Syllabus

Course – 1: INTRODUCTION TO INDUSTRIAL AUTOMATION

1.1 Automation Uses

1.2 Automation - PLC Basics

1.3 Mechanical relays versus PLC

1.4 Functions of various blocks and working principle of advanced blocks.

Course – 2: ADVANCED PROGRAMMING & CONTROL BLOCKS OF PLC

2.1 CPT, ADD, SUB, MUL, DIV, SQR, NEG, TOD, FRD

2.2 MOV, MVM, AND, OR, XOR, NOT. CLR.

2.3 BSL, BSR, SQC, SQL, SQO, FFL, FFU, LFL, LFU

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Practice:

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4.1 Alarms

4.2 Trends, Data base connectivity & Report generation

4.3 Recipe management

4.4 Security

Practice:

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P4.2 - Advanced controlling of industry by using SCADA

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5.1 Script

5.2 Networking

5.3 Device connectivity.

Practice:

P5.1 Script

P5.2 Networking

P5.3 Device connectivity

Course – 6: HUMAN MACHINE INTERFACE

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6.3 Connectivity of HMI and PLC.

Practice:

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P6.3 Recipe manager

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P7.2 OPC protocols

P7.3 Connectivity of PLC, SCADA & ARDUINO to OPC.

Centurion University of Technology and Management

School of Forensic Sciences

B.Sc. Forensic Science, M.Sc. Forensic Science and M.Sc. Cyber Security and Digital Forensics

Centurion University of Technology & Management offers undergraduate and postgraduate programs in **Forensic Science**. We aim to establish ourselves as a center of excellence in the field of Forensic Science, through innovative teaching-learning methods, intensive lab practices and to create a culture of instilling and nurturing creativity and scientific temper among the learners. The department focuses on developing skills in various domains of forensic such as questioned documents, fingerprint development, forensic medicine, forensic biology, crime scene management, Information Security, Penetration testing & Vulnerabilities Assessment , etc

Mission: An Institution dedicated to touch human lives with the aim of intensifying the field of investigative sciences to ensure a diminished rate of criminal record in the society by strengthening the justice delivery system leading towards to prosperity, integrity and peace.

Vision: To be a distinguished School of excellence aiming to create a peaceful society by imparting quality education/Training to the Prospective students and allied professionals. To make the institute an inclusive centre of excellence for forensic education, research and Training services , thereby strengthening justice delivery system.

PO (Programme Outcomes): B.Sc. Forensic Science

POs Outcomes	POs Outcomes
PO1	Forensic knowledge: Apply knowledge of mathematics, various disciplines of science and basic principles of forensic in investigation.
PO2.	Perform experiments as well as to carry out problem analysis and data interpretation of instrumental analysis
PO3	The crime and society: Apply reasoning informed by the contextual knowledge to assess civil and criminal laws,society,health and cultural issues and the consequent responsibilities relevant to forensics
PO4	Individual and team work: Function affectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings in the field of forensic Science.
PO5	Conduct investigations: Visit crime scene and help the police officials in proper collection, preservation and handling of scientific evidences which will aid in maintaining the integrity of evidences
PO6	Understanding of professional and ethical responsibility of forensic scientist
PO7	Communication: Communicate effectively on various activities of forensics with proper understanding of scientific and legal terminologies
PO8	Understand psychology of criminal mind
PO9	Life- long learning: Recognize the need for lifelong learning in the broadest contest of challenges and recent advances in the field of forensic science.
PO10	Project Management: Demonstrate knowledge & understanding of the forensic science and apply these to one's own work, as a member and leader in a team, to manage projects in forensic science.
PO11	Use of modern techniques, skills, and instruments necessary for forensic

	expert or any person working in such field.
PO12	Make a robust report on the basis of scientific analysis.

PSO-Program Specific Outcomes- B.Sc. Forensic Science

PSO1: Graduate will be able to develop skill which can be applied in the jobs of Forensic Science
PSO2: Graduate will be able to pursue higher studies and research
PSO3: Graduate will be able to use software and technologies that can be effectively used to solvevarious problems encountered during investigations.

Core Courses

BSFS0401 : Basics of Forensic Science

Course Objective : To teach in depth knowledge of forensic science, it's disciplines and importance and working of FSL.

Course Outcome : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	knowthe significance of forensic science to human society.
CO-2	understandfundamental principles and functions of forensic science.
CO-3	get idea about working of the forensic establishments in India and abroad.

BSFS0402 : Crime and Society

Course Objective : To obtain knowledge about criminology i.e. crime and its causes, its impact onsociety and basic elements of justice delivery system.

Course Outcome : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Student will know about importance of criminology.
CO-2	Understand the causes of criminal behaviour.
CO-3	Understand the significance of criminal profiling to mitigate crime.
CO-4	Understand the elements of criminal justice system.

BSFS0403 : Criminal Law

Course Objective : To obtain knowledge about basic law which governs our society
Course Outcome : On completion of this course, the successful students should be able to :

CO	Statements
CO-1	Know about Elements of Criminal Procedure Code related to forensic science.
CO-2	Understand the acts and provisions of the Constitution of India related to forensic science.
CO-3	Understand the acts governing socio-economic crimes.

CO-4	Understand acts governing environmental crimes

BSFS0404 : Forensic Psychology

Course Objective : To obtain knowledge about forensic psychology and various psychological investigative tools.
Course Outcome : On completion of this course, the successful students should be able to :

CO	Statements
CO-1	Know about importance of psychological assessment in gauging criminal behaviour.
CO-2	Understand the legal aspects of forensic psychology.
CO-3	Understand the significance of criminal profiling.
CO-4	Do critical assessment of advanced forensic techniques like polygraph, Narco analysis and brain electrical oscillation signatures.

BSFS0405 : Forensic Dermatoglyphics

Course Objective : To study fingerprints and its fundamental principles, its role in linking a person to the crime scene, techniques to develop prints
Course Outcome : On completion of this course, the successful students should be able to :

CO	Statements
CO-1	Know about physical and chemical techniques of developing fingerprints on crime science evidence.
CO-2	Understand the significance of foot, palm, ear and lip prints.
CO-3	Understand pattern types and matching

BSFS0406 :Technological Methods in Forensic Science

Course Objective : To gain knowledge about various instruments and techniques used in analysis and examination of evidences
Course Outcome : On completion of this course, the successful students should be able to :

CO	Statements
CO-1	Understand the importance of chromatographic and spectroscopic techniques in processing crime scene evidence.
CO-2	Understand the significance of microscopy in visualizing trace evidence and comparing it with control samples.
CO-3	Understand usefulness of photography and videography for recording the crime scenes.

BSFS0407 : Criminalistics

Course Objective : To gain knowledge about crime scene and its processing including securing, searching and documentation as well as collection and packaging of evidences.
Course Outcome : On completion of this course, the successful students should be able to :

CO	Statements
CO-1	Understand the methods of securing, searching and documenting crime scenes.
CO-2	Understand the tools and techniques for analysis of different types of crime

	scene evidence.
CO-3	Understand about legal importance of chain of custody.

BSFS0408 : Forensic Chemistry

Course Objective : The study enhances ability of investigating officer in arson cases. Scientific study to analyse the explosives and Petroleum product and investigation in cases of IED.

Course Outcome : On completion of this course, the successful students should be able to :

CO	Statements
CO-1	Understand the methods of analysing trace amounts of petroleum products in crime scene evidence.
CO-2	Understand the classification of explosives, including the synthesis and characterization of representative analogues.
CO-3	Understand significance of bomb scene management.

BSFS0409 : Questioned Documents

Course Objective : helps in understanding nature of paper and some other characteristics of written as well printed document with respect to class and individual characteristics and helps to examine fraud cases.

Course Outcome : On completion of this course, the successful students should be able to :

CO	Statements
CO-1	Understand the importance of examining questioned documents in crime cases.
CO-2	Understand the tools required for examination of questioned documents.
CO-3	Understand significance of comparing hand writing samples.
CO-4	Know about the importance of detecting frauds and forgeries by analysing questioned Documents.

BSFS0410 :Forensic Biology

Course Objective: To teach about biological fluid which helps to determine source of origin among the individuals. Hair evidence distinguishes between human and animal. Study of wild life forensic science enhances skill and knowledge of investigator in investigation smuggling cases.

Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know about the significance of biological and serological evidence.
CO-2	Understand importance of biological fluids – blood, urine, semen, saliva, sweat and milk – in crime investigations.
CO-3	Know about how wildlife forensics aid in conserving natural resources.
CO-4	Know about how forensic entomology assists in death investigations

BSFS0411 :Forensic Ballistics

Course Objective: It helps to identify class and individual characteristics of firearm and ammunition. Enhance the skill and knowledge of investigating officer.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know about classification of firearms and their firing mechanisms..
CO-2	Understand importance of firearm evidence
CO-3	Know about methods of identifying firearms.
CO-4	Know about methods for characterization of gunshot residue.

BSFS0412 : Forensic Toxicology

Course Objective : To study qualitative and quantitative analysis of poison in body fluids. It also helps understanding mode of administration of poison and their absorption.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know about the significance of toxicological studies in forensic science.
CO-2	Classify poisons and their modes of actions.
CO-3	Understand classification and characteristics of the narcotics, drugs and psychotropic substances.
CO-4	Know about menace of designer drugs.

BSFS0413 : Forensic Anthropology

Course Objective : Study focuses on skeletal parts and their significance in determining identification of person, characteristics that helps in identifying missing person as well facial reconstruction through sketching of individual characteristics.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know about the importance of forensic anthropology in identification of persons.
CO-2	Classify poisons and their modes of actions.
CO-3	Understand different techniques of facial reconstruction and their forensic importance.
CO-4	Know about significance of somatoscopy and somatometry

BSFS0414 : Forensic Medicine

Course Objective Study helps to distinguish between postmortem and anti-mortem characteristics of corpus delicti. Age and sex can also be determined by forensic odontology.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know about the importance of forensic odontology
CO-2	Understand the importance of autopsy
CO-3	Understand the importance of bloodstain patterns in reconstructing the crime

	scene.
CO-4	importance of bloodstain patterns in reconstructing the crime scene.

Ability Enhancement Elective Course

BSFL1101 : English

Course Objective : To expose the students to a variety of self-instructional, learner-friendly modes of language learning and to enable them to learn better pronunciation through stress on word accent, intonation, and rhythm.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Communicate fluently in different business situation
CO-2	Use appropriate words with correct pronunciation
CO-3	Do effective oral and written communication

FCBS0101 :Environmental Science

Course Objective : To understand the concept of multi-disciplinary nature of Environmental Science where different aspects are dealt with a holistic approach.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	develop a sense of community responsibility by becoming aware of environmental issues in the larger social context.
CO-2	Characterize and analyze human impacts on the environment
CO-3	Design and evaluate strategies, technologies and methods for sustainable management of environmental systems and for the remediation or restoration of degraded environments.
CO-4	Integrate facts, concepts, and methods from multiple disciplines and apply to environmental problems.

Ability Enhancement Elective (Skill Based) course

BSSE0201 : Introduction to Biometry

Course Objective : To understand the concept of biometry and its role in identification and various kinds of biometrics.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the basis of biometry.
CO-2	Know about the classification of biometric processes

CO-3	Know about the importance of behavioural biometry

BSSE0202 : Handwriting Identification and Recognition

Course Objective : To understand the important features of handwriting identification and perform detection of document forgery or alteration.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand important features in handwriting identification.
CO-2	Learn about basis of handwriting characteristics.
CO-3	Know about significance of forensic documentation.

Discipline Specific Elective

DEFS0401 : Digital Forensics

Course Objective : To understand the basic concepts of digital forensics and types of digital forensics, malwares and investigation methods applied in such cases.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the basics of digital forensics.
CO-2	Analyse the cases which fall under the purview of digital crimes.
CO-3	Understand the types of digital crimes.
CO-4	Understand the elements involved in investigation of digital crimes.

DEFS0402 : Economic Offences

Course Objective: To introduce to terminologies related to economic offences, some common economic offences and its impact on society.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand basic economic and financial terminology.
CO-2	Understand steps involved in mitigating economic crimes.
CO-3	Know about types of common economic offences and their consequences.

DEFS0403 :Forensic Serology

Course Objective: To gain knowledge about serological evidences and their importance in crucial cases and methods of their detection.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the significance of serological evidence.
CO-2	The importance of biological fluids – blood, urine, semen, saliva, sweat and

	milk – in crime investigations.
CO-3	Know about the usefulness of genetic markers in forensic investigations.

DEFS0404 :Accident Investigations

Course Objective: To study methods of investigation in accidental cases, types of injuries in accidents, documentation, collection and preservation of evidences and their analysis.

Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the significance of tiremark evidence.
CO-2	Understand the importance of air bags and photography of accident cases
CO-3	Know about the usefulness of trace evidences in forensic investigations.

DEFS0405 : DNA Forensics

Course Objective: Understanding basic concepts of DNA Analysis, DNA Typing, STR markers.

Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the basic principle of DNA analysis and it's significance
CO-2	Understand the importance of short tandem repeats and restriction fragment length polymorphism in DNA technique.
CO-3	Know about role of DNA typing in parentage testing

DEFS0406 : Audio Recognition and Video Analysis

Course Objective: To Understand the role of voice in forensic investigations, understanding speaker recognition and identification and their analysis.

Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the basic principle of voice production and forensic significance speaker identification and recognition.
CO-2	Know about the importance of audio recording evidences.
CO-3	Use various software in audio recognition and video analysis.

DEFS0407 : Explosives Analysis & Post Blast Investigation

Course Objective: To study the protocols followed for analysis of explosives and get in depth knowledge about post blast investigations.

Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements

CO-1	Know about History and development of explosives.
CO-2	Understand processing of crime scene.
CO-3	Know about clandestine Laboratories.

DEFS0408 : Quality Control and Quality Assurance

Course Objective : To study the various aspects of quality control and assurance aspects and understand important parameters such as cGMP, QC tests, documentation,
Quality certifications, GLP and regulatory affairs.
Course Outcome: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the cGMP aspects in a pharmaceutical industry.
CO-2	Know about the importance of documentation.
CO-3	Understand the Scope of quality certifications applicable to Pharmaceutical industries and responsibilities of QA and QC department.

ProgrammeOutcomes : M.Sc. Forensic Science

POs; Forensic postgraduate will be able to;

POs	Outcomes
PO1	Forensic knowledge: Apply knowledge of mathematics, various disciplines of science and basic principles of forensic in investigation.
PO2	Knowledge of psychology and law related to forensic science. Understanding of psychology of criminal mind and modus operandi of crime and statistical analysis in forensic science.
PO3	Knowledge and understanding of crime scene and their management, Visit crime scene and help the police officials in proper collection, preservation and handling of scientific evidences which will aid in maintaining the integrity of evidences.
PO4	Individual and team work: Function affectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings in the field of forensic Science.
PO5	Identification of individuals by knowledge and understanding of Fingerprints. Identify and analyse the questioned documents to aid the police officials and court of law.
PO6	Understanding of different instruments used for forensic analysis and perform experiments as well as to carry out problem analysis and data interpretation of instrumental analysis
PO7	Understanding of professional and ethical responsibility of forensic scientist.

PO8	Communication: Communicate and convey effectively on various activities of forensics with proper understanding of scientific and legal terminologies.
PO9	Understanding of drugs analysis, explosive materials, adulteration analysis as well as poison detection and analysis in forensic science.
PO10	Knowledge and understanding of biological aspects, serological analysis and DNA profiling as well as medico legal aspects in forensic science.
PO11	Understanding and knowledge of ballistics for the analysis of fire arms and projectiles in forensic science.
PO12	Life- long learning: Recognize the need for lifelong learning in the broadest contest of challenges and recent advances in the field of forensic science.
PO13	Project Management: Demonstrate knowledge & understanding of the forensic science and apply these to one's own work, as a member and leader in a team, to manage projects in forensic science.
PO14	Use of modern techniques, skills, and instruments necessary for forensic expert or any person working in such field.
PO15	Make a robust report on the basis of scientific analysis to administer the court of law.

PSOs: M.Sc. Forensic Science

PSO1: Post-graduate will be able to develop skill and knowledge which can be applied in the jobs of Forensic Science

PSO2: Post-graduate will be able to pursue higher studies and research

PSO3: Post-graduate will be able to use software and technologies that can be effectively used to solve various problems encountered during investigations.

Course Outcome (CO) : M.Sc. Forensic Science

1st Semester

CUTM1634 Introduction to Forensics, Psychology, Law and Statistics

Course Objective: To understand the Basic knowledge of Psychology, Law and Statistics in Forensic science.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand criminal mind, their Modus Operandi.
CO-2	Understand the Law used in Forensic science.
CO-3	Get idea about statistical analysis and can use in forensic science.

CUTM1635 Instrumental Techniques

Course Objective: To familiarize the students about the different instruments and their techniques used for analysis in Forensic Science.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the instrumentation and basic concept of the instruments.
CO-2	Understand the process for analysis of different evidences.
CO-3	Get knowledge on using different instruments, understanding the concept of the instruments.
CO-4	To know the different instruments required for respective evidences and prepare the results to administer the court of law.

CUTM1636 Crime Scene Management and Forensic Physics

Course Objective: To understand the management of crime scene, formulation of hypothesis and processing of evidence to FSL.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Visit the crime scene, conduct the investigation, processed the evidence and sent to FSL.
CO-2	Understanding of different type of evidence, formulation of hypothesis, reconstruction of the crime scene.
CO-3	Skills to investigate the crime scene, find out the evidence and forward the evidence to FSL for analysis.
CO-4	Formulate the hypothesis of the crime and reconstruction of the crime scene.

CUTM1637 Fingerprints and Questioned Documents

Course Objective: To impart knowledge of fingerprint and questioned document and to understand the role of individual characteristics and identification of Friction Ridges.

To equip the students with skills to analyse the fingerprints and questioned documents.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know about the important of fingerprint, pattern and their characteristics. Knowledge of analysis of fingerprints and identification of individuals on the basis of fingerprint pattern.
CO-2	Knowledge of documents evidences and their examination process and techniques.
CO-3	Get knowledge on different techniques and recent technologies developed used in fingerprint and questioned documents.
CO-4	Skills to analyse the fingerprint. Compare the fingerprint to match and identify the individuals.

CO-5	Skills to analyse the different documents and find out the contents and characteristics of the documents. Analyse the authenticity of the documents. Detect the forgery in the documents.

FCHU1203Business Communication

Course Objective: To impart knowledge on language to communicate in Forensic science.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know the basic terminologies.
CO-2	Will be able to communicate with different officers and convey the important information of forensic aspects.

2ND SEMESTER

CUTM1639 Quality Management, Narcotic Drugs, Explosives, and Forensic Chemistry

Course Objective: To understand the quality management and assurance. Knowledge of drugs, explosives materials and their analysis.

To identify the quality of the product. Analysis of drugs and explosive materials.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Impart the concept of quality management and quality assurance.
CO-2	Knowledge of drugs, analysis of drugs and their forensic aspects.
CO-3	Knowledge of explosive and the material used as explosive. Analysis of residue material and parts of the explosives. Detection of the cause of the explosion.
CO-4	Skill to identify the quality of the different product. Examination of different product as per BIS standards.
CO-5	Identification of NDPS drugs and detection of different drugs by different techniques.
CO-6	Identification of explosives materials and detection of explosives by different techniques.

CUTM1640 Forensic Biology and Forensic Medicine

Course Objective: Impart the knowledge of biological concept and materials used in forensic science, medico legal aspect.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know the biological material used in forensic science. Understand the wild life forensic, entomology and odontology.

CO-2	Understand the autopsy used in forensic science. Determine the cause of death and time of death and understanding the medico legal aspects.
CO-3	Skill to analyse the biological material and detection of age, sex, race, height and species origin.
CO-4	Identification of injuries and various types of death by post-mortem examination.

CUTM1641 Forensic Serology and DNA Profiling

Course Objective: To acquaint the students about different body fluids and their analysis. Impart the knowledge of DNA profiling and individualisation.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Know the body fluids analysis and serological techniques.
CO-2	Impart the knowledge of DNA and DNA analysis. Understand the basic concept of individualization and uniqueness of DNA in identification of individuals.
CO-3	Skill to analyse the body fluids and different serological techniques for serological analysis.
CO-4	Identification of individuals by DNA profiling.

CUTM1642 Forensic Toxicology and Pharmacology

Course Objective: To educate students about basic concepts of poison and their analysis.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Impart the knowledge of poison and their analysis. Detection of poison in the body or body fluids.
CO-2	Understanding of drug interaction with body and drug toxicity.
CO-3	Skill to analyse the type of poison and detection of different type of poison in body.
CO-4	Analyse the drug interaction and bioavailability of the drug in the body and their metabolites.

CUTM1643 Forensic Ballistics and Computer Forensics

Course Objective: To impart the knowledge of firearms and projectile and basic understanding of digital platform and cyber laws.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements

CO-1	Impart the knowledge of different firearms and projectile. Understanding of bullet and cartridge cases and gunpowder.
CO-2	To understand the computer parts, digital platform, cyber-crime and cyber laws.
CO-3	Skill to analyse the different firearms and projectiles. Identification and detection of gunshot residue, gunshot powder, range, marks and characters of projectiles.
CO-4	Analysis of storage media, deleted files and information from digital platform and tracking.

3RD SEMESTER

Specialisation in Forensic Chemistry and Toxicology

CUTM1647 Pharmacology and Pharmaceutical Drug Analysis

Course Objective: To teach the concepts Drug, analysis of drug. Understanding of drug therapy, abuses and interaction of drug with body.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand about the drug, factors, bioavailability, and responses of drugs.
CO-2	Understanding the different agents of drugs, designer drugs and NDPS substances.
CO-3	Analysis of drugs and agents.
CO-4	Qualitative and quantitative analysis of various chemicals.
CO-5	Instrumental analysis of various chemicals.

CUTM1648 Concepts of Toxicology

Course Objective: Concepts of poison and toxic materials. Understanding of toxic agents and their risk assessments.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Get knowledge on different toxic substances and their identification and detection.
CO-2	Understanding of analytical methods of toxicology and application of toxicology.
CO-3	Ability to detect the drugs by various analytical techniques.
CO-4	Ability to detect the poison by various analytical techniques from biological and non-biological matrices.

CUTM1649 Modern and Applied Analytical Forensic Chemistry

Course Objective: Understanding of nuclear forensics, detection and measurement of radioactive substances.

Understanding of drugs chemistry, NDPS laws and analytical method. Understanding and identification of fire crime scene and explosion crime scene.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Acquainted with proper knowledge chemistry of drugs and different laws related to drugs. Understanding the process of analysis involved to identify the drugs.
CO-2	Ability to detect the different drug component. Identify and detect the cause of fire and explosion and analyse the residue materials.
CO-3	Skill to detect the food adulteration in food and identify the adulterated material in food.

Specialisation in Forensic Biology

CUTM1644 Molecular Biology and Genetics

Course Objective: To understand the concept of serological analysis and uses of enzymes and proteins in criminal investigation. Understanding of methodologies in forensic DNA analysis.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand about the serological methods, enzymes and proteins for criminal investigation. Understanding of parameter and factors in forensic DNA typing.
CO-2	Understanding the different methods and techniques used for DNA analysis and development in technologies and methods for DNA analysis.
CO-3	Understanding of Bioinformatics, population structure and DNA databases.
CO-4	Extraction and estimation of DNA from different sources. Genotyping of the DNA with different markers and interpretation of the result to aid the police officials and court of law.
CO-5	Extraction and estimation of proteins from different sources. Analysis of protein structure using RASMOL software.

CUTM1645 Biotechnology in Pharmaceutical Sciences

Course Objective: Concepts of recombinant DNA technology, bioprocessing, animal and plant biotechnology and industrial microbiology.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Get knowledge on recombinant DNA technology and genetically modified organism. Understanding of Blotting techniques and molecular therapy.
CO-2	Understanding of quality control and assurances, regulatory affairs and intellectual property rights.
CO-3	Skills to isolate DNA from different sources and GMO detection.
CO-4	Ability to handle blotting techniques and identification and detection of production of industrial products.

CUTM1646 Environmental Biotechnology

Course Objective: Understanding the component of environment, waste analysis and detection of illegal waste.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Acquainted with proper knowledge of environmental forensic, analysis of the component of pollutants and materials.
CO-2	Acquainted with the knowledge og waste management and detection of waste material in the environments.
CO-3	Ability to detect the pollutants material in the environment and analysis of the pollutants.
CO-4	Skill to identify the adulterated material in food and examine the food quality.

Specialisation in Forensic Physics

CUTM1650 Advances in Physical Techniques

Course Objective: Skill to identify and examine various analyses of techniques used in Forensic Physics

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Ability to detect the various techniques Such as Microscopes, etc.

CO-2	Skill to identify the examination of nanotechnology and Forensic Engineering

CUTM1651 Concepts of Conventional and Modern Ballistics

Course Objective: Concepts of Ballistics, GSR and various Standards of V50, STANNG 4500, NIG .06

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Identifications and Examination of Ammunitions Range of Fire.
CO-2	Analysis and Examination of GSR Material with various Standards

CUTM1652 Audio Recognition and Video Analysis

Course Objective: Understanding the anatomy of Voice production, Audio and video Analysis

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Identification and Examination of Voice samples using Gold wave Software, Automatic Speaker recognition.
CO-2	Examination of Audio and Video analysis using AMphed Five.

Specialisation in Fingerprints and Questioned Documents

CUTM1653 Modern Trends in Fingerprint Sciences

Course Objective: Understanding of morphology and anatomy of fingerprints and their method for fingerprints detection.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Fundamental and principle of fingerprints and their detection methods.
CO-2	Understanding of development and detection of fingerprints from various methods.
CO-3	Skill to analyse the fingerprint with microscopic techniques and comparison of male and female fingerprint with specific reference and with AFIS method..
CO-4	Development of fingerprint with various chemical and physical methods.

CUTM1654 Questioned Document and Forensic Accounting

Course Objective: Concepts of documents and their examination. Understanding of forgery and their detection. Identification of fraud and writings and examination of financial documents.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understanding of writing forgery and documents forgery. Examination of questioned documents and writings.
CO-2	Understanding of frauds, money laundering and financial reports.
CO-3	Skill to examination of ink, paper age, currency notes and detection of forgery of the documents.
CO-4	Examination of passports, stamps, stamps impression.

CUTM1655 Forensic Photography and Biometric Traits

Course Objective: Understanding the knowledge of photography and different biometric techniques.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Skill to analyse the fingerprint with microscopic techniques and comparison of male and female fingerprint with specific reference and with AFIS method..
CO-2	Development of fingerprint with various chemical and physical methods.
CO-3	Do crime scene photography, evidences photography and videography. Development of photographic prints.
CO-4	Do photography with various light sources and with various filters. Analysis of various biometrics.

CUTM1656 : ASSIGNMENT

Course Objective: To familiar and skilled to write the content with order and right pattern.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understanding of writing the proper content with professional language and with proper explanation.

CUTM1657 : SEMINAR

Course Objective: to make student familiar and skilled to deliver in seminar

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Get familiar and skilled to deliver in seminar

CUTM1658 : Dissertation/project

Course Objective: To help in training of students with hands on experience of instruments while working on any research topic.

Course Outcome : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Have understanding of research methodology and lab work/field work.

Programme Outcomes (PO) : M.Sc. Cyber Security and Digital Forensics

Cybersecurity masters will be able to;

POs	Outcomes
PO1	Cyber forensic knowledge: Apply knowledge of mathematics, tools, techniques various disciplines of science and basic principles of digital forensic in investigation.
PO2	Perform live hands on as well as to carry out problem analysis and data interpretation of tools analysis.
PO3	The cybercrime and digital society: Apply cognitive informed by the circumstantial knowledge to assess corporate and digital criminal laws, society, health and educational issues and the consequent responsibilities relevant to the cyber forensics
PO4	Discrete and team work: Functions affectively as an individual, and as a member or leader in assorted teams, and in multidisciplinary settings in the field of digital forensics.
PO5	Conduct digital investigations: Tracing cyber victims and help the cyber police officials in proper collection, preservation and handling of digital evidences which will aid in maintaining the integrity of digital evidences.
PO6	Understanding of professional and ethical responsibility of cyber security professionals.
PO7	Communication: Communicate effectively on various activities of digital forensics with proper understanding of scientific tools and legal terminologies.
PO8	Understand thinking of felonious mind and finding digital signatures.
PO9	Life- long learning: Recognize the need for lifelong learning in the broadest contest of challenges and recent advances in the field of cyber forensic science.
PO10	Project Management: Demonstrate knowledge & understanding of the digital forensic science and apply these to one's own work, as a member and leader in a team, to manage projects in cyber forensic science.
PO11	Use of modern techniques, tools, skills, and digital devices necessary for forensic expert or any person working in such field.
PO12	Make a robust documentation on the basis of scientific tools analysis.

Programme Specific Outcomes (PSO): M.Sc. Cyber Security and Digital Forensics

PSO1: Masters will be able to develop skill which can be applied in the jobs of Cyber Forensic Science in private and public sector.
PSO2: Masters will be able to pursue higher studies and research.
PSO3: Masters will be able to use software and technologies that can be effectively used to solve various problems encountered during digital investigations.

Course Outcomes (CO): M.Sc. Cyber Security and Digital Forensics

Semester 1

MSCS1101 : PRINCIPLES OF INFORMATION SECURITY

Course Objective : The objective of this course is to focus on the models, tools, and techniques for enforcement of security. Student will also learn security from multiple perspectives.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Will gain familiarity with computer network, defences against them, and forensics to investigate the aftermath.
CO-2	Develop a basic understanding of Risk assessment
CO-3	Develop an understanding of security policies as well as protocols to implement such policies.

MSCS1102 : DIGITAL FORENSICS

Course Objective : This course focuses on two aspects of Cyber Security: analysis and assessment of risk plus how to minimize it, and, how to extract and use digital information from a wide range of systems and devices.
The course is structured so that all students cover the same introductory material, but then choose to specialize in either Cyber Security or Digital Forensics.
Any aforesaid science graduate who requires keen interest & knowledge of IT programming languages with basic knowledge of math beyond calculus.
Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Explain the origins of forensic science.
CO-2	Explain the difference between scientific conclusions and legal decision-making
CO-3	Explain the role of digital forensics and the relationship of digital forensics to traditional forensic science, traditional science and the appropriate use of scientific methods
CO-4	Outline a range of situations where digital forensics may be applicable
CO-5	Identify and explain at least three current issues in the practice of digital forensic investigations.

MSCS1103 : COMPUTER NETWORKS

Course Objective : The course objectives include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and gaining practical experience in installation, monitoring, and troubleshooting of current LAN systems.
Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	explain the concepts of confidentiality, availability, and integrity (CIA) in context of Information Assurance; articulate the threats to CIA and be able to analyse a given architecture, discern vulnerabilities, and recommend physical, logical, or administrative controls to mitigate the threat; (Cybersecurity Fundamentals—Theory)
CO-2	demonstrate expertise in configuring host and network level technical security controls, to include host firewalls, user access controls, host logging, network filtering, intrusion detection, and prevention and encryption at all levels; (Managing

	Security—Applied)
CO-3	describe the hardware, software, and services that comprise an enterprise network, and be able to articulate how these components integrate to form a network solution; (Network Integration—Theory)
CO-4	Explain key networking protocols, and their hierarchical relationship in the context of a conceptual model, such as the OSI and TCP/IP framework; be able to articulate the low-level data communications and subsequent abstractions that allow networked hosts and applications to communicate across the internet; (Networking Protocols—Theory)
CO-5	Build multiple host and network architectures, given business requirements and constraints; student will configure operating systems, network specific services, routing, switching, and remote access solutions; (Networking—Applied)

MSCS1104 : CYBER CRIME & INVESTIGATIONS

Course Objective : This course focusses on two aspects of Cyber Security: analysis and assessment of risk plus how to minimize it, and, how to extract and use digital information from a wide range of systems and devices. The course is structured so that all students cover the same introductory material, but then choose to specialize in either Cyber Security or Digital Forensics. Any aforesaid science graduate who requires keen interest & knowledge of IT programming languages with basic knowledge of math beyond calculus.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Discuss data and identify data sources
CO-2	Describe and discuss digital evidence
CO-3	Compare and contrast the differences between digital evidence and traditional evidence
CO-4	Describe and critique digital forensics process models
CO-5	Describe and critique digital forensics process models
CO-6	Critically evaluate standards and good practices for digital evidence and digital forensics

MSCS1105 : INTELECTUAL PROPERTY RIGHTS

Course Objective : The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work. The students will get a basic idea about registration in India and abroad of their invention, designs, thesis written/developed by them during their project work and for this they must have knowledge of patents, copy right, trademarks, designs.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Once the students complete their syllabus and assessment, they will develop the basic knowledge and awareness of acquiring the patent and copyright for their innovative works.
CO-2	They will also get an idea about plagiarism while writing any article, blog, research or review paper and learn how to avoid it.

2ND SEMESTER

MSCS1201 : NUMBER THEORY & CRYPTOGRAPHY

Course Objective : Covers fundamental algorithms for integer arithmetic, greatest common divisor calculation, modular arithmetic, and other number theoretic computations. Algorithms are derived, implemented and analysed for primality testing and integer factorization. Applications to cryptography are explored including symmetric and public-key cryptosystems. A cryptosystem will be implemented and methods of attack investigated. To be able to implement and analyse algorithms for integer factorization and primality testing. To be able to use a system like Maple to explore concepts and theorems from number theory. To understand fundamental algorithms from symmetric key and public key cryptography.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	To understand fundamental number theoretic algorithms such as the Euclidean algorithm, the Chinese Remainder algorithm, binary powering, and algorithms for integer arithmetic.
CO-2	To understand fundamental algorithms for symmetric key and public key cryptography.
CO-3	To understand the number theoretic foundations of modern cryptography and the principles behind their security.
CO-4	To implement and analyze cryptographic and number theoretic algorithms.
CO-5	To be able to use Maple to explore mathematical concepts and theorems.

MSCS1202 : ADVANCED INFORMATION SECURITY

Course Objective : The objective of this course is to focus on the models, tools, and techniques for enforcement of security. Students will learn security from multiple Perspectives.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Will gain familiarity with computer network, defences against them, and forensics to investigate the aftermath.
CO-2	Develop a basic understanding of Risk assessment
CO-3	Develop an understanding of security policies as well as protocols to implement such policies

MSCS1203:CYBER FORENSICS

Course Objective : The aim of this course is to equip you with the knowledge and techniques to computer forensics practices and evidence analysis. It prepares you to use various forensic investigation approaches and tools necessary to start a computer forensics investigation. It also aims at increasing the knowledge and understanding in cyber security and ethical hacking.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Define computer forensics.
CO-2	Identify the process in taking digital evidence.
CO-3	Describe how to conduct an investigation using methods of memory, operating system, network and email forensics.
CO-4	Assess the different forensics tools.
CO-5	Differentiate among different types of security attacks.
CO-6	Describe the concept of ethical hacking.

MSCS1204 : SYSTEM & NETWORK SECURITY

Course Objective : The course objectives include learning about computer network organization and implementation, obtaining a theoretical understanding of data communication and computer networks, and gaining practical experience in installation, monitoring, and troubleshooting of current LAN systems.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Able to understand the concepts of confidentiality, availability, and integrity (CIA) in

	context of Information Assurance.
CO-2	Articulate the threats to CIA and be able to analyze a given architecture.
CO-3	Discern vulnerabilities.
CO-4	Recommend physical, logical, or administrative controls to mitigate the threat; (Cybersecurity Fundamentals—Theory)

MSCS1205 : CYBER LAW

Course Objective: The Objectives of This Course Is to Enable Learner to Understand, Explore, And Acquire A Critical Understanding Cyber Law. Develop Competencies for Dealing with Frauds and Deceptions (Confidence Tricks, Scams) And Other Cyber Crimes for Example, Child Pornography Etc. That Are Taking Place Via the Internet.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Make Learner Conversant with The Social and Intellectual Property Issues Emerging From 'Cyberspace.
CO-2	Give Learners in Depth Knowledge of Information Technology Act and Legal Frame Work Of Right to Privacy, Data Security and Data Protection.
CO-3	Make Study on Various Case Studies on Real Time Crimes.

3RD SEMESTER

MSCS2101 : MOBILE SECURITY ANALYSIS

Course Objective: This course focuses on two aspects of Cyber Security: analysis and assessment of risk plus how to minimize it, and, how to extract and use digital information from a wide range of systems and devices. The course is structured so that all students cover the same introductory material, but then choose to specialize in either Cyber Security or Digital Forensics. Any aforesaid science graduate who requires keen interest & knowledge of IT programming languages with basic knowledge of math beyond calculus.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Students learn cryptography basics (concepts, algorithms, techniques, implementation, and evaluation) for mobile apps.
CO-2	Students learn basic cryptography implementation for Android mobile security.
CO-3	Understand how to outsource application and data to a cloud in mobile computing which will leverage services provided by cloud providers.

CO-4	Deal with the various aspects arising in architecting secure complex systems, such as analysing and identifying system threats and vulnerabilities, and investigating operating systems security.

MSCS2102 : IT GOVERNANCE, RISK& COMPLIANCE

Course Objective: This course focusses on two aspects of Cyber Security: analysis and assessment of risk plus how to minimize it, and, how to extract and use digital information from a wide range of systems and devices. The course is structured so that all students cover the same introductory material, but then choose to specialize in either Cyber Security or Digital Forensics. Any aforesaid science graduate who requires keen interest & knowledge of IT programming languages with basic knowledge of math beyond calculus.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the concepts of governance, risk management and compliance (GRC) and regulatory environment.
CO-2	Identify high-risk areas and compliance in your organization and apply Risk-based Approach
CO-3	Develop and implement a governance, risk management and compliance strategic plan
CO-4	Understand, define, and enhance organizational culture as it relates to performance, risk, and compliance
CO-5	Implement governance, risk management and compliance processes that are effective and efficient
CO-6	Using a risk-based audit approach

MSCS2103: BUSINESS CONTINUITY PLANNING & DISASTER RECOVERY

Course Objective: This course focuses on two aspects of Cyber Security: analysis and assessment of risk plus how to minimize it, and, how to extract and use digital information from a wide range of systems and devices. The course is structured so that all students cover the same introductory material, but then choose to specialize in either Cyber Security or Digital Forensics. Any aforesaid science graduate who requires keen interest & knowledge of IT programming languages with basic knowledge of math beyond calculus.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the concept of business continuity
CO-2	Learn the importance of a BCP (business continuity planning)

CO-3	See how load balancing maintains business continuity
CO-4	Discover how a DCP (Disaster recovery plan) is a second line of defence
CO-5	Learn how to choose the right failure over solution

MSCS2104: PENETRATION TESTING & VULNERABILITY ASSESSMENT

Course Objective: In the end, the goal is to identify security weaknesses in a network, machine, or piece of software. Once they're caught, the people maintaining the systems or software can eliminate or reduce the weaknesses before hostile parties discover them. "Security" isn't limited to how well the machines and software stand up against penetration attempts.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Explain the basic principles and techniques of how attackers can enter computer systems.
CO-2	Put acquired knowledge into practice by performing ethical penetration tests and hide the intrusion.
CO-3	Perform analyses of data breaches and audits of information technology security.
CO-4	Evaluate the strengths and weaknesses of various information technology solutions in terms of data security.
CO-5	Independently present and perform demonstrations of pen-tests for educational purposes.
CO-6	Evaluate the societal role of hacking from a social, ethical and economic standpoint

MSCS2105 : DIGITAL FRAUDS

Course Objective: To provide students with a comprehensive overview of collecting, investigating, preserving, and presenting evidence of cybercrime left in digital storage devices. To introduce topics of forensic data examination of computers and digital storage media. Investigation of computers used for wrong-doing. Understand file system basics and where hidden files may lie on the disk, as well as how to extract the data and preserve it for analysis. Understand some of the tools of e-discovery. Legal aspects must form a constant background for these types of investigations.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Understand the importance of a systematic procedure for investigation of data found on digital storage media that might provide evidence of wrong-doing.

CO-2	Understand the file system storage mechanisms of two common desktop operating systems (i.e., versions of Microsoft Windows and LINUX)
CO-3	Use tools for faithful preservation of data on disks for analysis. Find data that may be clear or hidden on a computer disk.

4TH SEMESTER

MSCS0301 : PROJECT/ DISSERTATION

Course Objective: To help in training of students with hands on experience of instruments while working on any research topic.

Course Outcomes : On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Have understanding of research methodology and lab work/field work.

11. M.Sc. Geoinformatics

11.1 PO (Programme Outcomes)

POs	Outcomes
PO1	Scientific knowledge: Apply the knowledge of basic science fundamentals to the solution of complex scientific problems.
PO2	Problem analysis: Identify, formulate, review research literature, and analyse complex scientific problems reaching substantiated conclusions using principles of Physic, Chemistry, Mathematics, Zoology, Botany, Geo-Informatics, and Applied Sciences.
PO3	Design/development of solutions: Design solutions for complex scientific problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern chemical IT tools including prediction and modelling to complex chemical activities with an understanding of the limitations.
PO6	Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO7	Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
PO8	Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them
PO9	Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
PO11	Project management and finance: Demonstrate scientific knowledge with the understanding of the management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
PO12	Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context research, scientific and technological change.
PO13	Demonstrate the ability to succeed in national and international competitive events in the relevant fields

11.2 PSO (Programme Specific Outcomes)

Sl.No.	Programme Specific Outcomes
PSO1	Explain basic physical principles of remote sensing, Geographical Information System, GNSS and relevant theories.
PSO2	Understand Geospatial and earth observation technology to generate, integrate, analyse and visualize spatial data as well as principles of databases and data models.
PSO3	Know the appropriate use of geospatial data for different applications. Apply research skills to formulate and carry out independent research in the general field of geoinformatics

School of Applied Sciences

Centurion University of Technology & Management

M. Sc. GEOINFORMATICS

(Two years programme)

2021

Overview

Several aspects of space technology have already touched the life of common people, e.g., Google Earth, GPS-enabled Mobiles and day-to-day navigation, using maps. All the technologies behind these services, when put in one basket, can be justifiably described as "Geoinformatics". This includes satellite remote sensing, airborne remote sensing, photogrammetry, geographical information system (GIS), Global Positioning System (GPS), electronic surveying, laser scanning, mobile mapping, image processing, algorithms, data structures and computer programming. Geoinformatics or Geospatial technology touches around 80% of human activities knowingly or unknowingly.

Geoinformatics have high potential for better management and monitoring of day-to-day activities and short-term and long-term physical processes that affect our living environment. Besides finding the use in the day-to-day life of people, these technologies are becoming essential for a large number of application domains, e.g., environmental sciences, civil engineering, urban development and management, water resource, geology, navigation, disaster management, forest, coastal zones, mining operations, entertainment, and many more. Geomatics encompasses the practices related to developing, managing, interpreting or analysing geographically referenced data and includes everything that is 'spatial' in its characteristic and content. Geospatial information empowers the nation to understand its topography, natural resources and human capital and allows it to develop the requisite industrial policies to harness its resources.

Objective:

The 2-year master degree course – M. Sc. Geoinformatics is an interdisciplinary course with an aim to meet the increasing demand for qualified manpower in this rapidly developing field encompassing both pure and applied sciences. Application of Remote Sensing techniques using Geographic Information System (GIS) and Global Positioning System (GPS) with advance surveying has its place in various activities such as resources monitoring and evaluation, environmental monitoring and land use/land cover mapping etc. RS data products are increasingly being used for designing of plan at all the levels of nation building. The department has a separate vision for this course in becoming a Centre of excellence in Geomatics education and research thus to match the needs of ever increasing requirement of trained manpower in these fields and to cater to the need of the human society. It is our mission to impart quality education to students supported by large-scale hands- on-activity that could make them capable

of handling challenges of modern technologies and also to maintain super specialized research facilities to go hand in hand with the world's leading universities and research institutions.

Eligibility:

Bachelor degree in any Science graduate or BA in Geography.

Minimum 40% mark in bachelor degree

Carrier Prospective:

- **Indian Space Research Organization (ISRO) -** [Space Application Centre (SAC), Indian Institute of Remote Sensing (IIRS), ISRO State application Centre, Orissa Space Application Centre (ORSAC)].
- Survey of India (SOI)
- Indian Rice Research Institute (IRRI)
- Defence Research & Development Organization (DRDO)
- Urban Authorities of India
- Forest department [Odisha Forest Sector Development Project (OFSDP)]
- Chilika Development Authority (CDA)
- Odisha PVTG Empowerment Livelihood Improvement Programme
- Odisha Tribal Empowerment & Livelihoods Programme Plus
- Odisha State Disaster Management Authority (OSDMA)
- Bhubaneswar Municipality Corporation (BMC)
- Indian Institute of Mineral and Material Technology (IMMT)
- AABSys
- Institute for Spatial Planning and Community E-services (I SPACE)

Award

After finishing the course, the student will be award as **"Master of Science in Geoinformatics"** in his / her certificate.

SYLLABUS AS PER CBCS STRUCTURE

M.Sc. GEOINFORMATICS

CORE SUBJECT				
Sl. No.	**Code**	**Subject Name**	**T-P-P**	**Credits**
1.	CUTM1068	GEOSPATIAL SURVEY	**1-2-0**	**3**
2.	CUTM1067	SURVEYING TECHNIQUES	**1-2-0**	**3**
3.	CUTM1081	COMPUTER-AIDED ENGINEERING	**0-2-1**	**3**
4.	CUTM2076	GEOSPATIAL DATA ANALYSIS IN PYTHON	**2-3-1**	**6**
5.	CUTM1059	DATABASE MANAGEMENT SYSTEMS	**2-1-0**	**3**
6.	CUTM1183	QUANTITATIVE TECHNIQUES	**3-1-1**	**5**
7.	CUTM1721	RESEARCH METHODOLOGY	**2-0-1**	**3**
8.	CUTM2067	GEOLOGICAL REMOTE SENSING TECHNIQUE	**2-2-0**	**4**
9.	CUTM2068	MICROWAVE REMOTE SENSING AND APPLICATIONS	**2-2-0**	**4**
10.	CUTM2069	RS & GIS FOR URBAN AND REGIONAL PLANNING	**1-1-2**	**4**
11.	CUTM2070	GIS IN HEALTH	**2-2-0**	**4**
12.	CUTM1019	MACHINE LEARNING USING PYTHON	**1-2-1**	**4**
13.	CUTM2071	RS & GIS FOR HYDROLOGY AND WATER RESOURCES	**1-2-0**	**3**
14.	CUTM2072	APPLICATION OF GEO-INFORMATICS TO HAZARDS MONITORING AND MODELLING	**2-2-0**	**4**
15.	CUTM2073	GEOSPATIAL DATA INFRASTRUCTURE	**2-2-0**	**4**
16	CUTM2074	RS & GIS FOR ENVIRONMENTAL ENGINEERING	**2-2-0**	**4**
17	CUTM2075	RS & GIS FOR AGRICULTURE AND FORESTRY	**2-1-0**	**3**
TOTAL CREDITS				**64**

SKILL/DOMAIN/INTERNSHIP				
Sl. No.	**Code**	**Subject Name**	**T-P-P**	**Credits**

Domain	**ASCU2020**	**Aerial Surveying and Remote Sensing Applications**		**4-10-4**
1.	CUAS2020	REMOTE SENSING & DIGITAL IMAGE PROCESSING	**2-2-0**	**4**
2.	CUAS2021	GEOSPATIAL TECHNOLOGY AND ITS APPLICATION	**2-2-0**	**4**
3.	CUAS2022	PHOTOGRAMMETRY AND ITS APPLICATION	**0-2-0**	**2**
4.	CUAS2023	LIDAR REMOTE SENSING AND ITS APPLICATIONS	**0-2-0**	**2**
5.	CUAS2024	HYPER-SPECTRAL REMOTE SENSING AND ITS APPLICATION	**0-2-0**	**2**
6.	CUAS2025	PROJECT (Domain)	**0-0-4**	**4**
7.		SKILL	**4-0-0**	**4**

Sl. No.	**Code**	**Subject Name**	**T-P-P**	**Credits**
1.	CUTM2077	INTERNSHIP	**0-0-10**	**10**
		TOTAL		**10**
		Total Credit:	**64+18+4+10**	**96**

Geospatial Survey

Code	**Course Title**	**Credit**	**T-P-PJ**
CUTM1068	Geospatial Survey	3	1-2-0

Objective:

1. To teach the basic concept of Geospatial Technology and to do various field works with the help of digital surveying instruments.
2. To provide basics of digital surveying and mapping of earth surface using GPS, DGPS, GPR.

Learning outcome:

1. Gain knowledge about the structure of spatial data including file associations, attribute tables, Metadata, coordinate systems, and projections.
2. Carryout measurements Differential Global Positioning System (DGPS)/ Global Navigation Satellite System (GNSS) in the field.
3. Preparation & digitization of different topography map with the help of Arc-GIS software.
4. Utility mapping using GPR

Module I: GIS (1Th+4Pra) Hrs.

Geographic Information System: Introduction, Definition of GIS, Components of GIS, Geographical concepts, Input data for GIS Types of output products, Application of GIS.

Practice:

1. Introduction to GIS (Overview, Features, About the software, Main user interface, Main menu Project menu; Layer menu; View menu; Bookmarks menu; Plug-ins menu; Help menu, Toolbar, Legend window, Preview map, add data to the map area, Opening and saving projects)

2. Building a catalog of geographic data (Arc Catalog, folder connection, inside the catalog, folder location, create a working copy of the data, connect directly to your copy of the data, and remove folders that do not need)

Module II: GIS Data types (2Th+4Pra) Hrs.

Introduction: GIS data types: Data representation: Data sources: Typical GIS data sets Data acquisition, Data verification and editing, Dereferencing of GIS data, Spatial data errors Spatial data models, Spatial data structures, Modelling surfaces , Modelling networks , GIS database and database management system.

Practice

1. Introduction to Google Earth, Convert Shape file to KML Format, Extract data From Google Earth, Extract Point Data, Extract Polygon data, Extract line data, Convert KML File to shape file, overlaying an image into google earth.
2. Exploring data and adding it to a map (The Contents tab, The Metadata tab, add a layer to a map, import metadata, Search for items, map compose).
3. Managing a dataset (Define a shape file's coordinate system, modify attributes in database tables, calculate attribute values in ArcMap, Update the table's metadata, create a layer using the related attributes, Add the vegetation type layer to the map).
4. ArcGIS Graphics language (generalization, symbology, and colour effect, change symbology and use transparency in creative ways)

Module III: Spatial Data Analysis (1Th+5Pra) Hrs.

Spatial Data Analysis: Introduction, Data analysis terminology, Measurement of length, perimeter and area. Queries. Reclassification. Buffering and neighborhood functions. Data integration-map overlay. Spatial interpolation. Surface analysis. Network analysis. Digital terrain visualization

Practice:

1. Topology (Concept of topology, topology in different GIS format, Coverage, shapefile, DXF-Drawing Exchange File, Geodatabase, Topology principle, Topological Error and Correction process, creating personal Geodatabase, creating a features dataset).

2. Buffering and Editing tools: (Buffering in ArcGIS, add the data layer, create the buffer, conflation, extend the line, Erase point, Flip line, Snap, trim line, Densify, create a polygon, create point, Create polygon).

3. Creation DEM , DSM,TIN from SRTM/Cartosat Data.

Module IV: Global Positioning System (2Th+3Pra)Hrs

Introduction of Global Positioning System, Satellite constellation, GPS signals and data, Geo-Positioning-Basic Concepts. Discussion on NAVSTAR, GLONASS, GALLILEO, COMPASS. Basic geodesy, Geoid /datum/ Ellipsoid-definition and basic concepts, Coordinate Systems, Special Referencing system, Map Scale, Scale factors, Indian geodetic System Segments of GPS:Control Segment, Space Segments, User Segment-operations of GPS, accuracy, error sources and analysis, methodology for collection of data, adjustment

computations and analysis. Selection of datum, units and scale; GPS measurement. GPS Positioning Types-Absolute Positioning.

Practice:

Setting of instrument, Observation, Data downloading and processing, plotting of points, Georeferencing, Error calculation.

Module V: Differential Global Positioning System (2Th+3Pra)Hrs.

Differential positioning Methods-Static & Rapid static, Kinematic-Real time kinematic Survey. DGPS-GPS data processing and Accuracy. Selection of Reference Station, Reference Station Equipment: GPS receiver, GPS antenna. Radio and its types, Radio Antenna GP. Application of GPS in Surveying and Mapping, Navigation, Military, Location Based Services, Vehicle tracking, etc. Limitation of GPS & DGPS.

Practice:

Instrument Setup (Base station and Rover), Post-Processed Kinematic (PPK); Single point observation, Double point with baseline processing methods, Triangulation method, Real-Time Kinematic (RTK);Navigation system, Collection of Ground Control Point (GCP), Data export to GIS software.

Module VI: Ground Penetrating Radar (1Th+3Pra) Hrs.

GPR Explain working principle of ground penetrating radar (GPR), Describe the type of antennas used with GPR for different type of underground material detection, Use ground penetrating radar until a predefined depth from sub-surface based on the conductivity of material. Explain use of sketch/single line diagram (SLD).Describe the use of GPS/DGP in sync with GPR to get all data populated on map. Describe the use of other Utility locator like electromagnetic locator and other utility locators.

Practice:

Instrument setup, Utility mapping (Waterline, electric line, etc.), Processing of data

Module VII: (1Th+3Pra) Hrs

Explain GPR screen reading for the data being recorded, Describe the use of Radiometer with GPR to measure distance, Explain all the connecting cables used with GPR, Describe the power source and running capacity of GPR batteries, Explain handling the GPR and it's components, Describe how to transport GPR instrument, Use appropriate GPR antenna for described type of survey, Demonstrate the assembly of GPR equipment, Demonstrate the GPR data collection suing cross section.

Text Books:

1. Remote sensing and GIS 2nd Edition, Basudeb Bhatt, Oxford Publication
2. Anji Reddy, M. Remote sensing and Geographical information system, B.S. Publications, 20011.

Surveying Techniques

Code	Course Title	Credit	T-P-PJ
CUTM1067	Surveying Techniques	3	1-2-0

Objective:

1. To study the temporary adjustment of survey instruments by standard methods levelling and cross sectioning survey and setting out works.
2. To do various field works with the help of Total station
3. To Carry out topographic survey

Learning outcome:

1. Carry out temporary adjustment of survey instruments by standard methods ,levelling and cross sectioning survey and setting out works.
2. Carry out topographic survey.
3. Doing centering, leveling & measuring coordinate points of area and calculation transfer to data from Total station to software spectrum link.
4. Doing field work using of simple machine parts such as Total –Station, Auto- level

Course outline:

Module-1 (2Th) HRS

Historical survey practice: Introduction to surveying: Classification, Basic Principle, List of Instruments used in surveying.

Module-II (2Th+4Pr) HRS

Leveling: Concept and principles of levelling, different types of levelling, their application ,selection of station points, staff measurement locations, ideal location for etc. ,computation of Reduced levels through rise and fall method and height of collimation method, standard procedure for conducting leveling works , Identification of errors, understanding their source and rectifying the same ,different causes of errors in the leveling works, their impact on the project, procedure for laying slopes and gradients for roads, bridges, pipelines, canals etc , Errors in slope alignment and their implications, identification & rectifications ,procedures for making entries in the field book and make necessary calculations.

Practices:

1. Calculation of RL using HI and Rise and fall method.
2. Longitudinal and cross sectional Leveling
3. Check Leveling

Module-III (2+5) HRS

Total station: Parts of the instrument, operational panel, guide light, basic key operation, display functions, setting up the instrument, focusing and target sighting, angle measurement, setting the horizontal, distance and angle measurement, REM measurement, coordinate measurement ,to view the data/ points collected, area calculation, data download.

Practices:

4. Distance, angle and slope Measurements
5. Traverse adjustment (With help of software)
6. Area calculation using Total station

Module-IV (1Th+5 Pr)HRS

Applications of total station :Detail survey i.e., data collection., Height measurement (Remove elevation measurement- REM, Fixing of missing pillars (or) Setting out (or) Stake out, Resection. etc. Remote distance measurement (RDM) or Missing line measurement (MLM).

Practices:

7. Height measurement (Remote elevation measurement- REM).
8. Fixing of missing pillars (or) Setting out (or) Stake out.

Module-V (1Th+3Pra) HRS

Concept of topographic survey, its importance and different methods of conducting topographic survey using modern and conventional instruments, calculations required for plotting contours, Interpretation and importance of contours. Knowledge of scale and key while plotting a contour map, represent topography of the area in required scale, different methods of computing levels.

Practice:
9. Preparation of contour maps using total station and surfer software.

Module-VI (2Th+4Pra) Hrs

Curves: Types of curves, Properties– simple, compound, reverse and transition curve of works

Practices:

10. Setting out of different curves (simple, compound, reverse and transition) using Total Station

Module--VII (4 hours)

Setting out of works

11. Setting out of Building

12. Setting out of culvert

Text Books:

1. Surveying Vol I & II, III B C Purnima, Laxmi Publication.

2. Surveying, volume 1&2 BY S.K.Duggal, TMH publisher.

Reference Books:

1. Surveying & Levelling by T.P Kanitkar& V S Kulkarni

E Books:

1. Source of reference; NSQF

Online Source: NPTEL Videos (www.nptel.ac.in)

Computer Aided Engineering

Code	Course Title	Credit	T-P-PJ
CUTM1081	Computer Aided Engineering	3	**0-2-1**

Objective

- This course will help student to use structural scenario, thermal scenario and to do Structural analysis and Thermal analysis of various problems.

Learning outcome

- Create complete finite element models
- Submit and monitor analysis jobs
- View and evaluate simulation results

Course content

Module I: Material and Selection Properties (6 Hrs)

Property Module, Material Definitions, Linear Elasticity, Large Strain Elasticity, Metal Plasticity, Material Calibration, Material Databases, Section Properties

Practice:

1. Analysis of crack in pressure vessel
2. Cable stayed bridge simulation

Module II: Element Selection Criteria (6 Hrs)

Solid Element Selection, Structural vs. Continuum Elements, Modeling Bending Using Continuum Elements, Stress Concentrations.

Practice:

3. Stress analysis of rail road with wheel.
4. Bike frame structural analysis

Module III: Meshing (8 Hrs)

Mesh Module, Mesh Elements Mesh Generation Workflow, Local Fine-tuning, Quality Checks, Mesh Compatibility, Mesh Convergence, Dependent and Independent Part Instances.

Practice:

5. Airplane bracket structural analysis
6. Structural analysis of wind turbine blade

Module IV: Boundary Condition (6 Hrs)

Step Module, Analysis Steps and Procedures, Output Requests, Output Files, Load Module, Loads and Boundary Conditions, Initial Conditions

Practice:

7. Generative structural analysis applied for design optimization
8. Stress analysis on a backhoe

Module V: Contact (6 Hrs)

Mechanical Contact Properties, Contact Domain, Contact Formulation and Controls, Handling Initial Over closures, Contact Output.

Practice:

9. Analysis of Economizer.
10. Analysis of Screw Jack

Module VI: Analysis Procedures (6 Hrs)

Model and Analysis Steps, Analysis Procedures, The static, general analysis procedure, Finding a converged solution, The Static, Linear Perturbation procedure, Buckle procedure, Frequency Procedure, The dynamic, explicit analysis procedure, Stability Limit, Analysis Continuation Techniques

Practice:

11. Steady state analysis of a composite bar.

Module VII: Thermal Analysis (8 Hrs)

*S*teady State Heat Transfer, Transient Heat Transfer, Thermal Interfaces, Thermal Stress Analysis

Practice:

12. Temperature distribution in radiators used in automobiles
13. Oven radiation simulation
14. Steady state thermal analysis of tungsten coil with internal heat generation
15. Thermal analysis of disc brake

Projects

1. Thermal Analysis of PV Solar Pannel

2. Structural and thermal analysis of Green House
3. Structural analysis of Quadcopter.
4. Structural analysis of landing gear.
5. Numerical study on different types of fins.
6. Overhead tank failure analysis.
7. Analysis of Rocket Nozzle
8. Analysis of BAJA SAE
9. Structural and Thermal Analysis of Downdraft Gasifier
10. Structural and Thermal Analysis of Stirling Engine
11. Structural Analysis of Hydraulic Press
12. Structural Analysis of Elevating Conveyor

Text Books/ Reference Books/ Reference Material

1. SIMULIA: 3DS Learning Space

Source of reference: 3DS peer learning

GEOSPATIAL DATA ANALYSIS IN PYTHON

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM 2076	GEOSPATIAL DATA ANALYSIS IN PYTHON	2-3-1	NIL

Objective

- To understand the programming features of Python
- To learn the elements of python programming
- To learn python libraries
- To learn data visualisation using python

Learning outcome

- To read data using Python Functions
- To perform data visualisation using Python Libraries
- To learn problem solving using python

Course contents

Module-I(4HrsTh+6Hrs Pra)

Introduction to Python: Features, History, applications etc., Installation of anaconda cloud and Integrated Development Environment (IDE) window/Linux Operation system: Spyder, Jupiter Note Book, Pycharm, Eclipse etc.

Spyder IDE: Introduction Spyder, Setting working Directory, Creating and saving a python script file, File execution, clearing console, removing variables from environment, clearing environment, Commenting script files etc.

Python Variables, Data Type, Keywords, Operators: Arithmetic and logical. Python Data Structure: Lists, Tuples, Dictionary, Sets.

Numpy: Array, Matrix and different operations, Linear algebra and analysis, Pandas data frame: Read & write Reading files (excel, CSV and txt etc.) data cleaning and analysis, Data elections & preprocessing, Data Visualization using matplotlib and seaborn library: Line plot, Scatter plot, Histogram, Bar plot, Box plot etc.

Module-II(4HrsTh+4Hrs Pra)

Pandas data frame: Read & write Reading files (excel, CSV and txt etc) data cleaning and analysis, Data elections & preprocessing, Data Visualization using matplotlib and seaborne library: Line plot, Scatter plot, Histogram, Bar plot, Box plot etc., Geocoding.

Module III(4HrsTh+4Hrs Pra)

Introduction to Geopandas, Fiona, shapely and GDAL and Rasterio, PyGRASS and ArcPy**.** Data Structure, Geometric Object: Point, Line and polygon, Attribute and methods and Geo-data Frame ArcPy**.** Reading and Writing Files Geo-spatial Data, subset based on location, attribute and geometry. Indexing and extracting spatial feature using multi-criteria**.**

Module IV(4HrsTh+4Hrs Pra)

Geometric Manipulation, subset Operation: Union, Intersection, difference, Identity, overlay etc**.** Aggregation, Dissolve, Append, Merging of spatial feature data, Geospatial Feature Extraction, Vector, Shapefile, Join Operation, Open Street Map Integration, Spatial Databases, Spatial Clustering.

Module V(4HrsTh+4Hrs Pra)

Spatial Interpolation Techniques: Kernel Density Estimation (KDE), IDW Interpolation, TIN Interpolation, Spatial and Temporal Statistics from Raster Data. Spatial auto correction.

Module VI(4HrsTh+4Hrs Pra)

Making Map and plot: Choropleth Analysis and Mapping, Population density map, create legend, color manipulation and marginal annotations, Cloud GIS, Multi-Client Visualization.

Text Books

1. Programming Python: Powerful Object Oriented Programming; Mark Lutz; Shroff/O'Reilly; 2010.

2. Beginning Python: Using Python 2.6 & Python 3.1; James Payne; Wiley India; 2011.

Database Management Systems

Code	Course Title	Credit	T-P-PJ
CUTM1059	Database Management Systems	3	2-1-0

Objective

- To understand the different issues involved in the design and implementation of a database system.
- To study the physical and logical database designs, database Modeling, relational, hierarchical, and network models.
- To understand and use data manipulation language to query, update, and manage a database.
- To develop an understanding of essential Peoperties of DBMS concepts such as: database security, integrity, concurrency.
- To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

Learning outcome

- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL
- Design ER-models to represent simple database application scenarios
- Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data
- Improve the database design by normalization
- Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing

Course content

Module-1: **DBMS Concepts [5 Hrs]**

Data Abstraction - Data models and data independence. Instances and Schemas. Components of a DBMS and overall structure of a DBMS- Life Cycle of a DBMS application- Database terminology.

Module-2: Data Modeling [5Hrs]

Basic concepts- Types of data models- Conceptual, physical and logical database models- E-R data model and Object-oriented data model. Components of ER Model- ER Modeling symbols. Entity and entity sets- Relations and relationship sets- E-R Diagrams- Reducing E-R Diagrams into tables.

Practice

Assume we have the following application that models soccer teams, the games they play, and the players in each team. In the design, we want to capture the following:

• We have a set of teams, each team has an ID (unique identifier), name, main stadium, and to which city this team belongs.

• Each team has many players, and each player belongs to one team. Each player has a number
(unique identifier), name, DoB, start year, and shirt number that he uses.
• Teams play matches, in each match there is a host team and a guest team. The match takes place in the stadium of the host team.
• For each match we need to keep track of the following:
• The date on which the game is played
• The final result of the match
• The players participated in the match. For each player, how many goals he scored, whether or not he took yellow card, and whether or not he took red card.
• During the match, one player may substitute another player. We want to capture this substitution and the time at which it took place.
• Each match has exactly three referees. For each referee we have an ID (unique identifier), name, DoB, years of experience. One referee is the main referee and the other two are assistant referee.
Design an ER diagram to capture the above requirements. State any assumptions you have that
affects your design (use the back of the page if needed). Make sure cardinalities and primary keys are clear.

Module-3: Relational DBMS Model [5 Hrs]

Basic concepts, Attributes and domains- Intention and extensions of a relation- concept of integrity and referential constraints- Relational Query Languages (Relational algebra and relational calculus (Tuple and domain relational calculus).

Module-4: Relational Database Design [6 Hrs]

Notion of normalized relations- Normalization using Functional Dependency- First Normal form- Second Normal Form- Third Normal form- BCNF.

Practice

Perform NF on the given table

Module-5: SQL [6 Hrs]

Structure of a SQL query- DDL and DML, TCL- SQL queries and sub queries- Tables, views and indexes.

Practice

To study DDL-create and DML-insert commands.

(i) Create tables according to the following definition.

CREATE TABLE DEPOSIT (ACTNO VARCHAR2(5) ,CNAME VARCHAR2(18) , BNAME VARCHAR2(18) , AMOUNT NUMBER(8,2) ,ADATE DATE);

CREATE TABLE BRANCH(BNAME VARCHAR2(18),CITY VARCHAR2(18));

CREATE TABLE CUSTOMERS(CNAME VARCHAR2(19) ,CITY VARCHAR2(18));

CREATE TABLE BORROW(LOANNO VARCHAR2(5), CNAME VARCHAR2(18), BNAME VARCHAR2(18), AMOUNT NUMBER (8,2));

(ii) Insert the data as shown below.

DEPOSIT, BRANCH, CUSTOMERS, BORROW

(1) Describe deposit, branch.

(2) Describe borrow, customers.

(3) List all data from table DEPOSIT.

(4) List all data from table BORROW.

(5) List all data from table CUSTOMERS.

(6) List all data from table BRANCH.

(7) Give account no and amount of depositors.

(8) Give name of depositors having amount greater than 4000.

(9) Give name of customers who opened account after date '1-12-96'.

Module-6: Aggregate functions [4 Hrs]

Set Operations, predicates and joins, Set Membership- Tuple variables- Set comparison- Database modifications using SQL.

Practice

Create the below given table and insert the data accordingly.

Create Table Job (job_id, job_title, min_sal, max_sal)

COLUMN NAME DATA TYPE

job_id Varchar2(15)

job_title Varchar2(30)

min_sal Number(7,2)

max_sal Number(7,2)

Create table Employee (emp_no, emp_name, emp_sal, emp_comm, dept_no)

COLUMN NAME DATA TYPE

emp_no Number(3)

emp_name Varchar2(30)

emp_sal Number(8,2)

emp_comm Number(6,1)

dept_no Number(3)

Create table deposit(a_no,cname,bname,amount,a_date).

COLUMN NAME DATA TYPE

a_no Varchar2(5)

cname Varchar2(15)

bname Varchar2(10)

amount Number(7,2)

a_date Date

Create table borrow(loanno,cname,bname,amount).

COLUMN NAME DATA TYPE

loanno Varchar2(5)

cname Varchar2(15)

bname Varchar2(10)

amount Varchar2(7,2)

Insert following values in the table Employee.

emp_n emp_name emp_sal emp_comm dept _no

101 Smith 800 20

102 Snehal 1600 300 25

103 Adama 1100 0 20

104 Aman 3000 15

105 Anita 5000 50,000 10

106 Sneha 2450 24,500 10

107 Anamika 2975 30

Insert following values in the table job.

Insert following values in the table deposit.

Perform following queries

(1) Retrieve all data from employee, jobs and deposit.

(2) Give details of account no. and deposited rupees of customers having account opened between dates 01-01-06 and 25-07-06.

(3) Display all jobs with minimum salary is greater than 4000.

(4) Display name and salary of employee whose department no is 20. Give alias name to name of employee.

(5) Display employee no,name and department details of those employee whose department lies in(10,20)

To study various options of LIKE predicate

(1) Display all employee whose name start with 'A' and third character is ' 'a'.

(2) Display name, number and salary of those employees whose name is 5 characters long and first three characters are 'Ani'.

(3) Display the non-null values of employees and also employee name second character should be 'n' and string should be 5 character long.

(4) Display the null values of employee and also employee name's third character should be 'a'.

(5) What will be output if you are giving LIKE predicate as '%_%' ESCAPE '\'

To Perform various data manipulation commands, aggregate functions and sorting concept on all created tables.

(1) List total deposit from deposit.

(2) List total loan from karolbagh branch

(3) Give maximum loan from branch vrce.

(4) Count total number of customers

(5) Count total number of customer's cities.

(6) Create table supplier from employee with all the columns.

(7) Create table sup1 from employee with first two columns.

(8) Create table sup2 from employee with no data

(9) Insert the data into sup2 from employee whose second character should be 'n' and string should be 5 characters long in employee name field.

(10) Delete all the rows from sup1.

(11) Delete the detail of supplier whose sup_no is 103.

(12) Rename the table sup2.

(13) Destroy table sup1 with all the data.

(14) Update the value dept_no to 10 where second character of emp. name is ‘m’.

(15) Update the value of employee name whose employee number is 103.

To study Single-row functions.

(1) Write a query to display the current date. Label the column Date

(2) For each employee, display the employee number, job, salary, and salary increased by 15% and expressed as a whole number. Label the column New Salary

(3) Modify your query no 4.(2) to add a column that subtracts the old salary from the new salary. Label the column Increase

(4) Write a query that displays the employee’s names with the first letter capitalized and all other letters lowercase, and the length of the names, for all employees whose name starts with J, A, or M. Give each column an appropriate label. Sort the results by the employees’ last names.

(5) Write a query that produces the following for each employee:

earns monthly

(6) Display the name, hire date, number of months employed and day of the week on which the employee has started. Order the results by the day of the week starting with Monday.

(7) Display the hiredate of emp in a format that appears as Seventh of June 1994 12:00:00 AM.

(8) Write a query to calculate the annual compensation of all employees (sal+comm.).

Displaying data from Multiple Tables (join)

(1) Give details of customers ANIL.

(2) Give name of customer who are borrowers and depositors and having living city nagpur

(3) Give city as their city name of customers having same living branch.

(4) Write a query to display the last name, department number, and department name for all employees.

(5) Create a unique listing of all jobs that are in department 30. Include the location of the department in the output

(6) Write a query to display the employee name, department number, and department name for all employees who work in NEW YORK.

(7) Display the employee last name and employee number along with their manager’s last

name and manager number. Label the columns Employee, Emp#, Manager, and Mgr#, respectively.
(8) Create a query to display the name and hire date of any employee hired after employee SCOTT.

Module-7: Transaction Management [8 Hrs]

Subqueries, Manipulating Data, Transaction management and Concurrency control

Practice

To apply the concept of Aggregating Data using Group functions.
(1) List total deposit of customer having account date after 1-jan-96.
(2) List total deposit of customers living in city Nagpur.
(3) List maximum deposit of customers living in bombay.
(4) Display the highest, lowest, sum, and average salary of all employees. Label the columns Maximum, Minimum, Sum, and Average, respectively. Round your results to the nearest whole number.
(5) Write a query that displays the difference between the highest and lowest salaries. Label the column DIFFERENCE.
(6) Create a query that will display the total number of employees and, of that total, the number of employees hired in 1995, 1996, 1997, and 1998
(7) Find the average salaries for each department without displaying the respective department numbers.
(8) Write a query to display the total salary being paid to each job title, within each department.
(9) Find the average salaries > 2000 for each department without displaying the respective department numbers.
(10) Display the job and total salary for each job with a total salary amount exceeding 3000, in which excludes president and sorts the list by the total salary.
(11) List the branches having sum of deposit more than 5000 and located in city bombay.
To solve queries using the concept of sub query.
(1) Write a query to display the last name and hire date of any employee in the same department as SCOTT. Exclude SCOTT

(2) Give name of customers who are depositors having same branch city of mr. sunil.
(3) Give deposit details and loan details of customer in same city where pramod is living.
(4) Create a query to display the employee numbers and last names of all employees who earn more than the average salary. Sort the results in ascending order of salary.
(5) Give names of depositors having same living city as mr. anil and having deposit amount greater than 2000
(6) Display the last name and salary of every employee who reports to ford.
(7) Display the department number, name, and job for every employee in the Accounting department.
(8) List the name of branch having highest number of depositors.
(9) Give the name of cities where in which the maximum numbers of branches are located.
(10) Give name of customers living in same city where maximum depositors are located.
Manipulating Data
(1) Give 10% interest to all depositors.
(2) Give 10% interest to all depositors having branch vrce
(3) Give 10% interest to all depositors living in Nagpur and having branch city bombay.
(4) Write a query which changes the department number of all employees with empno 7788's job to employee 7844'current department number.
(5) Transfer 10 Rs from account of anil to sunil if both are having same branch.
(6) Give 100 Rs more to all depositors if they are maximum depositors in their respective branch.
(7) Delete depositors of branches having number of customers between 1 to 3.
(8) Delete deposit of vijay.
(9) Delete borrower of branches having average loan less than 1000.

To apply the concept of security and privileges.

To study Transaction control commands

TEXT BOOKS

Database Management Systems: Raghu Ramakrishnan
ORACLE PL/SQL Programming – Scott Urman BPB Publications.

REFERENCES

Database Systems Concepts – Henry F Korth, Abraham Silberschatz.
Database Management Systems – Alexis Leon, Mathews Leon – Leon, Vikas Publications

QUANTITATIVE TECHNIQUES

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
MSGM1104	QUANTITATIVE TECHNIQUES	5	3-1-1	NIL

2. Objective

- To acquaint the students with different application of quantitative techniques in business decision making.

3. Learning outcome

Understand statistical inference in relation to international business decision-making
Convey the results of quantitative analysis

4. Evaluation Systems

Internal Examination	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Seminar	*10*	Report and Presentation
	Internal Practice	*20*	Report and Viva
	Total	*50*	
External Examination	*End Sem. Test*	*30*	Written examination
	External Practice	*20*	Viva-Voice
Total		*100*	

5. Course outline

Unit: I Overview of Statistics(4HrsTh+4Hrs Pra)

Nature, Scope and limitations of statistics; uses of statistics to business and industrial activities, Statistical Data –primary and secondary data, Collection of data, Classification and tabulation of

data, Diagrammatic and graphic representation of data. Questionnaire –its characteristics and drafting.

Unit-II Measurement of Central Tendency & Dispersion(4HrsTh+4Hrs Pra)

Data Measure of Central Tendency: Introduction, Meaning of quantitative technique, statistical Research, Measures of central tendency (Averages), Arithmetic mean, Weighted Mean, Median,

Mode Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Standard Deviation,

Coefficient of Variation.

Unit: III Probability(4HrsTh+4Hrs Pra)
Probability: Basic concepts, Bayesian, Probability Distribution- Binomial, Poisson, Normal Distribution, Baye's Theorem.

Unit-IV Sampling and Hypothesis test(4HrsTh+4Hrs Pra)
Sampling: Introduction, why sampling, sampling methods, Sampling distribution, standard error, typeI and II error, Estimation, properties of good estimator, Type of estimation, Confidence limit. Hypothesis: Hypothesis testing, Z-test, t-test, Chi square test, F-test, ANOVA.

Unit-V Forecasting Technique(4HrsTh+4Hrs Pra)
Correlation, Regression, Time series.

Project will be an info-graphic project which has to include story line and descriptive statistics like measures of central tendency; comparison, graphs

6. Text Book

1. Gupta .S.C and Kapoor .V.K, *"Fundamentals of Mathematical Statistics"*, Sultan Chand and sons, Reprint 2003.
2. Gupta .S.C, and Kapoor, V.K, "*Fundamentals of Applied Statistics"*, Sultan Chand and sons, 2003.
3. Veerarajan.T, "*Probability Statistics and Random Processes"*, TMH, First reprint, 2004.

RESEARCH METHODOLOGY

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
MSGM1206	RESEARCH METHODOLOGY	3	2-0-1	

2. Objective

a) To equip students with a basic understanding of the underlying principles of quantitative and qualitative research methods.

b) Provide students with in-depth training on the conduct and management of research from inception to completion using a wide range of techniques.

3. Learning outcome

1. Students can understand the ethical and philosophical issues associated with research in education.
2. This study provides knowledge on various modes of presenting and disseminating research findings.
3. Enable students to acquire expertise in the use and application of the methods of data collection and analysis.
4. Provide learning opportunities to critically evaluate research methodology and findings.
5. Enable students to be reflexive about their role and others' roles as researchers.

4. Evaluation Systems

Internal Examination (Theory)	***Component***	***% of Marks***	***Method of Assessment***
	Midterm Test	*20*	Written examination
	Assignment	*0*	Assignment
	Experiments	*20*	Course Contents/Case studies
	Quiz	*10*	Surprise/preannounced ones
External Examination		*50*	Written examination
Total		*100*	

5. Course Outline

Module I(6HrsTh+4Hrs Pro)

Introduction to Research: Definition, Scope, Limitations, and Types. Objectives of Research. Research Process :Proposal Development: Basic steps involved in the health research proposal development process Literature Review: Importance and Sources, Strategies for gaining access to information, Library search, Computer search.

Research Designs: Research Title and Objectives Criteria for selecting a research title, Formulation of research objectives, Types of research objectives, Qualities of research objective.

Module II(4HrsTh+4Hrs Pro)

Data Collection: Secondary Data, Primary Data, and Methods of Collection. Scaling Techniques: Concept, Types, Rating scales & Ranking Scales, Scale Construction Techniques and Multi-Dimensional Scaling. Sampling Designs: Concepts, Types and Techniques and Sample size Decision.

Module III(4HrsTh+4Hrs Pro)

Research Hypothesis: Definition, Qualities of research hypothesis Importance and types of research hypothesis. Theory of Estimation and Testing of Hypothesis Small & Large Sample Tests, Tests of Significance based on t, F, Z test and Chi-Square Test. Designing Questionnaire. Interviewing. Tabulation, Coding, Editing. Interpretation and Report Writing.

6. TEXT BOOK:

1. DebashisPati, Marketing Research, University Press
2. Marketing research by N.Malhotra, Pearson Education
3. Cooper, Donald R and Pamela S schindler, Business Research Methods, Tata McGraw – Hill
4. C.R. Kothari, Marketing Research, New Age International
5. Zikmund, William G. , Business research methods by Cengage Learning

GEOLOGICAL REMOTE SENSING TECHNIQUES

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2067	GEOLOGICAL REMOTE SENSING TECHNIQUES	4	2-2-0	NIL

2. Objective

To study the spectral characteristics of Rocks and Minerals.
To study the remote sensing for geological structures mapping
To study the remote sensing for Lithological mapping
To understand geological survey techniques and GIS integration

3. Learning outcome

To study the role of remote sensing and GIS Tools in Earth Sciences.

4. Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation

	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

Module – I: SPECTRAL PROPERTIES OF ROCKS AND MINERALS (4HrsTh+4Hrs Pra)

Reflectance Properties of Rocks, minerals in visible, NIR, MIR, SWIR, TIR and Microwave regions Laboratory spectroscopy - laboratory and field spectral data comparative studies, Spectral reflection curves for important Rocks, Minerals.

Module – II: GEOLOGICAL STRUCTURE AND APPLICATIONS (4HrsTh+4Hrs Pra)

Significance of Geological structures, Role of aerial photographs, Photo interpretation characters of photographs and satellite images, structural mapping, Fold, fault, Lineaments, Direction circular features. Intrusive rocks, rock exposure, Fractures and Joints, Rose diagram. Digital image processing for structural mapping.

Module – III: LITHOLOGICAL MAPPING (4HrsTh+4Hrs Pra)

Introduction on Igneous rocks, sedimentary rocks, metamorphic rocks, mapping of regional scale lithological units, Image Characters of igneous rocks, sedimentary and metamorphic rocks, examples. Digital image processing of various rock types, resolution and Scale of lithological mapping and advantages.

Model – IV: GEOMORPHOLOGICAL MAPPING(4HrsTh+4Hrs Pra)

Significance of landform, Geomorphological guide, interpretation and image/photo characters, Tectonic landforms, Fluvial landforms, Denudation landforms, Volcanic landforms- Aeolian landforms, Coastal landforms. Importance of ground truth and geological field data collection.

Model – V: GEOLOGICAL SURVEY TECHNIQUES AND DATA INTEGRATION(4HrsTh+4Hrs Pra)

Geophysical survey, surface investigation, subsurface investigation, Gravity survey, Seismic survey, refraction methods, reflection methods, applications, Magnetic survey and Electrical resistivity survey, self-potential methods, potential drop methods, resistivity values, data interpretation, Curve fitting, GIS data generation , integration and analysis.

6. TEXT BOOK

1. John J. Qu , Wei Gao, MenasKafatos , Robert E. Murphy, Vincent V. Salomonson, "*Earth Science Satellite Remote Sensing"*, Springer 2007.
2. Gupta .R.P, "*Remote sensing Geology"*, Springer, 2003.
3. Jean-yvesscanvk, "*Aerospatial Remote Sensing in Geology"*, A.A. Balakarma, Netherlands, 1997.
4. Drury .S.A, "*Image interpretation in Geology"*, Chapman and Hall, London. 1993.
5. Pandey .S.N, "*Principles and Applications of Photogeology"*, Wiley eastern. 1987.

MICROWAVE REMOTE SENSING AND APPLICATIONS

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM 2068	MICROWAVE REMOTE SENSING AND APPLICATIONS	4	2-2-0	NIL

2. Objective

1. To study basics of Microwave Remote Sensing
2. To Understand parameters of radiometry and Antenna functions
3. To understand RADAR principles
4. To learn Microwave data processing
5. To study Microwave remote sensing Applications

3. Learning outcome

To study the RS & GIS data for microwave and Remote Sensing.

4. Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment

	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

Module – I: BASICS OF MICROWAVE REMOTESENSING(4HrsTh+4Hrs Pra)

Fundamentals – EMR-Electromagnetic Spectrum - Microwave Band Designation Microwave interaction with atmospheric constituents, Earth's surface, vegetation, and ocean.

Module – II: RADIOMETRY & ANTENNA SYSTEMS(4HrsTh+4Hrs Pra)
Basics - Theory of Radiometry - Sensors applications in atmosphere, ocean and land.
Antenna –Types and Functions of different types of antenna.

Module – III: RADAR(4HrsTh+4Hrs Pra)

Radar-Real and synthetic aperture radars, - Principles - different platforms and sensors, System parameters, Target parameters, Radar equation measurement and discrimination, Airborne Data products and selection procedure - SEASAT, SIRA, SIRB, ERS , JERS, RADARSAT missions.

Model – IV:RADAR DATA PROCESSING(4HrsTh+4Hrs Pra)

Radar grammetry, Image processing, SAR Interferometry – Polarimetry- Interpretation of microwave data - Physical mechanism and empirical models for scattering and emission, volume scattering.

Model – V: APPLICATIONS OF MICROWAVE REMOTE SENSING(4HrsTh+4Hrs Pra)
Geological interpretation of RADAR –sites-default-files, Application in Agriculture -forestry, Hydrology - ice studies – land use mapping and ocean related studies.

6. TEXT BOOK

1. Charles Elachi and Jakob Van 2y, "*Introduction to the Physics and Techniques of Remote Sensing"*, Wiley Interscience, A John Wiley and sons Inc., 2006.
2. Robert M. Haralick and Simmonett, "*Image Processing for Remote Sensing",* 1983
3. Robert N. Colwell, "*Manual of Remote Sensing Volume 1"*, Americal Society of Photo - grammetry 1983.
4. Travett .J. W, "*Imaging Radar for Resources Surveys",* Chapman and Hall, London 1986.
5. Ulaby .F.T, Moore .R.K, Fung .A.K, "*Microwave Remote Sensing; active and passive"*, Vol. 1, 2 and 3, Addison – Wesley publication company 2001

RS & GIS FOR URBAN AND REGIONAL PLANNING

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2069	RS & GIS FOR URBAN AND REGIONAL PLANNING	4	1-2-1	NIL

2. Objective

1. To study the RS & GIS data
2. To study the Mapping for Urban and Regional areas
3. To study GIS Tool in Urban Planning

3. Learning outcome

1. The students will learn different tools using urban planning.
2. The students will handle different case study using image processing and GIS tools

4. Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
	End Sem. Test	30	Written examination

External Examination	External Practice	20	Viva-Voice
Total		100	

5. Course outline

Module – I: REQUIREMENTS FOR URBAN & REGIONAL PLANNING (4HrsTh+4Hrs Pra)

Relevance of remotely sensed data for Urban & Regional Analysis and Planning - Identification of settlement features from aerospace images - Visual and digital analysis techniques - Scale and Resolution concepts - Scope and limitations.

Module – II: URBAN & REGIONAL MAPPING (4HrsTh+4Hrs Pra)

Regional Mapping - City Mapping - Intra - city Mapping-Methodology - Base map preparation - Delineation of area - Change Detection and mapping - classification - Urban fringe - CBD - Urban sprawl - Case studies.

Module – III: SUSTAINABLE DEVELOPMENT PLANS (4HrsTh+4Hrs Pra)

Regional plan - Master plan - Detailed Development plan - Objective and contents - Delineation of planning area - Methodology - Integrated plans - Case studies.

Model – IV: URBAN STUDIES (4HrsTh+4Hrs Pra)

Urban growth analysis - Slum development - House typology - Site selection for urban development - Density analysis - Population estimation - Transportation network analysis - Case studies.

Model – V: GIS IN URBAN MODELLING(4HrsTh+4Hrs Pra)

GIS - Data Input - Storage - Retrieval - Suitability of GIS software for urban analysis - Modelling with GIS - Decision support systems for urban studies.

6. TEXT BOOK

1. Brench .M.C, "*City Planning & Aerial Information"*, Harvard University, Cambridge, 1971.

2. Margaret Roberts, "*An Introduction to Town Planning Techniques"*, Hutchinson, London 1980.

3. Gautam N.C, "*Urban land use Interpretation through Arial Photograph Interpretation"*, NRSA.

4. *"IRS RS Applications to Urban Planning and Development",* Institute of Remote Sensing.

GIS IN HEALTH

1. Nomenclature

Code	Subject Name	Type of course	Credit	T-P-P	Prerequisite
CUTM2070	GIS IN HEALTH	T+P	4	2-2-0	NIL

2. Objective

The course is on geospatial analysis methods in health and to the kinds of problems for which these methods are appropriate.

The course is appropriate as an elective for those who may have no background in human sciences but who have fair knowledge in RS and GIS and interested in questions of the health of populations in geographic context.

3. Learning outcome

At the end of the course the student will be able to understand

Techniques used for disease ecology mapping and disease mapping

The usefulness of GIS for location allocation of health resources

The tools for development of Health GIS systems

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

UNIT I: MAPPING DISEASE ECOLOGY(4HrsTh+4Hrs Pra)

Disease types and causes – environmental and social factors – genetic and chronic aspects – gender and occupational bias – time and space factors in disease distribution – life cycle, statistical curves and modelling – hazards, disasters, accidents and health. Health Care and Delivery Systems: Health Care Systems and Delivery in India; Medical Services and Facilities, Health Information and Planning; Issues and Prospects – Ecosystem Approach, The issue, The Approaches, Lessons and Successes – Future Directions.

UNIT II: GEOSPATIAL DATA FRAMEWORK (4HrsTh+4Hrs Pra)

Disease records and geo-referencing – birth, movements and permanency – individuals, families and communities – problems of address coding and digitization – the privacy of records – risk and vulnerability – short term and long term trends – resurgence – historical records and reliability.

UNIT III: DISEASE MAPPING (4HrsTh+4Hrs Pra)

Spatial patterns of disease – mapping causal factors – endemic and epidemic zonation – tests for spatial clustering and fragmentation – applications of RS and GIS in disease mapping – deterministic stochastic and uncertainty models -vulnerability and comforts.

UNIT IV: HEALTH ANALYSIS (4HrsTh+4Hrs Pra)

GIS for Analysis of Health. Choosing and applying analytical methods for mapping, modeling and analyzing health and disease, including point pattern analysis, surface analysis, overlay analysis, network analysis, and cluster and regression analysis.
Case studies of Odisha State.

UNIT V: HEALTH AND WEB-GIS(4HrsTh+4Hrs Pra)

Sharing disease data and web" ontology requirements and applications – open source service environments – methods of XML aid OGC services" web map context, services and processing (WMS. WMC and VVPS)" web service quality and SDI

TEXT BOOKS:

Phillips, D.R. Health and Health Care in the Third World, Longmans Scientific. London, 1990

Levine, A.J Viruses, Scientific American, New York, 1992.

Ellen K. Cromley, Sara L. McLafferty 2011 , GIS and Public Health, Second Edition, Guilford Press, ISBN 9781609187507 – CAT# Y124676, 2nd Edition
Massimo Craglia (Editor), Ravi Maheswaran (Editor) (2004) GIS in Public Health Practice, CRC Press, 1st Edition

REFERENCES:

1. Ravi Maheswaran and Massimo Craglia, GIS in Public Health Practice, Boca Raton, CRC Press, 2004.

2. Lai C, Ann S.H Mak. "GIS for Health and the environment: Development in Asia Pacific Region, Berlin, 2000.
3. Anthony C Gatrell "GIS and Health, Markku Loytonen, European Science Foundation, 1998.
4. Cromley, E.K. & McLafferty, S.L. (2012) GIS and Public health. 2nd Edition. Guilford Press. New York. pp 503. ISBN 978-1-60918-750-7. Available from the vendor of your choice or from Amazon.com - GIS and Public Health(link is external).

Machine Learning using Python

Course Code	Course Title	Credit	T-P-PJ
CUTM1019	Machine Learning using Python	4	1-2-1

Objective

- Understand the meaning, purpose, scope, stages, applications, and effects of ML.
- Explore important packages of python, such as numpy, scipy, OpenCV and scikit-learn.

Learning outcome

- Students will able to Create and incorporate ML solutions in their respective fields of study.

Course content

Module 1 – Application and Environmental-setup (12 hrs)

- Applications of Machine Learning In different fields (Medical science, Agriculture, Automobile, mining and many more).
- Supervised vs Unsupervised Learning based on problem Definition.
- Understanding the problem and its possible solutions using IRIS datasets.
- Python libraries suitable for Machine Learning(numpy, scipy, scikit-learn, opencv)
- Environmental setup and Installation of important libraries.

Module 2 - Regression (8 hrs)

- Linear Regression
- Non-linear Regression
- Model Evaluation in Regression
- Evaluation Metrics in Regression Models
- Multiple Linear Regression
- Feature Reduction using PCA
- Implementation of regression model on IRIS datasets.

Module 3 - Classification (24 hrs)

- Defining Classification Problem with IRIS datasets.
- Mathematical formulation of K-Nearest Neighbour Algorithm for binary classification.
- Implementation of K-Nearest Neighbour Algorithm using sci-kit learn.
- Classification using Decision tree.
- Construction of decision trees based on entropy.
- Implementation of Decision Trees for Iris datasets .
- Classification using Support Vector Machines.
- SVM for Binary classification
- Regulating different functional parameters of SVM using sci-kit learn.
- SVM for multi class classification.
- Implementation of SVM using Iris datasets .
- Implementation of Model Evaluation Metrics using sci-kit learn and IRIS datasets.

Module 4 - Unsupervised Learning (12 hrs)

- Defining clustering and its application in ML .
- Mathematical formulation of K-Means Clustering.
- Defining K value and its importance in K-Means Clustering.
- Finding appropriate K value using elbow technique for a particular problem.
- Implementation of K-Means clustering for IRIS datasets Projects
- To be defined based on respective study area of student.

Text Book:

1. EthemAlpaydin, Introduction to Machine Learning, Second Edition, http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12012.

Web Resource:

1. https://towardsdatascience.com/beginners-guide-to-machine-learning-with-python-b9ff35bc9c51

RS & GIS FOR HYDROLOGY AND WATER RESOURCES

1. Nomenclature

Code	Subject Name	Type of course	Credit	T-P-P	Prerequisite
CUTM2071	RS & GIS FOR HYDROLOGY AND WATER RESOURCES	T+P	4	2-2-0	NIL

2. Objective

To study the basic knowledge of hydrologic data
To study the watershed characters and applications
To study the hydrological disaster and role of remote sensing & GIS
To study the ground water resources mapping by remote sensing & GIS
To study the surface water resources mapping by remote sensing & GIS

3. Learning outcome

To study and understand application of RS and GIS techniques for hydrology and water resources.

4. Evaluation Systems

Internal Examination	Component	% of Marks	Method of Assessment
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

Module – I: HYDROLOGICAL COMPONENETS (4HrsTh+4Hrs Pra)

Hydrological cycle, Estimation of various components of hydrological cycle, rainfall, runoff, evaporation, transpiration, evapotranspiration, crop evapotranspiration, depression and interception loss, infiltration and percolation losses.

Module – II: WATERSHED CHARECTERS (4HrsTh+4Hrs Pra)

Watershed, types, divide, catchment , command area, stream types, influent, effluent, ephemeral, non perennial. Drainage network, different pattern, morphometric analysis, linear, area, relief aspects. GIS applications for watershed analysis.

Module – III: HYDROLOGICAL STIDIES (4HrsTh+4Hrs Pra)

Hydrological aspects- mapping and monitoring, management mapping of snow covered area and glacial outburst, soil moisture estimation, Optical and microwave remote sensing techniques, drought zonations, Agricultural, meteorological and hydrological, flood mapping pre and post flood area estimation and control measures –GIS applications for hydrological disaster studies

Model – IV: GROUNDWATER RESOURCES APPLICATIONS(4HrsTh+4Hrs Pra)

Types of Aquifers formations confined and unconfined aquifers Assessment of Groundwater potential zones and Groundwater mapping. Site selection for recharge structures- Hydrogeological Mapping GIS applications to ground water studies

Model – V: SURFACE WATER RESOURCES APPLICATIONS (4HrsTh+4Hrs Pra)

Surface water bodies, lakes, reservoirs, ponds, rivers, channels, mapping- change detection , Water harvesting structures, in-situ and Ex-situ , Mapping and monitoring of catchment and command area, Water logging and salt affected area mapping, Reservoir Sedimentation, sedimentation control. GIS applications to surface water studies

6. TEXT BOOK

1. Raghunath .H.M, "*Hydrology – Principles – Analysis – Design",* New Age International Publishers, New Delhi. 2006 .

2. Ramasamy .S.M, "*Remote sensing in water resources",* Rawat publications, New Delhi ,2005.
3. Murty.V.V.N, "*Land and Water Management Engineering"*, Kalyani Publishers, New Delhi – 2002.
4. Agarwal C.S and Garg.P.K, "*Text Book on Remote Sensing in Natural Resources, Monitoring and Management",* Wheeler publishing Co & Ltd., New Delhi, 2010.

Application of Geo-informatics to Hazards Monitoring and Modelling

1. Nomenclature

Subject Name	Code	Credit	T-P-P	Prerequisite
CUTM2072	Application of Geo-informatics to Hazards Monitoring and Modelling	4	2-2-0	NIL

2. Objective

To study the basic knowledge of Hazards
To study the about natural and environmental hazards
To study the damage estimation after hazards.

3. Learning outcome

To study and understand the applications of RS and GIS techniques for Natural, Environmental and Coastal hazards.

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

Module I : Overview of Hazards (4HrsTh+4Hrs Pra)

Introduction to natural hazards, impact and mitigation in Global and Indian context. An overview of geological hazards with special emphasis on causes and consequences. An overview of flood hazards and climate change issues. An overview of drought hazards and climate change issues. An overview of *Environmental hazards* and land degradation with special emphasis on extents, cause and consequences. An overview of *coastal hazards*. An overview of snow avalanche, GLOF and glacier related hazards and their assessment using geospatial inputs. An overview of urban and associated hazards.

Module II: Geological Hazards Modelling and Analysis (4HrsTh+4Hrs Pra)

Fundamental of landslide hazard assessment, Landslide hazard zonation and vulnerability analysis using spatial modelling technique. Early warning system and disaster preparedness, Flood inundation depth, vulnerability and risk assessment, Generation of Geospatial database for flood hazards for analysis & assessment.

Module III : Drought Monitoring and Desertification(4HrsTh+4Hrs Pra)

Concepts and definition of drought and importance of drought assessment, Fundamentals of agro-meteorology. Meteorological drought indicates, Remote sensing for droughts monitoring and assessment. Definition and processes for climate change impact assessment on droughts and desertification.

Practice:

1. Computation of meteorological drought and drought indices.
2. Vegetation condition Index for drought monitoring.
3. Mapping decertification lands/indicates.

Module IV : Forest fire and damage assessment (4HrsTh+4Hrs Pra)

Forest fire monitoring and active fire retrieval using LEO and geostationary satellite data. Forest fire risk modelling and fire spread modelling. Forest damage and assessment.

Practice:

1. Forest fire risk assessment.
2. Object based image analysis for forest fire damage.

Module V: Costal hazard mapping and Modelling (4HrsTh+4Hrs Pra)

Mapping monitoring and modelling of costal vulnerability / hazards (salt water intrusion and oil spill). Modelling cyclones and prediction (tracking, landfall determination, and inundation) and impact assessment (damage and loss estimation) and mitigation issues. Monitoring and modelling of tsunami.

Practice:

1. Shoreline Change Analysis
2. Coastal Vulnerability Index analysis
3. Monitoring and modelling of Tsunami.

Module VI: Extreme event analysis and air pollution studies (4HrsTh+4Hrs Pra)

Rainfall estimation / perdition and extreme event analysis. Study of haze and dust storm. Modelling of atmospheric pollution and impact on human health. Fog detection and monitoring using satellite data.

Module VII: Urban vulnerability, risk modelling and industrial hazards (4HrsTh+4Hrs Pra)

Seismic risk assessment in urban areas and building codes for earthquake resistant designs. Urban flood hazard and vulnerability modelling. Geospatial modelling for urban pollution is dispersion and modelling. Urban micro and heat islands: role of EO data.

Practice:

1. Urban seismic risk assessment.
2. Urban flood hazard and vulnerability modelling.
3. Urban micro climate heat island: role of EO data.

Referred Books

1. Barrett, E.C. & Brown (1991). Remote Sensing for Hazard Monitoring and Disater Assessment: Marine and Costal Applications In The Mediterranean Region. Philadelphia: Gordon and Breach Scence Punlishers.
2. Burrough, P.A. (1976). Principles of Geographic Information System for Land Assessment,. Oxford: Clarandon Press.
3. Cutter, S., Boruff, L., Bryan, J., & Shirley, W.L. (2003). Social Vulnerability to Environmental Hazards", Social Science Quarterly, 84 (2), 242-261.
4. Kogan., F. N. (2000). Contribution of Remote Sensing to Drought Early Warning. NOAA, NESDIS.
5. Komecny, G. (2003). Geoinformation : Remote Sensing ,Photogrammetry and GIS. New Delhi: Taylor and Francis.

Geospatial Data Infrastructure

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2073	Geospatial Data Infrastructure	4	2-2-0	NIL

2.Objective

Discuss the applicability and accessibility of spatial data at all levels

Understand the fundamentals about GeoSDI and its role in decision making

Describe critically the factors that influence the development of a GeoSDI

Practice data retrieval from GeoSDIs and combine it in a GIS environment

3. Learning outcome

Identify GeoSDI requirements and stakeholders

Understand the GeoSDI architecture that enables the availability of data at distinct levels

Use and manage web services, namely metadata catalogues and map services

4. Evaluation Systems

	Component	% of Marks	Method of Assessment
Internal Examination	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

Module I: GIS & Geo-visualization (4HrsTh+4Hrs Pra)

Introduction to GIS and Geo-visualization, Models and structures - Advanced models and structures (3D, temporal), Data acquisition (GPS, RS, field surveying), Precision and quality

of data , Reference systems and transformations, Spatial Databases, Spatial analysis and modelling of phenomena , Geo-visualization (cartography).

Module II: GeoSDI (4HrsTh+4Hrs Pra)

Introduction to GeoSDI, Definition, GeoSDI components, GeoSDI hierarchy (local, regional, national, trans-national), GeoSDI applications , Environmental protection, Risk management, Organizational dimension of GeoSDI, Laws, policies, institutions, people, Standards, specifications and metadata for spatial data, Public data, CRS, units, JRC, INSPIRE, etc. Public participation, VGI,Spatial data issues in the region of Australia, NewZealand and India.

MODULE III: Data for GeoSDI (4HrsTh+4Hrs Pra)

Data feeding for GeoSDI for environmental management, Connection to global geographical data websites, Cost free data, Satellite imagery, Meteorological data, Elevation data, Land use data, Population data, Road data, Using metadata to assess data quality, Centralizing real time data, Most common systems based on sensors with real time data collection, Hardware fundamentals, Meteorological sensors networks, Tide gauges, Participatory and mobile crowdsource data,Sensor types and capabilities, Applications and Problems of crowdsource data

Model IV: GEOSDI Business Analysis (4HrsTh+4Hrs Pra)

Web Services, Web Services, Web services standards / protocols, Geoportals, geo-visualization, dashboards, Web service composition, service oriented architectures, Client examples, Business Analysis Benefits, Global and national environmental strategies and legal frameworks Required data for activities subject to legal environmental constraints, Economical evaluation, Costs of the infrastructure Costs of operation, Possible strategies to generate income, Business models, Types of contracts, Citizens as data suppliers, Project management concepts (AGILE).

6. TEXT BOOK

1. SDI Cook Book, 2012
2. Developing Spatial Data Infrastructures From Concept to Reality Edited

ByIan P. Williamson, Abbas Rajabifard, Mary-Ellen F. Feeney, 2018

RS & GIS FOR ENVIRONMENTAL ENGINEERING

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2074	RS & GIS FOR ENVIRONMENTAL ENGINEERING	4	2-2-0	NIL

2.Objective

To study the basic Environmental aspects and satellites.
To study the RS & GIS application in soil degradation.
To study the RS & GIS application in water pollution.
To study the RS & GIS application in Air quality.
To understand the RS & GIS application in Environmental management.

3. Learning outcome

The outcome of this subject is to know how to prepare different environmental hazards map air pollution map water pollution map etc.

To prepare different modelling using software's.

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External	End Sem. Test	30	Written examination

Examination	External Practice	20	Viva-Voice
Total		100	

5. Course outline

UNIT I - BASICS (9 hours)

Water- Air-Land-Marine Environment Global Climatologic, urban Environment Environmental satellites GEOS, NOAA, AVHRR, CZCR Monitoring land, water, atmosphere and ocean using Remote Sensing Data. Water- Air-Land-Marine Environment Global Climatologic, urban Environment:

UNIT II - SOIL DEGRADATION (9 hours)

Spectral characteristics of soil- Soil formation- classification of soils- soil survey interpretation and mapping- impact of agricultural and industrial activity on soil properties. RS & GIS in assessing Soil salinity- alkalinity- water logging studies- soil erosion- types and estimation - control measures.

UNIT III - WATER QUALITY AND GROUND WATER POLLUTION (9 hours)

Spectral characteristics of water- classification of water quality -Data base creation and quality modeling using GIS. Aquifer Vulnerability -Intrinsic and specific vulnerability- contaminant transport model.

UNIT IV - AIR QUALITY AND COASTAL STUDIES (9 hours)

Atmosphere: Chemicals, Particulate matters present in the atmosphere, allowable limits, Remote Sensing techniques - Monitoring atmosphere constituents- air pollution- industrial activity, modeling using GIS - Ecology studies- Coastal color monitoring- marine studies

UNIT V - ENVIRONMENTAL MANAGEMENT (9 hours)

Revenue management-environment and ecological concerns- Resource development in remote areas-Impacts of anthropogenic activity- Solid Waste management- Forest classification Mapping – Biomass estimation - Carbon footprints and sinks, carbon trading, carbon credits and marketing, Indian and international status.

REFERENCES

1. Lilliesand .T.M and Kiefer .R.W, “Remote Sensing and Image Interpretation”, John Wily and sons, 1994.
2. Burrough .P.A and McDonnell .R.A, “Principles of Geograj1JhicaJ Information Systems”, Oxford University Press, 1988.
3. Lintz .J and Simonet, “Remote Sensing of Environment”, Addison Wesley Publishing Company, 1994.

RS & GIS FOR AGRICULTURE AND FORESTRY

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2075	**RS & GIS FOR AGRICULTURE AND FORESTRY**	4	2-2-0	NIL

2.Objective

To study the Spectral characteristics of Vegetation

To study the integrated analysis of GIS in agriculture and forest development

3. Learning outcome

The outcome of this subject is to know how to prepare Biomass estimation, forest fire map etc.

To prepare different modelling using software’s.

4. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Midterm Test	20	Written examination
	Seminar	10	Report and Presentation
	Internal Practice	20	Report and Viva
	Total	50	
External Examination	End Sem. Test	30	Written examination
	External Practice	20	Viva-Voice
Total		100	

5. Course outline

UNIT I - SPECTRAL CHARACTERISTICS OF LEAF (9 hours)

Structure of leaf - Spectral behavior of leaf – Vegetation indices – NDVI, TVI, SVI, PCA – Vegetation classification and mapping - Estimation of Leaf area index, Biomass estimation – Estimation of terrestrial carbon assimilation in forests - case studies.

UNIT II - FOREST MAPPING (9 hours)

Forest type and density mapping and forest stock mapping using RS technique - factors for degradation of forests – deforestation/afforestation/. Change detection in forests - case studies

UNIT III - BIODIVERSITY CHARACTERIZATION MAPPING (9 hours)

Forestry – Forest taxonomy – Linnaeus classification - Biodiversity characterization – Forest fire risk zonation – wildlife habitats suitability analysis - case studies.

UNIT IV - AGRICULTURAL APPLICATIONS (9 hours)

Identification of crops -acreage estimation -production forecasting - pests and disease attacks through remote sensing -crop stress detection due to flood and drought - catchments and command area monitoring.

UNIT V - SOIL APPLICATIONS (9 hours)

Soil survey and land use classification - water logging - characters of saline, alkali soils - soil erosion – types – Estimation of soil loss from USLE using Remote sensing and GIS - Wasteland development.

REFERENCES

1. Steven .M.D and clark .J.A, "Applications of Remote Sensing in Agriculture", Butterworths, London 1990.

2. Remote Sensing Applications Group", Space Applications Centre, Crop Average and production Estimation (CAPE): An Anthology from January 1986 - June 1996. (Publications in Journals, Seminars I Symposium proceedings), Ahmedabad, August 1996.

3. Negi .S.S," A Handbook of forestry. International Book distributors", Dehradun, 1986. Space Applications Centre, Manual of procedure for Forest mapping and Damage Detection using satellite data, Ahmedabad, 1990.

DOMAIN

Aerial Surveying and Remote Sensing Applications

Course Title	Code	Type of course	T-P-PJ	Prerequisite
Aerial Surveying and Remote Sensing Applications	ASCU2020	Theory + Practice + Project	4 - 10 - 4	Nil

Courses Division:

1. **Remote Sensing & Digital Image Processing** **(2-2-0) 45Hours**
2. **Geospatial Technology and its Application** **(2-2-0)45Hours**
3. **Photogrammetry and its Application** **(0-2-0) 25Hours**
4. **Lidar Remote sensing and its Applications** **(0-2-0) 25Hours**
5. **Hyper-spectral Remote Sensing and its Application** **(0-2-0) 25Hours**
6. **Project** **(0-0-4) 54Hours**

Objective:

- Apply the principles of Remote Sensing and GIS to collect, map and retrieve spatial information.
- Plan, assess and evaluate natural and manmade systems using geospatial models and methods.
- Use geospatial tools and techniques for natural resources planning and management.

Learning outcome:

- Identify specific data and methodologies for effective mapping and evaluation of natural resources.
- Develop geospatial models and tools to address the social and engineering problems
- Design multi-criteria geospatial systems for decision-making process
- Work in a team using geospatial tools and environment to achieve project objectives.
- Pursue lifelong learning for professional advancement

Evaluation System: As per university norms

Remote Sensing and Digital Image Processing

Subject Name	Code	Type of course	Credit	T-P-P	Prerequisite
Remote Sensing and Digital Image Processing	CUAS2020	T+P	4	2-2-0	NIL

Module: I Basic Concept of Remote Sensing (4+6) Hours

Introduction of Remote Sensing: Principles of RS and its Type; Energy sources and Radiation principles, Pixel, DN value, Energy equation; EMR and Spectrum; EMR interaction with Atmosphere; scattering, Absorption, Atmospheric window, Black body radiation; EMR interaction with earth surface features, reflection, absorption, emission and transmission, Spectral signature; Interaction with vegetation, soil, water bodies; Advantage of RS over conventional method, Limitation, Ideal remote sensing.

Practice:

1. Installation of Image Processing software's
2. Download satellite data from GLOVIS / Earth Explorer / Bhuvan etc.
3. Layer stacking
4. LUT and Image Subset
5. Spectral Signature mapping (soil, vegetation, water)

Module: II Digital Image (2+3) Hours

Data acquisition: Procedure, Reflectance and Digital numbers; Intensity, Reference data, Ground truth, Analog to digital conversion, FCCs, TCC, Platforms and sensors; orbits ,types, Resolutions; Image Interpretation; visual- Interpretation keys.

Practice:

1. FCCs and TCC
2. Resolution
3. Image Interpretation

Module: III Satellite Information and Principles (2+3) Hours

Land observation satellites, characters and applications; PSLV, GSLV, Satellite, Platform Types; LANDSAT series; IRS series; IKONOS Series; QUICKBIRD series; Weather/Meteorological satellites; INSAT series, NOAA, Applications, Marine observation satellites; OCEANSAT

Practice:

1. Image filtering and Band ratioing
2. Mosaicking

Module: IV Image Acquisition and Format (2+4) Hours

Digital Image Processing; Export and import, Data formats; BSQ, BIL, BIP, Run length encoding, Image Compression Data products.

Practice:

1. Export and Import
2. Histogram
3. Subset using AOI

Module: V Image Processing (3+4) Hours

IMAGE RECTIFICATION; Pre-processing and Post processing Geometric distortion; sources and causes for distortion, rectification, GCP, Resampling, Image registration; Radiometric distortion; sources and causes, atmospheric correction.

Practice: (Spectral Python and ENVI)

1. Geometric correction
2. Radiometric correction
3. Atmospheric correction

Module: VI Image Classification (4+4) Hours

IMAGE CLASSIFICATION; Classification techniques, types, Supervised and Un-supervised; Principal Component Analysis (PCA); Image Enhancement; Accuracy assessment.

Practice:

1. PCA analysis (spectral Python and ENVI)
2. NDVI, DVI, NDWI calculation
3. Image classification in Spectral angel Mapper
4. MNF Ratoing
5. Supervised Classification(spectral Python and ENVI)
6. Un-supervised Classification(spectral Python and ENVI)
7. Image Enhancement(ENVI)
8. Accuracy Assessment(ENVI)

Module: VI Remote Sensing and Its application (3+4) Hours

Microwave RS and its application; Thermal RS and its application; Optical RS and its application; Sensor and its types.

Practice: Using Spectral Python

1. Application of microwave remote sensing (Structural Trend line mapping)

2. Application of thermal remote sensing and case study(Land surface Temp.estimation)
3. Application of optical remote sensing and case study

Geospatial Technology and its Application

Module I: GIS & Cartography (2+4) Hours

Components of GIS, Types of Data in GIS, Scale Application of GIS, Advantage and limitation of GIS. History and development of Cartography; Definition, scope and concepts of

Subject Name	Code	Type of course	Credit	T-P-P	Prerequisite
Geospatial Technology and its Application	CUAS2021	T+P	4	2-2-0	NIL

cartography, Characteristics of Map; Categories of maps, Methods of mapping, relief maps, thematic maps.

Practice:

1. Symbology (generalization, symbology, and colour effect, change symbology and use transparency in creative ways) using GRASS and QGIS

Geo-referencing (Map to Image and Image to Image), Projection, Data base creation: Digitization using Point, line and polygon, Edit, Clip, Intersect, Union, Merge, Join and subset. Attribute table editing

2. Google Earth (Convert Shape file to KML Format and KML File to shape file, Import data into Google earth, Bhuvan view, Extract data From Google Earth, Extract Point Data, Extract Polygon data, Extract line data, overlaying an image into Google earth)

Module: II Data analysis tools(2+4) Hours

Raster data spatial analysis, Network analysis, Vector operations and analysis, Data editing, Primary and secondary data. Data model and data structure, Geodatabase and metadata, GIS data model, Overlay analysis, Network modeling, Data Structure Models, Spatial interpolation; measurement and analysis methods, Advantage and disadvantage

Practice:

1. Linking of spatial and Non-spatial data and queries, Joining tabular data with the feature attribute data, Non-spatial query, Spatial query, Spatial join, Vector based spatial analysis, Raster based spatial data analysis
2. Buffering and Creation of Contour
3. Network Analysis

Module: III Multi-criteria analysis and decision making (3+4) Hours

Principles and elements of multiple-criteria decision making, Classification of Multiple-criteria Decision Problem: Multi-objective Vs Multi-attribute, Decision Alternatives and constraints, Criterion weighting, Decision rules, Multiple-criteria decision making in spatial data analysis.

Introduction to AHP, Basic Principles of AHP, Effect Table, Pair Wise comparison, Consistency, Weightage, performance score, Case studies involving AHP

Practice:

1. Mapping accident locations using Linear Referencing technique.
2. Preparation of raster layers for Multicriteria Analysis
3. Solving a spatial problem using Multicriteria Analysis (Spatial AHP)

Module: IV Digital Elevation Model (DEM) (2+4) Hours

Concept of DEM, Various techniques to generate DEM, Importance of spatial resolution to DEM, Integration of DEM to satellite data, Common derivatives of DEM, Slope, Aspects, TIN, Sources of DEM, Laminations and future of DEM.

Practice:

1. Google earth to DEM, 3D Map preparation, Contour to DEM, TIN and Aspect
2. DEM based surface Hydrology modeling,
3. LiDAR classification, DEM from LiDAR

Module: V Geospatial Technology for Water resources Engineering (3+4) Hours

Watershed, types, divide catchment, command area, stream types, Drainage network, different pattern; morphometric analysis, Bifurcation ratio analysis; Assessment of **Groundwater potential zones** and Groundwater mapping; Site selection for recharge structures, Hydrogeological Mapping GIS applications to ground water studies.

Practice:

1. Mapping of catchment, command area
2. Drainage network analysis
3. Morphometric analysis
4. Mapping of Groundwater potential zones

Module: VI Geospatial Technology for Environmental Engineering (3+4) Hours

Monitoring atmosphere constituents; air pollution, industrial activity, modeling using GIS, Resource development in remote areas, Impacts of anthropogenic activity, Solid Waste management; Water Pollution, Shortest path Identification, Network analysis.

Practice:

1. Air pollution mapping

2. Solid waste management
3. Water pollution

Photogrammetry and Application

Practice Experiments:

3.1 Scale determination from aerial photo

3.2 Aerial photo Interpretation

3.3 Use of Parallax bar and determination of Height from stereo pair

3.4 Satellite DEM and ortho Image generation

Subject Name	Code	Type of course	Credit	T-P-P	Prerequisite
Photogrammetry and Application	CUAS2022	T+P	2	0-2-0 25Hours	NIL

3.5 Primary and additive colour creation

3.6 Stereo test

3.7 Mosaic

3.8 Stereoscopic vision

3.9 Relief displacement

3.10 Analog to digital conversion, Orientation of stereo model and Determination of Height

3.11 Aerial mapping using DRONE

3.12 Mosaicking of aerial Photo

3.13 Correction and rectification

3.14 DTM generation Image correction ,Link between GIS and Digital Photogrammetry and Ortho Image generation

LIDAR Remote Sensing and Application

Practice Experiments:

4.1 Download of LIDAR data

4.2 Layer stacking

4.3 Data Validation

4.4 Georeferencing Technology

4.5 Boresight Calibration - Lidar Data Pre-processing

Subject Name	Code	Credit	T-P-P	Prerequisite
LIDAR Remote Sensing and Application	CUAS2023	2	0-2-0 25Hours	NIL

4.6 Project Coverage Verification - Review Lidar Data against Field Control

4.7 Lidar data errors and rectifications, - processes calibration of Lidar data - artifacts and anomalies - Lidar Error Budget.

4.8 Noise Removal and other sensor-related artifacts - Layer Extraction - Automated Filtering

4.9 Manual Editing and Product Generation – Surface Editing - Hydrologic Enforcement

4.10 Breaklines, Contours, and Accuracy Assessment

4.11 Topographic Mapping, flood inundation analysis, line-of-sight analysis

4.12 Forestry, various types of LIDAR sensors-, vegetation metric calculations - specific application software.

4.13 Corridor mapping system, data processing and quality control procedures.

4.14 Modelling

Hyperspectral Remote Sensing and Application

Practice Experiments:

5.1 Introduction to ENVI, Python and Downloading, Displaying, and Analyzing Hyperspectral Imagery

5.2 Atmospheric Correction of Hyperspectral Imagery.

5.3 MNF ratioing from Hyperspectral(EO1)

5.4 Hyperspectral Image Classification Using Spectral Angle Mapper (SAM) & Spectral Feature Fitting (SFF).

Subject Name	**Code**	**Credit**	**T-P-P**	**Prerequisite**
Project	CUAS2025	4	0-0-4	NIL

Subject Name	**Code**	**Type of course**	**Credit**	**T-P-P**	**Prerequisite**
Hyperspectral Remote Sensing and Application	CUAS2024	T+P	2	0-2-0 25Hours	NIL

5.5 Hyperspectral Imagery Classification Using an Unsupervised Neuron fuzzy System.

5.6 Application of Hyperspectral Imagery in Geological Studies.

5.7 Hyperspectral Signatures & Feature Fitting.

5.8 Hyperspectral Remote Sensing for Agriculture and soil Studies.

5.9 Hyperspectral Remote Sensing for Forestry Applications.

5.10 Hyperspectral Remote Sensing for Urban Studies.

5.11 Mineral identification from Hyperspectral imagery

5.12 Python Programming for Hyperspectral data analysis.

Project

List of Projects :

1. Flood inundation mapping and Risk Evaluation using Geospatial Technology.

2. Landslide Hazard mapping using GIS and RS.

3. Land use and Land cover Dynamics using Earth observation Technology.

4. Mangrove change detection study using Multi-Temporal satellite data.

5. Solid waste management and shortest path identification using GIS Technology.

6. Watershed management using GIS Technology.

7. Identification Mineral mapping using GIS and RS.

8. Crop Health Monitoring using Geospatial Technology.

9. Identification of Hydrocarbon Locales using space inputs and Geospatial Technology.

10. Ground water exploration using GIS and RS Techniques.

11. Interlinking of River using GIS Technology.

12. Biomass estimation using Space Technology.

13. Land surface Temperature mapping using RS Technology.

14. Climate Change study using Earth Observation Technology.

15. Erosion and Accretion study of Shorelines and its impact in coastal habitats.

Students take up group projects and deal the following activities during the project. The project Report should contain below gate process.

Step 1: Functional Planning of the project and Objective Identification

Step 2: Literature Review

Step 3: Preparation of Flow chart for Methodology

Step 4: Layer creation and GIS analysis

Step 5: Identifying the possible Risks involved (specific to the project)

Step 6: Report writing

INTERNSHIP

1. Nomenclature

Code	Subject Name	Credit	T-P-P	Prerequisite
CUTM2077	INTERNSHIP	10	0-0-10	NIL

2. Objective

The student shall be capable of identifying a problem related to the program of study and carry out wholesome research on it leading to findings, which will facilitate development of a new/improved product, process for the benefit of the society.

3. Learning outcome

1. To undertake research in an area related to the program. 2. Publication is mandatory in peer review journal

5. Evaluation Systems

Internal Examination	**Component**	**% of Marks**	**Method of Assessment**
	Review 1	10	
	Review 2	15	
	Review 3	25	
	Total	50	
External Examination	Final	50	
Total		100	

6. Course outline

M.Sc. internship should be socially relevant and research oriented ones. Each student is expected to do an individual project. At the completion of a project the student will submit a project report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project. Student will be allowed to appear in the final viva voce examination only if he / she has submitted his / her project work in the form of paper for presentation / publication in a conference / journal and produced the proof of acknowledgement of receipt of paper from the organizers / publishers.

Centurion University of Technology and Management

School of Pharmacy and Life Sciences

M.Pharm (Pharmaceutics)

Mission:

An institution dedicated to touch human lives in health care and happiness to ensure holistic societal development through skill based education, research, Drug development and community welfare services.

Vision:

- Contribute to the national programmes of providing manpower trained through interdisciplinary integration such as Pharmaceutical sciences et al.
- To achieve professional excellence to meet effective competency and to undertake the task of meeting professional and social needs like identification, cure, mitigation of disease and innovative drug design.
- Enable students to seek fulfilling career in pharmaceutical sector, research and entrepreneurship.
- Enhancing student research in academics beyond the class room study like hand on practice by involving themselves on making dissertation and small tenured projects in pharmacy and life sciences.
- Managing Govt. and Non Govt projects by the faculties and students with pharmacy skills contributing towards a healthy State and Nation.

Programme Objectives:

1. To produce pharmacy graduates with strong basics and high technical knowledge to cater the various areas of Pharmaceutical industry.

2. To provide the required training in all aspects to the graduates to work as a health care professional in community and hospital pharmacy.

3. To provide a Pharmacists to the society with skill and will to make and serve quality pills.

POs: Pharmacy Graduates will be able to:

Sl No.	Programme Outcomes
PO1	**Applied Pharmacy Knowledge**: Possess knowledge of the core and fundamental principles associated with modern pharmaceutical technologies, biopharmaceutics, drug regulatory affairs, formulation and evaluation of novel drug delivery systems.
PO2	**Research and Development**: Utilize skills for the development of novel drug delivery approaches for diverse type of active pharmaceutical ingredients. Demonstrate an understanding of the computer-aided processes required to conduct pharmaceutical research.
PO3	**Problem analysis**: Develop ability for in depth analytical and critical thinking in order to identify, formulate and solve the issues related to pharmaceutical development, manufacturing and regulatory processes.

PO4	**Modern tool usage:** Select modern formulation optimization technologies with application of statistical hypothesis testing during development and evaluation of nanoformulation. Use *in silico* approaches for biopharmaceutical studies.
PO5	**Communication:** Make effective documentation, report writing and presentations as per the needs of pharmaceutical industry and academia.
PO6	**Professional identity:** Demonstrate typical professional, legal manners, conforming to all the guidelines of regulatory bodies. Contribute to the training of pharmacy students and the growth and success of pharmacy profession.
PO7	**Leadership skills:** Demonstrate the ability to implement plans and organize tasks within deadlines in the areas of research and manufacturing. Able to apply skills related to management of resources.
PO8	**Planning abilities:** Develop and apply skills for planning and executing activities related to formulation development, manufacturing and regulatory filings.
PO9	**Pharmaceutical ethics:** Apply ethical principles while making decisions and take accountability for the outcomes related to the decisions.
PO10	**Environmental sustainability (SDG):** Address the issues of environmental pollution, industrial waste, and utilization of huge amount of water by applying skills to improve production processes and to ensure environmental sustainability.
PO11	**Life-long learning:** Ability to involve in independent and continuous learning process as per the need and technological advancements. Use of feedback from other professionals and identification of learning requirements for life-long learning improvement. Understand the role of conferences, seminars and workshops for knowledge progression.

2.2 PSO (Program Specific Outcomes)

Sl No.	Program Specific Outcomes
PSO1	Work in different divisions of pharmaceutical industry like manufacturing, quality control, quality assurance, analytical research, formulation research and regulatory affairs.
PSO2	Become an entrepreneur in the areas of formulation research and development, pharmaceutical manufacturing, pharmaceutical consultancy services, drug sales and distribution.
PSO3	Explore opportunities in different government and non-government organizations as drug analyst, academician, research scientist and drug inspector.

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
PSO1	H	M	H	H	H	M	L	L	H	M	H	H
PSO2	H	H	H	M	H	M	M	M	M	L	M	H
PSO3	H	H	L	L	M	M	M	H	L	M	H	H

Course Outcome (CO)

1st Semester

CUTM1583- MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

Course Objective: This subject deals with various advanced analytical instrumental techniques and different skills for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	Analysis of Chemicals and Excipients
CO-2	The analysis of various drugs in single and combination dosage forms
CO-3	Theoretical and practical skills of the instruments
CO-4	Explain general principles and theory of spectroscopy
CO-5	Learn various skill-based separation techniques by employing chromatographic methods for better employability

CUTM1584- DRUG DELIVERY TECHNIQUE

Course Objective: This course deals with the specific skills to be employed for controlled drug delivery systems & novel oral and parenteral controlled drug delivery systems.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	The various skilled approaches for development of novel drug delivery systems.
CO-2	The criteria for selection of drugs and polymers for the development of delivering system
CO-3	The formulation and evaluation of Novel drug delivery systems.
CO-4	Develop various delivery systems for controlled release / a specific drug target
CO-5	Discuss recent skills and advances used in preparation of novel oral and parenteral controlled drug delivery systems

CUTM1585- MODERN PHARMACEUTICS

Course Objective: This course is designed to impart advanced knowledge and skills required to learn various aspects and concepts at pharmaceutical industries to generate better employability.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	The elements of preformulation studies.
CO-2	The Active Pharmaceutical Ingredients and Generic drug Product development.
CO-3	Industrial Management and GMP Considerations.
CO-4	Optimization Techniques & Pilot Plant Scale Up Techniques.
CO-5	Stability Testing, sterilization process & packaging of dosage forms.

CUTM1586- REGULATORY AFFAIRS

Course Objective: This subject deals with the Course designed to impart advanced knowledge and skills required to learn the concept of generic drug and their development, various regulatory filings in different countries, different phases of clinical trials and submitting regulatory documents: filing process of IND, NDA and ANDA.

Course Outcomes: On completion of this course, the successful students should be able to empower with:

CO	Statements
CO-1	The Concepts of innovator and generic drugs, drug development process
CO-2	The Regulatory guidance's and guidelines for filing and approval process
CO-3	Preparation of Dossiers and their submission to regulatory agencies in different countries
CO-4	Post approval regulatory requirements for actives and drug products
CO-5	Clinical trials requirements for approvals for conducting clinical trials

2nd Semester

CUTM1589- MOLECULAR PHARMACEUTICS (NANO TECHNOLOGY& TARGETED DDS) (NTDS)

Course Objective: This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	The various approaches for development of novel drug delivery systems.
CO-2	The criteria for selection of drugs and polymers for the development of NTDS
CO-3	The formulation and evaluation of novel drug delivery systems.
CO-4	Design and develop various delivery systems for a specific drug target
CO-5	Perform skilful evaluation of the developed targeted drug delivery system

CUTM1590- ADVANCED BIOPHARMACEUTICS & PHARMACOKINETICS

Course Objective: This course is designed to impart knowledge and skills necessary for dose calculations, dose adjustments and to apply biopharmaceutics theories in practical problem solving. Basic theoretical discussions of the principles of biopharmaceutics and pharmacokinetics are provided to help the students' to clarify the concepts

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	The basic concepts in biopharmaceutics and pharmacokinetics
CO-2	The use raw data and derive the pharmacokinetic models and parameters the best describe the process of drug absorption, distribution, metabolism and elimination.

CO-3	The critical evaluation of biopharmaceutic studies involving drug product equivalency.
CO-4	The design and skilful evaluation of dosage regimens of the drugs using pharmacokinetic and bio pharmaceutics parameters.
CO-5	The potential clinical pharmacokinetic problems and application of basics of pharmacokinetic.

CUTM1591- COMPUTER AIDED DRUG DELIVERY SYSTEM

Course Objective: This course is designed to impart knowledge and skills necessary for computer Applications in pharmaceutical research and development who want to understand the application of computers across the entire drug research and development process. Basic theoretical discussions of the principles of more integrated and coherent use of computerized information (informatics) in the drug development process are provided to help the students to clarify the concepts.

Course Outcomes: On completion of this course, the successful students should be able to:

CO	Statements
CO-1	History of Computers in Pharmaceutical Research and Development
CO-2	Computational Modeling of Drug Disposition
CO-3	Optimization Techniques in Pharmaceutical Formulation
CO-4	Computers in Market Analysis
CO-5	Artificial Intelligence (AI) and Robotics

CUTM1592- COSMETICS AND COSMECEUTICALS

Course Objective: This course is designed to impart knowledge and skills necessary for the fundamental need for cosmetic and cosmeceutical products.

Course Outcomes: On completion of this course, the successful students should be able to empower with

CO	Statements
CO-1	Key ingredients used in cosmetics and cosmeceutical.
CO-2	Key building blocks for various formulations.
CO-3	Current technologies in the market
CO-4	Various key ingredients and basic science to develop skilled cosmetics and cosmeceutical.
CO-5	Scientific knowledge to develop cosmetics and cosmeceutical with desired Safety, stability, and efficacy.

School of Applied Sciences

Program Objectives

1. To Acquire the knowledge with facts and figures related to various subjects in pure sciences and allied subjects. To understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
2. To Acquired the skills in handling scientific instruments, planning and performing in laboratory experiments

3. To think creatively to propose novel ideas in explaining facts and figures or providing new solution to the problems.

4. To initiate research practices and develop scientific outlook not only with respect to science subjects but also in all aspects related to life.

POs; Science Graduates will be able to;

POs	**Outcomes**
PO1	Apply mathematics, science, fundamentals and specialization to the conceptualization of different scientific models
PO2	Identify, formulate, research literature and solve complex science related problems reaching substantiated conclusions using first principles of mathematics and applied sciences
PO3	Design solutions for complex scientific problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations
PO4	Conduct investigations of complex problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
PO5	Create, select and apply appropriate techniques, resources, and modern engineering tools, including prediction and modeling, to complex scientific activities, with an understanding of the limitations
PO6	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
PO7	Communicate effectively on complex science activities with the science community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO8	Demonstrate understanding of the societal, health, safety, legal and cultural issues andthe consequent responsibilities relevant to scientific application
PO9	Understand and commit to professional ethics and responsibilities and norms of engineering practice
PO10	Understand the impact of science solutions in a societal context and demonstrate knowledge of and need for sustainable development
PO11	Recognize the need for, and have the ability to engage in independent and life-long learning

PO12	Demonstrate a knowledge and understanding of contemporary technologies, their applications and limitations, contemporary research in the broader context of relevant fields
PO13	Demonstrate the ability to succeed in national and international competitive events in therelevant fields

PSOs: Department of Physics

PSO-1: Learn the concepts and advanced theory of Classical Mechanics, Solid State Physics, Quantum Mechanics, Relativity, Nuclear and Particle Physics, Electronics etc.

PSO-2: Analyze the applications of mathematics to the problems in physics & develop suitable mathematical method for such application & for formulation of physical theories.

PSO-3: Realized how developments in any science subject helps in the development of other science subjects and vice-versa and importance of interdisciplinary approach required for sustainable developments. Provide knowledge about material properties and its application for developing technology to ease the problems related to the society.

Cos:

COs	**Skills**
CO1	Knowledge
CO2	Observe, Classify, Quantify, Interpret and Communicate
CO3	Investigation and Judgements
CO4	Problem Solving
CO5	Leadership & Entrepreneurship
CO6	Product/Publication/Patent

***Correlation is noted as "H" for High, "M" for Medium and "L" for Low**

Mapping PSOs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
PSO1	**H**	**H**	**M**	**M**	**L**	**M**	**L**	**H**	**H**	**L**	**M**	**M**	**M**
PSO2	**H**	**H**	**M**	**H**	**H**	**M**	**M**	**M**	**M**	**M**	**M**	**H**	**M**
PSO3	**H**	**H**	**M**	**M**	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**	**M**

Course Code	*Course Title*	*Course Type*	*Credits*	*Prerequisite*	CO1	CO2	CO3	CO4	CO5	CO6	PSO 1	PSO 2	PSO 3
MSCP1101	Mathematical Physics	Theory	4	BSC Physics completed	H	H	-	H	-	L	H	M	M
MSCP1102	Classical Mechanics	Theory	4	BSC Physics completed	H	H	-	H	-	-	H	M	M
MSCP1103	Quantum Physics I	Theory	4	BSC Physics completed	H	H	-	H	-	-	H	M	M
MSCP1104	Electrodynamics & Special Relativity	Theory	4	BSC Physics completed	H	H	-	H	-	-	H	M	M
MSCP1105	Modern Physics Lab	Practice	4	BSC Physics completed	H	H	-	-	-	-	H	L	L
MSPH3602	Statistical Physics	Theory	4	BSC Physics completed	H	H	-	H	-	L	H	M	M
MSCP1201	Solid State Physics	Theory	4	BSC Physics completed	H	H	-	H	-	H	H	M	M
MSCP1202	Electronics Devices and Circuits	Theory	4	BSC Physics completed	H	H	-	H	-	L	H	M	M

Course Code	*Course Title*	*Course Type*	*Credits*	*Prerequisite*	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**	**PSO 1**	**PSO 2**	**PSO 3**
MSCP1203	Computational Physics	Theory	4	BSC Physics completed	H	H	-	H	-	M	H	M	L
MSCP1204	Computational Physics Lab	Practice	2	BSC Physics completed	H	H	-	H	-	M	H	M	L
MSCP1205	Electronics Devices Lab	Practice	2	BSC Physics completed	H	H	-	-	-		H	M	L
MSCP2301	Atomic and Molecular Physics	Theory	4	BSC Physics completed	H	H	M	H	-	L	H	M	L
MSCP2302	Nuclear and Particle Physics	Theory	4	BSC Physics completed	H	H	M	H	-	L	H	M	L
MSRM5101	Introduction to Research	Theory	2	NIL	H	H	H	-	-	M	H	H	L
MSCP2303	Quantum Physics II	Theory	4	Quantum Physics I	H	H	H	H	-	H	H	M	L
MSPS2301	Seminar I	Practice	2	NIL	H	H	M	-	-	-	H	M	L
MSCP2304	Microprocessor and Interfacing devices	Theory	4	1st year completed	H	H	H	H	-	M	H	M	M
MSCP2306	Microprocessor lab	Practice	4	1st year completed	H	H	H	-	-	L	H	M	L
MSCP2401	Electronics Communication System	Theory	4	1st year completed	H	H	H	M	-	M	H	M	M
MSPH5103	Embedded System	Theory	4	1st year completed	H	H	H	H	-	H	H	M	M
MSCP2402	Electronics simulation Lab	Practice	4	1st year completed	H	H	H	-	-	L	H	M	L
MSCP2305	Soft Matter Physics	Theory	4	1st year completed	H	H	H	H	-	L	H	M	H

Course Code	*Course Title*	*Course Type*	*Credits*	*Prerequisite*	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**	**PSO 1**	**PSO 2**	**PSO 3**
MSCP2307	Materials Lab I	Practice	4	1st year completed	H	H	M	-	-	-	H	M	L
MSCP2403	Introduction to Bio- and Nano-materials	Theory	4	1st year completed	H	H	H	H	-	M	H	H	M
MSCP2404	Advanced Solid State Physics	Theory	4	1st year completed	H	H	H	H	-	M	H	H	H
MSCP2405	Materials Lab II	Practice	4	1st year completed	H	H	M	L	-	-	H	M	H
SBFE3125	Image Processing through MATLAB-I	Practice	4	NIL	H	H	M	L	-	-	H	M	L
SBFE4102	Programming in C	Practice	4	NIL	H	H	M	L	-	-	H	M	L
SBFE3130	Optical Fiber Technician	Practice	4	NIL	H	H	M	L	-	-	H	M	L
MSPP2401	Project/Dissertation	Practice	4	NIL	H	H	M	L	M	H	H	M	H

Code (Prefix"CUTM")	**Course Title**	**Credit**	**Type (T+P+Pj)**
1399	Energy storage materials	4	3+1+0
1400	Bio and bimimetic nanomaterials	4	3+0+1
1401	Photovoltaic technology and nanocatalysts	4	3+1+0

1402	Advanced characterization techniques	4	3+1+0
1403	Smart and electronic materials	4	3+0+1
1404	Corrosion and advanced coating application	4	3+0+1
1405	Synthesis and application of nano composites	4	3+1+0
1406	Material behavior of nanostructures	4	3+1+0
1407	Emerging materials	4	3+0+1
1408	Synthesis routes of nanomaterials	4	3+1+0
1409	Computational materials science	4	2+2+0
1410	Plasma technology	4	3+0+1
1411	Essentials of nanomaterials	4	3+1+0
1412	Advanced quantum mechanics	4	2+0+2
1413	Physics of solids and semiconductors	4	3+1+0
1414	Laser technology	4	2+1+1

Code	**Course Title**	**T-P-Pj (Credit)**	**Prerequisite**
CUTM 1399	Energy Storage Materials	3-1-0	Basics of Nanomaterials

Objective

- This course will educate the students the concepts and operation of accessible energy storage systems, significance of energy storage in current scenario, reason and transfer of efficiency losses in different energy storage systems.
- This course is designed to help the students to provide adequate knowledge regarding nanomaterials in fuel cells, hydrogen Storage, thermoelectric materials (in nano scale), super capacitors.
- The students will also learn various types of batteries used in modern technology and the intercalation of nanomaterials inside them.

Learning outcome

- The students will be able to know the usage of nano-materials in various battery applications (Li ion battery, K ion battery, Na ion battery)
- The students will be able to know the utilization of next generation super-capacitors and its applications.
- The students will be able to understand the use of nanomaterials in fuel cells, various hydrogen storage systems, and thermoelectric materials.

Course outline

Module I **(4 Hours Theory)**

Nanotechnology in energy research, Fossil fuels, Nanotechnology in fuel production, Renewable energy sources; Advantages of renewable energy sources.

Module II **(4 Hours Theory)**

Thermoelectric materials (bulk), Thermoelectric materials (in nanoscale), Thermoelectric nanocomposites, Applications of thermoelectric nano materials

Module III **(6 Hours Theory + 2 Hours Practice)**

Supercapacitors, Types of supercapacitors, Design of supercapacitors, Carbon based materials for supercapacitors, Necessary parameters for supercapacitors, Applications.

Practice-1

To learn the specific charge/discharge characteristics of a supercapacitor through experimental testing of a remote triggered ultracapacitor battery supercapacitor

Module IV **(6 Hours Theory)**

Fuel Cells: Low temperature fuel cells; High temperature fuel cells; Catalysts for fuel cells and electrolytes; Solid oxide fuel cells; Applications

Module V **(4 Hours Theory)**

Semiconductor based Hydrogen production; Selection of nanomaterials for energy harvesting and storage applications; Other significant materials for Hydrogen storage; Thermal energy storage systems

Module VI **(3 Hours Theory+ 4 Hours Practice)**

Batteries: Lithium ion battery; Nanomaterials in Li ion battery; Nanomaterials in K ion battery

Practice 2: To learn the specific charge/discharge characteristics of a Lithium- ion (Li- ion) battery through experimental testing of a remote triggered Li- ion Battery

Practice 3: To learn the specific charge/discharge characteristics of a Lithium- Polymer (Li- Po) battery through experimental testing of a remote triggered Li- Po Battery.

Module VII **(3 Hours Theory+8 Hours Practice)**

Aluminium ion battery; Graphene battery; Sodium ion battery

Practice 4: To learn the specific charge/discharge characteristics of a Lead Acid battery through experimental testing of a remote triggered Lead Acid Battery

Practice 5: To learn the specific charge/discharge characteristics of a Nickel Metal Hydride (NiMH) battery through experimental testing of a remote triggered NiMH Battery

Practice 6: To learn the specific charge/discharge characteristics of a Nickel-Cadmium (Ni-Cad) battery through experimental testing of a remote triggered Ni-Cad battery.

Total theory 30 hours and total practice12 hours

Reference Books:

1. Robert A. Huggins; Energy Storage, Fundamentals, Materials and Applications
2. KunihitoKoumoto , Takao Mori ; Thermoelectric Nanomaterials
3. Electrochemical Supercapacitors for Energy storage and delivery; Aiping Yu, Victor Chabot, and Jiujun Zhang.

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1400	**Bio and Biomimetic Nanomaterials**	3-0-1	Nil

Objective

- Gain knowledge about biomaterials, their properties, behavior, interaction and use of them over in pharmaceutical science.
- The emphasis of course is to understand the physics of biomaterials in detail and to explore the wide application.

Learning outcome

- The students will obtain fundamental concepts of biomaterials and their biomedical applications.
- Able to use the knowledge for higher study and research
- Able to explore the possible physics research and their applications in society and health care units.

Course outline

Module-I:Fundamentals **(4 Hours Theory)**

Definition of biomaterials, requirements & classification of biomaterials, Properties of biomaterials

Module-II: Metallic Implant Materials **(5 Hours Theory+ 2 Hours Assignment)**

Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking.

Assignment-1: Orthopedic implants

Module-III:Polymeric Implant Materials **(5 Hours Theory+ 2 Hours Assignment)**

Classification according to thermosets, thermoplastics and elastomers. Importance of molecular structure, hydrophilic and hydrophobic surface properties, Biodegradable polymers for medical purposes

Assignment-2: Dental implants

Module-IV:Ceramic Implant Materials **(5 Hours Theory+ 2 Hours Assignment)**

Definition of bioceramics, common types of bioceramics, the importance of wear resistance and low fracture toughness

Assignment-3: Soft tissue replacement implants

Module-V: Biocompatibility & Toxicological Screening of Biomaterials (5 Hours Theory+ 2 Hours Assignment)

Biocompatibility & toxicological screening of biomaterials

Assignment-4: Percutaneous and skin implants

Module-VI: Biomimetic **(3 Hours Theory+ 2 Hours Assignment)**

Inspiration from animals, self-healing materials

Assignment-5: Vascular implants

Module-VIIBiomimetic in Photonics **(3 Hours Theory+ 2 Hours Assignment)**

Biomimetic in photonics, various applications of Biomimetic

Assignment-6: Heart valve implants

Total theory 32 hours and total project 12 hours

Text Books:

1. Biomimetic Biomaterials Structure and Applications

   By Andrew Ruys, ISBN: 9780857094162

2. Biomimetics in Photonics

   By Olaf Karthaus, ISBN 9781439877463

Code	**Course Title**	**T-P-Pj (Credit)**	**Prerequisite**
CUTM 1401	Photo-Voltaic Technology & Nano-Catalysis	3-1-0	Basics of Nanomaterials & Physics of Semiconductor Devices

Objective

- This course will educate students on the design, working of photo voltaic technology and use of materials in nanoscale in these photovoltaics.
- This course will provide the study of several types of nanocatalysts for various industrial applications.

Learning outcome

- The students will be able to obtain adequate knowledge regarding several photovoltaic technologies and its various applications in nano-scale.
- The students will be able to gain significant knowledge about industrial catalytic processes and catalysts at nano-levels which helps them to apply for several industrial applications and help them for higher research and employability.
- The course will help the students to apply for various internship opportunities available in various Photovoltaic start-up organizations. Also this course is a boost for the students to apply into various R&D organizations to work as a project scholar.

Course outline

Module I **(4 Hours Theory + 4 Hours Practice)**

Electro-Magnetic visible spectrum, Optical absorption, Direct bandgap & indirect bandgap semiconductors, Minority carrier transport properties

Practice 1: To calculate the sun position at a given place and time and thereby study the variation in power production in a solar photovoltaic panel with respect to the change in incidence angle.
Practice 2: Learn how to assess the solar energy potential of a site

Module II **(4 Hours Theory + 8 Hours Practice)**

Surface and interface recombination; PN junctions and transport of charge carriers; Solar cell parameters; Photo current & spectral responses; Types of different generation of PV systems: 1st, 2nd, 3rd generation PV systems

Practice 3 : Find the GHI using the pyranometer data and assess the feasibility of a solar PV station in the area

Practice 4: Learn how to assess the solar energy potential of a site using a pyrheliometer.

Practice 5: To measure the outlet and inlet temperatures of the parabolic trough collector as a function of angle of incidence of solar radiation.

Practice 6: To measure the outlet and inlet temperatures and flow rate of the parabolic trough collector as a function of flow rate variation.

Module III **(4 Hours Theory)**
Si photovoltaics; Thin film solar cell production; Nano coating on photovoltaics; ;CdTe PV systems

Module IV **(6 Hours Theory)**
CIGs PV Systems; Dye-sensitized solar cell; III-V multi junction solar cells; Organic solar cell; OPV working principles; Perovskite solar cell;
Module V **(3 Hours Theory)**
Quantum dots based solar cells; Nanowire based solar cells; Carbon nanomaterials based solar cells,

Module VI **(5 Hours Theory)**

Nano catalyst production; Use of graphene as nano catalytic applications; Artificial photosynthesis; CO_2 conversion;

Module VII **(4 Hours Theory)**

Photocatalysis; Au nanoparticle as effective catalyst; Hydrogen production using nanocatalyst, Nano titanium oxide as photocatalyst.

Total theory 30 hours and total practice 12 hours

Reference Books:

- Solar Energy: The physics and engineering of photovoltaic conversion, technologies and systems; Olindo Isabella, Klaus Jäger, Arno Smets, René van Swaaij, Miro Zeman.
- Nanomaterials in catalysis; Philippe Serp, KarinePhilippot.

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1402	Advanced Characterization Techniques	3-1-0	Nil

Objective

- The objective of the subject is that the student acquires knowledge of the different existing experimental techniques for the microstructural and physicochemical characterizations of materials.
- Students gain knowledge about the principles of various techniques.

Learning outcome

Upon successful completion of this course, students will be able to address following points:

- Depending on the problem or needs of each case, the student must have sufficient criteria to select the most appropriate technique, as well as the interpretation of their results.
- The knowledge gained from this subject definitely help students to optimize material research and and make ready them for higher R &D and enhance theirtechnical knowledge for employability in handling different advanced characterization techniques.

Course outline

Module-I **(3 Hours Theory+4 Hours Practice)**

Compositional and Structural Characterization

Principle of X-ray diffraction (XRD), Importance of Rietveld refinement in XRD (fundamental), Lattice parameters, Structure analysis, Phase identification, Crystallite size analysis using Scherrer's formula,X-ray photoelectron spectroscopy (XPS), X-ray fluorescence (XRF), Energy dispersive X-ray analysis (EDAX).

Practice-1

Crystal structure and phase identification determination by XRD (Biovia MS and phase identification by using relevant software)

Practice-2

Study on molecular spectroscopy by fluorescence instrument

Module-II **(5 Hours Theory)**

Advanced Microscopy Techniques for Nanomaterials

Field emission scanning electron microscope (FESEM), Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), Transmission electron microscopy (TEM), High-resolution transmission electron microscopy (HRTEM).

Module-III **(5 Hours Theory+4 Hours Practice)**

Spectroscopic Techniques

Ultraviolet-visible spectroscopy, Photo-luminescence spectroscopy, Fourier transform infrared (FTIR) spectroscopy, Raman spectroscopy, Nuclear magnetic resonance (NMR).

Practice-3

Familiarization with the ultraviolet-visible absorption spectroscopy

Practice-4

Band gap calculation from photo-luminescence spectra

Module-IV **(4 Hours Theory)**

Nanomaterials Electrical and Magnetic Characterization Techniques

Measurement of resistivity by 4-probe method, Hall measurement, Measurement of magnetic of properties of nanomaterial (Magnetic hysteresis and dielectric properties by LCR meter),Vibrating sample magnetometer.

Module-V **(5 Hours Theory+4 Hours Practice)**

Mechanical Characterization Techniques

Elastic and plastic deformation-mechanical properties of materials, models for interpretation of nanoindentation load-displacement curves, Nanoindentation data analysis methods-Hardness testing of thin films and coatings, Mechanical properties evaluation by universal testing machine (UTM), Dynamic mechanical analysis.

Practice-5

Evaluation of mechanical properties of material by nanoindentation technique

Practice-6

Measurement of tensile strength of material by UTM

Module-VI **(4 Hours Theory)**

Physical and Optical Characterizations of Nanostructured Materials

Introduction to particle size characterization, Zeta potential measurement – Particle size analysis, specific surface area by BET analysis, Photoconductivity.

Module-VII **(4 Hours Theory)**

Thermal and Electrochemical Characterization

Differential scanning calorimeter (DSC), Differential thermal analyzer (DTA), Thermogravimetric analysis (TGA), Electrochemical analysis (Charging-discharging cyclic voltammetry).

Total theory 30 hours and total practice 12 hours

Reference Books:

1. ASM Handbook: Materials Characterization, ASM International, 2008.
2. Yang Leng: Materials Characterization-Introduction to Microscopic and Spectroscopic Methods, John Wiley & Sons (Asia) Pte Ltd., 2008.
3. Robert F. Speyer: Thermal Analysis of Materials, Marcel Dekker Inc., New York, 1994.
4. Nanotechnology-Basic Science and Emerging Technologies, Mick Wilson, KamaliKannangra Geoff Smith, Michelle Simons and BurkhardRaguse, Overseas Press.

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1403	Smart and Electronic Materials	3-0-1	Nil

Objective

- To acquaint with various kinds of smart materials for device application
- To have the knowledge about the different types of structure of the materials which affect their properties
- To understanding the theories behind electric and magnetic properties
- To use the nanotechnology in electronics
- Application of different kinds of materials

Learning outcome

- Students will capable of gaining the knowledge about different kinds of materials
- Students may aware about the structure property relation of materials
- Students may know the use of materials with response to external stimuli

Course outline

Module I **(4 Hours Theory+2 Hours Assignment)**

Introduction: Overview of smart materials, Sensors and actuators, Pyroelectrics, Piezoelectrics, Electrostrictors, Magnetostrictors, Electrochromic, Shape memory alloys

Assignment-1
Application of high-k dielectric materials and Topological insulators

Module II **(4 Hours Theory+ 2 Hours Assignment)**
Structure Property Relation: Structure phase transition of different types of materials and their properties such as Perovskite structure materials, Tungsten Bronze, Aurivillius structure materials**,**

Assignment-2
Electrical properties of Pyrochloro-type Materials and hexaferrite materials

Module III **(4 Hours Theory+ 2 Hours Assignment)**

Multiferroic and Magneto electric Materials:Multiferroic materials, Ferroelectric materials, Ferromagnetic materials, Ferroelastic materials, requirement for multiferroic materials. Magnetoelectric material and ME coefficient

Assignment-3
Origin of magnetism, Ferro-, Antiferro-, Ferri-magnetic materials and their application

Module IV **(5 Hours Theory)**

Nanoelectroinc: Overview of nano electronics, Quantum dots, Quantum wire and Quantum well, 2D Materials: Graphene

Module V **(4 Hours Theory+ 2 Hours Assignment)**

Spintronics:Introduction to spintronics, Generation of Spin Polarization, Theories of spin Injection, Spin accumulation, spin relaxation, Spin current, Spin hall effect and spin dephasing,

Assignment-4
Spintronic devices and applications

Module VI **(4 Hours Theory+ 2 Hours Assignment)**

High Temperature Superconductor: Discovery **a**nd experimental facts of superconductor, High TC superconductors, High-Tc Superconducting Oxides: Structure, properties, comparison on the basis of BCS Theory, Structure and properties of Iron based High temperature superconductor

Assignment-5
Structure, properties and application of Hg and Fe based High temperature superconductor

Module VII **(5 Hours Theory+2 Hours Assignment)**

Application: Sensors (conductive sensor, capacitive sensor), Optoelectronics, Supercapacitors, Radiofrequency identification

Assignment-6
Development of solar energy devices, silicon solar technology for clean energy

Total theory 30 hours and total assignment 12 hours

Textbook:

Reference Books:

4. .Dielectric Phenomena in Solids by Kwan Chi Kao,Academic Press,2004
5. High Temperature Superconductivity: The Road to Higher Critical Temperature by Shin-ichi Uchida, Springer Japan 2015

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM 1404	Corrosion and advanced coating applications	3-0-1	Nil

Objective

- To impart knowledge on surface coating and engineering of nanomaterials and their applications.
- Role of surface coating and surface modification technologies in obtaining required surface characteristics (mechanical, chemical, thermal, electrical, electronic, optical) of a product.
- Learn about different surface coating technologies (chemicalvapour deposition, physical vapour deposition, electro-deposition, thermal spray, etc).
- Substrate technology and its significance in obtaining high performance coating. Various methods for evaluating the performance of the coating.

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Learning outcome

- Student can able to understand the knowledge on surface coating and engineering.
- Able to do surface coating and surface modification for different practical application.
- Able to pursue higher study/research on surface technology.
- Able to understand different surface coating technologies and their application.
- Able to use nano technology on surface coating for practical application

Course outline

Module I **(4 Hours Theory+2 Hours Assignment)**

Introduction to surface engineering fundamentals: Introduction to surface science, Surface degradation, corrosion, importance of corrosion, Corrosion studies: Atmospheric, Galvanic, Pitting, Crevice corrosion, Intergranular corrosion,Stress corrosion & cracking

Assignment-1

Corrosion effects on degrading the properties of materials

Module II **(4 Hours Theory+ 2 Hours Assignment)**

Surface preparation methods: Surface cleaning and finishing processes, Electrochemical, Mechanical- Sand blasting, Hydroblasting, Vapor phase degreasing

Assignment-2

Surface preparation for advanced coating applications

Module III **(5 Hours Theory+ 4 Hours Assignment)**

Advanced coating practices: Cold spray, Sputter deposition, Electrolysis techniques, Physical vapor deposition(PVD), Chemical Vapor deposition (CVD), Carburising, Aluminizing

Assignment-3

Current and advanced coating technologies for industrial applications

Assignment-4

Coating surface characterization techniques

Module IV **(3 Hours Theory)**

Plasma coating: Plasma deposition, Sputtering, Plasma spray mechanisms & applications, Laser processing.

Module V **(5 Hours Theory+ 2 Hours Assignment)**

Characterization of coating: Physical characterization and porosity, Assessment of coating hardness, Assessment of friction and wear of coating, Assessment of surface roughness and thickness of Coating, Assessment of Adhesion of coating

Assignment-5

Coating for wear resistant applications

Module VI **(4 Hours Theory+2 Hours Assignment)**

Application-I : Wear resistant coating. Thermal barrier coating, CVD Diamond coated tool, Biomedical coatings

Assignment-6

Advanced coating applications

Module VII **(5 Hours Theory)**

Application-II: Super hydrophobic application, Coating in semiconductor, Zinc coating, Coating for marine atmosphere,Antireflective Coating

Total theory 30 hours and total Assignment 12 hours

Text Book:

1. Advanced Coating Materials book Online ISBN:9781119407652 |DOI:10.1002/978111940765
2. Advanced Surface Coating Techniques for Modern Industrial Applications by Supriyo Roy (Haldia Institute of Technology, India) and Goutam Kumar Bose (Haldia Institute of Technology, India)

References:

1. https://nptel.ac.in/courses/112/105/112105053/
2. https://link.springer.com/book/10.1007%2F978-94-017-0631-5
3. http://home.ufam.edu.br/berti/nanomateriais/8403_PDF_CH13.pdf
4. https://www.azom.com/article.aspx?ArticleID=17081
5. https://www.hindawi.com/journals/ijc/2018/4749501/

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM 1405	Synthesis and Application of Nanocomposites	3-1-0	

Course Objectives

- To provide knowledge of the advantages of using different types of nanocomposites.
- To make the students familiar with the mechanism of nanocomposites.
- To make them aware the manufacturing and testing methods of nanocomposites.

Learning outcome

- Students will understand and appreciate the significance of the nanocomposites as an important class of materials.
- Students will be well equipped to design and develop nanocomposites for specialized applications.
- They will be able to predict the appropriate synthesis and application for different classes of nanocomposites
- This course will develop the career competency of students in composite materials and help them in joining R & D and industry based composite sector.

Course content

Module-I: Introduction to Nanocomposite Materials(5 Hours Theory)

Definition of nanocomposites, Classification based on matrix and topology, Constituent of nanocomposites, General characteristics of particle reinforced composites- classification, Terminology used in fiber reinforced composites, Core-Shell nanocomposites

Module-II: Basic Constituents materials in Nanocomposites (4 Hours Theory)

Role and Selection of reinforcement materials, Glass fibers, Carbon fibers, Boron Fibers, Natural fibers, Multiphase fibers, Aramid fibers

Module-III: Fabrication of various types Nanocomposites(5 Hours Theory)

Ceramic/Metal nanocomposite Systems, Nanocomposites based on polymer matrix, Carbon carbon, Carbon-metal nanocomposites, Bio-inspired nanocomposites

Module -IV: Nanocomposite Processing Methods (4 Hours Theory+4 Hours Practice)

Nanocomposite processing: In-situ polymerization technique, Solution casting, Electro spinning, melt mixing, Filament Winding, Injection and compression molding, Vacuum bag moulding Method, Pultrusion Process

Practice 1: Synthesis of polymer nanocomposite using solution casting techniques

Practice 2: Preparation of different polymer blends using BIOVIA materials studio

Practice 3: Fabrication of nanocomposite fibers using electro spinning technique

Module -V: Mechanical Properties -Stiffness and Strength (4 Hours Theory)

Geometrical aspects – volume and weight fraction, Unidirectional continuous fiber, Determination of stiffness and strengths of unidirectional composites, tension, compression, flexure and shear

Module -VI: Application of Nanocomposites I (4 Hours Theory+4 Hours Practice)

Application of Nanocomposites in Aerospace, Coating, Mechanical, Electrical & Electronics, Fuel cell

Practice 4: Determination of tensile properties of nanocomposite

Practice 5: Determination of Dielectric constant for a given nanocomposite material

Module -VII: Applications of Nanocomposites II (4 Hours Theory+4 Hours Practice)

Hybrid Nanocomposite materials for food packaging, graphene-carbon nanotube nanocomposite for energy storage applications, Nanocomposites for solar cells, Nano composite materials for Lithium ion battery.

Practice 6: Synthesis of Graphene Oxide by Modified Hummer's Technique

Practice 7: Studies on Dye Sensitized Solar Cell

Text Books:

- Composite Polymeric Materials – Sheldon
- Lubin - Handbook of composites – (Van Nostrand, 1982)
- Carbon Nanotube and Graphene Device Physics, by H.-S. Philip Wong (Author), DejiAkinwande (Author)
- K. Chawla, Composite Materials – Science &Engg., Springer- Veslag, New York, 1988.
- Mohr - SPIE Handbook of Technology and Engineering of Reinforced Plastics/Composites – (Van Nostrand, 1998)

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1406	Material Behavior of Nanostructures.	3-1-0	Nil

Course Objective:

To understand the influence of dimensionality of the object at nanoscale on their properties;

- To study size and shape controlled synthesis of nanomaterials and their future applications in industry.
- To bring out the distinct properties like mechanical, magnetic, thermal, electronic, optical, and photonic properties of of nanostructures.

Learning Outcomes:

Upon successful completion of this course student should be able to:

- To familiarize about the various properties of nanostructures.
- To bring out the differences between nano and macro structures.
- To discuss applications and specific properties of nanomaterials.

Course outline

Module-I(3 Hours Theory)

Introduction: Peculiarities of nanostructured materials: Introduction, Extended internal surface, Increasing of surface energy and tension, Grain boundaries, Instability of three dimensional nanostructured materials due to grain growth, Size effects in nanostructured materials.

Module -II (5 Hours Theory+ 2 Hours Practice)

Mechanical Properties:Mechanical properties of nanocrystalline metals and alloys, Inverse Hall Petch effect, Strain-rate sensitivity, Ceramics and composites. Types of indentation: Oliver &Pharr, Vickers indentation process, Nano Indentation by Atomic Force Microscope , Young's modulus, Contact angle.

Practice-1 : Strength vs ductility of steel bar

Module -III (5 Hours Theory+2 Hours Practice)

Thermal Properties of Nanostructures:Thermo electric materials (TEM): Concept of phonon, Thermal conductivity, Specific heat, Exothermic & endothermic processes. Bulk TEM properties, Different types of TEM; One dimensional TEM; Composite TEM; Applications.

Practice-2: Thermal conductivity measurement

Module–IV(4 Hours Theory+4 Hours Practice).

Magnetic Properties: Introduction of magnetic materials, basics of ferromagnetism – ferro magnetic resonance and relaxation, Magnetic properties of bulk nanostructures, Magnetic clusters, Dynamics of nanomagnets, Nanopore containment of magnetic particles, Nano carbon ferromagnets, Ferrofluids.

Practice-3: Exploring magnetic nanoparticles with Diana Borca

Practice -4: B -H curve of ferromagnetic material

Module–V(5 Hours Theory+ 2 Hours Practice)

Electronic Properties : Energy bands and gaps in semiconductors, Fermi surfaces , Localized particle, Donors, Acceptors, Deep traps, Excitons, Mobility, Size dependent effects, Conduction electrons and dimensionality Fermi gas and density of states, Semiconducting nano particles , Direct and reciprocal lattices of the fcc structure.

Practice-5: Determination of band gap energy of semiconductor.

Module–VI(4 Hours Theory+ 2 Hours Practice)

Optical Properties: Optical properties , Photonic crystals, Defects in photonic crystals , Optical properties of semiconductors, Band edge energy, Band gap, Dependence on nanocrystallins size, Quantum dots, Optical transitions, Absorptions, Interband transitions.

Practice- 6: Explanation of surface plasmon resonance.

Module -VII (4 Hours Theory).

Luminescence Properties: Fluorescence/luminescence, Photoluminescence / fluorescence, Optically excited emission Electroluminescence, Laser emission of quantum dot, Photo fragmentation and columbic explosion, Phonons in nanostructures, Luminescent quantum dots for biological labeling.

Total theory 30 hours and total practice 12 hours.

Text books:

1. Introduction to Nano Technology by Charles. P. Poole Jr& Frank J. Owens. Wiley India Ltd.
2. Solid State physics by Pillai, Wiley Eastern Ltd.

Reference Books:

1. Processing & properties of structural naonmaterials -Leon L. Shaw (editor)
2. Nanoscale materials -Liz Marzan and Kamat

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1407	Emerging Materials	3-0-1	Nil

Objective

- Efficient to understand materials and materials properties
- Develop their confidence on self driven experimental materials research
- Able to work in research and industrial set up on material research
- Understanding of materials behavior, or conceived, designed, and realized useful products and technology

Learning outcome

- Students will be able to describe the structure of emerging materials at the molecular, microscopic, and macroscopic scales.
- To acquaint the student with common manufacturing processes and recent technological developments that are used in creating products.
- To promote an understanding of the relationship between material structure, processing and properties.

Course outline

Module I **(4 Hours Theory)**
Classification of Materials: Classification of materials: Conductor, Semiconductor, Insulator, Superconductor, Ceramics

Module II **(4 Hours Theory+ 2 Hours Assignment)**
Carbon Nano science : Carbon allotropes(Basic), new carbon structures, Carbon Nanotube (CNT), Single Wall Carbon Nanotubes (SWCNT), Multi Wall Carbon Nanotubes (MWCNT), Carbon fiber
Assignment-1
Advanced Carbon Materials and Technology

Module III **(5 Hours Theory+ 2 Hours Assignment)**
Graphene Science: Introduction of Graphene, Graphene Reinforced Metal (aluminum) composites, From a Graphene Sheet to a Nanotube - Archiral and Chiral Nanotubes, Graphene Reinforced Non-Metal (aluminum oxide) composites
Assignment-3
Graphene for industrial applications

Module IV **(5 Hours Theory+ 2 Hours Assignment)**
Synthesis Techniques: CNT: Arc discharge, Laser ablation, Chemical vapour deposition; Graphene: Mechanical exfoliation, Hummers' method, Chemical vapour deposition

Assignment-3
Method of preparation of Graphene

Module V **(4 Hours Theory+ 2 Hours Assignment)**

Properties of Carbon Nanotubes and Graphene: Mechanical, Electronic, and Optical properties of Carbon Nanotubes and Graphene; Raman spectroscopy of carbon nanotubes, Absorption spectroscopyof carbon nanotubes and Transmission Electron Microscopic (TEM) of carbon nanotubes.

Assignment-4

Study of the XRD of CNT through experimental/MS Studio

Module VI **(4 Hours Theory+ 2 Hours Assignment)**

Application of nanostructure graphene: carbon material for energy storage, hydrogen storage in carbon nanotubes, Role of carbon nano-tubes in Li ion battery (electrodes), Supercapacitor

Assignment-5

Application of CNT and Graphene in developing advanced electrodes used in Li ion battery

Module VII **(4 Hours Theory+2 Hours Assignment)**

Other Advanced Materials: High-temperature material, Bulletproof, material Amorphous Materials, Nano Quasicrystals

Assignment-6

Material for high temperature and bulletproof applications

Total theory 30 hours and total project 12 hours

Textbook:

1. .

Reference Books:

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1408	Synthesis Routes of Nanomaterials.	3-1-0	Nil

Course Objective:

- To equip the students with the concepts of synthesis routes in nanoscience that he/she needs for understanding theoretical treatment in different courses taught in this class and for developing a strong background to pursue research in Nanotechnology as a career.
- This course is intended to cover the two groups of synthesis of nanostructures namely top-down and bottom-up approach various synthesis methods, including biological methods, advantages and disadvantages etc.

Learning Outcomes:

- The students will be exposed to various structure specific synthesis methods, their advantages etc.
- To know about Top-down to Bottom up approach techniques.
- To optimize the methods for specific material applications.

Course outline

Module-I **(4 Hours Theory)**

Introduction : Introduction to synthesis of nanostructure materials, Bottom-up approach and Top-down approach with examples-Trapped particles-quantum dots and artificial atoms-quantum wires and quantum wells. Conductivity and enhanced catalytic activity compared to the same materials in the macroscopic state.

Module-II **(5 Hours Theory+ 2 Hours Practice)**

Physical Methods: Inert gas condensation, RF-plasma, MW plasma, Ion sputtering, Laser ablation, Laser pyrolysis, Ball milling, Molecular beam epitaxy, Electro-deposition.

Practice-1: Ball-miling method of synthesis of nanomaterials.

Module -III **(4 Hours Theory)**

Chemical Methods (I): Chemical precipitation and co-precipitation, Sol-Gel synthesis; Microemulsions synthesis, Hydrothermal, Solvothermal synthesis methods.

Module - IV **(4 Hours Theory)**

Chemical Methods (II): Microwave assisted synthesis Core-Shell nanostructure, Quantum dot (QDs) synthesis, Sonochemical, Ultraviolet, Sonication

Module-V **(6 Hours Theory)**

Thermolysis Route: Flame spray pyrolysis, Flame spray Hydrolysis, solvated metal atom dispersion, hydrothermal routes, solution combustion synthesis, reaction types, boundaries and flow, PVD, CVD.

Module VI: **(2 Hours Theory+ 2 Hours Practice)**
Different Lithography Route: M based nanolithography and nanomanipulation, E beam lithography and SEM based nanolithography and nanomanipulation, Ion beam lithography, X-ray based lithography.

Practice 2: Electron beam lithography.

Module VII **(5 Hours Theory+ 8 Hours Practice)**

Preparation of Some Special Nanomaterials: Preparation of metal nano particles like gold, silver, Iron and Copper, different types of nanooxides, TiO_2, ZnO etc.

Practice-3: Synthesis of TiO2 nanotubes by hydrothermal method.

Practice-4: Synthesis of copper nanoparticles.

Practice-5: Synthesis of gold nano particles.

Practice-6: Synthesis of ZnO nano particles by sol-gel route.

Total theory 30 hours and total practice 12 hours.

Text Books:

1. Inorganic Materials Synthesis and Fabrication by J.N. Lalena, D.A. Cleary, E.E. Carpenter, N.F. Dean, John Wiley & Sons Inc.
2. Introduction to Nano Technology by Charles P. Poole Jr and Frank J. Owens. Wiley India PvtLtd.
3. The Chemistry of nanomaterials: Synthesis, Properties and Applications, Vol-I by C.N.R. Rao, A. Muller and A.K. Cheetham.
4. Fabrication of fine pitch gratings by holography, electron beam lithography and nano-imprint lithography (Proceedings Paper) Author(s): Darren Goodchild; Alexei Bogdanov; Simon Wingar; Bill Benyon; NakKim;Frank Shepherd.

Reference Books:

1. Encyclopedia of Nanotechnology by M.Balakrishna Rao and K.Krishna Reddy, Vol I to X,
2. Encyclopedia of Nanotechnology by H.S. Nalwa
3. Nano: The Essentials – Understanding Nano Scinece and Nanotechnology – by T.Pradeep; Tata Mc.Graw Hill

4. Handbook of chemical Vapor deposition (cvd), Principles, technology, and applications, By Hugh o. Pierson, Second edition, Noyes publications, William Andrew Publishing, LLC.

Code	Course Title	T-P-Pj (Credit)	Prerequisite

CUTM1409	Computational Materials Science	2-2-0	Nil

Objective

- Expose the students to the challenges in the analyses of materials and how to address those challenges
- Impart practice of developing Toy Models of Molecular Dynamics, HartreeFock and Density Functional Theory in Python for small scale systems using various Pseudo-Potentials
- Hands-on training on open source tools in Molecular Dynamics (LAMMPS) and Hartree-Fock and Density Functional Theory (Quantum Espresso); Data Visualization Tools like OVITO and VMD

Learning outcome

A student who completes this course should be able to:

- Get an idea of the issues and challenges involved in calculations of atomic, molecular and bulk properties of materials and how to approach their resolution using open source classical and quantum mechanical tools.
- Code and execute concepts of Molecular Dynamics, Monte Carlo Methods in Molecular Dynamics and derive thermodynamic properties of materials ensuing from Classical Statistical Mechanics
- Code and execute concepts of HartreeFock Theory and Density Functional Theory using Python and derive various molecular and bulk material properties ensuing from electronic structure calculations involving Quantum Mechanics and Quantum Statistics
- Use open source software like LAMMPS, Quantum Espresso, OVITO and VMD for analysis and visualization of various types of materials and their properties

Course outline

Module I **(2 Hours Theory + 3 hours Practice)**

Models of Molecular Interactions: Model Van der Waals interaction potentials between neutral atoms and molecules: The Lennard-Jones potential, Other Van der Waals Interactions: the Buckingham Potential, the Stockmayer Potential

Practice (1 hour sessions):

1. Understanding the Lennard-Jones (LJ) Potential and its Parameters
2. Python simulation of Equation of State of Ideal Gases using LJ Interaction
3. Python simulations of Equation of State of Ideal Gases with Buckingham and Stockmayer Potentials

Module II

Molecular Dynamics (3 Hours theory + 4 hours Practice)

Molecular Dynamics theory and numerical implementation, Statistical Ensembles and Molecular Dynamics, Diffusion and Osmosis.

Practice (1 hour sessions):

4. Thermodynamics of a Real Gas using LJ potential using Python
5. Introduction to Molecular Dynamics in LAMMPS; Visualization using OVITO & VMD
6. Simulation of Diffusion in LAMMPS
7. Simulation of Osmosis using LAMMPS

Module III

Monte Carlo Methods (6 Hours Theory + 5 Hours Practice)

Monte Carlo Simulations, Metropolis algorithm, 2D Ising Model and its simulation, Phase Transitions, Monte Carlo Grand Canonical (MCGC) simulation of Lennard Jones (LJ) Fluid Flow and Heat Transfer

Practice (1 hour sessions):

8. Introduction to Monte-Carlo-Metropolis Algorithm: Python Implementation
9. Simulation of 2D-Ising Model using Monte-Carlo-Metropolis algorithm
10. Simulation 0f Phase Transitions Using LAMMPS
11. Simulation of Lennard-Jones (LJ) Fluid Flow Using LAMMPS

12. Thermal Conductivity and Viscosity simulation using LAMMPS

Module IV

HartreeFock Methods: (3 Hours Theory+4 Hours Lab)

The Variational Principle, The Hartree Approximation, The Hartree-Fock Approximation, Electron Density Distribution in Many-Electron atoms and simple Di-atomic molecules, Beyond HF Theory: Coupled Cluster Approximation

Practice: (1 hour)

13. Introduction to HartreeFock Implementation in Python
14. Creation of data files and running the HF code
15. Electron Density Distribution in H, He, Li atoms
16. Electron Density Distribution in simple diatomic molecules: H2, N2, O2, CO

Module V

Density Functional Theory-I (2 Hours Theory)

Introduction to Density Functional Theory, The Hohenberg-Kohn Theorems, The Kohn-Sham Theory, Numerical Implementation

Module VI

Extensions of Density Functional Theory (2 Hours Theory)

The Local Density Approximation (LDA), The Generalized Gradient Approxiamtion (GGA) , Meta GGA, Adiabatic Connctions-Hybrid Orbitals, Perdew–Burke-Ernzerhof (PBE) Approximation, the Born-Oppenheimer Molecular Dynamics (BOMD), the Car-Parrinello Molecular Dynamics (CPMD)

Module VII **(2 Hours Theory+8 Hours Practice)**

Introduction to Quantum Espresso: Modules and Possibilities

Practice (1 hour sessions)

17. Introduction to Quantum Espresso software: Implementation of DFT
18. Loading Data Files and Execution of Quantum Espresso; Interpretation of Output
19. Ground State Electron Density Distributions in C, N, O using LDA
20. Ground State Electron Density Distribution in C, N, O, Si using GGA, Meta GGA, PBE
21. Ground State Properties of Simple Molecules like N2, O2, H2O, CO2
22. Material Property Simulations in DFT with LDA/GGA/Meta GGA/PBE and their various combinations
23. Liquid-Gas Phase Transition Simulations in Born-Oppenheimer Molecular Dynamics
24. Liquid-Gas Phase Transition Simulations in Car-Parrinello Molecular Dynamics

Total theory 20 hours and total practice 24 hours

Textbook:

2. Introduction to Computational Materials Science, Richard LeSar, (Cambridge University Press, 2016).
3. Modern Quantum Chemistry: Introduction to Advanced Electronic Structure Theory. Attila Szabo, Neil S Ostlund. (Dover Publications Inc. 1996)

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Reference Books:

Computational Materials Science: An Introduction. June Gunn Lee, (CRC Press, 2011).

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1410	Plasma Technology	3-0-1	Nil

Objective

- To explore the fourth state of matter, Plasma.
- To understand fundamental characteristics of plasma, various plasma generation methods, various applications of plasma technology in nanomaterial synthesis, energy production and storage, medicine/health care, etc.
- To acquire comprehensive knowledge of how plasmas are utilized for different types of materials processing specially in nanotechnology and developing advanced materials

Learning outcome

- Upon successful completion of this course the student should be able to
- Learn using fundamental plasma parameters, under what conditions an ionised gas consisting of charged particles (electrons and ions) can be treated as a plasma to set feasible criteria on the plasma-assisted processes.
- Assess relations between the process and properties of the treated surface and/or material.
- Assess suitability of individual kinds of plasma for application in materials and surface engineering, nanomaterial production applications and in environmental technologies.
- Understand application of plasma technology for eco-friendly future "green" energy.

Course outline

Module-I **(5 Hours Theory)**

Fundamentals of Plasma Physics

Plasma-the fourth state of matter, Plasma parameters, Debye length, Plasma sheath, Plasma oscillations & frequency, Saha's theory of thermal ionization, Concept about plasma equilibrium and types of plasma (only classification), Plasma classification on basis of temperature and pressure (only fundamental)

Module-II **(6 Hours Theory+ 2 Hours Assignment)**

Plasma Production Techniques

DC discharges, Glow discharge, I-V characteristic of electrical discharge, Paschen curve, Arc discharge, Transferred and non-transferred arcs, RF discharge, Capacitively and inductively coupled plasmas, Microwave discharge, Vacuum arcs

Assignment-1

Gases break-down, Paschen Curves, Advanced plasma generation techniques

Module-III (3 Hours Theory+ 2 Hours Assignment)

Plasma Diagnostics

Basic plasma diagnostics: electric probes (single and double), Optical emission spectroscopy (basic idea), Laser based diagnostics

Assignment-2

Plasma diagnostic for understanding the basic plasma

Module-IV (4 Hours Theory+ 2 Hours Assignment)

Plasma Etching, Spraying and Atomization processes

Etching, Plasma cleaning, Surfactants removal, Non transferred plasma torches, Advanced plasma atomization process

Assignment-3

Advanced plasma atomization for nano material production

Module-V (5 Hours Theory+ 2 Hours Assignment)

Plasma Sputtering Deposition Processes

Introduction of thin film coatings by plasma,Plasma-Enhanced Chemical Vapor Deposition (PECVD), Physical vapor deposition (PVD), Pulsed laser deposition (PLD), Plasma nitriding

Assignment-4

Surface treatment and thin film coating by advanced plasma techniques

Module-VI (4 Hours Theory+ 2 Hours Assignment)

Plasma Melting, Cutting and welding

Arc plasma melting, Synthesis of nanomaterials (Al_2O_3 and SiC) by plasma reactor/furnace, Plasma cutting, Plasma Welding

Assignment-5

Plasma cutting and welding

Module-VII (3 Hours Theory+ 2 Hours Assignment)

Special Plasma Applications

Controlled thermo-nuclear fusion: the green technology-Tokamaks (fundamental), Plasma waste processing (Plasma pyrolysis), Biomedical and health applications

Assignment-6

Plasma Technology: An emerging clean and green energy technology for future

Total theory 30 hours and total assignment class 12 hours

Reference Books:

1. Principles of Plasma Discharges and Materials Processing, M. A. Lieberman and A. J.. Lichtenberg (John Wiley and Sons, 2005)
2. Introduction to Plasma Physics and Controlled Fusion, 3rd edition, Francis F. Chen, (Springer, 2018)
3. Plasma Technology, B. Gross, B. Greyz and K. Miklossy, (Iliffe Books Ltd., London, 1968).
4. Handbook of Advanced Plasma Processing Techniques, Eds. R.J. Shul and S.J. Pearton.
5. Fundamentals of Plasma Physics, J. A. Bittencourt, Springer-Verlag New York Inc., 2004.
6. Handbook of Plasma Processing Technology: Fundamental, Etching, Deposition and Surface Interactions, S. M. Rossnagel, J. J. Cuomo, W. D. Westwood, (Noyes Publications, 1990) SAP 4005 Plasma Processing of Materials.

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM 1411	Essentials of Nanomaterials	3-1-0	Nil

Objective

- Understand and use the properties of Nano-materials in diverse fields.
- Gain knowledge about the Nanomaterials, their properties, behavior, interaction and use of them over many discipline of science.
- The emphasis of the course is to understand the physics of Nanomaterials in detail and to explore the wide application.
- Highlights of the course is to provide virtual way of understanding the courses materials. Especially the application based approach.

Learning outcome

- Understand the constituents of matter, Nanomaterials, properties and usefulness.
- Able to learn how to understand the basic behavior of Nanomaterials.
- Able to compete with International Student in Nanomaterial Sciences.
- Able to use the knowledge for higher study and research.

- Able to explore the possible physics research, their applications in society and health care unit.

Course outline

Module I **(4 Hours Theory)**

Fundamentals of Nanomaterials: Introduction to Nanomaterials, Definition of Nano, Atomic Structure and atomic size, significance of nano material over micro/macro, size dependent roperties.

Module II **(4 Hours Theory+ 2 Hours Practice)**

Material structure and the Nano-surface: Importance of surface at Nanoscale, Significance of Particle shape and Size in Nanomaterials, Surface to Volume Ratio, Particle orientation.
Practice 1: Polarization of light

Module III **(5 Hours Theory+ 2 Hours Practice)**

Energy at the Nanoscale: Surface energy, surface energy of Liquids, surface energy of solids, Surface energy of crystallographic planes in fcc& bcc, surface energy minimization mechanism.
Practice 2: Surface tension of liquid

Module IV **(6 Hours Theory+ 6 Hours Practice)**

Nanostructured Materials : Zero Dimensional: Nano particles through homogenous nucleation; Nano particles through heterogeneous nucleation, Quantum Dots; One Dimensional: Nano wires and nano rods, Two dimensional: Fundamentals of film growth; Carbon Nanotubes. hierarchal structure, Quantum size effect and scaling law
Practice 3: Particle/wave nature of particle
Practice 4: Quantum dot
Practice 5: Quantum tunneling

Module V **(5 Hours Theory+ 2 Hours Practice)**

Nano thermodynamics: Classical equilibrium in thermodynamics, Nano Thermodynamics, Modern Nano Thermodynamics. hermodynamics of surfaces: surface and interfacial energy, uses of Wulff plot.
Practice 6: Seebeck effect

Module VI **(5 Hours Theory)**

Chemical interaction at the Nanoscale: Long range and short range order forces, electrostatic forces, hydrogen bonding, Vanderwaal forces, hydrophobic forces

Module VII **(7 Hours Theory)**

Essentials of nanoscience in diverse Emerging area : Nano-electromechanical systems, Nano sensors, Nano Optics, Nano-electronics, Nano medicine, environmental, health and safety issues.

Total theory 36 hours and total practice 12 hours

Text Book:

1. Introduction to nanoscience by G.Louis Hornyak
2. Introduction to nanotechnology by C. P. Poole

References:

1. NPTEL (Nano materials)
2. MIT (Nano material)

Code	Subject Name	Type of course	T-P-P	Prerequisite
CUTM1412	Advanced Quantum Physics	• Theory & Project	2-0-2	Nil

Objective

- Learn methods to solve Schrodinger's equation by WKB method, Variational method and perturbation method.
- Learn Practical application of these methods to real time problems
- Learn to apply these methods to solve several problems.

Learning outcome

On completion of this course students will be able to

- Solve Schrodinger's equation for different systems using WKB method, Variational method and perturbation method.
- To write Python code to solve Schrodinger's equation and find energy eigen values

Course outline

Module-I (Theory 4 hours, Project 2 hours)

Time independent Perturbation Theory:Energy Shifts and Perturbed Eigen states, Nondegenrate and degenerate perturbation theory, spin orbit coupling.

Assignment1:(Any one)

- Develop solution for shifting and splitting of spectral lines of atoms - The Stark Effect
- Develop solution for shifting and splitting of spectral lines of atoms - Zeeman Effect

Module -II (Theory 4 hours + Project 2 hours)

Pictures of quantum mechanics: The Schrodinger picture, The Heisenberg picture, The interaction picture.

Variational Methods: General formalism, Ground State of One-Dimensional Harmonic Oscillator, First Excited State of One-Dimensional Harmonic Oscillator

Assignment 2:(Any one)

- Solve theproblem for Tunneling of a particle through a Potential Barrier
- Find out the energy of ground state and first excited states of Harmonic oscillator

Module -III (Theory 4 hours + Project 2 hours)

WKB Approximation: General Formalism, Validity of WKB Approximation Method, Bound States for Potential Wells with no rigid walls.

Assignment 3:(Any one)

- Gamow's theory of alpha decay – Finding solution with WKB method
- Find out the energy of particle in Bound States for Potential Wells with One Rigid Wall
- Find out the time taken for a can of soft drink at room temperature to topple spontaneously- applications of quantum tunneling

Module -IV (Theory 4 hours + Project 2 hours)

Time Dependent Perturbation Theory: Introduction,Transition Probability, Transition Probability for Constant Perturbation, Transition Probability for Harmonic Perturbation, Adiabatic Approximations, Sudden Approximations.

Assignment 4:

- Calculate the transition probability rate for an excited electron that is excited by a photon from the valence band to the conduction band in a direct band-gap semiconductor by using Fermi golden rule.

Module -V (Theory 4 hours + Project 2 hours)

Applications of**Time Dependent Perturbation Theory: Interaction of Atoms with Radiation, classical treatment of incident radiation, Transition Rates for Absorption and Emission of Radiation,**

Assignment 5:(Any one)

- Light absorption and emission - mathematical formulation using electric dipole radiation
- The quantum mechanical selection rules for electric dipole transitions
- Find out expression for transition rates within the dipole approximation

Module -VI **(8 project sessions 2 hours each)**

Assignment 6:(Any one)
Group Project

1. One-electron phenomena in strong Laser fields – derivation and Python programming**-** application of adiabatic approximation
2. Two-electron phenomena in strong Laser fields **-** application of adiabatic approximation
3. Fermi's golden rule applied to find tunneling current of a scanning tunneling microscope
4. Derivation and Python programming for bound states for potential wells with two rigid walls
5. Ground state of Hydrogen atom - solve using Python programming.
6. Study of the neutron quantum states in the gravity field - Python programming
7. Find an expression for electric-dipole two-photon absorption selection rules and use it to summarize the rules for two photons of unequal frequency.
8. Simulation using Python programming for tunneling through a potential barrier
9. Quantum harmonic oscillator using Python
10. Gamow's theory of alpha decay – solution and simulation sing python
11. Time taken for a can of soft drink at room temperature to topple spontaneously- applications of quantum tunneling - Python programming.

Total theory 20 hours and total project 26 hours

Textbook:

4. Advanced Quantum Mechanics by Satyaprakash, S Chand Publications

Reference Books:

6. Quantum Mechanics: Concepts and Applications by NouredineZettili
7. Introduction to Quantum Mechanics, D J Griffith, Pearson, 2014.
8. Modern Quantum Mechanics, J.J. Sakurai, Pearson, 2013.

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1413	Physics of solid state and semiconductors	3-1-0	Nil

Objective

- To learn about crystal structure, electronic and dielectric properties of solids.
- To learn about basic properties of metals, insulators and semiconductors.
- To learn about semiconductor physics and discus working & applications of basic devices.

Learning outcome

After learning the course the students will able to

- Explain different types of crystal structures in terms of the crystal lattice and the basis of constituent atoms.
- Understand the origin of energy bands in solids.
- Explain the physical characteristics such as electronic structure and optical and transport properties, and current-voltage characteristics of semiconductors.
- Apply the knowledge of semiconductors to illustrate the functioning of basic electronic devices

Course outline

Module I **(5 Hours Theory+ 2 Hours practice)**

Structure of Solids

Bravais lattice, primitive vectors, primitive unit cell, conventional unit cell, Wigner-Seitz cell, Symmetry operations and classification of 2- and 3-dimensional Bravais lattices, point group and space group (information only). Common crystal structures- NaCl and CsCl structure, Close-packed structure, Zinc blende and Wurtzite structure, tetrahedral and octahedral interstitial sites, Spinel structure. Crystal diffraction by X-ray, Anomalous scattering. Atomic and geometric structure factors, systematic absences. Reciprocal lattice and Brillouin zone, Electron and neutron scattering by crystals (qualitative discussion)

Practice-1

V Lab: To study various crystals structures

Module II **(4 Hours Theory+ 2 Hours practice)**

Band Theory of Solids

Bloch equation, Empty lattice band, Number of states in a band, Effective mass of an electron in a band, Concept of holes, Electronic band structures in solids, Nearly free electron model.

Practice-2

Determination of band gap of semiconductor by Four probe method

Module III **(4 Hours Theory+ 2 Hours practice)**

Lattice Dynamics

Tight binding method - application to a simple cubic lattice, Band structures in copper, GaAs and silicon, Classical theory of lattice vibration under harmonic approximation, Dispersion relations of one dimension lattices, Mono atomic and diatomic cases, Characteristics of different modes, Long wavelength limit.

Practice-3

Determination of thermal and electrical conductivity of metals (copper and silver)

Module IV **(4 Hours Theory+ 2 Hours practice)**

Specific Heat

Optical properties of ionic crystal in the infrared region, Inelastic scattering of neutron by phonon, Lattice heat capacity, Debye and Einstein models-omparison with electronic heat capacity, Anharmonic effects in crystals - thermal expansion.

Practice-4

Determination of specific heat of solids (copper, glass and lead)

Module V **(5 Hours Theory+ 2 Hours practice)**

Dielectric Properties of Solids

Electronic, ionic and orientationalpolarisation, Static dielectric constant of gases and solids, ClaussiusMossotti relation, Complex dielectric constant and dielectric losses, Relaxation time, Debye equations, Cases of distribution of relaxation time, Cole - cole distribution parameter, Dielectric modulus, Ferroelectricity, Displacive phase transition, Landau Theory of Phase transition.

Practice-5

Determination of dielectric constant of air, glass and polystyrenes

Module VI **(4 Hours Theory)**

Imperfections in Solids

Frenkel and Schottky defects, Defects by non-stoichiometry, Electrical conductivity of ionic crystals, Classifications of dislocations, Role of dislocations in plastic deformation and crystal growth, Colour centers and photoconductivity, Luminescence and phosphors, Bragg - Williams theory, Order-disorder phenomena.

Module VII **(4 Hours Theory+2 Hours practice)**

Semiconductors

Kronig Penny model (no derivation required). Band gap. Conductor, semiconductor (P and N type) and insulator. Conductivity of semiconductor, Mobility, Direct and indirect band gap semiconductors and their behaviour to external field, Types of semiconductors, Charge carriers, Intrinsic and extrinsic materials, Carrier concentration, Fermi Level, Electron and hole concentration equilibrium, Temperature dependence of carrier concentration, Compensation and charge neutrality. Conductivity and mobility, Effect of temperature, Doped semiconductors, Doping and high electric field.

Practice-6

Study of Hall Effect (Determination of nature of charge carriers in a semiconductor)

Total theory 30 hours and total practice 12 hours

Textbook:

1. .Introduction to Solid State Physics, C. Kittel, Wiley
2. Principles of Semiconductor devices, Bart Van Zeghbroeck.

Reference Books:

1. Solid State Physics, by N. W. Ashcroft and N. D. Mermin (Cornell University)
2. Introduction to Solid State Physics,S. O. Pillai, New Age International-

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Code	Subject Name	Type of course	T-P-P	Prerequisite
CUTM1414	Lasers Technology	• Theory, Practice &Assignment	2-1-1	Nil

Objective

The aim of this course is

- To acquire a thorough understanding of the theory of modern Laser Physics
- understand different types of modern lasers and their applications
- computationally verify material properties for Laser production.

Learning outcome

After learning the course the students will be able to

- describe and explain fundamental concepts in laser physics
- compare the function and properties of a number of common lasers
- verify properties of materials used for laser production

Course outline

Module-I (3 hours theory,2hours practice, 2 hours Assignment)
Laser Fundamentals:Spontaneous and stimulated emission, Absorption, Einstein's coefficients, Active medium, population inversion, laser-pumping, Laser gain, metastable state, condition for light amplification.Solid state laser:Ruby Laser.

Practice1:

Building and operating a Diode laser pumped Nd:YAG laser. Measure its efficiency and spiking effects to be demonstrated OR Any other Laser to explain the operation of Lasers

Assignment 1:

Neodymium Glass Lasers – Construction, Properties and Applications.

Module-II (3 hours theory, 2 hours Assignment)
Liquid Lasers: Principle of, Main components of Laser, Levels of laser action, Continuous Wave Lasers, construction and working of Dye laser.

Assignment 2: (Any one)

- Application of Tuning in Dye laserastronomy as a laser guide star
- Alexandrite Lasers application in dermatology – Working, Properties and Applications in industrial like medical field
- Model-Locked Ring Dye laser application for Optical Data Storage

Module-III (3 hours theory,4hours practice, 2 hours Assignment)
Gas Laser: Principle, working and usefulness of gas laser. He-Ne laser. Lasing Action in Ion Lasers, construction and operation of ion lasers

Practice2: Determine the wavelength and angular spread of He-Ne laser using plane diffraction grating**.**
Practice 3: Argon Ion Laser spectrum- Operating and selecting various wavelengths for a single line operation in an Argon Laser.

Assignment 3:(Any one)

- Application of Krypton ion laser in medicine
- Application of Copper vapour laser for entertainment purposes
- Application of He-Cadmium laser – Working, Properties and Applications
- Industrial application of Carbon dioxide laserfor cutting and drilling
- Application of excimers laser Photolithography and Medical purposes

Module-IV (3 hours theory,2hours practice, 2 hours Assignment)
Semiconductor Laser:Principle of semiconductor laser diode, threshold frequency, difference between a diode and laser diode, Characteristics of semiconductor lasers, Semiconductor diode lasers, LED versus Laser diode.

Practice 4: Operating characteristics of a Semiconductor diode lasers- measuring its threshold current, output power versus current etc.

Assignment 4:(Any one)

- Application of heterojunction structures to optical devices
- Application of Homojunction lasers
- Application of Quantum well lasers for applications in optical information processing

Module-V (3 hours theory,2hours practice, 2 hours Assignment)
Laser applications: Material processing with lasers, Interaction mechanism, Lattice heating, Material processing mechanism.
Practice 5: Drilling process with laser – Either Physical lab or virtual lab.
Practice 6: Cutting and Welding process with laser – Either Physical lab or virtual lab.

Assignment 5: Industrial application of laser - Material processing with lasers

Module-VI **(3 hours theory,2 hours Assignment)**

Application of Laser in Medical Science - Medical lasers, Laser diagnostic, Laser for general surgery, Laser in medicine.

Assignment 6: (Any one)

- Understanding the properties of GaN for Laser application by Density Functional theory using Biovia Material Studio
- Understanding the properties of InGaN for Laser application by Density Functional theory using Biovia Material Studio
- Understanding the properties of GaAs for Laser application by Density Functional theory using Biovia Material Studio
- Understanding the properties of AlGaAs for Laser application by Density Functional theory using Biovia Material Studio

Module-VII **(3 hours theory,2 hours Assignment)**

Laser in Optical Communication: Optical source for fiber optical communication, Essential characteristics of Laser in fibre optic communication.

Assignment 6:(Any one)

- Understanding the properties of "Tungsten oxide-based mediums"for Laser application by using Biovia Material Studio
- Understanding the properties of "sapphire crystals usually doped with titanium particles"for Laser application by using Biovia Material Studio

Textbook:

1. Laser Principles, Types and Application by KR Nambiar, New Age International.

Reference Books:

9. Lasers Theory and Applications by K. Thyagarajan and A.K. Ghatak, Mcmillan (1981)

10. Laser Fundamentals, by William T. Silfvast, Cambridge University Press, 2008.

11. Principles of Lasers, by OrazioSvelto; Springer, 2009.

12. Industrial Applications of Lasers, by K. Koebner (ed.), Wiley (1984).

M.Sc Mathematics Curriculum

Program Objectives:

- To acquire the knowledge with facts and figures related to various subjects in pure sciences and allied subjects. To understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
- To acquire the skills in handling scientific instruments, planning and performing in laboratory experiments.
- To think creatively to propose novel ideas in explaining facts and figures or providing new solution to the problems.
- To initiate research practices and develop scientific outlook not only with respect to science subjects but also in all aspects related to life.

POs; Students will be able to;

Pos	Outcomes
PO1	Apply mathematics, science, fundamentals and specialization to the conceptualization of different scientific models
PO2	Identify, formulate, research literature and solve complex science related problems reaching substantiated conclusions using first principles of mathematics and applied sciences
PO3	Design solutions for complex scientific problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations
PO4	Conduct investigations of complex problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
PO5	Create, select and apply appropriate techniques, resources, and modern engineering tools, including prediction and modelling, to complex scientific activities, with an understanding of the limitations
PO6	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
PO7	Communicate effectively on complex science activities with the science community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO8	Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to scientific application
PO9	Understand and commit to professional ethics and responsibilities and norms of engineering practice

PO10	Understand the impact of science solutions in a societal context and demonstrate knowledge of and need for sustainable development
PO11	Recognize the need for, and have the ability to engage in independent and life-long learning
PO12	Demonstrate a knowledge and understanding of contemporary technologies, their applications and limitations, contemporary research in the broader context of relevant fields
PO13	Demonstrate the ability to succeed in national and international competitive events in the relevant fields

PSOs of M.Sc Mathematics:

PSO1: Ability to apply appropriate methods of research, investigation and design, to solve problems in Mathematics.

PSO2: An understanding of professional, ethical, legal, security and social issues and responsibilities.

PSO3: An ability to analyze the local and global impact of Mathematics on individuals, organizations, and society.

COs of Master of Science programmes:

COs	Skills
CO1	Knowledge
CO2	Observe, Classify, Quantify, Interpret and Communicate
CO3	Investigation and Judgements
CO4	Problem Solving
CO5	Leadership & Entrepreneurship
CO6	Product/Publication/Patent

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
PSO1	H	H	H	H	H	H	H	H	H	H	H	H	H
PSO2	H	H	H	H	H	H	H	H	M	H	H	H	L
PSO3	H	H	H	H	H	H	H	H	M	H	H	H	L

Mapping COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	H	H	H	H	H	H	H	H	H	H	H	H	H
CO2	H	H	H	H	H	H	H	H	H	H	H	H	H
CO3	H	H	H	H	H	M	M	H	H	H	H	H	H
CO4	H	H	H	H	H	H	H	H	H	H	H	H	H
CO5	H	H	H	H	H	M	M	H	M	H	H	H	H
CO6	H	H	H	H	H	M	M	H	M	H	H	H	H

Course Code	Course Title	Course Type	Credits	CO1	CO2	CO3	CO4	CO5	CO6	PSO1	PSO2	PSO3
MSMA4701	MATHEMATICAL MODELLING	Theory	4	H	M	M	M	L	H	M	H	H
MSMA4702	ABSTRACT ALGEBRA-I	Theory	4	H	M	M	M	L	L	M	H	M
MSMA4703	ADVANCED ANALYSIS	Theory	4	H	M	M	M	L	L	M	H	M
MSMA4704	PARTIAL DIFFERENTIAL EQUATION-II	Theory	4	H	M	M	M	L	L	M	M	M
MSMA4705	DIFFERENTIAL GEOMETRY	Theory	4	H	M	M	M	L	L	M	M	M
MSMA4801	MEASURE THEORY	Theory	4	H	M	M	M	L	L	M	M	M
MSMA4802	ADVANCED CALCULUS	Theory	4	H	M	M	M	L	L	M	M	M
MSMA4803	TOPOLOGY	Theory	4	H	M	M	M	L	L	M	M	M
MSMA4804	FLUID DYNAMICS-I	Theory	4	H	M	M	M	L	L	M	M	M
MSMA4805	TENSOR ANALYSIS	Theory	4	H	M	M	M	L	L	M	M	M
MSSE0205	Renewable Energy Sources and Applications	Theory	6	H	H	H	H	L	L	H	M	M
SBFE3125	Image Processing through MATLAB-I			H	H	H	H	L	L	H	M	M

MSMA5101	ABSTRACT ALGEBRA-II	Theory	4	H	M	M	M	L	L	M	M	M
MSMA5102	COMPLEX ANALYS-II	Theory	4	H	M	M	M	L	L	M	M	M
MSMA5103	FLUID DYNAMICS - II	Theory	4	H	M	M	M	L	L	M	M	M
MSMA5104	OPERATION RESEARCH-II	Theory	4	H	M	M	M	L	L	M	M	M
MSMA5105	NUMBER THEORETIC CRYPTOGRAPHY	Theory	4	H	M	M	M	L	L	M	M	M
MSRM5101	INTRODUCTION TO RESEARCH	Theory	2	H	H	H	H	L	L	M	M	H
MSSM5101	SEMINAR		2	H	H	H	H	H	H	M	H	H
MSMA5201	THEORY OF COMPUTATION	Theory	4	H	M	M	M	L	L	M	M	M
MSMA5202	ADVANCED NUMERICALANALYSIS	Theory	4	H	M	M	M	L	L	M	M	M
MSMS5201	SEMINAR		4	H	H	H	H	H	H	M	H	H
MSMP5201	PROJECT/DISSERTATION		12	H	H	H	H	H	H	M	H	H
CUTM1525	Heat and Mass Transfer	(Th+Pr+Pj)	4	H	H	M	H		H	H	L	
CUTM1526	Numerical Methods for CFD	(Th+Pr+Pj)	4	H	H	M	H		H	H	L	
CUTM1527	Fluid Dynamics	(Th+Pr)	4	H	H	M	H		H	H	L	
CUTM1528	Geometry and Grid Generation	(Pr+Pj)	4	H	H	H	L		M	M	L	
CUTM1529	Applications of CFD using Computational Tool-Simulia	(Pr+Pj)	4	H	H	H	L		M	M	L	
CUTM1530	Advanced differential equations	(Th+Pr+Pj)	4	H	H	M	H		H	H	L	
CUTM1531	Graph Theory	(Th+Pr)	4	H	H	M	H		H	H	L	L

CUTM1532	Optimization techniques	(Th+Pr)	4	H	M	M	H		H	H	L	
CUTM1533	Advanced Statistical Methods	(Th+Pr+Pj)	4	H	M	M	H		H	H	L	
CUTM1534	Applied Number Theory	(Th+Pr)	4	H	M	M	H		H	H	L	
CUTM1535	Advanced complex analysis	(Th+Pj)	4	H	M	M	H		H	H	L	
CUTM1536	Topology	(Th+Pj)	4	H	H	M	H		H	H	L	
CUTM1537	Differential Geometry and Tensor Calculus	(Th+Pj)	4	H	H	M	H		H	H	L	
CUTM1538	Advanced Algebra	(Th+Pj)	4	H	L	M	H		H	M	L	
CUTM1018	Data Analysis and Visualisation using Python	(Pr+Pj)	4	H	H	M	H		H	H	L	L
CUTM1019	Machine Learning using Python	(Th+Pr+Pj)	4	H	H	M	H		H	H	L	L

CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT ODISHA

CHOICE BEASED CREDIT SYSTEM

COURSE STRUCTURE & SYLLABUS

M.Sc (Core Courses)

[*With effect from 2021-22 Academic Session]*

2021

Course Structure
(Core Courses)

Sl.No	Code	Subject Name	Cerdit	Course Type (Th+Pr+Pj)
1	CUTM1525	Heat and Mass Transfer	4	2+1+1
2	CUTM1526	Numerical Methods for CFD	4	2+1+1
3	CUTM1527	Fluid Dynamics	4	3+1+0
4	CUTM1528	Geometry and Grid Generation	4	0+2+2
5	CUTM1529	Applications of CFD using Computational Tool-Simulia	4	0+2+2
6	CUTM1530	Advanced differential equations	4	2+1+1
7	CUTM1531	Graph Theory	4	3+1+0
8	CUTM1532	Optimization techniques	4	3+1+0
9	CUTM1533	Advanced Statistical Methods	4	2+1+1
10	CUTM1534	Applied Number Theory	4	3+1+0
11	CUTM1535	Advanced complex analysis	4	3+0+1
12	CUTM1536	Topology	4	3+0+1
13	CUTM1537	Differential Geometry and Tensor Calculus	4	3+0+1
14	CUTM1538	Advanced Algebra	4	3+0+1
15	CUTM1018	Data Analysis and Visualisation using Python	4	0+1+3
16	CUTM1019	Machine Learning using Python	4	1+2+1
		Total	64	

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Course outline

CUTM1525 HEAT AND MASS TRANSFER

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
HEAT AND MASS TRANSFER	CUTM1525	Theory+Practice+Project	2-1-1	Nil

Objective

- To understand the basic concepts and mechanisms of heat and mass transfer under steady state and transient conditions.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Apply heat conduction equations to different surface configurations under steady state and transient conditions and solve problems.
- Apply free and forced convective heat transfer correlations to internal and external flows through/over various surface configurations and solve problems.
- Explain basic laws for radiation and apply these principles to radiative heat transfer between different types of surfaces to solve problems.
- Apply diffusive and convective mass transfer equations and correlations to solve problems for different applications.

Course outline

CUTM1525 Heat and Mass Transfer (2-1-1)

Module I (T-3 Hrs.+P-2Hrs.)

Introduction to heat transfer: Heat Transfer Mechanisms

Conduction:

Fourier's Law of Conduction, General Heat Conduction Equation in Different Coordinate Systems (No Derivation), One Dimensional Steady State Conduction in Plane Wall, Conduction with Internal Heat Generation.

Practice 1: To find the thermal conductivity of a material by the two slabs guarded hot plate method.

Assignment 1: Assignment on Conduction.

Module II (T-2 Hrs.+P-2Hrs.)

Fins and Transient Conduction:

Overall Heat Transfer Coefficients, Unsteady State Heat Conduction, Lumped Heat Capacity System and Lumped Capacitance Method.

Practice 2: To find the thermal resistance of the sample.

Assignment 2: Assignment on Fins and Transient Conduction.

Module III (T-4 Hrs.+P-4Hrs.)

Convection:

Thermal Boundary Layer, Principles and Governing Equations, Forced Convection: External Flow over a Flat Plate, Internal Flow Through Pipe, Natural Convection: Vertical&Horizontal Surfaces.

Practice 3: To determine the overall heat transfer coefficient at the surface of a given vertical metal cylinder by the natural convection method.

Practice 4: To verify Newton's Law of Cooling of different materials and different liquids.

Assignment 3: Assignment on Convection.

Module IV (T-2 Hrs.+P-2Hrs.)

Heat Transfer with Phase Change:

Film Wise and Drop Wise Condensation, Boiling Heat Transfer, Regimes of Boiling.

Module V (T-2 Hrs.+P-2Hrs.)

Heat Exchangers:

Types of Heat Exchangers, Heat Exchanger Analysis, LMTD, Overall Heat Transfer Coefficient, Heat Exchanger Effectiveness, NTU.

Practice 5: Determination of Effectiveness and Efficiency of Parallel Flow and Counter Flow Heat Exchanger.

Assignment 4: Assignment on Heat Exchangers.

Module VI (T-4 Hrs.+P-2Hrs.)

Radiation:

Black Body Emission, Emissive Power, Laws of Radiation, Nature of Black Bodies, Radiation Shape Factor, Radiation Heat Transfer Between Two Surfaces.

Practice 6: To find the emissivity of different material surface.

Assignment 5: Assignment on Radiation.

Module VII (T-3 Hrs.+P-2Hrs.)

Mass Transfer:

Introduction, Analogy between heat and mass transfer, Mass diffusion, Fick's law of diffusion, boundary conditions, Steady mass diffusion through a wall, Mass convection.

Assignment 6: Assignment on Mass Transfer.

Text Books:

1. Mahesh M. Rathore, Engineering Heat Transfer , Jones & Bartlett Learning, 2011
2. Yunus A. Cengel & Afshin J. Ghajar, "Heat and Mass Transfer-Fundamentals and Applications", McGraw Hill, 5th Edition 2015
3. Yunus Cengel, Heat And Mass Transfer: Fundamentals And Applications, McGraw-Hill Higher Education, 2014

Reference Books:

1. R.C Sachdeva, Fundamentals of Heat and Mass Transfer
2. R.K. Rajput, Heat Transfer, Laxmi Publication

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Course outline

CUTM1526 NUMERICAL METHODS FOR CFD

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
NUMERICAL METHODS FOR CFD	CUTM1526	Theory + Practice + Project	2-1-1	Nil

Objective

- To learn fundamentals of computational methods like FDM and FVM for solving linear and non-linear partial differential equations related to fluid dynamics and heat transfer.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Assess the principles of numerical analysis and concepts of consistency, stability, and convergence.
- Evaluate finite difference/volume schemes on model problems of computational fluid dynamics.
- Construct program-code using Python to obtain numerical solutions of partial differential equations, relevant to Computational Fluid Dynamics.

Course Outline

CUTM1526 Numerical Methods for CFD (2-1-1)

MODULE I

Introduction to CFD: Basics of computational fluid dynamics, Definition and overview of CFD- need, advantages, problem areas, Governing equations of fluid dynamics –

Continuity, Momentum and Energy equations, Non-Dimensional form of these governing equations, Classifications of PDE: Elliptic, Parabolic and Hyperbolic equations.

MODULE II

Finite Difference Method (FDM): Derivation of Finite difference equations (FDE) of 1^{st} and 2^{nd} order derivatives using Taylor series expansion. Explicit method-FTCS Method, Implicit method-BTCS Method, Crank-Nicholson method, Error, Convergence and stability analysis of above numerical Scheme, Keller Box Method.

MODULE III

Solution of Simultaneous Equations: Direct and Iterative methods; Gauss-elimination, Gauss-Jordan, Gauss-Jacobi and Gauss-Seidel methods, Tri Diagonal Matrix Algorithm (TDMA) (Thomas)

Practice 1: Gauss-elimination method using Python

Practice 2: Gauss-Seidel method using Python

Practice 3: Tri Diagonal Matrix Algorithm using Python

Project 1: Solution of Simultaneous Equations using Gauss-Jordan method.
Project 2: Solution of Simultaneous Equations using Gauss-Jacobi method.

MODULE IV

Application of FDM: Solutions of

Elliptic PDE:One-and Two-dimensional steady heat conduction, Laplace's Equation, Poisson's equation

Parabolic PDE: Unsteady heat conduction, Stoke's 1^{st}& 2^{nd} Problems.
Hyperbolic PDE: One-dimensional wave equation

Practice 4: Solution of One-dimensional steady heat conduction using Python.
Practice 5: Solution of Laplace's equation using Python.

Practice 6: Solution of Unsteady heat conduction using Python.
Practice 7: Solution of One-dimensional wave equation using Python.
Practice 8: Solution of Stoke's Problem.

Project 3: Solution of Poisson's equation.

Project 4: Solution of Burger's equation.

MODULE V

Finite Volume Method (FVM):
Fundamentals of FVM, Integral Form of 1-D Conservation equation, Finite Volume Method in 2-D

MODULE VI

Application of FVM: Solutions of1-D steady state Diffusion and Convection equations.

Project 5: Solutions of1-D steady state Diffusion equation.

MODULE VII

Application of FVM: Solutions of 2-D steady state Diffusion and Convection equations.

Project 6: Solutions of2-D steady state Convection equation.

Text Books:

1. Computational Fluid dynamics by John D.Anderson,Jr
2. Computational Fluid dynamics and Heat Transfer , by John C. Tannehill , Dale A.Anderson , Richard H. Pletcher

3.Introduction to finite elements in engineering, by Tirupathi R. Chadraupala, Ashok D. Belegundu, Chapter .3

4.An introduction to computational fluiddynamics, by HKVersteeg and W Malalasekera, Chapter 4,5

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Course outline

CUTM1527FLUID DYNAMICS

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
FLUID DYNAMICS	CUTM1527	Theory	3-0-1	Nil

Objective

- To introduce the foundations of fluid dynamics, various formulations of governing equations and their mathematical properties in order to establish a firm basis for other modules.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Distinguish and analyse the governing equations of fluid dynamics in various formulations for compressible and incompressible viscous and inviscid flows.
- Estimate the impact of different physical phenomena based on dimensional analysis.
- Examine mathematical properties of governing equations and be able to critically evaluate correct boundary/initial value problems for various flows.

Course Outline

CUTM1527 Fluid Dynamics (3-0-1)

MODULE – I (4hr+0hr+2hr)

Kinematics of Fluids, Methods describing Fluid motion, Lagrangian and Eulerian Methods, Translation, Rotation and Rate of Deformation, Streamlines, Path lines and Streak lines.

PROJECT 1: A Report on Steady vs Unsteady Flow, Compressible vs incompressible Flow, Laminar vs Turbulent Flow, Newtonian vs Non-Newtonian Flow, Invisid vs Viscous Flow, Rotational vs Irrotational Flow. (Definition, Comparative Study & Examples)

MODULE – II (5hr+0hr+0hr)

Fundamental equations of the flow of viscous compressible fluids: Equations of continuity**,** motion and energy in Cartesian coordinate systems, The equation of state, Fundamental equations of continuity, motion and energy in Cylindrical & Spherical coordinate systems.

MODULE – III (4hr+0hr+2hr)

2-D and 3-D inviscid incompressible flow: Basic equations and concepts of flow, Circulation theorems, Velocity potential, Rotational and Irrotational flows, Bernoulli's Equation.

PROJECT 2: A study on Stokes Circulation Theorem

MODULE – IV (4hr+0hr+8hr)

Laminar Flow of Viscous Incompressible Fluids: Flow between parallel flat plates:Couette flow, Steady Flow in pipes: Hagen-Poiseuille flow, Unsteady motion of a flat Plate.

PROJECT 3: A study on plane Poiseuille flow.

PROJECT 4: A report on steady flow of viscous incompressible fluid between two porous parallel plates.

PROJECT 5: A study on laminar flow between two coaxial circular cylinders (i.e. an annulas).

PROJECT 6: A report on unsteady flow of a viscous incompressible fluid over an oscillating plate.

MODULE – V (5hr+0hr+0hr)

The Laminar boundary layer Flow: Properties of Navier-Stokes equations, Boundary layer equations in 2-D flow, Similarity of Flows, Reynold's Number, The boundary layer along a flat plate, Boundary layer on a surface with pressure gradient.

MODULE – VI (4hr+0hr+0hr)

Momentum Integral theorems for the boundary layer, Von karman-Pohlhausen method, Separation of boundary layer flow, Boundary layer control.

MODULE – VII (4hr+0hr+0hr)

The origin of Turbulence, Reynold's modification of the Navier-Stokes equations for Turbulent flow, Reynold's stresses, Prandtl's mixing length theory.

BOOK PRESCRIBED

1. S. W. Yuan, "Foundations of Fluid Mechanics", Prentice – Hall of India
   Chapters: 3 (3.1 to 3.4), 5 (5.1 to 5.6), 7 (7.1 to 7.5), 8(8.1, 8.3, 8.4, 8.8),9 (9.1 to 9.6, 9.8, 9.9), 10(10.1 to 10.3(a))

BOOK REFERENCE

1. J. L. Bansal , "Viscus Fluid Dynamics", IBH Publication, Joypur.
2. M. D. Raisinghania, "Fluid Dynamics with Complete Hydrodynamics", S. Chand & Company Ltd, New Delhi.

Link: https://nptel.ac.in/courses/112/105/112105171/

Course outline

CUTM1528 GEOMETRY AND GRID GENERATION

Subject Name	Code	Type of course	T-P-P(Credit)	Prerequisite
GEOMETRY AND GRID GENERATION	CUTM1528	Practice + Project	0-2-2	Nil

Objective

- To introduce the concepts of grid generation required for Computational Fluid Dynamics applications providing hands-on experience using Simulia.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Evaluate the requirements of grid generation for Computational Fluid Dynamics applications.
- Understand the construction techniques of structured and unstructured grids using Simulia.
- Assess the control and efficiency of grid generation procedures.

Course Outline

CUTM1528 Geometry and Grid Generation (0-2-2)

Detailed Structure of Practice:

1. Introduction to 2D & 3D Geometrical shapes used for CFD
   - 1.1 Geometrical shapes for Internal Flows
     - 1.1.1 2D Geometry shapes (Circle/Square/Rectangle/Triangle)
     - 1.1.2 3D Geometry shapes (Hollow Cylinder/Duct)
   - 1.2 Geometrical shapes for External Flows

1.2.1 2D Geometry shapes (Circle/Square/Rectangle/Triangle/Aerofoil)
1.2.2 3D Geometry shapes (Wedge/Sphere/Solid Cylinder/Cone)
1.3 Importing Geometry, Geometry Clean up, Finding & Fixing Errors in Geometry

2. Grid Generation in CFD
   2.1 Structured Grid/Mesh Generation (2D-Quadrilateral/3D-Hexahedral)
      2.1.1 Mapped Meshing
      2.1.2 Sweeping Meshing
   2.2 Un-structured Grid/Mesh Generation(2D-Triangular/3D-Tetrahedral)
      2.2.1 Octree Meshing
      2.2.2 Delaunay Meshing
3. Creation of Density box, Prism mesh Generation, Mesh Quality checks, Mesh export

Practice:2Hrs.
Project:2Hrs. expect 8 and 9
Projects 8 & 9: 4 Hrs.

Practice 1. Generation of 2D mapped meshing for Rectangle.

Project 1. Grid generation for pipe at Re=500.

Practice 2. Generation of 2D mapped meshing for Aerofoil.

Project 2.3D coarse/ medium/ fine unstructured Octree Tetrahedron mesh for Aerofoil.

Practice 3. Generation of 2D Mapped meshing for Converging and Diverging Nozzle.

Project 3. Grid generation for compressible flow nozzle.

Practice 4. Generation of 3D mapped meshing for Cylinder.

Project 4. Grid generation for circular cylinder at Re=10^7.

Practice 5. Generation of 3D mapped meshing for Cuboid.

Project 5. Grid generation for rectangular Duct.

Practice 6. Generation of 3D Sweep mesh for U-Bend Pipe.

Project 6. Grid generation for cross flow heat exchanger.

Practice 7. Generation of 3D Mesh for Ahmed Body.

Practice 8. Generation of 3D mesh for 3D Cone.

Practice 9. Generation of 3D coarse/ medium/ fine sweep mesh for Pipe.

Practice 10. Generation of grid for Turbine Blade.

Practice 11. Generation of 3D mesh for Dimple Ball. **Practice**

12. Generation of 2D Mapped meshing for a Wedge. **Project**

7. Grid generation for flat plate at Re=1000000.

Project 8. Generation of grid for Narrowing pipe(4Hrs.)

Project 9. Grid generation for turbulent flow turbine blade(4Hrs.)

Project 10. Grid generation for cylinder with rectangular domain varying height and radius.

Course outline

CUTM1529 APPLICATIONS OF CFD USING COMPUTATIONAL TOOL-SIMULIA

Subject Name	Code	Type of course	T-P-P(Credit)	Prerequisite
APPLICATIONS OF CFD USING COMPUTATIONAL TOOL-SIMULIA	CUTM1529	Practice + Project	0-2-2	Nil

Objective

- To produce a CFD simulation in order to generate an exact picture of a particular flow problem in various engineering fields.
- To apply for resolving different fluid flow related problems like flow velocity, density, temperature, and chemical concentrations for any area where flow is present.

Learning Outcome

Upon successful completion of this course, students will be able to:

- To apply CFD simulation in various industries in order to achieve flawless product designs using computational tools.

Course Outline

CUTM1529 Applications of CFD using Computational Tool-Simulia (0-2-2)

Practice: 2Hrs.

Project:4Hrs.

Practice 1. Getting Started with the 3DExperience Platform.

Practice 2.CFD analysis of steady state internal Laminar Pipe flow.

Project 1. Analysis of pipe flow at Re= 500.

Practice3.CFD analysis Steady-state external flow over an Airfoil.

Project 2. Estimation of Drag and lift coefficients in flat plate at Re=10,000.

Practice4. Grid Independence study for above cases (pipe / airfoil) using different solver schemes.

Project 3. Flow analysis over a circular cylinder at Re=10^7.

Practice5. Conjugate Heat Transfer (CHT) Analysis of an Electronics Module.

Project4. Temperature analysis through cross flow heat exchanger.

Practice 6. Aerodynamics analysis of DS Car. **Practice**

7.Unsteady Flow across a Circular Cylinder. **Practice**

8.Transonic Flow over an Airfoil.

Project 5. Varying radius and height of sphere inside the rectangular domain.

Practice9. Turbulent analysis for Ahmed body.

Practice10. Cavitating Flow through a Narrowing Pipe.

Project 6. Analysis of compressible flow of nozzle at nozzle exit.

Practice11. Flow Analysis in the Turbine Blade.

Practice12. Post processing results for above studies.

Course outline

CUTM1530 ADVANCED DIFFERENTIAL EQUATIONS

Subject Name	Code	Type of course	T-P-Pj	Prerequisite
ADVANCED DIFFERENTIAL EQUATIONS	**CUTM1530**	**Theory+Practice+ Project**	**2-1-1**	

Objective

- Working with systems of ordinary differential equations and non-linear ordinary differential equations is also stressed.
- Developing and understanding and appreciation of the qualitative behaviour of the solution
- To introduce wave equations, Laplace equations, Heat equations, Diffusion equations.

Learning outcome

After successfully completing this course the expectation is that students will be able to:
1. Solve wave equation and understand significance of transverse waves.
2. Identify classes of non-linear ordinary differential equations.
3. Apply an appropriate method for the solution of non-linear ordinary differential equations.
4. Solve the problems choosing the most suitable method.
5. Solve Laplace equation, Diffusion equation, heat equation
5. Competence in solving applied problems which are linear and nonlinear form.

Course outline

Module I:

Introduction to Ordinary Differential Equations and Partial Differential Equations, First Order Non- linear Ordinary differential equations such as Equations solvable for x, Equations solvable for y, Equations solvable for p.

Practice- 1: Solve Ordinary Differential Equations in Python

Practice-2: Solve Partial differential Equations by python

Module II

Partial differential equation of second order with variable coefficients- Monge's method and its properties.

Project 1: Monge's Method of Solution of Non-linear Partial Differential Equations of Order Two

Module III

Classification of linear partial differential equation of second order, Cauchy's problem, Method of separation of variables.

Module IV

Solution of one- dimensional Laplace equation by method of separation of variables and Fourier series

Project 2 : Solution of Laplace's Equation for a Disk

Module V

Solution of one- dimensional Wave equation by method of separation of variables and Fourier series

Project 3: D' Alembert's solution of the wave equation

Practice 3: Solution of wave equation associated condition

$u(x,0)=\varphi(x), u_t(x,0)=\psi(x), u(0,t)=0, x\epsilon(0,\infty), t>0$

Practice 4: Solution of wave equation associated condition

$u(x,0)=\varphi(x), u(0,t)=a, x\epsilon(0,\infty), t\geq 0$

Module VI

Solution of one- dimensional Diffusion equation by method of separation of variables and Fourier series

Project 4: Solution of Diffusion equation in n-dimensional

Practice 5: Solution of one-dimensional diffusion equation by using boundary conditions $u(x,0)=\varphi(x), u(0,t)=a, x\epsilon(0,\infty), t\geq 0$

Practice 6: Solution of one-dimensional diffusion equation

$u(x,0)=\varphi(x), u(0,t)=a, u(1,t)=b, 0<x0$

Module VII

Solution of one- dimensional Heat equation by method of separation of variables and Fourier series

Project 5: Two dimensional Heat equations- Polar form

Project 6: Temperature distribution in Rectangular plate

Text Books

1. Differential Equations and Their Applications, by Martin Braun, Springer, 4e, ISBN 9781111827052 (1993).

2. S. L. Ross: Differential Equations, Blaisdell Publishing Company, Londan, 1964.

Reference books:

1. S.J. Farlow: An Introduction to Ordinary Differential Equations, PHI

2. M.D. Raisinghania: Ordinary and Partial Differential Equations, S. Chand & Co.

3. V. Sundarapandian: Ordinary and Partial Differential Equations, McGraw-Hill

Developed by:(Faculty name), Saubhagyalaxmi Singh

Developed on (Month and Year): JUNE 2020

Centurion University

Course outline

CUTM-1531 GRAPH THEORY

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
GRAPH THEORY	CUTM-1531	Theory & Practice	3-1-0	Nil

Objective:

- To introduce the students to graphs, their properties and their applications as models of networks.
- To represent almost any physical situation involving discrete objects and a relationship among them.
- To introduce the students to generating functions and their applications.

Learning Outcome:

Upon successful completion of this course, the student will be able to:

- Know the basic definitions and concepts of graph theory and Write in a coherent and technically accurate manner.
- Learn about how to develop graph theoretical algorithm and Know about many different coloring problems for graphs.

Course Outline

Module-I

Introduction to Graphs and Definition of graphs;Basic terminologies and types of graphs;Degree of a vertex,Isolated and Pendent vertices;Sub graphs and graph Isomorphism.

Practice 1: Determine if two graphs are isomorphic and identify the isomorphism

Module-II

Directed Graphs and Types of Digraphs;Out-degree, In-degree, Connectivity and Orientation;Digraphs and Binary relations , Directed paths and contentedness;Euler Digraphs, De-Brujin sequences;Tournaments.

Practice 2: Ways to Represent Graphs using Python

Module-III

Basic concepts of Planar Graphs; Kuratowski's Two graphs ;Representation of Planar Graphs; Detection of planarity ;Euler's formula for planar graphs;

Practice 3: A look in to Planar Graphs and Euler's Relationship

Module-IV

Distance, cut-vertices, cut-edges, blocks;weighted graphs, connectivity;Dijkstra's shortest path algorithm;Floyd-War shall Shortest path algorithm;

Module-V

Proper Coloring of graphs;Chromatic numbers of a graph;Chromatic polynomial;Chromatic Partitioning;Four Colour theorem.

Practice 4: Finding **C**hromatic number using python-networks.

Module-VI

Definition and properties of trees;Rooted and Binary trees; Counting trees, Spanning trees;

Practice 5: Applications of graphs with Euler and Hamiltonian path and circuits(Chinese postman Problem)

Module-VII

Minimum spanning trees;Fundamental Circuit;Cut set and Separability;

Practice 6: Application of Minimum spanning tree in a Net work model

Text Book:

1. Deo, N., "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall India 2004

Chapters: 1(1.1,1.2,1.3,1.4,1.5) ,2 (2.1,2.2,2.4,2.4,2.6,2.9), 3 (3.1,3.2,3.5,3.7,3.8,3.9,3.10), 4 (4.1,4.4,4.5), 5(5.2,5.3,5.4,5.5), 7(7.1,7.2), 8 (8.1,8.2,8.3,8.6), 9 (9.1,9.2,9.3,9.4, 9.5)

Reference Books:

1. West, D. B., "Introduction to Graph Theory ", Prentice Hall India (2nd Edition 2009)

2. Aldous, J. M., Wilson, R. J. and Best S., “Graphs and Applications: An Introductory Approach”, Springer2003.
3. Deistel, R., “Graph Theory”, Springer (4th Edition) 2010.
4. Chartrand, G. and Zhang, P., "Introduction to Graph Theory", Tata McGraw Hill2007.
5. Bondy, J. A. and Murty, U. S. R., “Graph Theory”, Springer 2011

Centurion University

Course Outline

CUTM1532 OPTIMIZATION TECHNIQUES

Subject Name	Code	Type of Course	T-P-Pj (Credit)	Prerequisite
OPTIMIZATION TECHNIQUES	CUTM1532	T + P	3-1-0	Nil

Course Objective

- To introduce a brief understanding about Non Linear Programming Problems.
- To cater the characteristics of Non Linear Programming Problems and its Applications.
- To demonstration of the utilization of Non Linear Programming Problems in industry and business.
- To apply the evolutionary optimization techniques in machine learning prediction model
- To solve the case study related to strategic management

Learning Outcome

Upon successful completion of this course, students will be able to:

- Formulate the necessary and sufficient optimality conditions for Non linear programming and demonstrate the geometrical interpretation of these conditions.
- Use Evolutionary optimization techniques to optimize the forecasting models in machine learning.
- Use the optimization techniques learned in this course to formulate new applications as optimal decision problems and seek appropriate solutions algorithms.

Course Outline

CUTM1532 Optimization Techniques (3-1-0)

Module-I (5 Hours)

Non Linear Constrained Optimization Problem: Constrained optimization using Lagrange Method, Lagrange Multiplier Equality Constraints, Constrained optimization using Kuhn Tucker Method, Kuhn Tucker inequality Constraints.

Practice-1: **(2 Hours)**

Solving minimization constrained optimization problem using python

Practice-2: **(2 Hours)**

Solving maximization constrained optimization problem using python

Module-II (5 Hours)

Direct Search Method for Unconstrained Optimization Problem: Univariate Search Method, Golden Section Search Method and Application of Golden Section Search Method.

Practice-3: **(2 Hours)**

Solving nonlinear system of equations using Python

Module-III (4 Hours)

Gradient Method for Unconstrained Optimization Problem: Gradient Descent Method, Algorithm for Gradient Descent Method, Steepest Descent Gradient Method.

Practice-4: **(2 Hours)**

Implementing Gradient Descent algorithm in Python

Practice-5: **(2 Hours)**

Linear Regression using Gradient Descent in Python

Module-IV (4 Hours)

Sequencing Models: Problems with n' Jobs through Two Machines, Problems with 'n' Jobs through Three Machines, Problems with Two Jobs through 'm' Machines.

Module-V (4 Hours)

Particle Swarm Optimization: Particle Swarm Optimization Theory, Particle Swarm Optimization Algorithm, Application of Particle Swarm Optimization,

Practice-6 & 7: **(2+2 Hours)**

Implementing the Particle Swarm Optimization (PSO) Algorithm in Python

Module-VI (4 Hours)

Game with Pure Strategy: Game and Strategy, Maximin-Minimax principle, Two person zero-sum game with Saddle Point, Solving matching coin problem using game theory.

Module-VII (4 Hours)

Game with Mixed Strategy: Mixed Strategy Game, Game without Saddle Point, Graphical Method to Solve Mixed Strategy Game, Dominance Principle to Solve Mixed Strategy Game.

Text Books:

Kanti Swarup, P.K. Gupta and Man Mohan-Operations Research, S. Chand and Co. Pvt.Ltd.

Engineering Optimization Theory and Practice by Singiresu S. Rao, JOHN WILEY & SONS, INC., Fourth Edition

Reference Book:

Mathematical Programming by N. S. Kambo, East West Press.

Course Outline

CUTM1533 ADVANCED STATISTICAL METHODS

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1533	ADVANCED STATISTICAL METHODS	2-1-1	NIL

Objective

- Ability to summarize and present data numerically and visually.
- Knowledge of which statistical methods to use in which situations
- Ability to think critically about data-based claims and quantitative arguments.
- Ability to learn new statistical analysis techniques on your own.

Learning outcome

Upon successful completion of this course, students will be able to:

- Apply statistical methods and hypothesis testing to business problems
- Learn the details and complexities of Analysis of Variance (ANOVA)
- Understand Chi Squared Tests
- Learn some of the details and complexities of Multiple Regression (MR)
- Understand different types of data

Course Content

Module I: (2 hrs+0 hrs+2hr)

Statistics: Population, Sample, Sampling, Estimators and Estimates, Maximum Likelihood , Confidence Intervals

Project-1

Application of Confidence intervals as a tool in decision making

Module II: (3 hrs+0hr+2hr)

Hypothesis Testing: Null and the alternative hypothesis, Rejection region and significance level, Chi-Square Test

Project-2

Hypothesis Testing in Quality Management

Module III: (4 hrs+4 hrs+0hr)

Regression: Multiple Regression and Logistic Regression

Practice-1

Multiple Regression Analysis in Python

Practice-2

Logistic Regression using Python

Module IV: (3 hrs+4 hrs+2hr)

Analysis of Variance (ANOVA): F- Distribution, One way ANOVA, Two Way ANOVA

Practice-3

One way ANOVA using Python

Practice-4

Two way ANOVA using Python

Project-3

The utility of multivariate statistical techniques in hydro geochemical studies

Module V: (3 hrs+2 hrs+2hr)

Covariance: (ANCOVA): Analysis of Covariance (ANCOVA), Bivariate Pearson Correlation, Alternative Correlation Coefficients

Practice-5

Python Analysis of covariance (ANCOVA)

Project-4

Application of Analysis of covariance (ANCOVA) in psychological research

Module VI: (3 hrs+0hr+2hr)

Multivariate analysis of variance (MANOVA): One-way MANOVA, Two-way MANOVA

Project-5

Comparison of MANOVA to ANOVA Using an Example

Module VII: (3 hrs+2 hrs+2hr)

Time Series Analysis: Introducing Time Series Analysis, Components of Time Series Analysis, Multivariate Time Series Analysis

Practice-6

Time Series Analysis using Python

Project-6

A Report on Applications of Time Series Analysis in Census Analysis

Text Books:

1. Statistical Methods By S.P. Gupta (31st Edition) ; Publisher: Sultan Chand & Sons

2. Mathematical Statistics by S.C. Gupta & V.K. Kapur (10th Edition); Publisher: Sultan Chand & Sons.

Reference Books:

Understanding And Using Advanced Statistics by Jeremy Foster Emma Barkus Christian Yavorsky, SAGE Publications

Course outline Prepared by: Dr.Banitamani Mallik **Date**: 18-06-2020

Centurion University

Course outline

CUTM1534 APPLIED NUMBER THEORY

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
APPLIED NUMBER THEORY	CUTM1534	Theory	3-1-0	Nil

Objective

- To analyze, evaluate, or solve problems with in given a set of circumstances or data.
- To understand and utilize mathematical functions and empirical principles and processes.
- Enhance and reinforce the student's understanding of concepts through the use of technology when appropriate

Learning Outcome

Upon successful completion of this course a students will:

- Demonstrate knowledge and understanding of topics including applications.
- Learn methods and techniques used in number theory.
- Use mathematical induction and other types of proof writing techniques and programming to compute number theoretic problems.

Course Outline

CUTM 1534 APPLIED NUMBER THEORY (3-1-0) MODULE – I

(4hr+2hr+0hr)

Divisibility, Representations of Integers,Computer Operations with Integers,Prime Numbers

Practice-1: Write a program to decide whether an integer is prime using trial division of the integer by all primes not exceeding its square root.

MODULE – II (6hr+4hr+0hr)

Greatest common divisor,EuclideanAlgorithm,Modified Euclidean Algorithm, Prime factorization,Factorization of Integers

Practice-2: Write a program to find the greatest common divisor of two integers using the Euclidean algorithm.

Practice-3:Find the prime factorization of a positive integer.

MODULE – III (5hr+2hr+0hr)

Congruence's, Properties of Congruence's,System linear Congruence's

Chinese Remainder Theorem.

Practice -4: Write a program to solves systems of linear congruence

MODULE – IV (5hr+0hr+0hr)

Wilson's Theorem,Fermat's Little Theorem,Pseudo prime, Carmichael number

MODULE – V (4hr+2hr+0hr)

Euler's Theorem, Euler Phi-function, Perfect Numbers, Mersenne Primes

Practice -5: Write programs to find values of the Euler phi-function

MODULE – VI (3hr+2hr+0hr)

Character Ciphers, Block Ciphers, Exponentiation ciphers, Public-Key Cryptography (RSA Cryptosystem).

Practice-6: Write a program for RSA crypto system/Algorithm

MODULE – VII (3hr+0hr+0hr)

Knapsack ciphers, Some applications to computer science.

BOOK PRESCRIBED

1. Elementary Number Theory and lts Applications by Kenneth H. Rosen, ADDISON-WESLEY PUBLISHING COMPANY ISBN 0-201-06561c chapter- 1(1.2-1.5), 2(2.1-2.4), 3,5,6(6.1-6.3),7

BOOKS FOR REFERENCE

1. Elementary Number Theory by David M. Burton, fifth edition, McGraw-Hill Publication, ISBN- 0-07-232569-0
2. A Course in Number Theoretic Cryptography by Neal Koblitz, Springer Verlag, GTM

Course outline

CUTM1535 ADVANCED COMPLEX ANALYSIS

Subject Name	Code	Type of course	T-P-Pj (Credit)	Prerequisite
ADVANCED COMPLEX ANALYSIS	CUTM1535	Theory	3-0-1	Nil

Objective

- To understand the applications of Residue for evaluation of definite and improper integrals occurring in Real analysis and Applied mathematics.
- To know about special functions like Riemann zeta function which plays a pivotal role in analytic number theory and has applications in physics, probability theory, and applied statistics.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Get a deep understanding of the fundamental concepts of Residues, Laurent series, Harmonic and Periodic functions.
- Evaluatedefinite and improper real integrals applying the Cauchy's Residue Theorem.

Course Outline

CUTM1535 Advanced Complex Analysis (3-0-1)

MODULE – I (3hr+0hr+0hr)

Index of a point with respect to a closed curve, Simply connected region, General statement of Cauchy's theorem.

MODULE – II (4hr+0hr+2hr)

Residue, process for finding out the residues, Residue theorem,the Argument Principle.

PROJECT 1: Study on Residues and their applications.

MODULE – III (5hr+0hr+2hr)

Definite Integrals: Evaluation of definite integrals (Types -1, 2, 3, 4, 5).

PROJECT 2: Evaluation of different types of real definite integrals using Residue theorem.

MODULE – IV (4hr+0hr+2hr)

Harmonic functions, conjugate differential, The Mean-Value Property, Poisson's formula.

PROJECT 3: A study on Harmonic functions.

MODULE – V (6hr+0hr+2hr)

Taylor Series, Taylor's theorem, Laurent series, Laurent's theorem, infinite products, theorems on infinite products.

PROJECT 4: A study on Laurent series expansion of different types of meromerphic functions.

MODULE – VI (3hr+0hr+2hr)

Entire functions: Jensen's formula, Riemann Zeta function, theorem on Riemann Zeta function.

PROJECT 5: A study on Riemann Zeta function and it's properties.

MODULE – VII (6hr+0hr+2hr)

Simply periodic function, Module, Discrete module, Unimodular transformation, Canonical basis, theorem on Canonical basis.

PROJECT 6: A study on discrete modules.

BOOK PRESCRIBED

1 L. V. Ahlfors, “Complex Analysis”, McGraw-Hill, Inc.

Chapters: 4 (2.1, 4.2 to 4.5, 5.1 to 5.3, 6.1 to 6.3), 5 (1.2, 1.3, 2.2, 3.1, 4.1), 7 (1.1, 2.1, 2.2, 2.3)

Course outline

CUTM1536 TOPOLOGY

Subject Name	Code	Type of course	T-P-P	Prerequisite
TOPOLOGY	CUTM1536	Theory & Project	3-0-1	NIL

Objective

- To introduce the student to elementary properties of topological spaces and structures defined on them
- To introduce the student to maps between topological spaces
- To develop the student's ability to handle abstract ideas of Mathematics and Mathematical proofs

Learning outcome

- Understanding elementary properties of topological spaces and structures defined on them
- Construct maps between topological spaces
- ability to handle abstract ideas of Mathematics and Mathematical proofs
- Demonstrate an understanding of the concepts of metric spaces and topological spaces, and their role in mathematics.
- Demonstrate familiarity with a range of examples of these structures.
- Prove basic results about completeness, compactness, connectedness and convergence within these structures.

Course outline

Module I

Introduction of topological space**,** Open sets and limit points, Closed sets and closure, Bases and relative topologies

Project 1: Applications of Topology to the Analysis of 1-Dimensional Objects

Project 2: Topologies sequentially equivalent to Kuratowski Painlev´e convergence

Module II

Connected sets and components,compact and Countable compact spaces **,** continuous functions, Homeomorphisoms

Project 3: Sober topological space

Module III

To-and T_1-spaces and sequence, Separation axioms

Module IV

Axioms of count ability, Regular and normal spaces, Completely regular spaces

Project 4: Upper Topology

Module V

Urysohn's metrization theorem **,** Urysohn's Lemma, Metrization**,** Tietze extension theorem

Project 5: Scott topology

Project 6: Scott continuity

Module VI

Finite products, product invariant properties, product topology

Module VII

Metric topology, Metric products, Dense set

Text Books

1. W.J. Pervin, Foundations of General Topology, Academic Press. Chapters: 3 (3.1, 3.2 and 3.4), 4(4.1 to 4.4), 5 (5.1 to 5.3, 5.5 and 5.6), 8 (8.1 to 8.4), 10 (10.1only).
2. J. R. Munkres; Topology – A First Course, Prentice Hall of India, 1996.

Reference Book

1. K. D. Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983.
2. http://mat.uab.cat/ret/sites/default/files/material/otras_contribuciones/ProceedingsWI AT10.pdf

Developed by:(Faculty name), Saubhagyalaxmi Singh

Developed on (Month and Year): JUNE 2020

Course outline

CUTM 1537 DIFFERENTIAL GEOMETRY

Subject Name	Code	Type of course	T-P-Pj	Prerequisite
DIFFERENTIAL GEOMETRY AND TENSORS CALCULUS	**CUTM 1537**	**Theory & Project**	**3-0-1**	**NIL**

Objective

- This course unit aims to introduce the basic ideas and techniques of Differential Geometry for use in many other courses.
- To study about different geometrical skills for figure and their representation in mathematical equations
- To study about notations and operations of Tensor.

Learning outcome

Upon successful completion of this course, students will be able to:

- write equation of normal , binormal and tangent to a curve.
- able to understand tonsorial expressions.

Course outline

Module-I

Introduction to Differential Geometry,Osculating plane and Rectifying Plane
Project 1:.finding the direction of tangent , normal and binormal at any point of curve

Module-II

Curvatures of a curve at a point,Torsion of a curve at a point, Expression of Curvature and Torsion in terms of arc length parameter, Expression of Curvature and Torsion in terms of arbitrary parameter

Project 2: Compute the Curvature of an ellipse.

Module-III

Spherical Indicatrix, Evolutes , Involutes
Project 3: Determine the evolutes of the given curve.

Module-IV

Betrand Curve,Osculating Spheres , Osculating circles.
Project-4 : Show that the tangent to the locus of osculating sphere passes through the centre of the Oscilating Circle.

Module-V

Surface: Tangent planes and Normals,The two fundamental forms
Project 5: Find the normal to a given surface

Module-VI

Tensor : Definitions and explanations,Vector Space,Free systems, Basis and Dimension, Suffix Conventions,Transformation law for change of Basis Vectors and Components ,Dual Spaces

Module-VII

Transformation law for change of Basis in dual Space, Isomorphism, Tensor Product of Vector Spaces, Real Valued Bilinear Functions, Special Tensors
Project-6: Show that the velocity of a fluid at any point is component of a contravariant vector

BOOK PRESCRIBED

1. A text book of vector calculus-Shanti Narayana and J.N.Kapoor
   Chapters: II and III

2. An Introduction to Differential Geometry by T.G. Willmore-Oxford University Press (1983) Chapters: V

BOOK FOR REFERENCE

1. Differential Geometry-P.P.Gupta,G.S.Malik, S.K.Pundir
2. Tensor Analysis- Edward Nelson(Princeton University Press & University of Tokyo Press),1967
3. Introduction to Tensor Analysis and the Calculus of Moving Surfaces-Pavel Grinfeld, Springer

Developed by:(Faculty name) : Dr T.N.Samantara

Developed on (Month and Year): May 2020:

Course outline

CUTM1538 ADVANCED ALGEBRA

Subject Name	Code	Type of course	T-P-P(Credit)	Prerequisite
ADVANCED ALGEBRA	CUTM1538	Theory	3-0-1	Nil

Objective

- A major objective is to introduce students to the language and precision of modern algebra. This means that the course will be proof-based, in the sense that students will be expected to understand, construct, and write proofs.
- A challenge for all students of mathematics is to balance the understanding with the communication. There is a tendency to think you are finished once you see why a mathematical statement is true or false.
- In fact you are just half-way there because constructing a legitimate proof involves different skills and expertise than the discovery part of the process. In this course both angles of problem-solving will be stressed.

Learning Outcome

Upon successful completion of this course, students will be able to:

- Effectively write abstract mathematical proofs in a clear and logical manner.
- Locate and use theorems to solve problems in number theory and theory of polynomials over a field.
- Demonstrate ability to think critically by interpreting theorems and relating results to problems in other mathematical disciplines.
- Demonstrate ability to think critically by recognizing patterns and principles of algebra and relating them to the number system.
- Work effectively with others to discuss homework problems put on the board.

Course Outline

CUTM1538 Advanced Algebra (3-0-1)

MODULE – I (6hr+0hr+2hr)

Group Theory:

Another Counting Principle, Sylow's Theorems. **Project**

1 : A Notes on the Proof of the Sylow Theorem

MODULE – II (6hr+0hr+2hr)

Ring Theory:

Introduction to Ring, Some special classes of ring, Ring homomorphisms.

Project 2: A study on ring theory and it's property

MODULE – III (3hr+0hr+2hr)

More Ideals and Quotient Rings, The Field of Quotients of an Integral Domain.

Project 3: The Quotient Field of an Intersection of Integral Domains **MODULE**

– IV (4hr+0hr+2hr)

Euclidean Rings, A Particular Euclidean Ring, Polynomial Rings.

Project 4: On the Existence of a Euclidean Algorithm in Number Rings with Infinitely Many Units

MODULE – V (4hr+0hr+0hr)

Polynomial Rings over the Rational Field, Polynomial Rings over Commutative Rings.

MODULE – VI (3hr+0hr+2hr)

Fields:

Extension Fields, Roots of polynomials

Project 5: A study on Structure of a Finite Field

MODULE – VII (4hr+0hr+2hr)

Vector Spaces:

Elementary Basic Concepts of Vector Space, Linear Independence and Basis, Dual Spaces, Inner Product Spaces

Project 6: Notes on dual spaces

BOOK PRESCRIBED

Topics in Algebra – I. N. Herstein (John Wiley and Sons or Vikas Publication), 2nd Edition

Chapters: 2 (2.11 to 2.12), 3 (3.1 to 3.11), 4 (4.1 to 4.4), 5(5.1 and 5.3)

BOOKS FOR REFERENCE

1. S.Singh and Q. Zameeruddin, Modern Algebra, Vikas Publishing House, 1990
2. P.B. Bhattacharya, S. K. Jain and S. R. Nagpal, Basic Abstract Algebra, Cambridge University Press, 1995.

M.Sc. Zoology
School of Applied Sciences

Program Objectives:

1. To acquire the knowledge with facts and figures related to various subjects in pure sciences and allied subjects. To understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.
2. To acquire the skills in handling scientific instruments, planning and performing in laboratory experiments.
3. To think creatively to propose novel ideas in explaining facts and figures or providing new solution to the problems.
4. To initiate research practices and develop scientific outlook not only with respect to science subjects but also in all aspects related to life.

POs

Pos	**Outcomes**
PO1	Apply mathematics, science, fundamentals and specialization to the conceptualization of different scientific models
PO2	Identify, formulate, research literature and solve complex science related problems reaching substantiated conclusions using first principles of mathematics and applied sciences
PO3	Design solutions for complex scientific problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations
PO4	Conduct investigations of complex problems including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions
PO5	Create, select and apply appropriate techniques, resources, and modern engineering tools, including prediction and modelling, to complex scientific activities, with an understanding of the limitations
PO6	Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings
PO7	Communicate effectively on complex science activities with the science community and with society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO8	Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to scientific application
PO9	Understand and commit to professional ethics and responsibilities and norms of engineering practice

PO10	Understand the impact of science solutions in a societal context and demonstrate knowledge of and need for sustainable development
PO11	Recognize the need for, and have the ability to engage in independent and life-long learning
PO12	Demonstrate a knowledge and understanding of contemporary technologies, their applications and limitations, contemporary research in the broader context of relevant fields
PO13	Demonstrate the ability to succeed in national and international competitive events in the relevant fields

PSOs of Department of Zoology:

PSO1: Jobs

PSO2: Higher studies

PSO3: Research

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PO13**
PSO1	**H**	**H**	**M**	**M**	**L**	**M**	**L**	**H**	**H**	**L**	**M**	**M**	**M**
PSO2	**H**	**H**	**M**	**H**	**H**	**M**	**M**	**M**	**M**	**M**	**M**	**H**	**M**
PSO3	**H**	**H**	**M**	**M**	**M**	**M**	**L**	**M**	**M**	**M**	**M**	**M**	**M**

COs of Master of Science programmes:

COs	**Skills**
CO1	Knowledge
CO2	Observe, Classify, Quantify, Interpret and Communicate
CO3	Investigation and Judgements
CO4	Problem Solving
CO5	Leadership & Entrepreneurship
CO6	Product/Publication/Patent

Mapping COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13
CO1	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**
CO2	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**	**H**	**H**
CO3	**M**	**H**	**H**	**M**	**H**	**H**	**H**	**M**	**M**	**H**	**H**	**H**	**H**
CO4	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**H**	**M**	**H**	**H**	**H**	**H**
CO5	**H**	**H**	**H**	**M**	**H**	**H**	**H**	**M**	**M**	**H**	**H**	**H**	**H**
CO6	**M**	**M**	**H**	**M**	**H**	**M**	**H**	**L**	**M**	**H**	**H**	**H**	**H**

Course Code	***Course Title***	***Course Type***	***Credits***	***Prerequisite***	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**	**PSO 1**	**PSO 2**	**PSO 3**
MSZO1101	Animal Diversity	Theory	4	***B.Sc. Pass***	H	H		M		H	M	H	H
MSZO1102	Biosystematics and Taxonomy	Theory	4	***B.Sc. Pass***	H	H		H		H	M	H	H
MSZO1103	Cell & Molecular biology	Theory	4	***B.Sc. Pass***	H	H		H		H	H	H	H
MSZO1104	Biochemistry	Theory	4	***B.Sc. Pass***	H	H		H		H	H	H	H
MSZO1105	Zoology Laboratory-I	Practice	4	***B.Sc. Pass***	H	H	H	H		H	H	H	H
MSZO1201	Comparative Anatomy of vertebrates	Theory	4	***B.Sc. Pass***	H	H		M		H	M	H	H
MSZO1202	Microbiology	Theory	4	***B.Sc. Pass***	H	H		H	H	H	H	H	H
MSZO1203	Genetics	Theory	4	***B.Sc. Pass***	H	H		M	**H**	H	H	H	H
MSZO1204	Immunology & Cancer biology	Theory	4	***B.Sc. Pass***	H	H		H	**H**	H	H	H	H
MSZO1205	Zoology Laboratory-II	Practice	4	***B.Sc. Pass***	H	H	H	H	**H**	H	H	H	H

MSZO2301	Physiology & Endocrinology	Theory	4	***B.Sc. Pass***	H	H		M	**H**	H	M	H	H
MSZO2302	Animal Biotechnology	Theory	4	***B.Sc. Pass***	H	H		H		H	H	H	H
MSZO2303	Ecotoxicology	Theory	4	***B.Sc. Pass***	H	H		M	H	H	H	H	H
MSZO2304	Quantitative Biology& wild life	Theory	4	***B.Sc. Pass***	H	H		H		H	H	H	H
MSZO2305	Zoology Laboratory-III	Practice	4	***B.Sc. Pass***	H	H	H	H		H	H	H	H
MSRM5101	Introduction to Research	Theory	2	***B.Sc. Pass***	H	H		H		H	L	H	H
MSZP2301	Scientific visit	Practice	2	***B.Sc. Pass***	H	H	H	M		H	L	H	H
MSZO2401	Developmental Biology	Theory	4	***B.Sc. Pass***	H	H		M		H	M	H	H
MSZO2402	Instrumentation & Biophysics	Theory	4	***B.Sc. Pass***	H	H		H	**H**	H	H	H	H
MSZO2403	Environment & Pollution management	Theory	4	***B.Sc. Pass***	H	H	H	M	**H**	H	M	H	H
MSZP2401	Project	Practice	8	***B.Sc. Pass***	H	H		M		H	L	H	H
MSZS2401	Seminar	Practice	4	***B.Sc. Pass***	H	H		M		H	L	H	H

Year 2020-21

Course Code	*Course Title*	*Course Type*	*Credits*	CO1	CO2	CO3	CO4	CO5	CO6	PSO1	PSO2	PSO3
CUTM1442	Advanced Aquaculture	Theory	4	H	H	M	L	H	H	H	H	H
CUTM 1452	Animal Biotechnology	Theory	4	H	H	H	L	M	H	H	H	H
CUTM 1453	Animal Breeding	Theory	4	H	H	M	L	M	H	H	H	H
CUTM 1447	Coastal Aquaculture	Theory	4	H	H	H	M	H	H	H	H	H
CUTM 1443	Water and Soil quality management in aquaculture	Theory	4	H	H	H	M	M	M	H	H	H
CUTM 1446	Anatomy and Biology and Shellfish	Theory	4	H	H	M	L	M	H	H	H	H
CUTM 1448	Fish processing and value addition	Theory	4	H	H	M	L	H	H	H	H	H
CUTM1444	Fish and Shellfish nutrition	Theory	4	H	H	H	M	M	H	H	H	H
CUTM1450	Animal Physiology and Biochemistry	Theory	4	H	H	H	M	L	H	H	H	H
CUTM 1451	Immunology & Cancer biology	Theory	4	H	H	H	M	M	H	H	H	H
CUTM1438	Bioanalytical Techniques	Theory	4	H	H	H	M	M	H	H	H	H
CUTM1445	Fish and Shellfish Health Management	Theory	4	H	H	H	M	H	H	H	H	H

CUTM1437	Cell & Molecular biology	Theory	4	H	H	M	L	M	H	H	H	H
CUTM1449	Ornamental Aquaculture	Theory	4	H	H	M	M	H	H	H	H	H
CUTM1454	Genetics and Epigenetics	Theory	4	H	H	H	M	M	H	H	H	H
CUTM1436	Microbiology	Theory	4	H	H	H	L	M	H	H	H	H

2021

M.Sc. Zoology
(Two Year Programme)
Course Structure-2020-21

Basket I (Core Courses)

Sl. No.	Code	Subject Name	T-P-P	Credits
1.	CUTM1442	Advanced Aquaculture	3-1-0	4
2.	CUTM1452	Animal Biotechnology	3-1-0	4
3.	CUTM1453	Animal Breeding	3-1-0	4

4.	CUTM1447	Coastal Aquaculture	3-1-0	4
5.	CUTM1443	Water and Soil Quality Management in Aquaculture	3-1-0	4
6.	CUTM1446	Anatomy and Biology shellfish	3-1-0	4
7.	CUTM1448	Fish Processing and Value Addition	3-1-0	4
8.	CUTM1444	Fish and Shell fish Nutrition	3-1-0	4
9.	CUTM1450	Animal Physiology and Biochemistry	3-1-0	4
10.	CUTM1451	Immunology and Cancer Biology	3-1-0	4
11.	CUTM1438	Bioanalytical Techniques	3-1-0	4
12.	CUTM1445	Fish and Shellfish Health Management	3-1-0	4
13.	CUTM1437	Cell and Molecular Biology	3-1-0	4
14.	CUTM1449	Ornamental Aquaculture	3-1-0	4
15.	CUTM1454	Genetics and Epigenetics	3-1-0	4
16.	CUTM1436	Microbiology	3-1-0	4
		Basket II (DomainCourses)		**32**
		Total		**96**

Course Outline for MSc courses

Advanced Aquaculture

Subject Name	Code	Type of course	T-P-P	Prerequisite
Advanced aquaculture	CUTM1442	Theory-Practice	3-1-0	-

Objective

- The goal of the Aquaculture Biology specialization is to give a theoretical basis and practical experience for understanding the biological principles in aquatic food production.
- The specialization is intended to give a solid background for students who wish to work in aquaculture or related industries, or to pursue further research.

Learning outcome

- Students will understand the basis of technologies of fisheries and aquaculture.
- Students will develop a better understanding of the history of aquaculture and different production systems employed for better production.
- Basic knowledge on Aquaculture will promote the students for research activities and encourage them for higher studies.

Course outline

Module- I

Basics of aquaculture, definition and scope of aquaculture, History of aquaculture, Present global and national scenario. Systems of aquaculture - Pond culture , Pen culture, Cage culture and Running water culture, Zero water exchange system.

Practice 1(2 h) : Aquaculture production and resource statistics- World and India

Module- II

Extensive, semi-intensive,intensive and super intensive aquaculture in different types of water bodies - Fresh water , Brackish water, Inland saline and Marine water, Principles of organic aquaculture.Pond Management - Pre stocking and Post stocking, Carrying capacity of pond, Factors influencing carrying capacity.

Practice 2(2 h): Components of Aquaculture farms

Module- III

Criteria for selection of animal species for aquaculture, Major animal species for aquaculture: freshwater,brakish water, marine water. Culture System - Monoculture and Polyculture System, Integrated culture systems**.**

Practice3 (2 h) : Practices on pre stocking and post stocking management

Module- IV

Waterand soil quality in relation to fish production, Physical and chemical factors affecting productivity of ponds, Biological factors affecting productivity of ponds.

Practice 4 (2 h) : Study on waste accumulation in aquaculture system (NH3, Organic matter, CO2)

Module- V

Feed technology**:** Micro encapsulated feeds; micro coated feeds; micro particulate feeds and bio-encapsulated feeds; mycotoxins and their effects on feeds. Application of Nanotechnology in aquaculture.

Practice 5 (2 h): Analysis of manure

Module- VI

Algal biotechnology**:** Biotechnological approaches for production of important microalgae; single cell protein from *Spirulina;* vitamins, minerals and omega3 fatty acids from microalgae; enrichment of micro algae with micronutrients.

Module- VII

Health management**:** vaccines; molecular diagnosis of viral diseases; Biofilms and its impact on health management; genetically modified microorganisms as probiotics, immunostimulants, bioremediation of soil and water.

Practice 6 (2 h): Use of probiotics in aquaculture farms.

Reference and Textbooks

- Aquaculture principles and practices ----TVR Pillay and MN Kutty
- Encyclopedia of aquaculture
- Hand book fisheries and aquaculture----ICAR New Delhi 2006
- Sustainable aquaculture by Nagabhushanam R, Diwan AD, Zahurnec BJ & Sarojini R. 2004. *Biotechnology of AquaticAnimals.* Science Publ.

Animal Biotechnology

Subject Name	Code	Type of course	T-P-P	Prerequisite
Animal Biotechnology	CUTM1452	Theory andPractice	3-1-0	-

Objective

- To make the student understand the tools and techniques required for the animal cell culture, assisted reproductive technology, development of transgenic animals, and development of animal models.

Learning outcome

The students will learn

- the methods of culturing animal cells
- various techniques involve in making of transgenic animals
- to integrate assisted reproductive biotechnology techniques in livestock improvement.
- to utilize animal production technologies for sustainable agriculture and food security

Course outline

Module-I (Animal Cell and tissue culture technology-I): 8 H

Overview of animal cell and tissue culture technology; Cell culture laboratory design and basic laboratory equipments; Media preparation, Role of important components of culture media; Common laboratory hazards and safety issues to consider in cell culture laboratory

Practice 1(2h): Sterilization techniques used in animal cell culture
Practice 2(2h) : Preparation of media for animal cell culture

Module-II (Animal Cell and tissue culture technology-II): 8 H

Types of animal cell culture; Characterization and preservation of animal cells; Advances in cell culture technology; Opportunities and challenges in animal cell and tissue culture technology

Practice 3 (2h): Study of primary cell culture technique using chick embryo
Practice 4(2h) : Animal cell batch culture technique

Module-III (Transgenesis for livestock improvement-I): 4 H

Overview of transgenic technology; Biopharming through animal transgenesis; Methods of producing transgenic farm animals; Identification and transfer of gene influencing better production and disease resistance

Module-IV (Transgenesis for livestock improvement-II): 5 H

Gene transfer methods in animals: Microinjection, Retrovirus mediated gene delivery, Embryonic stem cell mediated gene transfer; Knockout model systems & their utility; Animal as bioreactor

Module-V (Assisted reproduction biotechnology for livestock improvement): 4 H

Reproduction biotechnologies and their use in livestock; Somatic cell nuclear transfer cloning; In Vitro Fertilization, Embryo production, preservation and transfer; Sperm and embryo sexing; Intracytoplasmic sperm injection (ICSI); Cryopreservation and gamete banking

Module-VI (Animal Production technology for sustainable agriculture and food security):7H

Polyculture of fish for high yield; Edible oyster production; Pearl oyster production; Vermi-culture and vermicomposting for alternative and sustainable agriculture; Fish culture in flow through system and recirculation technology

Practice 5 (2h) : Vermicompost preparation from plant debris, cattle dung and paper waste

Module-VII (Animal Biotechnology & human health): 6 H

Recombinant therapeutics and production of pharmaceuticals; Production of tissues and organs for humans and xenotransplantation; Process of gene therapy, *Pros* and *cons* in gene therapy; Retrovirus and adenovirus mediated gene therapy

Practice 6(2h) : Preparation of competent cell (Calcium chloride treatment method)

Text Books:

- Freshney RI (1992) Animal cell culture: a practical approach, Oxford University Press
- Singh B, Gautam SK (2013) Text Book of Animal Biotechnology, TERI

Reference Books:

- SinghB, Mal G, Gautam SK, Mukesh M (2019) Advances in Animal Biotechnology, Springer
- Butler M (2003) Animal Cell Culture and Technology, Taylor & Francis

Animal Breeding

Subject Name	Code	Type of course	T-P-P	Prerequisite

Animal Breeding	CUTM1453	Theory and Practice	3-1-0	-

Objective

- To educate about the concept of conservation of Animal Genetic Resources and their sustainable utilization.
- To educate about the concept of cattle and buffalo breeding.
- To educate about the small farm animal breeding concepts.
- To impart knowledge about the latest tools and techniques of animal genetics and their uses in animal sciences.
- To acquaint with recent trends in animal breeding and designing of need-based breeding strategies.

Learning outcome

- To educate about molecular techniques to identify molecular markers as an aid to selection.
- To study genetic structure of animal population and importance of genetic variation and covariation among traits.
- To explain the methodology of selection and breeding systems for genetic improvement of livestock and poultry.
- To educate about the various biometrical techniques for data analysis and their

applications in animal breeding research.

Course outline

MODULE -1

Domestication, Early Developments in Animal Breeding,Overview of Animal Breeding, Economic Traits ,Statistical Measures and Methods in Animal Breeding.

PRACTICE -1 (2h) :- Problems relating to gene and genotypic frequencies under different conditions.

MODULE-2

Selection and Response to Selection, Improving Response to Selection, Computation of Selection Differential, Computation of Generation, Interval bases of selection.

PRACTICE-2(2h) :- Estimation of inbreeding in regular and irregular systems.

Estimation of effective population size.

MODULE-3

In-breeding & line breeding, Outbreeding& heterosis, Estimation of heterosis & Systems of cross-breeding.

PRACTICE-3(2h) :- a) Computation of quantitative genetic effects.

b) Estimation of variance components

MODULE-4

Development of New Breeds, Breed and Breeding Industry Structure, Breed Comparison: Genotype-Environment Interaction, Animal Genetic Resources &Designing of Breeding Program.

PRACTICE-4 (2h) :- Computation of heritability, repeatability, genetic, environmental and phenotypic correlations and their standard errors.

MODULE-5

Breeds–Economic traits–Prolificacy-Breeding records and standardization, Genetic parameters – Selection of males and females – Breeding systems, Development of new breeds& Breeding policy – Breeding research – Conservation of breeds.

PRACTICE -5 (2h) :- Estimation of breeding values from different sources of information. Prediction of direct and correlated response to different bases of selection.

MODULE-6

Biometrical models and their analytical techniques on simulated and actual animal breeding data using computer application and use of programme in the field of animal breeding, Advanced techniques in genetic manipulation for multiplication and improvement of livestock species.

PRACTICE-6 (2h) :- a) Computation of realized heritability and genetic correlation.

b) Selection index: Computation, Accuracy and response in component trait

c) Estimation of hetrerosis for different types of crosses.

d) Estimation of GCA and SCA

MODULE-7

History of dairy cattle and buffalo breeding, Breeds of cattle and buffalo and their Characterization, Inheritance of important economic traits, Recording and handling of breeding data, Standardization of records, Computation of correction factors for the adjustment of the data and Estimation of the breeding values of cows and bulls.

Text books and References

- Animal breeding – by Groen kennisnat
- Animal breeding – by Gurvinder Singh Brar
- Animal Genetics and Breeding – by Sukhbir Singh Tomar
- Textbook of Veterinary Physiology – by Bhattacharya. B
- Textbook of Animal husbandry – G.C Banerjee

Coastal Aquaculture

Subject Name	Code	Type of course	T-P-P	Prerequisite
Coastal Aquaculture	CUTM1447	Theory -Practice	3-1-0	-

Objective

To gain knowledge in establishing and managing different fish/shellfish farming systems in coastal waters.

Learning outcome

Students get an insight into the culture of different commercially important aquaculture species in coastal/marine waters.

Course outline

Module-I

Brackish water aquaculture: Principles of pond design – Inland and Coastal, Tank and raceway farms, cage farms, pens – Types of culture systems: Traditional, extensive, modified extensive, semi extensive,intensive and super-intensive culture of shrimps and their management, Economics of Shrimp Culture, Design and construction of shrimp culture ponds, Liming and fertilization in shrimp pond.

Practice 1 (2h) : Primary productivity calculation, Estimation by Light and Dark Bottle method

Module-II

Seed procurement of shrimps: Natural seed, hatchery reared seed production, Transportation stocking in nursery ponds, rearing and growout ponds, pond harvesting of Shrimps, Principles of crab hatchery, brood stock, larval and post-larval management. Packing and transportation of crab instar and brood stock, Crab culture: Pond design, management of crab farm.

Practice 2 (2h) :Identification of important cultivable species.

Module-III

Crab culture and crab fattening process, economics of carb culture, Principles involved in seed production of lobsters and mussels. Cage Culture

Practice 3 (2h): Collection and identification of commercially important seed of fish and shellfishes

Module-IV

Pen culture, Potential Brackish water fish species for culture, Traditional culture of brackish water fish, Culture of finfish – Sea-bass, Culture of milk fish.

Practice 4(2h): Dissecting out the pituitary gland and preparing the extract

Module-V

Culture of mullet, Culture of Cobia, Culture of Pompano, Lobster culture

Module-VI

Mussel culture, Pearl culture, Oyster culture, Sea-weed culture, Different types of Products obtained from seaweeds.

Practice 5(2h): Visit To shrimp hatchery/Farm

Module-VII

Methods of Shellfish Culture rafts, racks, cages, poles and ropes, Sea ranching, Resources for shore-based aquaculture and sea farming in India, Regulation for mariculture.

Practice 6(2h): Estimation of seed survival.

Reference and Textbooks

- Advances in aquaculture----TVR Pillay and Won A Dill
- Aquaculture –the farming and husbandry of fresh water and marine organismsFisheries sciences ----R Santhanan
- World fish farming cultivation and economics ---- E Evan Brown

Water and Soil Quality Management in Aquaculture

Subject Name	Code	Type of course	T-P-P	Prerequisite

Water and soil quality management in aquaculture	CUTM1443	Theory -Practice	3-1-0	-

Objective

- To learn effective soil and water quality management practices which is important for any aquaculture endeavours .

Learning outcome

Students will have an insight into the important water and soil quality management and their amalgamation for successful aquaculture operation

Course outline

Module-I

Soil and water interaction: Physical and chemical properties of soil and water, Productivity vs nutrient quality and quantity of soil and water; aquatic microorganisms and their role in carbon, nitrogen, phosphorus and sulphur cycles and impact on aquatic habitats and species; Fertilizers and manures: Different kinds of fertilizers and manures; fertilizer grade, source, rate and frequency of application; Use of treated sewage for pond fertilization and biofertilizers, Ecological changes taking place after fertilizing.

Practice I (2h): Water analysis: measurement of temperature,turbidity, determination of pH and EC. Determination ofinorganic nitrogen, and phosphorus

Module-II

Primary production and its estimation; degradation of molecules in aquatic environment; Utilization of bioactive compounds by microorganisms; Cat clay/pyrite soil and its management; seepage and its control.

Practice 2(2h): Estimation of primary productivity and chlorophyll

Module-III

water treatment, water filtration devices, aeration, chlorination, ozonization and UV radiation; eutrophication; Algal bloom control; Aquatic weed management.

Practice 3(2h): Determination of salinity, Chlorinity, Total solids,Redox potential, DO, Free CO2.

Practice 4(2h): Determination of total alkalinity, hardness.

Module-IV

Waste water treatment practices; Waste discharge standards; Water quality management in carp culture; Water quality management in brackishwater shrimp culture; Water quality management in hatcheries.

Practice 5(2h) : Calculation of dose of fertilizers and pond liming

Module-V

Ecology of Pond system; Role of microorganisms in fish production; Microbial load and algal blooms; fluxes between mud and water, methane and hydrogen sulphide formation

Module-VI

Alkali soils and its management; Saline soils and its management; acid sulphate soils, iron pyrites, soil reclamation; Soil and water amendments: lime, manures,fertilizers, micronutrients, zeolites, alum, gypsum.

Module-VII

Effluent Treatment plant; Areation,Chlorination,Ozonisation and UV radiation; Waste and water Treatment Practices; Machine Leaning for water quality analysis.

Practice 6(2h) : Jar Test

Reference and Textbooks

1. Bottom soil, sediment and pond aquaculture --- Claude E.Body
2. Fundamentals of Soil --- V.N.Sahai
3. Water quality in ponds for aquaculture --Claude E.Body
4. Fresh water fish culture--- V.R.P.Sinha and V.Ramachandran

Anatomy and Biology of Fish and Shellfish

Subject Name	Code	Type of course	T-P-P	Prerequisite
Anatomy and Biology and	CUTM1446	Theory -Practice	3-1-0	-

Shellfish				

Objective

- Introduces students to an integrated approach to fish biology, including anatomy, morphology, physiology, ecology and behavior.
- Students will study how fishes interact with their environment and the wide range of biological adaptations they have evolved to live in a remarkably diverse range of habitats.

Learning outcome

- Introduces students to an integrated approach to fish biology, including anatomy, morphology, physiology, ecology and behavior.
- Students will study how fishes interact with their environment and the wide range of biological adaptations they have evolved to live in a remarkably diverse range of habitats.

Course outline

Module-I - Diversity of Fishes

Introduction to diversity of fishes , Classification , Basic Structural Features, Body shape,scales, and fins , Internal features

Practice-1(2h): Museum Specimen

Module-2:**Habitat**

Introduction to Habitat , Biogeography , Marine Habitats , Freshwater Fishes

Practice -2(2h) : Slide preparion of scales

Module-3: Anatomy

Integumentary , Digestive system , Skeleton system , Respiratory System , Circulatory system

Practice -3(2h): Food habit study

Module-4: Anatomy

Nervous System , Excretion and osmoregulation , Reproductive system , Endocrine System , Sense and specialised organ

Practice -4(2h): Hematological study

Module-5: Food and feeding habits

Introduction , Techniques for Studying Food Habits and Feeding , Optimal Foraging Theor , Food Choices, Size, and Development , Food Capture

Practice -5(2h): Biochemical study

Module-6: Reproduction, and Life Histories

Types of Life History , Intersexes and Unisexual Species, Fertilization to Hatching (Incubation)
Parental Care , Growth
Practice-6(2h): Writing Review literature

Module-7: Behavior and Cognition

Introduction tobehavior as a Discipline, Schooling, Orientation and Migration, Symbiosis

Practice-7(2h): PowerPoint Presentation

References

- R.L. Kothpal- Vertibrates Rastogi Publications
- Handbook of Fish Biology and FisheriesEdited by Paul J.B. Hart and John D. Reynolds 2002 Volume 1 Fisheries
- Handbook of Fish Biology and Fisheries Edited by Paul J.B. Hart and John D. Reynolds 2002 Volume 2 Fisheries
- Quentin Bone & Richard H. Moore 2008. Biology of Fishes. Taylor & Francis Group

Fish Processing and Value addition

Subject Name	Code	Type of course	T-P-P	Prerequisite
Fish processing and value addition	CUTM1448	Theory -Practice	3-1-0	-

Objective

To impart skill-based training to the students on different aspects of fish processing technologies related to production of value added quality fish products and their preservation

Learning outcome

Students learn how to preserve and process of fishery products and their value additions.

Course outline

Module-1: Challenges to the Fish-Processing Industry

Introduction , Sustainability tool the capture fishery , Contribution of aquaculture , Implications for the processing industry

Practice 1(2h): How to make your own fish food

Module-2: Canning Fish and Fish Products

Principles of canning , Packaging materials , Processing operations , Canning of specific species

Practice-2(2h) : Dry fish preparation

Module-3: Preservation by Curing

Drying , Salting , Smoking , Post-harvest losses in fish smoking

Practice-3(2h) : Fresh fish packing

Module-4: **Freezing and Chilling of Fish and Fish Products**

Introduction **,** Freezing systems , Environmental impact of freezing operations

Practice-4(2h) : preparation of fish pickle

Module-5: Sustainability Impacts of Fish-Processing Operations

Introduction , Sustainability issues , Life cycle assessment

Practice-5 (2h): Field study report

Module-6: On-board Fish Processing

Introduction , On-board processing , Advantages of on-board processing

Practice-6(2h) : Field processing

Module-7: Fishmeal Production and Sustainability

Introduction , The fishmeal process , Sustainability issues , Alternatives to fishmeal

Practice-7(2h) : Related to theory

References

Fish Processing – Sustainabilityand New Opportunities2011Edited byGeorge M. Hall. John Wiley & Sons Ltd, UK

Fish and Shellfish Nutrition

SubjectName	Code	Type of course	T-P-P	Prerequisite
Fish and Shellfish nutrition	CUTM1444	Theory and Practice	3-1-0	

Objective

- To learn basic concepts of feed formulation
- To learn about different feed processing techniques

Learning outcome

- Student can prepare feed based on the nutritional requirements of fish/shell fish.
- They can prepare feed using different feed formulations

Course Outline

Module- I

Food and feeding habits of commercially important fish and shell fish, Principal Nutrients essential for feed formulation, Role of different nutrients on fish and shellfish growth, Nutritional requirement of cultivable fish and shellfish, Importance of Priciple of Protein: Energy Ratio for aquaculture

Module- II

General principles for feed formulation, Different steps of feed formulation, Methods of Feed formulation, Classification of feed ingredients, Energy and protein sources

Module- III

Evaluation of ingredient quality, Types of feed Dry (pellets, flakes, powdered, Moist Feed), Micro-encapsulated, micro-bound and micro-coated diets, Feed manufacturing units and processes

Module- IV

Pulveriser, Grinder and Mixer (Types and importance), Pelletizer, Crumbler and Drier, Extruder and Fat sprayer, Hydro-stability of feed and their storage, Prevention of spoilage from rancidity, fungus and associated toxins

Module- V

Feed Additive, Anti-nutritional factors in feed ingredients and methods of their, Principles of Nutritional energetic, Energy partitioning

Module-VI

Concept of GE, ME, FE, UE etc. and their relation, Methods of digestibility study, Factors affecting digestibility, Role of feed digestibility study in feed quality evaluation, Feed Management in Aquaculture Farms

Module-VII

Traditional Feeding methods in Aquaculture, Different Feeding Practices used by Indian Farmers, Demand Feeders

Fish and Shellfish Nutrition Lab (Practice).

Experiments:(2h each experiment)

- Identification of Common feed ingredients
- Preparation of artificial feeds using locally available feed ingredients
- Proximate analysis of feed ingredients and feeds: Moisture, Crude protein
- Proximate analysis of feed ingredients and feeds: Crude lipid, Ash
- Preparation of feeds with various binders in order to determine their hydro-stability
- Effect of Storage on Feed Quality and Determination of sinking rate feeds

References:

- Fish in Nutrition ---- Halver
- Fish Nutrition in Aquaculture ---- De Silva, Trevor & Anderson

E-sources-https://www.researchgate.net/publication/308653321_Microencapsulated_diets_for_fish_larvae_-_current_'state_of_art'

Animal Physiology and Biochemistry

SubjectName	Code	Type of course	T-P-P	Prerequisite
Animal Physiology and Biochemistry	1450	Theory and Practice	3-1-0	

Objective

- To know the functioning of various organs and their inter relationship.

- To understand about the various metabolic processes
- To facilitate students about applications in medicine, drugs and research

Learning outcome

- Students would be able to know and compare the different anatomical aspect of various organisms.
- Students will acquire the knowledge of functioning of different body parts.
- The students can apply the acquired knowledge for higher study

Course Outline

Module- I

Physiology of Digestion and Respiration: Absorptions of essential molecules (carbohydrates, proteins, lipids, vitamins and minerals), Hormonal control and enzymatic roles in Gastrointestinal tract**,** Pulmonary ventilation, Respiratory volumes and capacities**,** Role of respiratory pigments and factors influencing respiration**,** Control and regulation of respiration

Module- II

Physiology of Circulation and Excretion: Coronary circulation ,conducting system(Origin and conduction of cardiac impulses), Frank-Starling Law ,Cardiac cycle and cardiac output,Neural and chemical regulation of heart**,** Mechanism of Urine formation ,counter-current theory, Regulation of water and acid-base balance

Module- III

Physiology of Nervous, Reproduction and Endocrine system: Control and coordinating system**,** Mechanism of neural action(Action potential and propagation in myelinated and non-myelinated nerve)**,** Sympathetic, parasympathetic and reflex action, Muscle contraction**,** Physiology of male and female reproduction**,** Mechanism and regulation of hormonal action

Module- IV

Metabolic of Carbohydrate: Sequential Reactions and regulation of : Glycolysis, Citric acid cycle and Gluconeogenesis**,** Phosphate pentose pathway, Glycogenolysis and Glycogenesis, Compartmentalization, Shuttle systems and membrane transporters**,** Oxidative phosphorylation(Redox system and coupler reaction), Inhibitors and un-couplers of ETC

Module- V

Biochemistry of Lipid:β-oxidation and omega-oxidation of saturated fatty acids(with even and odd number of carbon atoms)**,** Biosynthesis Palmitic acid;**,** Ketogenesis**,** Metabolism of unsaturated fatty acids

Module-VII

Biochemistry of Protein: Transamination and Deamination**,** Mechanism of Urea cycle**,** Protein-protein interactions, Fate of C-skeleton (Glucogenic and Ketogenic amino acids)

Module-VII

Enzymes: Mechanism of enzyme action, Enzyme Kinetics, Inhibition and Regulation

Animal Physiology and Biochemistry Lab (Practice)

Experiments: (2h each experiment)

- Study of T.S/L.S/V.S of digestive organs (Stomach,Liver,Kidney,intestine etc.)
- Study of TLC/DLC from prepared blood smear/Determination of ABO Blood group
- Estimation of haemoglobin using Sahli's haemoglobinometer /Enumeration of RBC & WBC using haemocytometer
- Estimation of presence of lipid/carbohydrate from supplied sample by using spectrophotometer

- Estimation of total protein content by spectrophotometer/Lowrey's Method
- To demonstrate the effect of temperature/pH/concentration on salivary enzyme activity

References:

Online Source:

https://www.udemy.com/course/human-physiology/

https://www.coursera.org/specializations/anatomy

https://www.edx.org/course/anatomy-cardiovascular-urinary-and-respiratory-sys

Text Books:

1. Guyton's Physiology

Reference Books:

1. Guyton, A.C. & Hall, J.E. (2006). Textbook of Medical Physiology. XI Edition. Hercourt Asia PTE Ltd. W.B. Saunders Company.
2. Tortora, G.J. & Grabowski, S. (2006). Principles of Anatomy & Physiology. XI Edition John Wiley & sons,
3. Victor P. Eroschenko. (2008). diFiore's Atlas of Histology with Functional correlations. XII Edition. Lippincott W. & Wilkins.
4. Vander A, Sherman J. and Luciano D. (2014). Vander's Human Physiology: The Mechanism of Body Function. XIII Edition, McGraw Hills

Immunology and Cancer Biology

Code	Course Title	Course Type	Credits	L-Pr-P (hrs)
CUTM1451	Immunology and Cancer biology	Theory + Practice	4	3-1-0

Objective

- The primary objective of this course is to help students develop knowledge and skills related to health and disease and role of immune system.
- students are taught immunology so as to develop understanding of the subject, such as functioning the immune system, the molecular and cellular components and pathways that protect an organism from infectious agents.
- The common cellular and molecular mechanisms that are deregulated in cancerous cells and their contribution to the development of cancer.Role of gene mutation and environmental factors in the development of cancer.

Learning outcome

- Understand the immunomodulatory strategies essential for generating or suppressing immune responses as required in hypersensitivity reactions, transplantation, autoimmune diseases and cancer.
- Students also know about biological aspects of cancer, carcinogenesis and cancer therapy.
- Students will know the principle and application of various immune techniques and they can Will be able to make a strategy for immunological research and execute it.

Course Outline

Module-1 Cells and Organs of the Immune System- Hematopoiesis, Cells and Organs of the Immune System, Structure and function of antibodies, Inflammation

Practice 1(2h): Demonstration of lymphoid organs

Module-II

Development and Signaling of Immune system- Innate Immunity, TLRs and their role in innate, immune response Adaptive Immunity, cytokines, development of B-lymphocyte and T-lymphocyte

Practice 2(2h): To isolate the lymphocyte from whole blood by density gradient centrifugation method

Module III Structure and function of MHC complex -antigen processing cells, antigen processing and presentation to T lymphocytes, MHC restriction. TCR structure and function

Practice 3(2h): Screening antisera or hybridoma supernatants for specific antibodies

Module-IV Effector mechanisms and regulation of immune responses: Complement system, hypersensitivity, autoimmunity and tolerance, transplantation

Module V Techniques related to immunology Monoclonal Antibodies, Vaccines , Radio immunoassay, ELISA,Diffusion.

Practice 4(2h) : To detect the presence of an antigen in a sample

Practice 5 (2h): To learn coupling of antibody to enzyme Horse Radish Peroxidase (HRP)

Practice 6(2h): Study of basic Ouchterlony's double immuno-diffusion method.

Module-VI biology of cancer cells, Genetics of Cancer, Genetic Variation and Mutation, Two-Hit Hypothesis , Epigenetics of cancer

Practice 7(2h): Tumor cell growth in different media

Module VII Oncogene and tumour suppressor gene: progression of cancer, Metastasis, apoptosis in cancer, DNA repair in cancer

Recommended books:

Text Books:
Owen, J. A., Punt, J., &Stranford, S. A. (2013). Kuby immunology. seventh Edition, New York: WH Freeman.
Robert A. Weinberg, "The Biology of Cancer," Garland Science; 1 Cdr Edition, 2010

Reference Books:
1. Owen, J. A., Punt, J., &Stranford, S. A. (2013). Kuby immunology. New York: WH Freeman.
2. Abbas, K. Abul and Lechtman H. Andrew (2003.) Cellular and Molecular Immunology, V Edition, Saunders Publication.
3. Janeway's Immunobiology(2016) 9th Edition, by Kenneth Murphy, Casey Weaver, Garland Science
4. David Male, Jonathan Brostoff, David Roth and Ivan Roitt(2012) Immunology,8th Edition, Elsevier Publication
5. Lauren Pecorino, "Molecular Biology of cancer: Mechanisms, Targets, and Terapeutics," Oxford University.

Bioanalytical Techniques

Code	Course Title	Course Type	Credits	L-Pr-P (hrs)
CUTM1438	Bioanalytical Techniques	Theory + Practice	4	3-1-0

Objective

- This course is introduced to bridge the gap between academics, research and industry. This course begins with a review of basic bio analytical technique and an introduction to general terminologies.
- This course contains bio analytical techniques along with their theory, working principal, common instrumentation and possible applications. This course will be equally beneficial to various scientific areas.
- Students will be exposed to various biological techniques and their applications in identification, isolation of different biological molecules.

Learning outcome

- Students will know the principle and application of various instruments and they will be able to make strategy molecular techniques for the improvement in any trait or its well being based on the techniques learned during this course.
- Can use the knowledge for designing a project for research and execute it.

Course Outline

Module-1: Microscopic techniques
Visualization of cells and sub-cellular components by light microscopy and fluorescent microscope, Resolving powers of different microscopes, Electron microscope, Scanning and transmission microscopes, fixation and staining techniques for EM, Scanning probe microscopes: AFM and STM.

Practice1(2h): To study and gain expertise on differential and cytological staining techniques.

Module-II: Spectroscopic techniques

Laws of absorption of light, Beer-Lambert's Law, Absorption spectra, Measurement of absorption of light, Factors affecting the absorption properties of chromophores, Ultraviolet-visible absorption spectroscopy: Principle, Instrumentation and application, Fluorescence spectrophotometry: Principle, Instrumentation and application, Mass spectroscopy: Principle, Instrumentation and application.

Practice 2 (2h): Demonstration of UV-vis Spectrophotometer.

Module-III: Radiolabeling Techniques

Isotopes and Nature of radioactivity, Radioactive decay, Radioisotopes used in Biology, Detection and measurement of radioactivity, Carbon dating, Geiger-Muller counting and liquid scintillation Counting, Safety guidelines related to Radiolabeling techniques.

Module-IV : Centrifugation techniques

Basic principles of sedimentation, Types of centrifuges, Types of rotors, Preparative centrifugation (Differential & density gradient), Analytical ultracentrifugation. FISH and GISH

Practice3(2h): To separate proteins on the basis of their size and charge

Module-V:Chromatographic techniques

Principles of chromatography (Adsorption and Partition chromatography), Planar chromatography (Paper and Thin-layer chromatography), Column chromatography,Gas chromatography, Gel permeation chromatography, Ion exchange chromatography, Affinity chromatography, HPLC

Practice4(2h): To separate the amino acids in a mixture by thin layer chromatography.

Practice5(2h): Purification of immunoglobulins by affinity chromatography

Module-VI: Electrophoretic techniques

General principles, Electrophoresis of nucleic acids (Agarose gel, pulse-field),Electrophoresis of proteins (SDS-PAGE, native gels)isoelectric focusing and two dimensional gels, Blotting techniques-Southern, northern,Western blotting.

Practice 6 (2h): To study the separation of DNA by agarose gel electrophoresis

Module-VII

Electrophysiological & Biostatistical methods

Electrocardiogram (ECG), Positron emission tomography (PET), Magnetic resonance imaging (MRI), Flow cytometry,Nuclear magnetic resonance , Gene expression analysis. Sampling distribution; Regression and Correlation; t-test; Analysis of variance; Chi-square test.

- **Text Books:**
  Keith Wilson and John Walker (2009)Principles and techniques of biochemistry and molecular biology.7th Edition,Cambridge University Press, Cambridge, UK.

- **Reference Books:**

- Wilson K and Walker J (2009)Principles and techniques of biochemistry and molecular biology.7th Edition,Cambridge University Press, Cambridge, UK.

- Voet D and Voet J Biochemistry, 4th Edition. (2010). John Wiley and Sons. New Jersey, USA

- Rodney F Boyer(2012) Biochemistry laboratory: modern theory and techniques.2nd Edition, Pearson Prentice Hall, Boston,USA.

- R. Katoch(2011) Analytical techniques in biochemistry and molecular biology,Springer, New York.

Fish and Shellfish Health Management

SubjectName	Code	Type of course	T-P-P	Prerequisite
Fish and Shellfish Health Management	CUTM1445	Theory and Practice	3-1-0	

Objective

To provide holistic knowledge on fish and shellfish pathogens and their control measures.

Learning outcome

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Students will gain knowledge about different types of fish pathogen and their treatments.

Course outline

Module I

Significance of fin Fish and Shellfish diseases in aquaculture, stress in aquaculture and its role in disease development, pathological processes: cellular response to injury, inflammatory response to diseases, pathogencity mechanism of parasite and bacterial, pathogencity mechanism of virus and fungus.

Module II

OIE listed diseases, disease surveillance and reporting, quarantine and health certification in aquaculture, health management strategies in aquaculture, good and best management practices.

Module III
Disease control through environmental management, sanitary and phytosanitary agreement, vaccines used in aquaculture, immuno-stimulants used in aquaculture.

Module IV
Bioremediation, viral diseases of fish, viral diseases of shellfish, bacterial diseases of fish, bacterial diseases in shellfish.

Module V
Fungal diseases of fish, fungal diseases of shell fish, protozoan diseases in fish, protozoan diseases in shellfish.

Module VI
Metazoan parasites of fish, metazoan parasites in shell fish, crustacean parasites of fish, environmental induced diseases of fish, nutrition deficiency diseases.

Module VII
Diseases caused by other factors: hereditary factors, tumours of hereditary origin, hydrocoel, tumours, benign and malignant, SPF and its importance, SPR and its importance, quarantine methods and its importance.

Practicals (Duration for each practice is 2hours)

1. Examination of normal and diseased fish - thorough examination of external surface.
2. Autopsy of the diseased fish.
3. Histopathology of organs of diseased fish (sectioning – staining and mounting).
4. Slide preparation of fish parasites (Protozoan – Helminth and Copepod).
5. Collection of ectoparasites and its preservation.
6. Extraction of DNA from fish fins.

Reference and Textbooks

1. Fish Pathology. Author: Ronald J. Roberts.
2. Prevention and control of fish and prawn diseases. Author: KP Biswas.

Cell and Molecular Biology

SubjectName	Code	Type of course	T-P-P	Prerequisite
Cell andMolecular Biology	CUTM1437	Theory and Practice	3-1-0	

Objective

By the end of the course, learners should have a knowledge of:
● The cell biology of all major groups of organisms, including microorganisms, plants and animals
● How genome organisation differs in the major groups of organisms
● The complex interactions between nucleus and cytoplasm that determine how cells function
● Basic concepts of how cells become specialised into different types in complex organisms
● How the cytoskeleton is organised and its role in cellular function

Learning outcome

At the end of Cell and Molecular Biology, learners should have developed knowledge of the major ideas and current experimental approaches in cell biology and molecular biology and should be able to progress to related courses in Biological Sciences, including Biochemistry, Genetics, Neuroscience, Pathology, Plant Sciences.

Course outline

Module I: Biological Membranes And Transport Of Biomolecules

Structure of biological membranes: Cell wall (Prokaryotic versus eukaryotic), the plasma membrane, Membrane proteins, Mobility of membrane proteins, Membrane biogenesis: Cell wall and cell membrane biogenesis, Cell-Cell and cell-matrix interactions: Extracellular matrix and cell-matrix interactions (Matrix structural proteins, Matrix Polysaccharides; Matrix adhesion proteins), Cell-Cell interactions (Adhesion Junctions, Tight Junctions, Gap junctions, Plasmodesmata), Membrane Trafficking (Pu

mps, channels, transporters): Ions channels, Active transport driven by ATP hydrolysis, Active transport driven by Ion gradients, Passive transport, Facilitated transport, Endocytosis (Phagocytosis, receptor-mediated endocytosis).

Module II: Cytoskeleton, Cell motility and Cell division

Structure and Organization of Actin Filaments: assembly and disassembly of actin filaments, organization of actin filaments, association of actin filaments with the plasma membrane, Intermediate filaments: assembly of intermediate filaments, intracellular organization of intermediate filaments, The microtubule: structure and dynamic organization of microtubules, Eukaryotic cell division: Mitosis and Meiosis, Cell death and cell renewal: Programmed cell death, stem cells and maintenance of adult tissues. Cell cycle and its regulation. Chek point.

Module III: Intercellular communication and the Nucleus

Signaling molecules and their receptors, modes of cell signaling, Cell surface receptors, G Protein-coupled receptors. Receptor protein tyrosine kinases, cytokine receptors, Pathways of Intracellular signal transduction, second messengers, the cAMP Pathway, cGMP, Nuclear organization, traffic between the nucleus and the cytoplasm, chromosomes, Chromatin organization (DNA packaging), Lampbrush chromosome, Polytene chromosome, telocentric chromosome, Inter-phase chromatin, Euchromatin and Heterochromatin, karyotype and its significance, the Nucleolus.

Module IV: Replication, Protein-Nucleic Acid Interactions and Transcription

Prokaryotic and eukaryotic DNA replication: DNA polymerases, replisome, primase, telomerase, inhibitors of replication. DNA synthesis by reverse transcription,Prokaryotic transcription mechanisms, Prokaryotic transcriptional regulation (Operon concept), Eukaryotic transcription – core promoter and general transcription factors (GTFs), Eukaryotic transcription–activating transcription factors and enhancers, Post-Transcriptional Control of Gene Expression.

Module V: RNA Processing, Translation and Protein sorting.

RNA-processing, mRNA export. Post transcriptional modification and: RNA splicing, spliceosome, RNA editing, Genetic code. Translation: Protein synthesis, post-translational modifications: Glycosylation, Phosphorylation, Ubiquitination, Inhibitors of transcription and translation.Protein sorting and Targeting: Co translational targeting and post translational targeting. Protein targeting to Mitochondria,Chloroplast, Endoplasmic reticulum, Peroxisome and Plasmamembrane. Regulation of gene expression in prokaryotes and eukaryotes: role of chromatin in regulating gene expression and gene silencing.

Module VI: Protein Structure, Function and Evolution

Unique principles of protein structure and molecular machines (primary, secondary, tertiary, quaternary structures), Study of protein structures (circulsardichorism, X-ray crystallography and cryo electron microscopy), How proteins have evolved and how analysis of protein structure can help us to understand the evolutionary relationships between different proteins and their function

Module VII: Enzyme Catalysis and Protein Engineering

How the peptide and protein structures discussed in the preceding module can assume functions, Enzyme catalysis, mechanism and kinetics, Co-operative (allosteric) molecular basis of metabolic regulation, Principles of protein folding and stability, Protein engineering and mechanistic enzymology–how to create novel, functional proteins, by rational design, semi-rational approaches, and by directed evolution.

Practicals(Duration of each practice is of 2hours)

1. Visualization of DNA by performing agarose gel electrophoresis and extraction of DNA from the agarose gel.
2. Extraction of DNA from the fish fins.
3. Plasmid isolation (miniprep).
4. Polymerase Chain Reaction (PCR)
5. Glucose uptake assay
6. *In silico* membrane-receptor and ligand interaction studies using DISCOVERY STUDIO (BIOVIA).

Reference

E-content:
Youtube animations and videos, virtual lab, Slide share.

Text Books:

1. Geoffrey M. Cooper, Robert E. Hausman (Boston University). The Cell: A Molecular Approach. ASM Press, Washington D.C. Fourth edition.
2. Cell and molecular biology Robertis, De and Robertis Lea and Febiger. Eighth Edition.

Reference Books:

1. Molecular Biology of the Cell Alberts, B., et al. 6th Rev ed. Taylor & Francis; 2014 ISBN 978-0-8153-4432-2 (hard), 978-0-8153-4524-4
2. Essential Cell Biology Alberts, B., et al. 4th Rev ed. Garland; 2013 ISBN 9780815344544
3. Lewin's Genes XII Krebs, J.E. et al. Jones & Bartlett; 2018 ISBN 9781284104493
4. Molecular Cell Biology Lodish H. et al. 8th ed. W.H. Freeman and Company; 2016 ISBN 9781464183393

Ornamental Aquaculture

SubjectName	Code	Type of course	T-P-P	Prerequisite
Ornamental Aquaculture	CUTM1449	Theory and Practice	3-1-0	

Objective

- To impart knowledge on ornamental fish production, bait fish culture and aquatic ornamental plant propagation.
- Production of ornamental fish for aesthetic appeal and financial enhancement.
- The specialization is intended to give a solid background for students who wish to work in aquaculture or related industries, or to pursue further research.

Learning outcome

- Students learn about fabrication of aquarium and mass culture of different live food organisms and aquatic plants. Further we will able to produce ornamental fishes in mass scale.
- Basic knowledge on Ornamental Aquaculture will promote the students for research activities and encourage them for entrepreneurship.
- Students knowledge about various techniques of Ornamental fish breeding, rearing and marketing will make them self sustainable.

Course outline

Module 1: Concept of Aquaculture (5 h)

Criteria of selection of suitable fish species, External morphology of important marine aquarium fishes, External morphology of important fresh water aquarium fishes (egg layers and live bearers), Other ornamental organisms (Sea anemone, lobsters, and star fish)

Practice 1 (2h): Identification of common ornamental fishes and plants

Module 2: Aquarium setup and management(5 h)

Construction and setting of aquarium - Types of aquarium tanks, Construction of home aquarium, Setting up of home aquarium 1, Maintenance of aquarium (cleaning and water quality management), Feeding of aquarium fishes

Practice 2 (2h) : Fabrication of all-glass aquarium

Module 3: Aquarium Accessories (3 h)

Aquarium plants and their propagation methods, Aquarium accessories and decorative, Lighting and aeration, Aquarium fish feeds. Dry, wet and live feeds

Practice 3(2h) : Setting up and maintenance of Aquarium accessories and equipment

Module 4: Breeding techniques of Ornamental fish (4 h)

Ornamental fish breeding - Brood stock maintenance, Breeding techniques of ornamental fishes, Nursery rearing of ornamental fishes, Transportation of ornamental fishes, Application of genetics and biotechnology for producing quality strains

Practice 4 (2h): Conditioning and packing of ornamental fishes. Preparation of feed

Module 5: Ornamental fish culture and management (4 h)

Ornamental Fish Farm Management Construction of commercial ornamental fish farm, Feeding and maintenance of stock, Common ornamental fish diseases and their management(4.3.i - Argulus, 4.3.ii - White spot, 4.3.iii- Fin rot 4.3.iv-Mouth fungus)

Practice 5 (2h) : Conditioning and packing of ornamental fishes. Preparation of feed

Module 6: Ornamental fish culture technique (5 h)

Management practices of backyard culture of ornamental fish, Conditioning, packing, transport and quarantine methods, Trade regulations and wild life act in relation to ornamental fishes.(*Value addition;ColourEnhancement,Gene Editing and production of new stains,hybrids)*

Practice 6 (2h): Setting up of breeding tank for live bearers, barbs, goldfish, tetras, chiclids, gouramis, fighters and catfishes

Module 7: Ornamental fishes and Entrepreneurship -(4 h)

World trade of ornamental fish and export potential, Starting an aquarium shop – a business opportunity, Small scale ornamental fish farming business

Practice 7(2h): Identification of ornamental fish diseases and prophylactic measures.

Reference and Textbooks

1 . Aquarium fish keeping and management----CLS Srivastava and Amita Saxena
2 . Aquarium fishes ---Jena Burton

3 . Hand book of fresh water ornamental fishes----S.Mathur, LL Sharma and AK Mathur

4 . Profitable fish keeping ----Guy N Smith

5. Ornamental fish farming ---- Brian Andrews

6. Marine Ornamental species aquaculture--- Wiley online Books.

Genetics and Epigenetics

SubjectName	Code	Type of course	T-P-P	Prerequisite
	CUTM1454	Theory and Practice	3-1-0	

Objective

- Be able to explain and provide examples of how continuous traits are “quantitative traits” and that phenotypic variation may be due to genetic variation within a population and/or environmental variation experienced by individuals within a population.
- To explain the polygenic theory of genetic variance and the nature of additive alleles, and the assumptions that accompany these ideas and also able to provide competing hypotheses that explain a distribution data set of phenotypes.
- To discuss epigenetics and its role in cancer, imprinting and X chromosome inactivation.
- To describe the modifications/mechanisms of DNA marks that result in epigenetic changes and also to discuss the role of epigenetics in environmental exposures.

Learning outcome

- Students will have an understanding of the role of genetic mechanism in evolution.
- Be able to predict the phenotypic classes and their ratios from a monohybrid cross involving dominant and recessive alleles.
- Be able to predict the phenotypic classes and their ratios from a cross involving co-dominant or incompletely dominant alleles .
- Be able to predict the ratio of a specific genotype and/or phenotype from a cross involving multiple independently assorting genes (with each gene exhibiting only dominant and recessive alleles) .
- Be able to list features of an organism that could make it a good genetic model. Be able to cite features of peas and flies that make them ideal organisms in which to study many aspects of genetics.
- Basic knowledge on Epigenetics will promote the students for research activities and encourage them for higher studies
- Students will have an understanding of the role of genetic mechanism in evolution.
- Be able to predict the phenotypic classes and their ratios from a monohybrid cross involving dominant and recessive alleles.
- Be able to predict the phenotypic classes and their ratios from a cross involving co-dominant or incompletely dominant alleles .
- Be able to predict the ratio of a specific genotype and/or phenotype from a cross involving multiple independently assorting genes (with each gene exhibiting only dominant and recessive alleles) .
- Be able to list features of an organism that could make it a good genetic model. Be able to cite features of peas and flies that make them ideal organisms in which to study many aspects of genetics.
- Basic knowledge on Epigenetics will promote the students for research activities and encourage them for higher studies and make them self-sustainable.

Course outline

Module - 1: Principles of Inheritance (5 h)

Laws of heredity, Co-and incomplete dominance, Gene Linkage and crossing over, Varieties of Gene interractions - lethal genes, multiple alleles, pleiotropic genes, gene epistasis, Structural and numerical alterations of chromosomes and meiotic consequence, Cytoplasmic Inheritance , Sex-chromosome systems; Different mechanisms of sex determination in animals(Drosophila, Man, Bees and Bonellia)

Module - 2: Linkage and Crossing over in diploid organisms (5 h)

Sex linkage: Sex linked genes in man, sex chromosome disorders in man, Detection of linkage & Linkage maps: Test cross, test for linkage on the basis of F2 generation, LOD score, gene mapping, three point test cross in Drosophila, construction of linkage maps, Identification of particular linkage groups with specific chromosome, Physical distance and map distance, Interference and coincidence

Module - 3: Mitotic recombination and Chromosomal abnormalities (4 h)

Mitotic Recombination, Recombination within gene, Spontaneous and induced mutations, physical and chemical mutagens, chromosomal aberrations, meiotic behaviour of deletion, duplication, inversion and translocation, Euploids and aneuploids-classification, origin, induction, role of polyploidy in evolution.

Practice 1 (2h) : Preparation of Mitotic chromosomes from the given sample

Module - 4: Human genetics and Genomics (5 h)

Human genetics - Chromosomal disorder, Some common human syndromes, Twin study, Superfoetation, Polyembryony, Free Martin, Multiple birth, Amniocentesis and Genetic Counselling, Nature and function of genetic material, Chemical compounds causing genetic damage, Gene mapping and genome analysis.

Practice 2 (2h): To study the karyotyping of chromosomes from the given animal samples.

Module - 5: Epigenetics and Chromatin structures (4 h)

Epigenetics vs Genetics, Epigenetics from phenomena to field : overview and concepts, Basic organization of eukaryotic genome, Histone proteins.

Practice 3 (2h): To study the chromatin modelling and Chromatin-immunoprecipitation (ChIP)

Practice 4(2h):Isolation of total histones, and resolution on SDS-PAGE.

Module - 6: Epigenetic marks and chromatin modifications (5 h)

Histone modifications and the histone code, Chromatin remodelling complex and histone variants, DNA Methylation, Acetylation and Deacetylation, Phosphorylation, Ubiquitylation, Deubiquitylation and Phosphorylation.

Practice 5 (2h): Isolation of DNA from animal cell (Isolation of nuclei (as a source for studies on structure of chromatin) from rat/mouse liver by discontinuous sucrose-density gradient centrifugation.

Module - 7: Dosage compensation and Genomic imprinting (4 h)

Dosage compensation in mammals, Genomic imprinting in mammals, Germline and pleuripotent stem cells, Epigenetics and human disease.

Practice 6(2h): Identification of inactivated X chromosomes as barr body from the given sample

Practice 7 (2h) : Preparation and study of metaphase chromosomes from mouse bone marrow

Reference and Textbooks

- Gardner, E.J., Simmons, M.J., Snustad, D.P. (2008). Principles of Genetics. VIII Edition. Wiley India.
- Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. V Edition. John Wiley and Sons Inc.
- Klug, W.S., Cummings, M.R., Spencer, C.A. (2012). Concepts of Genetics X Edition. Benjamin Cummings.
- Russell, P. (2009). Genetics- A Molecular Approach. III Edition. Benjamin Cummings.
- Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B.
- Introduction to Genetic Analysis. IX Edition. W. H. Freeman and Co.
- Ridley, M. (2004). Evolution. III Edition. Blackwell Publishing
- Barton, N. H., Briggs, D. E. G., Eisen, J. A.Goldstein, D. B. and Patel, N. H. (2007). Cold Spring, Harbour Laboratory Press.
- Hall, B. and Hallgrimsson, B. (2008). Evolution. IV Edition. Jones and BartlettPublishers
- Campbell, N. and Reece J. B. (2011). Biology. IX Edition, Pearson, Benjamin,Cummings.
- Douglas, J. Futuyma (1997). Evolutionary Biology. Sinauer Associates.
- Epigenetics, C. David Allis and Thomas Jenuwein, (2007)Cold Spring Harbor Laboratory Press, New York, USA .
- Molecular Biology of Gene, Watson et al., (5th Ed. 2004), Pearson Education, Delhi, INDIA
- Genetics by P.K Gupta.

Microbiology

SubjectName	Code	Type of course	T-P-P	Prerequisite
Microbiology	CUTM1436	Theory and Practice	3-1-0	

Objective

- To know various Culture media and their applications and also understand various physical and chemical means of sterilization.
- Master aseptic techniques and be able to perform routine culture handling tasks safely and effectively.
- To know the various Physical and Chemical growth requirements of microbes and get

equipped with various methods of microbes culture techniques and their role in various industry.

Learning outcome

- At the time of completion of the programme the student will have developed extensive knowledge in various areas of Microbiology.
- They will be able to explain vaccine strategies and mechanisms of antiviral drugs and interferons.
- Can know how viruses can be used as tools to study biological processes, as cloning vectors and for gene transfer.
- Understand the interactions between viruses, bacteria and the host immune system.
- The student will be instilled with values of professional ethics and be made ready to contribute to society as responsible individuals.

Course Outline

Module-I

Bacteria and virus

Classification, taxonomy, cataloguing virus to ICTV and ICNV Structural and genetic diversity of viruses; Transmission and Replication; Prions, Viriods, Anti viral agents, and Vaccines; Bacterial Classification (phenetic, genetic and phyllogenetic); Bergeys manual of systematic bacteriology; Classification, Identification and Culturing Technique of cyanobacteria; Industrial Application, Cyanotoxins.

Practice 1(2h): Preparation of bacterial smear and staining – Gram's, Acid-fast, Staining of bacterial spores flagella, capsule, spirochaetes

Practice 2(2h):Isolation, purification, identification and biomass production of cyanobacteria

Module 2

Microbial Physiology and Metabolism

Growth Kinetics, Growth cycle, Logistic growth equation, Measurement and growth monitoring in culture, Factor affecting growth. Photosynthetic pigments, Paths of carbon and electron in bacterial photosynthesis. Fermentation, Respiratory metabolism, Embden-Meyerhoff pathway, Entner-Doudroff pathway, Pasteur Effect.

Practice 3(2h): Methods for measurement of bacterial growth by haemocytometer and spectrophotometer

Module 3

Environmental Microbiology & Wastewater Management:

Microbes and quality of environment, Biotransformation, Microbes in waste water management; Microbial degradation of pesticides, toxic chemicals, oil; Bioleaching, bioremediation.

Module 4

Agricultural and food Microbiology

Agriculturally important microorganisms, Mycorrhizae, Microbial mineralization, Microbial toxins, Biological control. Microbial toxins produced in food items, Probiotics and preBiotics, Methods of food preservation, Microbiological legal standards of selected food and milk products.

Practice 4(2h): Estimation of phosphate solubilizing capacity of microorganisms

Practice 5(2h): Qualitative analysis of Milk and milk products; Microbiological analysis of food products; Detection of bacteria in milk by Standard plate count

Module **5**

Medical Microbiology:

Host pathogen interactions, Pathogenicity of bacteria invasiveness and toxigenicity, Constitutive and inducible host defence mechanism, Important diseases caused by bacteria, protozoa, virus. Antibiotics: Definition, phenomenon of antibiotics, Chemical and biochemical modification of antibiotic structures, assay and Mode of action, Biochemical mechanisms of resistance development, Multiple-drug resistance.

Practice 6(2h): Antibiotic sensitivity test disc preparation; Antibiotic sensitivity test – Kirby – Bauer, Stoke's; MIC determination by filter paper disc assay

Module 6

Industrial Microbiology

Cyanobacterial Biotechnology:

Application as nutraceuticals, pharmaceuticals, cosmetic, biofertilizer; application as biofuel, CO_2 sequestration and pollution control, Mass cultivation, Single cell protein

Microbial enzymes: Sources, Large scale production, Recovery, Microbial enzymes of industrial interest, Novel medicines from microbes, Biotechnological application of Microbial enzyme, Use of Microbes in Biotechnology.

Bioprocess technology and Engineering:

Culture media (types, Different culturing Technique, Media formulation, Preservation of Microbes, Fermenter design and growth processes, Bioreactors, and Membrane Bio reactors, Analysis of different bioreactors, stability of microbial reactors, specialized bioreactors. Isolation, preservation, and Maintenance of Industrial Microorganisms.

Practice 7(2h): Preparation of different microbial culture media

Module 7 : **Microbial genetics**

Lytic and Lysogenic cycle, Conjugation, Transduction, Recombination; Genetic regulation: Operon concept (lac,trpara), Genetic mapping: Genome mapping of E. *coli*, QTL Mapping.Molecular markers in genome analysis, RAPD, RFLP,AFLP, FISH and GISH.

Text Books:

1. Prescott, L. M., Harley, J. P. and Klen, D. A. (1999). Microbiology, 7th Ed., McGraw-Hill, New York.
2. Pelczar, Jr., M. J., Chan E.C.S. and Krieg, N. R. (2005). Microbiology, 5th Ed, Tata McGraw-Hill, New Delhi.
3. Alexopoulus, C. J., Mims, C. W. and Blackwel, M. (1996). Introductory Mycology, John Wiley, New York.
4. Kumar, H. D. (1988). Introductory Phycology. East-West Press, New Delhi.
5. Maloy, S. R., Cronan, J. E. Jr. and Freifielder, D. (2008). Microbial Genetics, 2nd Ed. Norosa, New Delhi.

Reference Books

1. Mehrotra, R. S. and Aneja, R. S. (1998). An Introduction to Mycology, New Age International, New Delhi
2. Agrios, G. N. (2005). Plant Pathology,5th Ed, Elsevier Academic press, USA

Centurion University of Technology and Management

School of Media and Communication

BA-MC

Programme Objectives;

The programme of BA-MC aims to satisfy the demand for skilled and well-honed media and communication professionals in to the ever changing Media and Entertainment Industry. It also aims at imbibing the digital skills, knowledge, attitude and ethics among the learners to innovate, incubate and acquire entrepreneurship abilities along with professional and employable skills. It is also focuses on developing research skills among students to carry out research and development activities in the domain. The following program objectives are offshoot of the specified aims of the programme.

- To impart the basic knowledge of media communication and related areas of studies
- To develop Industry ready professionals
- To empower learners with appropriate communication, professional and life skills
- To impart Information Communication Technologies (ICTs) skills, including digital and media literacy and competencies
- To pursue higher studies and develop research skills in the specified field
- To develop entrepreneurial skills focusing on innovation in the field
- To inculcate professional ethics, values in order to work in diversified cultural milieus

Program Outcomes:

PO	**Outcomes**
PO1	**Knowledge:** demonstrate acquired knowledge in the field and appreciate the role of press in a democratic set up
PO2	**Professional :** engage the professional skills in the field of advertising, public relations, corporate communication, digital communication, media management.
PO3	**Effective Communication, Professional and life Skill:** effectively engage in communication to share thoughts and ideas
PO4	**ICT**: able to use various communication technologies and ability to use various software
PO5	**Leadership:** able to lead with appropriate vision
PO6	**Critical/ Reflective thinking:** able to think critically in professional life
PO7	**Entrepreneur:** demonstrate the skills of on an entrepreneur to start a venture
PO8	**Learning and Research**: develop a sense of inquiry and investigation life long

PO9	**Ethics:** Follow high ethical standard and appreciate the value system of different cultures

Programme Specific Outcome

PSO1: acquire and able to utilize fundamental knowledge on media communication and related areas-concepts, principles and processes.

PSO2: able to handle the professional jobs in the Media and Entertainment Industry

PSO3: able to carry out effective communication; listening, comprehending, writing and presenting with societal and the environmental considerations in the industry

PSO4: demonstrate ICTs competencies including digital literacy required in the industry

PSO5: able to lead a team

PSO6: able to demonstrate critical thinking in the field of media and communication

PSO7: able to carry out entrepreneurial ventures successfully in the media and entertainment field

PSO8: pursue acquiring knowledge throughout life in the discipline and carry out research in the field of media and communication

PSO9: become ethically committed media professionals and entrepreneurs adhering to the human values, the Indian culture and the Global culture.

Mapping PSOs with POs (Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
PSO1									
PSO2									
PSO3									
PSO4									
PSO5									
PSO6									
PSO7									
PSO8									
PSO9									

Course Outcomes:

Course Outcomes (COs)	Competency/skill
CO1	Knowledge
CO2	Analytical and Creative Thinking
CO3	Problem Solving
CO4	Leadership
CO5	ICT and digital Skill/Competency
CO6	Ethical Behaviour
CO7	Information Literacy
CO8	Employability skill/ Higher study/ Entrepreneurship

MCFC0501 Communication in History and History of Communication Credit:0+4+0+3=7

Course Objectives:
For a student of any particular discipline the understanding the history of that discipline is a crucial need. The Course aims at providing a basic understanding of the history and development of the communication system through ages.

Course Outcome:

CO	Statements
CO1	students will able to appreciate and refer the historical development of the communication system through ages.
CO2	Use the new communication technologies.

MCCC0101 Introduction to communication Theory Credits: 0+7+0+0=7

Course Objectives
The course aims at providing a fundamental idea on Mass Media and different communication models along with the different theories of communication. It further aims to provide a basic understanding of Media organization, its functioning, content production, Cultural dimensions of communication content, Media economics, its audience , the new Media and communication system.

Course Outcomes
After completion of the course, students will be able to

CO	Statements
CO1	Critically analyze the fundamentals of Mass Communication
CO2	Use the theories and models of mass media
CO3	Can differentiate between different forms and types of communication
CO4	adapt audience research traditions

MCFC1101 Introduction to Print & Electronic Media Credits: 3+0+2+2=7

Course Objectives

The Course aims at providing an understanding of the electronic and print media systems, its impacts on society and the methods and techniques of the content production along with the limitations of the medium.

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Demonstrate their skills in Print and Electronic Media.
CO2	Carry out print and electronic production without any flaws
CO3	Produce print and electronic documentation

MCCC1101 Introduction to Social Media **Credit: 3+0+2+2=7**

Course Objectives:

The course will provide a basic understanding of Modern social media communication, its management and influences on society

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Analyze Social media and its functioning.
CO2	work and manage different social media platforms for different purposes.
CO3	develop and manage their own YouTube channels and can create campaigns in social media

MCFC0902 Media, Communications and Culture **Credits:0+3+2+2=7**

Course Objectives

The course will help students to understand the triangular relationship between media, culture and society and at the same time it will enable students to understand how culture and media influence each other

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Analyse the process of production of media culture and its influences.
CO2	Appreciate and utilize cultural diffusion, cultural lag and acculturation kind of procedures

MCCC1102 Electronic Media **Credits: 3 +0+2+2=7**

Course Objectives

In this course students will be specialized television program production or Radio Program production according to their Choice. As a part of the study they will submit practical projects.

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Demonstrate their skills in TV/Radio
CO2	Carry out sound recording, editing / camera operation

CO3	Use the grammars of the medium
CO4	Handle radio/ TV production and the complexities of production process

MCCC0904 Development Communication Credits: 0+ 5+1+1=7

Course Objectives

Communication is a tool for development and social change. The strategic application of communication as a tool for development is quite popular and it is also producing nice results. This course will provide an understanding into the concepts of communication, development, historical dimensions of development communication and the techniques to use communication for development. It further aims at providing an idea into different selected programs, policies and experiments of the governmental and non governmental agencies at different times.

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Apply appropriate communication for development
CO2	Develop strategies and campaign designing
CO3	Develop contents for development purposes
CO4	Adapt to different programs and policies of governmental and non-governmental agencies.

MCCC0905 Gender and Communication Credits: 0+5+0+2=7

Course Objectives

The course aims at developing a better understanding of gender and its cultural aspects along with an idea about communication and its role in case of gender issues and the changing scenario of gender issues.

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	manage gender issues and role of media in it.
CO2	Focus on cultural dimensions of gender.
CO3	develop critical thinking skills related to gender issue
CO4	recognize the expression of gender in everyday contests.

MCCC0906 Intercultural Communication Credits: 0+5+1+1=7

Course Objectives

The purpose of this course is to develop the skills necessary to build and maintain positive communication and relationships across cultures. Students will focus on similarities and differences in communication behaviors. Perceptions, language usage, nonverbal style, thinking modes, and values all will be explored to see how they influence face-to-face communication between individuals of different cultures.

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Manage constraints and limitations of intercultural communication
CO2	Adopt appropriate communication process across societies

CO3	Handle nonverbal communication

MCCC1103 Film Studies **Credits:3+0+2+2=7**

Course Objectives

The course aims to provide students a clear understanding of film as an art, its production process and its different dimensions

Course Outcomes

After completion of the course, students will be able to

CO	**Statements**
CO1	Apply skills in different aspects of Film
CO2	Analyze film as an art
CO3	Handle film production process

MCCC1104 Public Relations and Advertising **Credits: 3+0+2+2=7**

Course Objectives

The Course will provide knowledge to students about the tools and techniques of Advertising and Public Relation and their use in a corporate organization.

Course Outcomes

After completion of the course, students will be able to

CO	**Statements**
CO1	Mange Public Relations
CO2	Develop appropriate Advertising
CO3	integrate various functions with organizational goals and strategies.
CO4	Develop production of brand and social campaigns.

MCCC1105 DIGITAL MEDIA **Credits: 3+0+2+2=7**

Course Objectives

Rise of Social Media, and video sharing platforms has created new channels of communication and more opportunities to reach audiences in interactive ways that traditional media can't provide. The new media plays important role in revolutionizing corporate and business communication and changing the very nature of the media industry. The applications of new media have made every user a publisher, broadcaster and a channel owner. This course will look at how new media engages with society in all its manifestations.

Course Outcomes

After completion of the course, students will be able to

CO	**Statements**
CO1	Apply skills in new media
CO2	use advertising, marketing, social networking
CO3	Use social media for different purposes.
CO4	work effectively in digital media platforms

MCCC0301 Final Project **Credits: 0+0+4+3=7**

Course Objectives

The course aims to evaluate the skills the students have developed in audio visual production and it will help them to fine tune their skills in audio visual Production.

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Demonstrate skills in audio visual production
CO2	fine tune their skill in this area

MCDE0601 Animator **Credit: 0+0+4+3=7**

Course Objectives

- This course was designed to be the ultimate boot-camp for anyone who wants to master the digital film and game industries.
- This master class covers everything 3D Modeling and Animation.
- Through each section of this course you will complete fun and simple projects that make learning these complex programs simple.
- By the end of this course you will have a deep understanding of Modeling, Texturing, Rigging, Animation, Lighting, Rendering and projects work flow in Maya

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Demonstrated the ability to create quality animation performance through a creative and professional portfolio using principles of animation.
CO2	exhibit a personal and professional commitment to artistic growth and cultural literacy that conveys passion, confidence a collaborative and independent spirit, refined communications skills and the adaptability to work within a dynamic animation community.

MCDE0602 Radio Jockeying **Credit- 0+0+4+3=7**

Course Objectives

- The paper will provide students a clear understanding of radio jockeying by skilling them in same
- To enhance the creative and innovative way of writing and speaking skills of the learner
- Host live broadcasting program using radio equipment in Studio Setup

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	host both live and recorded program for radio
CO2	Handle Radio Jockey

MCDE0603 TV Anchoring **Credit- 0+0+4+3=7**

Course Objectives

- Introduce the learner to the challenges of the constantly evolving world of journalism.
- Provide the students with the basics of good journalistic writing

- Help the learner to develop the skills to think critically about the News
- The course helps to learn Voice Modulation, live news anchoring and field reporting

Course Outcomes

After successful completion of this course students will be

CO	Statements
CO1	good news reporter and news anchor
CO2	work as a reporter, copy editor and bulletin producer in electronic media
CO3	organise live shows, group discussion and exclusive interviews with experts of any field

MCDE0604 Fashion Photography **Credit- 0+0+4+3=7**

Course Objectives

- This course teaches the technical skills and creative principles required for single camera ('film style') video field shooting and production
- The student will gain experience in planning and shooting
- Entertainment- and/or information-based video projects
- The course will provide hands-on skills in audio, video recording technology, composition, lighting and production in the field of entertainment

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Handle contemporary video technology and operation of cameras, audio, lighting and other television production equipment
CO2	Manage aesthetics of sound and image production
CO3	Demonstrate literacy in film and video, including shot composition and projects
CO4	Handle digital nonlinear post-production in entertainment

MCDE0605 Camera Operator **Credit- 0+0+4+3=7**

Course Objectives

The course will provide students a clear understanding of the process of camera operation by imparting the skills of skill of camera operation in them.

Course Outcomes:

After completion of the course, students will be able to

CO	Statements
CO1	Handle the role of camera operator
CO2	Demonstrate the skills of camera handling

MCDE0606 Video Editor **Credit- 0+0+4+3=7**

Course Objectives

The course will provide students a clear understanding of Video Editing Process by skilling them in same.

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Demonstrate the skills of a video editor
CO2	Use modern technology in the field of video editing

MCDE0607 Web Content Development **Credit- 0+0+4+3=7**

Course Objectives

The course will provide students a clear understanding of web content development Process by skilling them in same.

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Handle the role of web content Developer
CO2	Prepare blogs
CO3	Demonstrate competency in website coding

MVDE0608 Sound Engineer **Credit- 0+0+4+3=7**

Course Objectives

The course will provide students a clear understanding of sound and will impart the skills of skill of Recording and editing sound.

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Mange sound editing and production
CO2	Demonstrate the effective use of modern technology

MCDE0609 Adobe Tools and Illustrations **Credit :0+0+4+3=7**

Course Objectives

This course includes the study of illustration as visual interpretation of words, concepts and ideas. Students learn basic software skills while developing drawing abilities in a digital environment. Strategies for communicating content through pictorial narrative are also explored.

Course Outcomes

After completion of the course, students will be able to

CO	Statements
CO1	Use digital technology is part of the texture of their daily existence.
CO2	Develop creative expression
CO3	Develop own creative products by observing other learners creating and sharing.

MA-MC

Programme Objectives;

The programme of MA-MC aims to develop professionals to be engaged in the changing Media and Entertainment Industry. It also aims at inculcating digital skills, knowledge, attitude and ethics among the learners to innovate, incubate and acquire entrepreneurship abilities along with professional and employable skills. It is also focuses on developing research skills among students to carry out research and development activities in the domain. The following program objectives are offshoot of the specified aims of the programme.

- To impart the basic knowledge of media communication and related areas of studies
- To develop Industry ready professionals
- To empower learners with appropriate communication, professional and life skills
- To impart Information Communication Technologies (ICTs) skills, including digital and media literacy and competencies
- To pursue higher studies and develop research skills in the specified field
- To develop entrepreneurial skills focusing on innovation in the field
- To inculcate professional ethics, values in order to work in diversified cultural milieus
- To apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts and to identify and analyse problems and issues and seek solutions to real-life problems

Program Outcomes:

PO	**Outcomes**
PO1	**Knowledge:** demonstrate acquired knowledge in the field and appreciate the role of press in a democratic set up
PO2	**Professional :** engage the professional skills in the field of advertising, public relations, corporate communication, digital communication, media management.
PO3	**Effective Communication, Professional and life Skill:** effectively engage in communication to share thoughts and ideas
PO4	**ICT**: able to use various communication technologies and ability to use various software
PO5	**Leadership:** able to lead with appropriate vision
PO6	**Critical/ Reflective thinking:** able to think critically in professional life
PO7	**Problem Solving:** able to apply the knowledge and skills in solving real life problems faced by the society

PO8	**Entrepreneur:** demonstrate the skills of on an entrepreneur to start a venture
PO9	**Learning and Research**: develop a sense of inquiry and investigation life long
PO10	**Ethics:** Follow high ethical standard and appreciate the value system of different cultures

Programme Specific Outcome

PSO1: acquire and able to utilize fundamental knowledge on media communication and related areas-concepts, principles and processes.

PSO2: able to handle the professional jobs in the Media and Entertainment Industry

PSO3: able to carry out effective communication; listening, comprehending, writing and presenting with societal and the environmental considerations in the industry

PSO4: demonstrate ICTs competencies including digital literacy required in the industry

PSO5: lead a team in cross cultural context

PSO6: able to demonstrate critical thinking in the field of media and communication

PSO7: resolve real life problems with acquired knowledge and skills

PSO8: able to carry out entrepreneurial ventures successfully in the media and entertainment field

PSO9: pursue acquiring knowledge throughout life in the discipline and carry out research in the field of media and communication

PSO10: become ethically committed media professionals and entrepreneurs adhering to the human values, the Indian culture and the Global culture.

Mapping PSOs with POs (Correlation)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	
PSO1										
PSO2										
PSO3										
PSO4										
PSO5										
PSO6										
PSO7										
PSO8										

PSO9										
PSO10										

Course Outcomes:

Course Outcomes (COs)	Competency/skill
CO1	Knowledge
CO2	Analytical and Creative Thinking
CO3	Problem Solving
CO4	Leadership
CO5	ICT and digital Skill/Competency
CO6	Ethical Behaviour
CO7	Information Literacy
CO8	Innovations
CO9	Research
CO10	Employability skill/ Higher study/ Entrepreneurship

MAMC1101 Communication Research Methods Credits: 4+0+2+2=8

Course Objectives

- This course will provide an understanding of the basic techniques of social science research and its applications among the students and will help them to understand the basics of communication research and its utilities in the current scenario.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Apply social research methodology and its practical applications in the field.
CO2	Demonstrate use of research for investigating truth.

MAMC1102 Introduction to Print & Electronic Media Credits: 3+0+3+2=8

Course Objectives

- The Course aims at providing an understanding of the electronic and print media systems, its impacts on society and the methods and techniques of the content production along with the limitations of the medium.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Demonstrate their skills in Print and Electronic Media

CO2	Demonstrate their skills in TV production
CO3	Manage audio-visual production techniques
CO4	Produce programs for television.

MAMC0501 Society, Media and Communication **Credits: 0+4+0+4=8**

Course Objectives

- The course will help students to understand how communication plays a crucial role in the society and how the society and media influence each other. They also will get idea about media business and Its functioning along with constrains and opportunities.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Manage media business, its functioning
CO2	Use effectively inter-relationship between media and society.

MAMC0903 Cultural Studies **Credits: 0+ 4+2+2=8**

Course Objectives

- Culture as a part of the communicative ecology plays a crucial role in the process of communication. To become a successful communication professional there is a need of understanding cultural scenario and cultural phenomena. This paper aims at developing a better understanding about cultural phenomena across different societies and their influences on the entire communication system. The paper further aims to create an understanding among students about the effective manipulation of cultural elements to make the communication process more effective and meaningful.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Manage media, culture and society interrelationship
CO2	Appreciate role of media in the area of cultural diffusion and acculturation.

MAMC1103 Advanced Digital Media **Credits: 2+0+3+3=8**

Course Objectives

- Rise of Social Media, and video sharing platforms has created new channels of communication and more opportunities to reach audiences in interactive ways that traditional media can't provide. The new media plays important role in revolutionizing corporate and business communication and changing the very nature of the media industry. The applications of new media have made every user a publisher, broadcaster and a channel owner. This course will look at how new media engages with society in all its manifestations.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Demonstrate skills in new media

CO2	use advertising, Marketing, social networking appropriately
CO3	Use social media for different purposes.

MAMC1104 Digital Media Platforms **Credits: 2 +0+3+3=8**

Course Objectives

- In this course students will be specialized television program production or Radio Program production according to their Choice. As a part of the study, they will submit practical projects.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Demonstrate their skills in in TV/Radio/ Digital media platforms
CO2	Handle production effectively
CO3	Follow the legal aspects

MAMC1105 Film Studies **Credits: 3+0+3+2=8**

Course Objectives

- The course aims to provide students a clear understanding of film as an art, its production process and its different dimensions

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Adopt and produce Film for societal benefits
CO2	analyse film as an art.

MAMC1106 Advertising and Public Relations **Credits-3+0+3+2=8**

Course Objectives

- The course will provide knowledge to students about the tools and techniques of Advertising and Public Relation and their use in a corporate organization.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Manage Public Relations
CO2	Use Advertising appropriately

MAMC0301 Thesis **Credits: 0+0+4+3=7**

Course Objectives

In this course students will learn the practical and field-based application of research and under the guidance of a faculty member they have to submit a thesis as a part of their practical understanding of research and its applications.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	use research methodology and carry out research in real field situations.
CO2	Prepare dissertation

MCDE0601 Animation **Credit-0+ 0+4+3=7**

Course Objectives:
The course will provide students a clear understanding of the process of Animation by imparting the skills of animation in them.

Course Outcomes
After the end of the course, the students will be able to:

CO	Statements
CO1	Work as an animator
CO2	Use modern technology in the field of animation effectively

MCDE0602 Radio Jockeying **Credit-0+ 0+4+3=7**

Course Objectives
The paper will provide students a clear understanding of radio jockeying by skilling them in same.

Course Outcomes
After the end of the course, the students will be able to:

CO	Statements
CO1	Carry out the role Radio Jockey
CO2	Anchor the programmes
CO3	Conduct interviews

MCDE0603 TV Anchoring **Credit-0+ 0+4+3=7**

Course Objectives
The course will provide students a clear understanding of TV Anchoring Process by skilling them in same.

Course Outcomes
After the end of the course, the students will be able to:

CO	Statements
CO1	Handle the role of Television Anchor
CO2	Mange news bulletins
CO3	Use modern technology effectively

MCDE0604 Fashion Photography **Credit-0+ 0+4+3=7**

Course Objectives
This course is designed to teach students how to direct a fashion photo shoot.

Course Outcomes
After the end of the course, the students will be able to:

CO	Statements
CO1	Handle fashion photography
CO2	Manage the production
CO3	Demonstrate literacy in film and video, including shot composition and projects

MCDE0605 Camera Operator Credit-0+ 0+4+3=7

Course Objectives

- The course will provide students a clear understanding of the process of camera operation by imparting the skills of skill of camera operation in them.

Course Outcomes:

After the end of the course, the students will be able to:

CO	Statements
CO1	Handle the role of camera operator
CO2	Demonstrate the photography skills

MCDE0606 Video Editor Credit-0+ 0+4+3=7

Course Objectives

This course teaches the technical skills and creative principles required for single camera ('film style') video field shooting and post production. The course will provide hands-on skills in audio, video recording technology, composition, lighting and editing. The course will provide students a clear understanding of Video Editing Process by skilling them in same.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Handle contemporary video technology and operation of cameras, audio, lighting and other television production equipment
CO2	Mange the aesthetics of sound and image production
CO3	Demonstrate literacy in film and video, including shot composition and continuity editing
CO4	Develop digital nonlinear post-production

MCDE0607 Web Content Development Credit-0+ 0+4+3=7

Objectives of the Paper

The paper will provide students a clear understanding of web content development Process by skilling them in same.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Handle the role web content Developer
CO2	Mange digital news writing
CO3	Demonstrate skills in website coding

MVDE0608 Sound Engineer Credit-0+ 0+4+3=7

Course Objectives

The course will provide students a clear understanding of sound and will impart the skills of skill of Recording and editing sound.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Manage sound editing and production effectively
CO2	Use modern software

MCDE0609 Adobe Tools and Illustrations **Credit :**0+**0+ 4+3=7**

Course Objectives

This course includes the study of illustration as visual interpretation of words, concepts and ideas. Students learn basic software skills while developing drawing abilities in a digital environment. Strategies for communicating content through pictorial narrative are also explored.

Course Outcomes

After the end of the course, the students will be able to:

CO	Statements
CO1	Use where digital technology is part of the texture of their daily existence.
CO2	Use digital tools which support creative expression
CO3	make their own creative products by observing other learners creating and sharing.

Centurion University of Technology and Management

School of Management

BBA

Programme Objectives;

The programme of BBA may be viewed as an intermediate step towards pursuing a master's degree in management or pursuing a career in the management field. The programme aims to satisfy the demand for skilled and well-honed management professionals in the industry in general and in the holistic world of Indian corporates in particular.

The teaching and learning philosophies of the BBA program are honed by an unwavering focus on students as learners and creating a peer-to-peer learning environment which provides opportunities to maximise their potential. Therefore, in every course which is taught, independent of the content of the course, the motivation is to create environments whereby students are inspired to take part as members of this learning community. This objective is achieved through class participation, expository writing, creation of e-learning tools, projects, problem-based learning, and assignments, etc. All the courses are designed and evaluated for rigor in terms of difficulty level, skills acquired, and improvement in communication ability. Another unique aspect of the program is the linkage to industry interface:

- To impart the basic knowledge in the field of management
- To develop Industry ready professionals
- To empower learners with appropriate communication, professional and life skills
- To impart Information Communication Technologies (ICTs) skills, including digital literacy and competencies in the field of management
- To pursue higher studies and develop research skills in the specified field
- To develop entrepreneurial skills focusing on innovation in the field
- To inculcate professional ethics, values in order to work in diversified cultural milieus

Program Outcomes:

PO	**Outcomes**
PO1	**Knowledge:** demonstrate acquired knowledge in the field of management and appreciate the different organizations fulfilling societal needs
PO2	**Professional :** engage the professional skills in the field of management
PO3	**Effective Communication, Professional and life Skill:** effectively engage in communication to share thoughts and ideas

PO4	**ICT**: able to use various communication technologies and ability to use various software for analysis
PO5	**Leadership:** able to lead with appropriate vision
PO6	**Critical/ Reflective thinking:** able to think critically in professional life
PO7	**Entrepreneur:** demonstrate the skills of on an entrepreneur to start a venture
PO8	**Learning and Research**: develop a sense of inquiry and investigation life long
PO9	**Ethics:** Follow high ethical standard and appreciate the value system of different cultures

Programme Specific Outcome

PSO1: acquire and able to utilize fundamental knowledge on management and related areas-concepts, principles and processes.

PSO2: able to handle the professional jobs in different organizations

PSO3: able to carry out effective communication; listening, comprehending, writing and presenting with societal and the environmental considerations in the industry

PSO4: demonstrate ICTs competencies including digital literacy required in the industry

PSO5: able to lead a team at the work front

PSO6: able to demonstrate critical thinking in the field of management

PSO7: able to carry out entrepreneurial ventures successfully.

PSO8: pursue acquiring knowledge throughout life in the discipline and carry out research in the field of management

PSO9: become ethically committed management professional and entrepreneur adhering to the human values, the Indian culture and the Global culture.

Mapping PSOs with POs (Correlation)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
PSO1									
PSO2									
PSO3									

PSO4									
PSO5									
PSO6									
PSO7									
PSO8									
PSO9									

Course Outcomes:

Course Outcomes (COs)	Competency/skill
CO1	Knowledge
CO2	Analytical and Creative Thinking
CO3	Problem Solving
CO4	Leadership & Management
CO5	Domain Skill/Competency
CO6	Ethical
CO7	Information Literacy
CO8	Employability skill/ Higher study/ Entrepreneurship

BBAR1101 Proficiency in English Credit: 2+0+0

Course Objective:

This course is designed to enhance the basic language skills viz. listening, speaking, reading and writing of learners which are identified as the basic proficiency in English. The main objective of this course is to provide a rich linguistic environment in a class which will allow students to adequately practice Basic English language proficiency (EPT) including a range of language functions simulating real life situations. This in turn is expected to help learners to function confidently in social spheres, both in familiar and unfamiliar environments.

Course Outcome:

CO	Statements
CO1	demonstrate and apply appropriate study skills for success. Further it employs a writing process and demonstrate the ability to write clear sentences
CO2	construct paragraphs and essays that effectively make use of supporting details, examples, and evidence.

BBAR1102 Basic Financial Accounting 6+0+0

Course Objectives:

- To give an insight into the basics of Accounting Concepts and Principles to Prepare to Students to have the foot hold in Accounts
- To develop conceptual knowledge about the preparation and use of financial statements.

Course Outcome

CO	Statements
CO1	Ability to use basic accounting system to create (record, classify, and summarize) the data according to accounting concepts, principles, and frameworks to analyse and effectively communicate information to a variety of audiences.
CO2	Gain fundamental knowledge on accounting equation to analyse the effect of business transactions on an organization's accounting records and financial statements.
CO3	Develop and understand the nature and purpose of financial statements accordance with appropriate standards in relationship to decision making.
CO4	Develop the ability to use accounting information to solve a variety of business problems.

BBAR1103 Management Principles and Applications 4+0+0

Course Objective :

To acquaint the participant with the concept of management principle and its application in the organization. The course aims at providing theoretical knowledge and practical skills in the area of management principles and to hone the skills of students for meeting the requirements for emerging markets and business.

Course Outcome

CO	Statements
CO1	Gain knowledge on the aspects of management, its growth and development, organizing, staffing and how it is initiated in an organization which will help in getting employment.
CO2	Management functions and motivational theories will help in developing skills of the students in managing the employees in the organisation.

CO3	Overall understanding the concepts will help the students in starting their own business

BBAR1104 Micro Economics 4+0+0

Course Objective:

The **o**bjective of the course is to acquaint the students with the concepts of microeconomics dealing with consumer behavior. The course also makes the student understand the supply side of the market through the production and cost behavior of firms.

Course Outcome

CO	Statements
CO1	The students will be able to learn key economic term
CO2	The students will be able to understand the market, functions of market
CO3	They will gain skill in estimating as well as forecasting the demand
CO4	the end of the course, students will gain skill in managing the business

BBAR1107 Computer application in Business 0+0+4

Course Objective :

Upon completion of the course, the student is expected to be able to identify and utilize appropriate technology for effective decision-making and improved performance, having mastered the Microsoft Office topics presented in the following course modules:

Microsoft Word: word-processing skills including creating, editing, formatting, enhancing, and sharing documents.

Microsoft Excel: spreadsheet skills including creating and editing formulas, functions, charts, and working with worksheets and tables.

Microsoft PowerPoint: presentation skills including creating and editing a presentation, presentation development, presentation design, and multimedia tools.

Course Outcome

CO	Statements
CO1	Students will get familiar with the use of Microsoft word.

CO2	Students will get familiar with the use of Microsoft Excel.
CO3	Students will get familiar with the use of Microsoft PowerPoint.
CO4	Gain familiarity with the concepts and terminology used in the development, implementation and operation of business computer applications.

Code: FCMG0115 **HUMAN RIGHTS**

Course Objective:

The course is an introduction to human rights. Human beings are rational beings. They by virtue of their being human possess certain basic and inalienable rights which are commonly known as human rights. Human Rights are defined as all those rights which are essential for the protection and maintenance of dignity of individuals and create conditions in which every human being can develop his or her personality to the fullest extent. The purpose of this course is for students to gain a holistic view of human rights and their implications.

Course Outcome**:**

CO	**Statements**
CO1	Student will give importance to human rights in daily life
CO2	Protect human dignity, avoid violation of Universal Declaration of Human Rights.

BBAR1201 Reading to Writing

2+0+0

Course Objective:

Course Objective

This course will develop the students' ability to develop reading speed and building academic vocabulary. It will utilize digital literacy tools to develop reading and vocabulary skills. Further its objective is to demonstrate behavior and attitudes appropriate to a university environment (work collaboratively, manage time, are prepared, comply with academic integrity rules)

Course Outcome

CO	**Statements**
CO1	demonstrate and apply appropriate study skills for success.
CO2	Further it employs a writing process and demonstrate the ability to write clear sentences
CO3	nstruct paragraphs and essays that effectively make use of supporting details, examples, and evidence

BBAR1202 Organisational Behaviour 4+0+0

Course Objective:

- To help students to observe, experience, analyze individual behaviour and Group behaviour
- Students will learn in improving employee behaviour, enhancing leadership skills
- Students will learn on how to increase employee motivation and satisfaction
- Students will able to observe, experience, analyze communication process, barriers thus communicating effectively.

Course Outcome

CO	Statements
CO1	Apply the concept of organizational behaviour to understand the behaviour of people in the organization in order to be employed.
CO2	Examine the work styles, communication preferences and employee traits that can help to create effective work teams in the organisation.
CO3	Understanding the own management style as it relates to influencing and managing behaviour in the organization systems thus helping in enhancement of critical thinking and analysis skills.
CO4	Develop the competency to assess others behaviour, give feedback and integrate into group environment which will help in employees growth in their organisation thus helping in becoming an entrepreneur as well.

BBAR1203 Business Statistics 6+0+0

Course Objective:

The objective of this course is to familiarise students with the basic statistical tools used for managerial decision-making.

Course Outcome

CO	Statements
CO1	Demonstrate skill in identifying different types of data
CO2	Demonstrate skill in collecting sample and data

BBAR1204 Macro Economics 4+0+0

Course Objectives:

The course aims at providing the student with knowledge of basic concepts of the macro economics. The modern tools of macro-economic analysis are discussed and the policy framework is elaborated, including the open economy.

Course Outcome

CO	Statements
CO1	develop the skill to analyze real-world business problems with a systematic theoretical economics framework
CO2	to use critical thinking skills within the discipline of economics about economic matters such as issues of growth, unemployment, poverty, inflation etc.
CO3	develop the ability to explain core economic terms such as GDP, GNP, inflation etc., and theories like unemployment vs poverty, national income determination that can help them to crack interviews
CO4	develop the skill to analyze real-world business problems with a systematic theoretical economics framework

BBAR1205 MS EXCEL 0+0+4

Course Objective

- Indicate the names and functions of the Excel interface components.
- Enter and edit data.
- Format data and cells.
- Construct formulas, including the use of built-in functions, and relative and absolute references.
- Create and modify charts.
- Preview and print worksheets.

Course Outcome

CO	Statements
CO1	Students will get more familiar with the use of Microsoft Excel.
CO2	Excel also contains fairly powerful programming capabilities for those who wish to use them that can be used to develop relatively sophisticated financial and scientific computation capabilities.
CO3	Gain familiarity with the concepts and terminology used in the development, implementation and operation of business computer applications.
CO4	plore various methods where Information Technology can be used to support existing businesses and strategies.


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FCMG0116 **Introduction to Ethic s** **Course Objective :**

Objectives:

The course is an introduction to Ethics. This course will introduce the meaning of ethics and the historical development – utilitarianism, ethical relativism and virtue ethics. Will also examine some current ethical issues, especially in science and engineering. Questions which will be considered are: what is the good life? Do we have a moral duty to act in certain ways? Are there such things as natural human rights? Are some values more compelling than or better than others?

This course is designed to introduce undergraduate engineering students to the concepts, theory and practice of engineering ethics. It will allow students to explore the relationship between ethics and engineering and apply classical moral theory and decision making to engineering issues encountered in academic and professional careers.

Course Outcome

CO	Statements
CO1	Demonstrate knowledge of important ethical systems
CO2	Demonstrate their respect of different ethical perspectives
CO3	Critique some aspects of an ethical position
CO4	early formulate their ethical position on an issue and develop arguments based on sound inferences and clear premises (through project)

BBAR2101 **Human Resource Management** **6+0+0**

Course Objective

- Here the student can develop the knowledge, skills and concepts needed to resolve actual human resource management problems or issues.
- The student will able to manage the employment relationship, which is a shared responsibility between employers, management, human resources specialists, and employees.
- Student will able to identify the human resources needs of an organization or department.
- Conduct a job analysis and produce a job description from the job analysis.

Course Outcome

CO	Statements
CO1	Gain knowledge on the aspects of human resource, its growth and development, its characteristics and how it is initiated in an organization.
CO2	Develop competency to recruit, train and appraise the performance of the employee thus enhancing their own skill in the organisation.

CO3	It will help in getting employability in managerial levels and effectively able to solve employee issues effectively.

BBAR2102 Principles of Marketing 6+0+0

Course Objective :

- To understand how organizations identify customers and their wants/needs.
- To comprehend marketing decisions, based upon the combination of product, price, promotion, and distribution elements. In this course, you will study consumer and industrial markets and understand the value of the marketing mix in the marketing planning process.
- To understand how marketing is carried out by an organization to meet the requirements of consumer and industrial markets.

Course Outcome

CO	Statements
CO1	monstrate the ability to critically evaluate a marketing program from consumer and marketing practitioner viewpoints, including consideration of ethical implications.
CO2	mmunicate clearly, in an organized fashion, the concepts of marketing in both oral and written work.
CO3	monstrate an understanding of how marketing fits with the other business disciplines within an organization.

BBAR2103 Cost & Management Accounting 6+0+0

Course Objective :

- To equip the students with various concepts, tools and techniques of Cost accounting as well as Management accounting which is essential for managerial decision making process.
- Students will understand the relationship between cost accounting financial accounting and managerial accounting.
- To understand budgetary control, marginal costing, preparation of cost sheet, standard costing. It will increase the managerial skills of the students.
- Students can analyse the financial statements by using ratio analysis, common size statement analysis, comparative analysis, funds flow statement analysis and also cash flow statement analysis.

Course Outcome

CO	Statements
CO1	This course will increase the analytical skills in finance, which will help the students to start their own business.
CO2	Students can join in the companies as finance manager.
CO3	Understanding financial statement analysis will give them added advantages to increase the profit of the company, which is the main objective of any company.
CO4	Students can use their skills in controlling the cost of the company.

BBAR2104 Oral Communication Skills 0+0+2

Course Objective :

This course aims to develop awareness and use of the conventions of academic English. More specifically the course will further develop reading and writing ability in a variety of academic registers as well as developing listening and speaking skills through lectures, seminars and presentations within a university context. Various transferable skills will also be developed.

Course Outcome:

CO	Statements
CO1	The Course encourages the use of strategies, such as contextualization of new vocabulary, use of previewing, skimming and scanning techniques, and knowledge of text organization and discourse markers, to aid the comprehension of written and spoken language.
CO2	It will help to build cross-cultural understanding and confidence in using language through collaboration with classmates, increased participation in college activities, and increased interaction within the college and the larger community in order to complete class assignments such as surveys, reports and presentations.

BBAR2105 Production & Operation Management 4+0+0

Course Objective:

The course is designed to acquaint the students with decision making in production and operation function of an organization.

Course Outcome:

CO	Statements
CO1	Identify the elements of operations management and various transformation

	processes to enhance productivity and competitiveness
CO2	Analyze and evaluate various facility alternatives and their capacity decisions, develop a balanced line of production & scheduling and sequencing techniques in operation environments
CO3	Develop aggregate capacity plans and MPS in operation environments.
CO4	Plan and implement suitable materials handling principles and practices in the operations.

FCMG0401 GENDER ISSUES IN DEVELOPMENT

Course Objective

In the traditional social order women have been assigned a subordinate status in society for centuries. They have been deprived of many social privileges and suffered from discriminations that prevented them from contributing to the development process. They have remained marginalized in society. To remedy the prevailing situation, gender concerns have become increasingly important in the development agenda in the last few decades. In spite of special policies and programmes being implemented, gender based injustice continues to exist and hinder development

Course Outcome

CO	Statements
CO1	Develop an understanding of perspectives on gender and development
CO2	Discuss in detail the gender question in selected development sectors and globalization
CO3	Familiarize with the different tools and techniques for gender planning, analysis and evaluation in the development sector
CO4	e course has three modules covering these three aspects of gender and development.

BBAR2201 Research Methodology 6+0+0

Course Objective :

1. To apply the basic concepts of research such as variables, sampling, schedule, questionnaire etc.
2. Develop understanding on various kinds of research and objectives of doing research
2. Introduce course methods that will be applied in higher education

Course Outcome

CO	Statements

CO1	Develop skill in reviewing literature critically, do case study, structured survey, interviews and focus group discussion
CO2	Develop skill in formulating research proposal, framing research questions and choosing appropriate methodologies

BBAR2202 Operation Research 6+0+0

Course objective : The intent of Operational Research is to learn about management and administration of socio-cultural behaviour and economic factors that exist as bottleneck to effective implementation and← to develop more effective approaches to the programming

Course Outcome:

CO	Statements
CO1	Identify and develop operational research models from the verbal description of the real system.
CO2	Understand the mathematical tools that are needed to solve optimisation problems.
CO3	Use mathematical software to solve the proposed models.
CO4	velop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering

BBAR2203 Financial Management 6+0+0

Course Objective:

To familiarize the students with the principles and practices of financial management.

Course Outcome

CO	Statements
CO1	Demonstrate the applicability of the concept of Financial Management to understand the managerial Decisions and Corporate Capital Structure
CO2	Apply the Leverage and EBIT EPS Analysis associate with Financial Data in the corporate
CO3	Analyse the complexities associated with management of cost of funds in the capital Structure
CO4	Demonstrate how the concepts of financial management and investment, financing and dividend policy decisions could integrate while identification and resolution of problems pertaining to LSCM Sector

BBAR2204 Business Communication 2+0+0

Course Objective :

This course aims to develop awareness and use of the conventions of academic English. More specifically the course will further develop reading and writing ability in a variety of academic registers as well as developing listening and speaking skills through lectures, seminars and presentations within a university context. Various transferable skills will also be developed.

Course Outcome

CO	Statements
CO1	The Course encourages the use of strategies, such as contextualization of new vocabulary, use of previewing, skimming and scanning techniques, and knowledge of text organization and discourse markers, to aid the comprehension of written and spoken language.
CO2	will help to build cross-cultural understanding and confidence in using language through collaboration with classmates, increased participation in college activities, and increased interaction within the college and the larger community in order to complete class assignments such as surveys, reports and presentations.

BBAR2205 Tally and ERP 0+0+4

Objectives

To make students proficient in Tally and ERP

Course Outcome

CO	Statements
CO1	Manage accounts and preparation of report through Tally and ERP

BBAR3101 Financial Institutions and Markets 6+0+0

Course Objective:

- To offer a comprehensive exploration of the revolutionary developments occurring in the Financial markets and institutions i.e., innovation, globalization and deregulation - with a focus on the real practices of financial institutions, investors, and financial instruments.

- Extensive coverage of different products operates in Indian Financial Market.
- To provide a scope to analyze the Indian financial system in a broader prospective.

Course Outcome

CO	Statements
CO1	Understand Financial System of Indian, Banking and Non-Banking Institutions, Different Financial and Securities Markets and also the key terminology of Financial Market, which will help in employment opportunity.
CO2	Apply various types of financial products provided by Financial Institutions for investment advisor's perspective to the various kinds of investors, which will help in enhancing the skill in the area of finance which will help in becoming an entrepreneur.
CO3	alyse and frame out the profitability alternatives to mobilise funds from capital market and money market for client and company helping in enhancement of critical thinking and analysis skills.

BBAR3102 Business Law for Managers 4+0+0

Course Objective :

To introduce the students to some of the most important laws of business, particularly in the areas of contract law, partnership act, sale of goods act, negotiable instrument act for conducting business. To equip the students with the minimum legal framework for starting a business venture and running it successfully in conformity with legal parameters

Course Outcome

CO	Statements
CO1	Handle legal issues
CO2	Solo Practitioner
CO3	Powerful asset in entrepreneurial endeavours
CO4	seek extracurricular opportunities to explore the intersection of entrepreneurship and law.

BBAR3103 Summer Internship 0+0+6

Course Objective:
Develop and improve business skills in communication, technology, quantitative reasoning, and teamwork. Observe and participate in business operations and decision-making. Meet professional role models and potential mentors who can provide guidance, feedback, and support.

Course Outcome:

This is practical course. After completion of this course students will be able to

CO	Statements
CO1	communicate effectively (written and oral) in organizations
CO2	handle pressure at the work front by focusing on honesty and integrity
CO3	become self-disciplined, self-motivated and integrate theory and practice
CO4	display problem solving skills utilizing the theoretical framework learned in the classroom setting
CO5	develop appropriate work habits and attitudes necessary for job success.

BBAR3204 Strategic Management

6+0+0

Course Objective:

a) To familiarize the students about the basic concept of strategic management and the required tools and techniques for strategy analysis and implementation
b) To develop the skill of strategy analysis, choice and implementation for an organisation
c) To understand and apply the concept of ethics in a business

Course Outcome:

CO	Statements
CO1	conduct analysis of competitive situations of the enterprise they would be employed with, or the enterprise they world set up
CO2	demonstrate knowledge and ability to use different strategic frameworks and analytical tools
CO3	demonstrate knowledge and ability to formulate strategies and their implementation plans to improve organizational performance
CO4	understand the contemporary ethical and corporate governance standards and corporate social responsibility requirements

BBAR3202 Entrepreneurship Development 6+0+0

Course Objective :

Here the students can develop and systematically apply an entrepreneurial way of thinking that will help them to identify and create business opportunities that may be commercialized successfully. Here they will need to understand the basic concepts in the area of entrepreneurship.□ Understand the role and importance of entrepreneurship for economic development, □ Develop a personal creativity and entrepreneurial initiative. Adopt the key steps in the elaboration of business idea and understand the stages of the entrepreneurial process and the resources needed for the successful development of entrepreneurial ventures.

Course Outcome

CO	Statements
CO1	Understand the various concepts of Entrepreneurship
CO2	Have the ability to develop entrepreneurial traits so that they can start their own business.
CO3	Can assess the various opportunities and constraints for new business ideas.
CO4	Understand the systematic process to select and screen a business idea.

BBAR3203 SPSS 0+0+4

Course Objective:

Familiarize students with a statistical package for data analysis related to the Statistics and Market Research papers and which will also help in the Research Project. Any user friendly statistical package depending on resources available at each institution can be used. For example SPSS, PSPP (opensource)/ or any other equivalent. Some of the statistical analysis functions are also available in add in tools in Excel.

Course Outcome

CO	Statements
CO1	Enter, organize and save data
CO2	Learn and gain skill on statistical package that can be used for analyzing data
CO3	fine a variety of statistical variables

BBAF3101 International Finance 6+0+0

Objective:

The objective of this paper is to equip the students with the techniques that can help them in managing the financial issues in international environment. This course will help them to manage MNCs in more effective manner.

Course Outcome

CO	Statements
CO1	On successful completion of the course the learner will be able to
CO2	Understand the concept of International trade, International Business, International Finance, Balance of Payments, International Monetary System
CO3	in skill on techniques that can help them in managing the financial issues in international environment.

BBAF3102 Investment Banking & Financial Services 6+0+0

Course Objective:

- To understand the Overview of Indian Financial System, Investment Banking in India and also Recent Developments and Challenges ahead.
- To know the different aspects of Investment banking, SEBI guidelines on issue management and merchant banks.
- To know the main investment banking services offered to institutional and corporate clients.
- To understand the concepts of Leasing and Hire Purchase.
- To know the venture investment process, various steps in venture financing and also incubation financing.
- To understand the concept of Insurance, classification, principles of insurance, IRDA and different regulatory norms, operation of General Insurance, Health Insurance and Life Insurance.

Course Outcome

CO	Statements
CO1	Students can manage operations consisting of issuing debt securities and equities in primary markets and structure finance operations.
CO2	They can start their own business in financial services sector.
CO3	They can use their skills in any financial institutions, merchant banks or in Investment banks.
CO4	They can also join in Insurance sectors.

BBAF3103 Investment Analysis & Portfolio Management 6+0+0

Course Objective: The aim of this course is to provide a conceptual framework for analysis froman investor's perspective of maximizing return on investment – a sound theoretical basewith examples and references related to the Indian financial system.

Course Outcome

CO	Statements
CO1	Students can start their own broking firm and can be an entrepreneur.
CO2	They can join in a company as broker, financial analysist or financial advisor as per their interest.

CO3	Their analytical skill on valuations of financial instruments will increase. They can use these skills to analyse the market timings, so that the investors can earn high return with low risk.
CO4	They can evaluate financial markets, how securities are traded and also investor behavior.

BBAF3104 Project Appraisal 6+0+0

Course Objectives :

- To explain identification of a project, feasibility analysis including market, technical and financial appraisal of a project.
- To understand the relevance of alternative project appraisal techniques, financial structure and financing alternatives.
- This course intends to involve students to apply appraisal techniques for evaluating live projects.
- To enable the students to acquire the skills necessary to prepare financial project & business plans.
- To focus on the analysis of technical and financial viability of starting, financing and managing the projects for its success.
- Students will be able to write a business plan and interpret their own business plan.

Course Outcome

CO	Statements
CO1	Students will be able to do the feasibility analysis like market, technical and financial appraisal of a project. They can start up their own business.
CO2	Students will be able to prepare the DPR (Detailed Project Report). By submitting the DPR to the bank or financial institutions, they can get a loan for their start up project.
CO3	Then can join in a company to manage the projects.
CO4	They can use their skills to evaluate live projects. They will be able to adopt appropriate techniques for Capital Budgeting decisions.

BBAF3105 Business Analysis & Valuation 6+0+0

Course Objective: This Paper will enable the students to analyze the health of a company through their annual reports and will equip them to understand what an asset is worth and what determines that value.

Course Outcome

CO	Statements
CO1	Work comfortably with Microsoft Excel, Format spreadsheets in a professional way, Work with large amounts of financial data without difficulty for analysing and interpreting the financial statements for various decision making purposes.
CO2	Acquire the necessary skills to frame project financial statement and Forecasting by using different financial ratios and different analytical tools of finance. All the above will help for getting employment in different corporate sector.
CO3	Apply tools of financial econometrics for evaluating and forecasting share prices in the stock market which will enhancing the skill in the area of financial analytics and will help in becoming an entrepreneur.

BBAF3106 Financial Modelling & Derivatives 6+0+0

Course Objective:

To equip students with principles and techniques of Financial modeling along with various Financial Derivatives including Greeks & Exotic Options.

Course Outcome

CO	Statements
CO1	Demonstrate an understanding of the uses of financial engineering and risk management approaches and techniques used by modern organizations.
CO2	Apply their knowledge of derivatives in solving problems involving financial risks including foreign exchange risk, interest rate risk, credit risk and portfolio risks.
CO3	Make informed judgements on the use of derivative instruments.
CO4	4.Evaluate, synthesise and communicate the ethical implications of financial risk management policies and practices to an intended audience.

BBAF 3107 Strategic Corporate Finance 6+0+0

Objective: The objective of this paper is to know the details of corporate finance andthe strategies involved in the corporate decisions. It will enable the students to steer thecorporate in better manner.

Course Outcome

CO	Statements
CO1	Develop competencies on strategic corporate finance issues, strategic corporate finance requires for International Corporation to navigate in the global capital markets.
CO2	Understand how corporate strategy and the significance of strategy in financial decisions,
CO3	Enhance their knowledge in the area of strategic costing and their relevance in the area of target costing, activity based costing strategic, cost reduction techniques and value chain analysis.
CO4	Equip students with the knowledge and skills on company valuation principles, tools & techniques, the link between valuation and corporate finance, management buy-outs valuing real assets in the presence of risk: tracking portfolios and real asset valuation,

BBAF3108 Research Project 0+0+6

Course Objective:
The course is intended to develop requisite expertise in students to handle research projects independently

Course Outcome

CO	Statements
CO1	Carry out a substantial research-based project
CO2	Demonstrate capacity to lead and manage change through collaboration with others
CO3	Demonstrate an understanding of the ethical issues associated with practitioner research
CO4	Analyse data and synthesize research findings

BBAM3101 Consumer Behaviour 6+0+0

Objective:

The course of Consumer behaviour equips students with the basic knowledgeabout the issues and dimensions of consumer behaviour and with the skill and ability toanalyse consumer information and develop consumer behaviour oriented marketingstrategies.

Course Outcome

CO	Statements
CO1	Detect the relevance of consumer behaviour to the entire marketing process, the nature and stages of consumers' decision making and the factors influencing consumers' choices.
CO2	Discover the knowledge of consumer behaviour on the development of marketing strategies including marketing communication, segmentation and target marketing.
CO3	Apply the concepts and theories covered in the course to develop their own theories of consumer behaviour and devise effective solutions

BBAM3102 Personal Selling & Sales Force Management 6+0+0

Objectives: To familiarize the students with the concepts of sales management and to equip them with the various tools required to be a success in the various techniques essential for sales staff management. To help them differentiate the nuances of personal, organizational and personal selling.

Course Outcome

CO	Statements
CO1	Recognize and demonstrate the significant responsibilities of sales person as a KEY individual.
CO2	Describe and formulate strategies to effectively manage company's sales operations.
CO3	Evaluate the role of sales manager and his/ her responsibilities in recruiting, motivating, managing and leading sales team.
CO4	

BBAM3103 Advertising & Brand Management 6+0+0

Objective: To equip the students with the nature, purpose & complex constructions in the planning and execution of a successful advertising program. The course will expose student to issues in brand management, faced by firms operating in competitive markets.

Course Outcome

CO	Statements
CO1	Understand and demonstrate knowledge on nature and processes of advertising and branding.

CO2	Relate advertising and brand management activities across the overall organizational context and other business areas.
CO3	Appraise key issues in managing brand portfolio and making strategic advertising and branding decisions.
CO4	

BBAM3104 Retail Management 6+0+0

Objective: The primary objective of the course is to have students develop marketing competencies in retailing and retail consulting. The course is designed to prepare students for positions in the retail sector or positions in the retail divisions of consulting companies. Besides learning more about retailing and retail consulting, the course is designed to foster the development of the student's critical and creative thinking skills.

Course Outcome

CO	Statements
CO1	Possess the knowledge of various retail formats and will be understand the retail customer.
CO2	Prepare to make merchandise plan to procure the right merchandise.
CO3	Able to perform categorization in the merchandise.
CO4	derstand the concepts of effective retailing.

BBAM3105 Distribution & Supply Chain Management 6+0+0

Objective: This course would help students develop an understanding about the role of marketing channels, distribution and supply chain, key issues of supply chain and the drivers of supply chain performance. The course would acquaint the students with various concepts.

Course Outcome

CO	Statements
CO1	Identify and Analyze Business Models, Business Strategies and, corresponding Competitive Advantage.
CO2	Formulate and implement Warehouse Best Practices and Strategies.
CO3	n Warehouse and Logistics operations for optimum utilization of resources.
CO4	

BBAM3106 Marketing of Services 6+0+0

Objective: The course is designed to equip students with the knowledge of marketing ofall types of services.

Course Outcome

CO	Statements
CO1	Explain the unique challenges of services marketing, including the elements of product, price, place, promotion, processes, physical evidence, and people.
CO2	The students shall also understand the roles played by employees and customers during service delivery.
CO3	Explain service blueprinting and its application across various service sectors.
CO4	sign service quality measurements to build customer loyalty and evaluate the effectiveness and efficiency of customer service offerings.

BBAM3107 International Marketing 6+0+0

Course objectives

To understand the technically involved in successfully marketing a product internationally

Course Outcome

CO	Statements
CO1	Develop an understanding of major issues related to international marketing.
CO2	Develop skills in researching and analyzing trends in global markets and in modern marketing practice.
CO3	sess an organization's ability to enter and compete in international markets.
CO4	

BBAM3108 Research Project 0+0+6

Course Objective:
The course is intended to develop requisite expertise in students to handle research projects independently

Course Outcome

CO	Statements
CO1	Carry out a substantial research-based project

CO2	Demonstrate capacity to lead and manage change through collaboration with others
CO3	Demonstrate an understanding of the ethical issues associated with practitioner research
CO4	Analyse data and synthesize research findings

BBAH3101 HRD : Systems & Strategies 6+0+0

Objective

The course gives an overview of the need for HRD and HRD practices whichcan develop and improve an Organization's systems and strategies leading to an optimalHRD climate.

Course Outcome

CO	Statements
CO1	It will help the student to develop knowledge on the importance of implementing HRD techniques in organizations.
CO2	will help the student to understand the concepts of organizational learning and developing core competencies by implementing HRD practices whether they are being employed or as an employer.

BBAH3102 Training & Management Development 6+0+0

Objective: To familiarize the students with the concept and practice of training and development in the modern organizational setting.

Course Outcome

CO	Statements
CO1	The student can effectively get a job in HR department in any organisation
CO2	The student will able to learn different training methods and can become an effective trainer.
CO3	will help the student to deliver the idea and relevance of qualitative HR practices in the field of training and development

BBAH3103 Management of Industrial Relations 6+0+0

Objective: To acquaint students with concepts of Industrial Relations and various legislations related to Labour Welfare and Industrial Relations.

Course Outcome

CO	Statements
CO1	Demonstrate descriptive knowledge of the field of industrial relations.
CO2	The student can effectively get a job in HR department in any organisation specifically in a Power/Manufacturing industry
CO3	Can find out solutions to industrial relations problems. Will able to recognise and consider the social, historical and equity issues within industrial relations.
CO4	ith the ability to know the different Acts pertinent to IR the student can become an Consultant, a freelancer later.

BBAH3104 Performance & Compensation Management 6+0+0

Objective: To familiarize students about concepts of performance and compensation management and how to use them to face the challenges of attracting, retaining and motivating employees to high performance.

Course Outcome

CO	Statements
CO1	The student can able to design an organizations performance management process in line with the organizational mission, vision and strategy.
CO2	Can undertake various organizational performance management programs and best practices and define parameters/attributes of effective performance management systems.
CO3	Can apply PMS where it is absent in any organisation or own organisation.
CO4	Can employ various job-related performance standards and indicators that reflect the employees range of responsibilities.

BBAH3105 Counselling & Negotiation Skills for Managers 6+0+0

Objective: The objective of this course is to provide insights into handling behavioural issues at work place by developing counselling skills. It is also intended to facilitate an understanding of the structure and dynamics of negotiation.

Course Outcome

CO	Statements
CO1	It will enable students to take counselling as profession and can apply understanding of counselling skills.
CO2	It will enable students to develop skills in negotiation through practical demonstration of the ideas and concepts presented in the course in various

	negotiation situations
CO3	The student can establish a triad counselling practice group and conduct an initial counselling session. The student can develop, apply and analyse the counselling skills of reflective listening, holding, use of silence, empathy, summarising and challenging in counselling sessions.
CO4	e student can develop the skills and techniques of a successful negotiator

BBAH3106 Cross Cultural HRM 6+0+0

Objective: - To explore the concepts and techniques of the essential elements of cross-cultural HRM and to enable the students to recognise its critical issues. The course aims to understand HRM concerns in the cross cultural scenario.

Course Outcome

CO	Statements
CO1	The student can understand the importance of cross-cultural management and the impact of different national cultures on work and employment.
CO2	A student can gain the knowledge on cross cultural trainings, performance appraisal and knowing the concept of repatriation.
CO3	The student can apply their understanding of cultural and institutional differences to evaluate the challenges and opportunities of doing business in different countries.
CO4	student can understand the cultural difference with interactions with different nationalities in the organisation working or being an employer as well.

BBAH3107 Talent & Knowledge Management 6+0+0

Objective - To prepare students for talent and knowledge management efforts in organisations. It aims at enabling students to gain insights in concepts and application of talent and knowledge management in organizations. The course aims at understanding basic elements, processes, approaches and strategies of managing talent and knowledge in organisations.

Course Outcome

CO	Statements
CO1	The student can examine the process for identifying high potential talent and

	developing a pool of talent to serve organizational present and future needs.
CO2	Can undertake the processes for talent development and succession planning. Student can examine the role of leadership related to TM
CO3	The student can understands the process of linking talent management to organizational strategy and other HR practices.
CO4	e student can effectively get a job in HR department in any organisation

BBAH3108 Research Project 0+0+6

Course Objective:
The course is intended to develop requisite expertise in students to handle research projects independently

Course Outcome

CO	Statements
CO1	Carry out a substantial research-based project
CO2	Demonstrate capacity to lead and manage change through collaboration with others
CO3	Demonstrate an understanding of the ethical issues associated with practitioner research
CO4	Analyse data and synthesize research findings

BBAB3101 International Trade Policy & Strategy 6+0+0

Objective: The paper aims to provide a thorough understanding of the basis for international trade and strategies. The role of the global institutional structure and trade strategies of developing countries and trade partners of India will be studied.

Course Outcome

CO	Statements
CO1	Analyze new opportunities in international trade such as global supply and value chains, investment agreements, trade in services, competition policy and regional economic integration

CO2	Critically examine the operation and application of regional economic integration tools such as international trade agreements in a practical context and from a sectoral aspect
CO3	Analyse the practical aspects of international trade and develop appropriate trade strategies

BBAB3102 Global Business Environment 6+0+0

Objective: To get the students acquainted with the present economic environment in India and abroad. To enable the students understand the various issues involved in the macro management of the economy

Course Outcome

CO	Statements
CO1	Identify the main features of the international business environment and its main institutions;
CO2	analyse the political, social, economic, technological and other configurations that support cross-border trade;
CO3	analyse the key decisions that multinational firms make in relation to the choice of markets and entry strategies;
CO4	Carry out research in international business issues and apply theoretical insights to the analysis of such issues in the context of a complex international business environment; and,

BBAB3103 Transnational & Cross Cultural Marketing 6+0+0

Learning Objective: The purpose of this paper is to provide an understanding of the impact the cultural differences have on global marketing. The methods of price decisions in international markets shall also be taught.

Course Outcome

CO	Statements
CO1	Critically analyse cultural differences, conduct comparative analyses and consider the impact on global business organisations
CO2	determine consumers' preferences in different societies
CO3	mulate marketing strategy taking into consideration cultural beliefs, values and customs of a specific country

CO4	

BBAB 3104 International Distribution & Supply Chain Management 6+0+0

Objective: To familiarize the students with the essential elements of the Supply Chain Management. Strategic issues in the International Supply Chain Management and logistics network configuration along with performance measurement and evaluation shall be studied thoroughly.

Course Outcome

CO	Statements
CO1	use commonly accepted frameworks and tools to analyze supply chain situations.
CO2	evaluate opportunities for process improvement, efficiency improvement, effectiveness improvement and integration
CO3	provide rationale solutions for identified opportunities.

BBAB3105 International Accounting & Reporting System 6+0+0

Objective: - To develop skill and competencies of various practices in the International Accounting and Reporting Systems. A comparative perspective of the accounting standards and practices across the different countries is the focus of the study.

Course Outcome

CO	Statements
CO1	understand the International Financial Reporting Standards (IAS or IFRS) and their application to the companies who use them
CO2	prepare the mandatory financial statements, according to the IFRS
CO3	trieve, analyze and synthesize data and information with the use of necessary technologies

BBAB3106 Multinational Business Finance 6+0+0

Objective: The course has been designed to familiarize the students with International Monetary System and Financial Institutions. Functioning of the Foreign Exchange Markets and Financial Management of a multinational firm will be the essential component of this course.

Course Outcome

CO	Statements
CO1	Knowledge about international finance agencies
CO2	Forecasting foreign exchange rates
CO3	Can handle – Problems and issues in foreign investment.
CO4	Manage payment settlements

BBAB3107 International Joint Ventures, Mergers & Acquisitions 6+0+0

Objective: This course is designed to provide an understanding of the essential elements of Joint Ventures, Mergers and Acquisitions with the basic methods of valuation, postmerger valuation, methods of payment and financing options at global level.

Course Outcome

CO	Statements
CO1	develop and implement successful strategies for company's international business growth
CO2	forecast the possible obstacles in the process of entering an international alliance, merger or an acquisition
CO3	conduct comparative analysis of alliances, M&As with other company's international business growth options
CO4	choose a target company | companies best suitable for a merger, acquisition or a partnership

BBAB3108 Research Project 0+0+6

Course Objective:
The course is intended to develop requisite expertise in students to handle research projects independently

Course Outcome

CO	Statements
CO1	Carry out a substantial research-based project
CO2	Demonstrate capacity to lead and manage change through collaboration with others
CO3	Demonstrate an understanding of the ethical issues associated with practitioner research

CO4	Analyse data and synthesize research findings

B.Com.

Programme Objectives;

The programme of B.Com may be viewed as an intermediate step towards pursuing a master's degree in commerce or pursuing a career organizations. The programme aims to satisfy the demand for skilled and well-honed commerce professionals in the industry in general and in the holistic world of Indian corporates in particular. Following objectives are enumerated for the programme

- To impart the basic knowledge in the field of commerce
- To develop Industry ready professionals
- To empower learners with appropriate communication, professional and life skills
- To impart Information Communication Technologies (ICTs) skills, including digital literacy and competencies in the field of commerce
- To pursue higher studies and develop research skills in the specified field
- To develop entrepreneurial skills focusing on innovation in the field
- To inculcate professional ethics, values in order to work in diversified cultural milieus

Program Outcomes:

PO	**Outcomes**
PO1	**Knowledge:** demonstrate acquired knowledge in the field of commerce: principles, process, theories, etc.
PO2	**Professional :** engage the professional skills in the field of commerce
PO3	**Effective Communication, Professional and life Skill:** effectively engage in communication to share thoughts and ideas
PO4	**ICT**: able to use various communication technologies and ability to use various software for analysis
PO5	**Leadership:** able to lead with appropriate vision
PO6	**Critical/ Reflective thinking:** able to think critically in professional life
PO7	**Entrepreneur:** demonstrate the skills of on an entrepreneur to start a venture
PO8	**Learning and Research**: develop a sense of inquiry and investigation life long
PO9	**Ethics:** Follow high ethical standard and appreciate the value system of different cultures

Programme Specific Outcome

PSO1: acquire and able to utilize fundamental knowledge on commerce and related areas-concepts, principles and processes.

PSO2: able to handle the professional jobs in different organizations

PSO3: able to carry out effective communication; listening, comprehending, reporting and presenting with societal and the environmental considerations in the industry

PSO4: demonstrate ICTs competencies including digital literacy required in the industry

PSO5: able to lead a team at the work front

PSO6: able to demonstrate critical thinking in the field of commerce

PSO7: able to carry out entrepreneurial ventures successfully.

PSO8: pursue acquiring knowledge throughout life in the discipline and carry out research in the field of commerce

PSO9: become ethically committed professional and entrepreneur adhering to the human values, the Indian culture and the Global culture.

Mapping PSOs with POs (Correlation)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
PSO1									
PSO2									
PSO3									
PSO4									
PSO5									
PSO6									
PSO7									
PSO8									
PSO9									

Course Outcomes:

Course Outcomes (COs)	**Competency/skill**
CO1	Knowledge
CO2	Analytical and Creative Thinking
CO3	Problem Solving

CO4	Leadership & Management
CO5	Domain Skill/Competency
CO6	Ethical
CO7	Information Literacy
CO8	Employability skill/ Higher study/ Entrepreneurship

BBAR1101 Proficiency in English 2+0+0

Course Objective:

This course is designed to enhance the basic language skills viz. listening, speaking, reading and writing of learners which are identified as the basic proficiency in English. The main objective of this course is to provide a rich linguistic environment in a class which will allow students to adequately practice Basic English language proficiency (EPT) including a range of language functions simulating real life situations. This in turn is expected to help learners to function confidently in social spheres, both in familiar and unfamiliar environments.

Course Outcome:

CO	Statements
CO1	demonstrate and apply appropriate study skills for success
CO2	Further it employs a writing process and demonstrate the ability to write clear sentences and construct paragraphs and essays that effectively make use of supporting details, examples, and evidence

BBAR1103 Management Principles and Applications 4+0+0

Course Objective:

To acquaint the participant with the concept of management principle and its application in the organization. The course aims at providing theoretical knowledge and practical skills in the area of management principles and to hone the skills of students for meeting the requirements for emerging markets and business.

Course Outcomes:

CO	Statements
CO1	Gain knowledge on the aspects of management, its growth and development, organizing, staffing and how it is initiated in an organization which will help in getting employment.
CO2	Management functions and motivational theories will help in developing skills of the students in managing the employees in the organisation.

CO3	Overall understanding the concepts will help the students in starting their own business

BBAR1105 Computer Application in Business 0+0+4

Coures Objective: Upon completion of the course, the student is expected to be able to identify and utilize appropriate technology for effective decision-making and improved performance, having mastered the Microsoft Office topics presented in the following course modules:

Microsoft Word: word-processing skills including creating, editing, formatting, enhancing, and sharing documents.

Microsoft Excel: spreadsheet skills including creating and editing formulas, functions, charts, and working with worksheets and tables.

Microsoft PowerPoint: presentation skills including creating and editing a presentation, presentation development, presentation design, and multimedia tools.

Course Outcomes:

CO	Statements
CO1	Students will be able to use of Microsoft word.
CO2	Students will be able use of Microsoft Excel.
CO3	Students will get familiar with the use of Microsoft PowerPoint.
CO4	Gain familiarity with the concepts and terminology used in the development, implementation and operation of business computer applications

BCFA1102 Financial Accounting I 4+0+0

Course Objectives:

- To give an insight into the basics of Accounting Concepts and Principles to Prepare to Students to have the foot hold in Accounts
- To develop conceptual knowledge about the preparation and use of financial statements.

Course Outcome

CO	Statements
CO1	Ability to use basic accounting system to create (record, classify, and summarize) the data according to accounting concepts, principles, and frameworks to analyse and effectively communicate information to a variety of audiences.

CO2	Gain fundamental knowledge on accounting equation to analyse the effect of business transactions on an organization's accounting records and financial statements.
CO3	Develop financial statements in accordance with appropriate standards in relationship to decision making.
CO4	use accounting information to solve a variety of business problems.

BBAR1106 Business Mathematics 4+0+0

Course Objectives:

The objective of this course is to familiarize the students with the basic mathematical tools, with an emphasis on applications to business and economic situations.

Course Outcomes:

CO	Statements
CO1	Define basic terms in the areas of business calculus and financial mathematics,
CO2	Solve problems in the areas of business calculus, simple and compound interest account, use of compound interest account, loan and consumer credit,
CO3	Connect acquired knowledge and skills with practical problems in economic practice.

BCFA1104 Business Economics 6+0+0

Course Objectives:

To expand the students' knowledge in the field of microeconomics and to make them ready to analyze real economic situations and to understand the concept of Macro Economics and its usefulness in the current economic scenario, for a student to comprehend its application in the real-world scenario.

Course Outcome

CO	Statements
CO1	Identify and evaluate the complexities of business environment and their impact on the business.
CO2	Analyze the relationships between Government and business and understand the political, economic, legal and social policies of the country.
CO3	Analyze current economic conditions in developing emerging markets, and evaluate present and future opportunities.
CO4	Gain knowledge about the operation of different institutions in international business environment.

FCMG0115 Human Rights (FC) 1+0+0

Course Objective : The course is an introduction to human rights. Human beings are rational beings. They by virtue of their being human possess certain basic and inalienable rights which are commonly known as human rights. Human Rights are defined as all those rights which are essential for the protection and maintenance of dignity of individuals and create conditions in which every human being can develop his or her personality to the fullest extent. The purpose of this course is for students to gain a holistic view of human rights and their implications.

Course Outcome :

CO	Statements
CO1	students would have an understanding of human rights, its history, characteristics, types, protection, violation and the legal framework for their protection, therefore, a fair knowledge of the Universal Declaration of Human Rights.

BBAR1201 Reading to Writing 2+0+0

Course Objectives:

- To acquaint the students with reading comprehension strategies and skills that facilitate their understanding and analyzing of written texts effectively and easily;
- To cultivate in the students the love for reading, and developing their oral and silent reading skills; also training students on critical reading and thinking.
- To develop the students' four basic skills (listening, speaking, reading and writing);
- To introduce texts containing new ideas and concepts and helping the students to make use of and build on their prior knowledge to understand the texts and gain more knowledge about the topics.
- Also to teach students how to connect the ideas and concepts to real life experience;

Course Outcome

CO	Statements
CO1	Develop reading skills and reading speed
CO2	Develop abilities as critical thinkers, readers and writers
CO3	Attain and enhance competence in the four modes of literacy: writing, speaking, reading & listening
CO4	Communicate appropriately, accurately and effectively in real life

BCOR1202 Business Law 6+0+0

Course Objective:

The objective of the course is to impart basic knowledge of the important business legislation along with relevant case law.

Course Outcomes:

CO	Statements
CO1	Define basic terms, values and laws in the area of business law,
CO2	Describe methods of applying principles and provisions of business law, compose simple contracts,
CO3	Asses the correctness of applying specific laws to specific cases and choosing the most appropriate one

BBAR1203 Business Statistics 6+0+0

Course Objective:

The objective of this course is to familiarize students with the basic statistical tools used for managerial decision-making.

Course Outcomes:

CO	Statements
CO1	Produce appropriate graphical and numerical descriptive statistics for different types of data.
CO2	Use simple/multiple regression models to analyse the underlying relationships between the variables through hypothesis testing.
CO3	Conduct and interpret a variety of hypothesis tests to aid decision making in a business context.

BBAR1208 Introduction to Banking 4+0+0

Course Objectives

- To provide the student an understanding of banking system in India.
- The conceptual and legal parameters of day to day banking.
- To provide knowledge about different products of a Bank including Deposits and Advances.
- New emerging dimensions in banking system including e-commerce and e-banking.

Course Outcome

CO	Statements
CO1	Learn to know basics of Banking in India
CO2	Have an understanding about basic terminologies in Banking
CO3	Understand about various banking products including digital products

BBAR1206 **Business Environment** **4+0+0**

Course Objective:

The objective of the course is to impart basic knowledge of the important business legislation along with relevant case law.

Course Outcomes:

CO	Statements
CO1	Define basic terms, values and laws in the area of business law,
CO2	Describe methods of applying principles and provisions of business law, compose simple contracts,
CO3	Asses the correctness of applying specific laws to specific cases and choosing the most appropriate one

BCFA1207 **Financial Accounting II** **4+0+0**

Course Objectives:

The course will enable the students to maintain the accounts of partnership firms, branch accounts, departmental accounts and hire purchase accounts. The students will also be able to calculate the amount of claims in case of fire insurance policy and loss of profit policy.

Course Outcome

CO	Statements
CO1	Prepare accounting information for planning and control and for the evaluation of finance.
CO2	Familiarize the concept of Branch account and its system
CO3	Introduce the system of Hire Purchase and Instalment Accounting
CO4	Enable the students to understand partnership account from Admission to

FCMG0116 **Introduction to Ethics (FC)** **1+0+0**

Course Objective :

The course is an introduction to Ethics. This course will introduce the meaning of ethics and the historical development – utilitarianism, ethical relativism and virtue ethics. Will also examine some current ethical issues, especially in science and engineering. Questions which will be considered are: what is the good life? Do we have a moral duty to act in certain ways? Are there such things as natural human rights? Are some values more compelling than or better than others?

This course is designed to introduce undergraduate engineering students to the concepts, theory and practice of engineering ethics. It will allow students to explore the relationship between

ethics and engineering and apply classical moral theory and decision making to engineering issues encountered in academic and professional careers.

Course Outcome

CO	Statements
CO1	Demonstrate knowledge of important ethical systems
CO2	Demonstrate their respect of different ethical perspectives
CO3	Critique some aspects of an ethical position
CO4	Clearly formulate their ethical position on an issue and develop arguments based on sound inferences and clear premises (through project)

BBAR2203 Financial Management 6+0+0

Course Objective:
To familiarize the students with the principles and practices of financial management.

Course Outcomes:

CO	Statements
CO1	Demonstrate an understanding of the overall role and importance of the finance function.
CO2	apply best practices in financial management to make plans, organize projects, monitor outcomes, and provide financial leadership;
CO3	apply best practices to create, evaluate, and rebalance financial portfolios to achieve investment outcomes
CO4	Demonstrate basic finance management knowledge.

BBAR2106 Direct Tax 4+0+0

Course Objectives:
To provide the student an understanding of Income Tax provisions and computation of income under Indian Taxation Laws.

Course Outcome

CO	Statements
CO1	Understand the basic principles underlying the Income Tax Act and Compute the taxable income of an assesse
CO2	Carry out Tax Planning by taking the benefits of available deductions, Rebates and Reliefs as per Income Tax Act.
CO3	File Income Tax Return electronically, which is beneficial for personal and professional career.

BBAR2206 **Business Ethics & Governance** **4+0+0**

Course Objectives:

To provide the student an understanding of Income Tax provisions and computation of income under Indian Taxation Laws.

Course Outcome

CO	Statements
CO1	Understand the basic principles underlying the Income Tax Act and Compute the taxable income of an assesse
CO2	Carry out Tax Planning by taking the benefits of available deductions, Rebates and Reliefs as per Income Tax Act.
CO3	File Income Tax Return electronically, which is beneficial for personal and professional career.
CO4	

BBAR2211 **Advanced Excel** **0+0+4**

Course Objective

- Indicate the names and functions of the Excel interface components.
- Enter and edit data.
- Format data and cells.
- Construct formulas, including the use of built-in functions, and relative and absolute references.
- Create and modify charts.
- Preview and print worksheets.

Course Outcome

CO	Statements
CO1	Students will get more familiar with the use of Microsoft Excel.
CO2	Excel also contains fairly powerful programming capabilities for those who wish to use them that can be used to develop relatively sophisticated financial and scientific computation capabilities.
CO3	Gain familiarity with the concepts and terminology used in the development, implementation and operation of business computer applications.
CO4	Explore various methods where Information Technology can be used to support existing businesses and strategies.

BBAR2110 **Cost & Management Accounting** **4+0+0**

Course Objectives

- To understand the basic concepts and processes used to determine product costs,
- To be able to interpret cost accounting statements,
- To be able to analyze and evaluate information for cost ascertainment, planning, control and decision making, and
- To explain the concept and role of cost accounting in the business management of manufacturing and non-manufacturing companies.
- To define the costs and their impact on value creation in the manufacturing and non-manufacturing companies.
- Use accounting methods of cost calculation.
-

Course Outcome

After successful completion of the course, the student will be able to

CO	Statements
CO1	Express the place and role of cost accounting in the modern economic environment,
CO2	Select the costs according to their impact on business,
CO3	Differentiate methods of schedule costs per unit of production,
CO4	Differentiate methods of calculating stock consumption,

BBAR2108 Corporate Law 4+0+0

Course Objectives

- To understand and evaluate the legal framework of Corporate Environment in India and to gain elementary knowledge of Indian Corporate Law.
- To impart basic knowledge of the provisions of the Companies Act 2013 and the Depositories Act, 1996

Course Outcome

CO	Statements
CO1	Gain knowledge about general administration of Company Law including Corporate Structure.
CO2	Know about the uses and application of various documents in Corporate Sector
CO3	Understand the basics of control and management of the companies in India
CO4	Have knowledge about Dividend Distribution, Accounts, Audits and Liquidation of Companies.

FCMG0401 Gender Issues in Development (FC) 1+0+0

Course Objective

In the traditional social order women have been assigned a subordinate status in society for centuries. They have been deprived of many social privileges and suffered from

discriminations that prevented them from contributing to the development process. They have remained marginalized in society. To remedy the prevailing situation, gender concerns have become increasingly important in the development agenda in the last few decades. In spite of special policies and programmes being implemented, gender based injustice continues to exist and hinder development

Learning outcome

CO	Statements
CO1	Develop an understanding of perspectives on gender and development
CO2	Discuss in detail the gender question in selected development sectors and globalization
CO3	Familiarize with the different tools and techniques for gender planning, analysis and evaluation in the development sector
CO4	The course has three modules covering these three aspects of gender and development.

BBAR2209 E-Commerce 4+0+0

Course Objectives:

- To provide the students necessary knowledge and skills required for organizing and carrying out entrepreneurial activities
- To develop the ability of analyzing various aspects of entrepreneurship – especially of taking over the risk, and the specificities as well as the pattern of entrepreneurship development
- To provide the students an entrepreneurial way of thinking that will allow them to identify and create business opportunities that may be commercialized successfully.

Course Outcomes:

CO	Statements
CO1	Discuss the e-Commerce process
CO2	List the seven major elements of web design
CO3	Identify and explain fundamental web site tools including design tools, programming tools, and data processing tools.
CO4	Identify the major electronic payment issues and options

BBAR2107 Indirect Taxes / GST 4+0+0

Course Objectives:

- To make the students about the basic differences of earlier indirect tax system and present indirect tax system

- To give the students a general understanding of the GST law in the country and provide an insight into practical aspects of GST and equip them to become tax practitioners.

Course Outcome:

CO	Statements
CO1	Explain the structure of GST
CO2	Analyze the benefits of GST
CO3	Describe the functions, powers and structure of GST Council and GSTN
CO4	Define basic concepts and terms under CGST Act and IGST Act

BBAR2207 Quantitative Techniques for Business 4+0+0

Course Objectives:
To familiarize the student with the theoretical foundation of qualitative business research. To familiarize the students with different statistical techniques used in business decisions.

Course Outcomes:

CO	Statements
CO1	Define basic terms in the areas of business calculus and financial mathematics,
CO2	Connect acquired knowledge and skills with practical problems in economic practice.

BBAR3202 Entrepreneurship Development 6+0+0

Course Objectives
- To provide the students necessary knowledge and skills required for organizing and carrying out entrepreneurial activities
- To develop the ability of analyzing various aspects of entrepreneurship – especially of taking over the risk, and the specificities as well as the pattern of entrepreneurship development
- To provide the students an entrepreneurial way of thinking that will allow them to identify and create business opportunities that may be commercialized successfully.

Course Outcomes:

CO	Statements
CO1	Have the ability to discern distinct entrepreneurial traits
CO2	Know the parameters to assess opportunities and constraints for new business ideas.
CO3	Understand the systematic process to select and screen a business idea

CO4	design strategies for successful implementation of ideas

BBAR2210 Auditing 4+0+0

Course Objectives:

The course is designed with an objective to enable students to understand the way auditing is conducted and put them in a position to identify the areas of fraud and errors in the accounts and take corrective actions while presenting the audit report.

Course Outcomes:

CO	Statements
CO1	Articulate knowledge of fundamental audit concepts.
CO2	Apply critical thinking skills and solve auditing problems through the use of case studies.
CO3	Demonstrate the use of the Auditing, Assurance and Ethics Handbook.
CO4	Explain the legal framework under which Indian company audits are conducted and apply the professions code of conduct.

BBAR2109 Tally.ERP 9 0+0+6

Course Objectives

- To be familiar with Tally accounting software, keeping books of accounts using Tally
- To prepare Bank Reconciliation Statement using Tally
- To be familiar with Tally ERP (GST Enabled) version
- To maintain TDS records using Tally
- To carry on Payroll activities using Tally

Course Outcome

CO	Statements
CO1	Maintain books of accounts in a computerized system, helpful for personal & professional career
CO2	Prepare GST return with Tally which may be helpful for entrepreneurs and accounts professionals.
CO3	Gain practical knowledge of maintaining Payroll records.

BBAR3109 Corporate Accounting 4+0+0

Course Objectives:

To understand how to communicate financial information to parties outside the business organization like equity investors, creditors, employees, suppliers and clients

Course Outcomes:

CO	Statements
CO1	To understand the basic concepts corporate accounting,
CO2	To understand the basic concepts equity share, preference share and debenture,
CO3	To understand the basic concepts and able to interpret goodwill valuation,
CO4	To understand the basic concepts and able to interpret amalgamation,

BBAR3110 Financial Market Operation 4+0+0

Course Objectives:

To understand how to communicate financial information to parties outside the business organization like equity investors, creditors, employees, suppliers and clients

Course Outcomes:

CO	Statements
CO1	To understand the basic concepts corporate accounting,
CO2	To understand the basic concepts equity share, preference share and debenture,
CO3	To understand the basic concepts and able to interpret goodwill valuation,
CO4	To understand the basic concepts and able to interpret amalgamation,

BBAR3111 On Job Internship-I 0+0+12

Course Objectives: Internships enable students:

- To acquire skills, which cannot be learned in the classroom environment.
- To develop interpersonal skills, team-working skills, professionalism and customer management experience.
- To improve their communication, confidence and self-efficacy. Those with internship experience are more likely to find jobs and earn more

Course Outcome:

CO	Statements
CO1	Get Experience of working conditions on live projects of company.
CO2	learn soft skill viz. Self-Confidence, widen Strong Work Ethic toward work, Positive Attitude towards work, develop effective Communication Skills, Time Management Abilities, Problem-Solving Skills etc.
CO3	Find successful employment after graduation.

BBAR3209 Global Finance 4+0+0

Course Objectives:

To understand the historical perspectives of international monetary system and theories of exchange rate determination

Course Outcome

CO	Statements
CO1	To learn the most suitable techniques and strategies to be applied for risk management in the foreign exchange market
CO2	To analysis and management of country risk involved in investment decisions at multinational levels
CO3	
CO4	

BBAR3210 Banking Law & Practice 4+0+0

Course Objectives:

The main objective of this course is to provide the student an understanding of legal and regulatory aspects of banking.

Course Outcome

CO	Statements
CO1	Understand the legal and conceptual aspects of Banking Law in India
CO2	Gain practical knowledge about E-Banking and IT Systems in Indian Banks
CO3	Acquire knowledge about the Loans and Advances policies Banks in India.
CO4	Prepare themselves for careers in Banking Sector

BBAR3211 On Job Internship-II 0+0+12

Course Objectives:

To provide students live examples of the business with the help of real life documents and scenarios

Course Outcome:

CO	Statements
CO1	Get Experience of working conditions on live projects of company.
CO2	learn soft skill viz. Self-Confidence, widen Strong Work Ethic toward work, Positive
CO3	Attitude towards work, develop effective Communication Skills, Time Management
CO4	Abilities, Problem-Solving Skills etc.

MBA

Program Objectives:

The programme objective is to create management leaders who can navigate the ever-changing business landscape. The curriculum is continuously updated to bring in existing and emerging challenges and opportunities in the business environment, both nationally and internationally. The teaching methods are geared towards experiential learning. It is accomplished through interactive class room teaching: case study analysis, workshops, student projects, live industry interactions and more.

Relevant topics comprise legal aspects of marketing, ethical, social and environmental concerns in product, pricing, distribution and promotion decisions, socially responsible marketing; green marketing, cause relating marketing; social marketing, corporate governance and social responsibility of business, legal framework of business, e-business and cyber laws, labor and social security laws, ethical and legal issues in performance management, workforce diversity, role of ethics in organizational behavior, negotiation, international business; ethical and social considerations in strategic management and cross border ethics management.←Provide students with the opportunity to develop and broaden their management and leadership skills. ←Develop managerial knowledge and strategic agility, providing students with a broader skill set and a fresh perspective and encouraging them to seek out bold, innovative solutions for today's business and societal challenges.

Program Outcome:

Masters of Business Administration programme helps in

PO1: Critical Thinking and Decision Making: An ability to apply conceptual foundations to solve practical problems through appropriate decision making

PO2: Analysis of Business Environment: An ability to develop a systematic understanding of changes in business environment

PO3: Problem Solving: An ability to analyze a problem, and use the appropriate managerial skills for obtaining its solution

PO4: Application of knowledge: An ability to use information and knowledge effectively.

PO5: Effective Communication: An ability to communicate effectively.

PO6: Team Building: An ability to function effectively in a team

PO7: Project management and finance: Demonstrate knowledge and understanding of the management principles and managerial analysis skills. The same can be applied to one's own

work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO8: Professionalism: An understanding of professional integrity.

PO9: Ethics: Improves the ability to identify and address ethical issues and apply them in organizational settings.

PO10: Entrepreneurship: Starting one's own business as an entrepreneur

PO11: Higher Education and Research: Pursuing higher education for a career in teaching and research

Program Specific Outcomes (PSO)

PSO1: Students should demonstrate their critical-thinking and problem solving skills.

PSO2: Students should exhibit their knowledge of management principles.

PSO3: Students should manifest their leadership qualities.

PSO4: Students should prove an awareness of their own values.

PSO5: Students should show a sense of responsibility.

PSO6: Students should evince their ability to recognize when change is needed, adapt to change

PSO7: Provide a clear corporate roadmap for creating a career trajectory among the students

PSO8: carry out appropriate interventions

PSO9: involve in research related activities and show an inclination to contribute by becoming a cog in the wheels of institutions in the academic space

Mapping PSOs with POs (Scale of High, Medium and Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
PSO1	H	H	H	H	H	M	H	H	M	H	H
PSO2	H	H	H	H	M	M	H	H	M	H	H
PSO3	M	H	H	H	H	H	M	H	H	H	M
PSO4	M	M	M	H	M	H	M	H	H	H	M
PSO5	H	H	H	H	M	H	H	H	H	H	M
PSO6	H	H	H	H	M	M	H	H	M	H	H
PSO7	H	H	H	H	M	M	M	H	M	L	H
PSO8	H	H	H	H	M	M	H	M	M	M	M
PSO9	H	M	H	H	M	M	M	M	H	H	H

Course Outcomes:

Course Outcomes (COs)	Competency/skill
CO1	Knowledge
CO2	Analytical and Creative Thinking
CO3	Problem Solving
CO4	Leadership & Management
CO5	Domain Skill/Competency in the field of management
CO6	Ethical
CO7	Information Literacy
CO8	Adaptability and drive for adequate Change
CO9	Employability skill/ Higher study/ Entrepreneurship

MGGM1101 EVOLUTION OF MANAGEMENT THOUGHT (EMT) 2+0+0

Course Objectives: Management Thought is a basic course in General Management. The broad objective of the course is to understand how the solution to the "age old problems of allocating scarce resources to meet the needs and wants of organizations and people have evolved over time". The course will provide a brief overview of the contributions of pioneers in management discipline. It will help students to understand the concepts and linkages better when they are covered in different courses in subsequent terms. It is also expected that the students will develop an interest to read the original works for in-depth understanding of the management concepts.

Course Outcome:

CO	Statements
CO1	Explain and use the principles of management in different organizations
CO2	Describe the major influences on the development of management thought
CO3	Handle future issues that will affect the organizations with sound conceptual knowledge

Code: MGGM1102 BASIC COMMUNICATION SKILLS (BCS)

4+0+0

Course Objective: Focus on the basic communication skills required to manage the human resources of the organization, emphasis on the core areas of functional language and provide a useful strategy for self- improvement.

Course Outcome: After completion of this course students will be able to

CO	Statements
CO1	Demonstrate critical and innovative thinking.
CO2	Display competence in oral, written, and visual communication in organizations
CO3	Use current technology related to the communication field in organizations
CO4	

Code: MBDM1104 QUANTITATIVE TECHNIQUES

4+0+0

Course Objective: To acquaint the students with different application of quantitative techniques in business decision making.

Course Outcome: After the completion of the course, the students will be able to

CO	Statements
CO1	develop the skill in distinguishing different statistical techniques and its interpretation
CO2	carry out sample survey skill, tabulate and analyze the data
CO3	
CO4	

Code: MGGM1104 MANAGERIAL ECONOMICS

4+0+0

Course Objective:

a) To equip the manager with the methodology of decision making using the concepts of Micro Economics.

(b) To help the students understand the working of the markets, the determination of prices and the techniques of decision making that the players in the market can adopt for sustainability

Course Outcome:

After the completion of the course, students will be able to

CO	Statements
CO1	develop the skill to analyze real-world business problems with a systematic theoretical framework of economics
CO2	design competition strategies, including costing, pricing, product differentiation, and market environment according to the nature of products and the structures of the markets that will help them to be entrepreneurs in future
CO3	make optimal business decisions by integrating the concepts of economics and statistics which is required by the present age industries
CO4	

MGDA1109 Data Analysis through Microsoft Excel 0+1+1

Course Objective: To familiarize the basic concepts of excel and enable quantitative analysis by using excel worksheet.

Course Outcome:

After the completion of the course, students will be able to

CO	Statements
CO1	gain skill of entering data in excel sheet
CO2	Students will be able to analyse the data by using various statistical tool
CO3	
CO4	

MGFM1101 ACCOUNTING FOR MANAGERS (AM) 4+0+0

Course Objective:
This course 'Accounting for Managers' has been designed to enable the students to acquire the skills necessary to prepare, use, interpret and analyze financial information.

Course Outcome:
After the completion of the course, students will be able to

CO	Statements
CO1	demonstrate progressive cognitive domain development of knowledge, comprehension, and application of rational economic decision making using: accounting discipline language, methods of classification, standards and computational procedures .
CO2	recognize commonly used financial statements, their components and how information from business transactions flows into these statements
CO3	demonstrate knowledge of preparation of Financial Statements and or financial schedules in accordance with Generally Accepted Accounting Principles through analysis and synthesis of information as well.
CO4	relevant financial accounting career skills, applying both quantitative and qualitative knowledge to their future careers in business.

MGMK1101 MARKETING MANAGEMENT (MM) 4+0+0

Course Objective:
a) To familiarize the students with the concepts and theories and strategies of marketing.
b) To focus on the application of these concepts to various marketing contexts
c) To understand the dynamic nature of environment where marketing decisions are made
d) To effectively manage the marketing mix
e) To focus on the emerging areas of marketing

Course Outcome:
After the completion of the course, students will be able to

CO	Statements
CO1	demonstrate the skill to interpret complex marketing issues facing a variety of enterprises they would be employed in or setting up as entrepreneurs and offer solutions using relevant theories, concepts, methods, and ethical frameworks
CO2	formulate and defend marketing decisions involving real-world marketing problems with incomplete information
CO3	improve skills in group problem-solving, and, oral and written communication
CO4	generate and analyse data/ information needed to make informed problem solving in marketing using appropriate methodology.

MGGM1105 ORGANIZATIONAL BEHAVIOR (OB) **Credit: 4**

4+0+0

Course Objective:

Organizational Behavior (OB) is a field of study that investigates the impact that individuals,groups, and structure have on behavior within an organization. Then it applies that knowledge tomake organizations work more effectively. This course will expose students to gain knowledge on the diversified behavioral science theories and its applications in organizations.

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	analyze and compare different models used to explain individual behaviour
CO2	explain group dynamics and demonstrate leadership skills required for working in groups in organizations
CO3	resolve conflict, motivate the employees, handle stress and communicate effectively
CO4	mange diversified workforce in workplace

FCMG0115 **HUMAN RIGHTS**

Course Objective : The course is an introduction to human rights. Human beings are rational beings. They by virtue of their being human possess certain basic and inalienable rights which are commonly known as human rights. Human Rights are defined as all those rights which are essential for the protection and maintenance of dignity of individuals and create conditions in which every human being can develop his or her personality to the fullest extent. The purpose of this course is for students to gain a holistic view of human rights and their implications.

Course Outcome :

After the completion of the course,

CO	Statements
CO1	students would have an understanding of human rights, its history, characteristics, types, protection, violation and the legal framework for their protection, therefore, a fair knowledge of the Universal Declaration of Human Rights.
CO2	
CO3	
CO4	

MGIT1202 MANAGEMENT INFORMATION SYSTEM: (MIS)

2+0+0

Course Objective:
Management Information systems (MIS) are like the nervous systems of the organizations, which provide the organization with ability to respond to changing business environment in a strategic way. MIS provides the crucial information needed to take informed decisions.

Course Outcome:

After the completion of the course, students will be able to

•

CO	Statements
CO1	Utilize Management Information Systems in achieving business competitive advantage through informed decision making.
CO2	analyze and synthesize business information and systems to facilitate evaluation of strategic alternatives.
CO3	effectively communicate strategic alternatives to facilitate decision making.
CO4	

MGGM1206 COMMUNICATION PERSPECTIVE OF MANAGEMENT (CPM)

2+0+0

Course Objective:
Provide a working knowledge of communication issues and skills required for managers, boost personal, oral, written and visual communication skills through strategic approach.

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	communicate effectively in organizations
CO2	write business proposals and reports
CO3	carryout effective negotiations required in organizations
CO4	

MGHR1201 HUMAN RESOURCE MANAGEMENT

4+0+0

Course Objective:
a) To expose the students to the intricacies of Human Resource Management practices and Human behavior at work.
b) To provide theoretical knowledge and practical skills in the area of HRM.

c) To expose the students to the legal framework of HRM and its application.
d) To stimulate analytical thinking, Problem solving, Communication skills and team orientation among students for meeting the HR requirements.

Course Outcome:

After completion of this course students will be able to

-

CO	Statements
CO1	Carry out human resource planning and Job analysis
CO2	Develop, implement and evaluate recruitment and selection; employee orientation; training, and development programs.
CO3	Facilitate and support effective employee relations
CO4	Handle industrial relations in organizations

MGGM1207 MANAGEMENT AND MARKETING RESEARCH (MMR)

4+0+0

Course Objective:

a) To sensitize students with a appropriate research design and research technique
b) To enable them to conduct investigation within and outside their organization by applying the concepts of Marketing research

Course Outcome:

After the completion of the course, students will be able to

CO	Statements
CO1	plan and undertake qualitative or quantitative Market Research and demonstrate the ability to appropriately analyze data to resolve marketing issues.
CO2	critically analyze market research methods and understand their strengths and weaknesses.
CO3	understand how marketing research fits into the broader strategic planning process, with reference to existing theories, concepts and models from within the program.
CO4	

MGFM1202 FINANCIAL MANAGEMENT (FM) Credit: 4

4+0+0

Course Objective:

Developing skills for preparation and interpretation of business information apart from application of financial theory in investment decisions, with special emphasis on working capital management, Capital Budgeting and other concepts.

Course Outcome:

After the completion of the course, students will be able to

CO	Statements
CO1	demonstrate the applicability of the concept of Financial Management to understand the managerial decisions and corporate capital structure
CO2	apply the Leverage and EBIT, EPS analysis associated with Financial Data in the Corporates
CO3	analyse the complexities associated with management of cost of funds in the capital structure
CO4	demonstrate how the concepts of financial management and investment, financing and dividend policy decisions could integrate while identification and resolution of problems pertaining to LSCM Sector
CO5	demonstrate how risk is assessed

MGOM1201 PRODUCTION AND OPERATION MANAGEMENT (POM)

4+0+0

Course Objective:

The course is designed to acquaint the students with decision making in production and operation function of an organization.

Course Outcome:

After the completion of the course, students will be able to

CO	Statements
CO1	identify the elements of operations management and various transformation processes to enhance productivity and competitiveness
CO2	analyze and evaluate various facility alternatives and their capacity decisions, develop a balanced line of production & scheduling and sequencing techniques in operation environments
CO3	develop aggregate capacity plans and MPS in operation environments.
CO4	plan and implement suitable materials handling principles and practices in the operations.

MGGM1208 ECONOMIC ENVIRONMENT OF BUSINESS (EEB)

4+0+0

Course Objective:

a) This course exposes students to an overview of economic environment and draws out the relationship between crucial macroeconomic variables like the level of income, employment, prices, investment, money supply, trade and forex, etc.
b) To discuss the design of government policy measures in regulating and planning for the economy.
c) To address specific problems like inflation, growth and the control of business cycles with respect to the Indian economy.

d) To provide the students with a fundamental knowledge of the macro economy on the basis of which policy decisions can be analysed and business decisions can be made.

Course Outcome:

After the completion of the course, students will be able to

CO	Statements
CO1	gain knowledge on different macroeconomic concepts that will be used for business analysis
CO2	know the minor and major factors that affect the business
CO3	gain skill in managing own business
CO4	

MGGM1212 INDIAN SOCIETY AND CULTURE (ISC)

2+0+0

Course Objective:

a) Develop an understanding social environment
b) Develop an understanding of cultural environment
c) Understanding the linkages among social, cultural and business environment

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	Identify the socio-cultural issues prevalent in a community
CO2	Tackle the social issues effectively for growth of organizations
CO3	Display scientific temperament in solving socio-cultural issues in organizations
CO4	

MGGM1210 APTITUDE AND CAREER ENHANCEMENT-II

0+1+0

Course Objective:

a) To familiarize the students with the concepts of written test for corportae
b) To provide fundamentals about English , Reasonig and Aptitude

Course Outcome:

After completion of this course students will be able to

CO	Statements

CO1	Compete and qualify in the selection process conducted by different organizations
CO2	Solve the arithmetic problems in due duration
CO3	
CO4	

MBDM1202 OPERATION RESEARCH Credit: 2

2+0+0

Course objective : The intent of Operational Research is to learn about management and administration of socio-cultural behaviour and economic factors that exist as bottleneck to effective implementation and← to develop more effective approaches to the programming

Course Outcome:

After the completion of the course, students will be able to

CO	Statements
CO1	Identify and develop operational research models from the verbal description of the real system.
CO2	Understand the mathematical tools that are needed to solve optimisation problems.
CO3	Use mathematical software to solve the proposed models.
CO4	Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering

FCMG0401: GENDER ISSUES IN DEVELOPMENT

Course Objective

In the traditional social order women have been assigned a subordinate status in society for centuries. They have been deprived of many social privileges and suffered from discriminations that prevented them from contributing to the development process. They have remained marginalized in society. To remedy the prevailing situation, gender concerns have become increasingly important in the development agenda in the last few decades. In spite of special policies and programs being implemented, gender based injustice continues to exist and hinder development

Course Outcome:

After the completion of the course, students will be able to

CO	Statements

CO1	develop an understanding of perspectives on gender and development
CO2	discuss in detail the gender question in selected development sectors and globalization
CO3	familiarize with the different tools and techniques for gender planning, analysis and evaluation in the development sector
CO4	

MGGM1211 SUMMER INTERNSHIP PROGRAM (SIP)

0+0+4

Course Objective:

Develop and improve business skills in communication, technology, quantitative reasoning, and teamwork. Observe and participate in business operations and decision-making. Meet professional role models and potential mentors who can provide guidance, feedback, and support.

Course Outcome:

This is practical course. After completion of this course students will be able to

CO	Statements
CO1	communicate effectively (written and oral) in organizations
CO2	handle pressure at the work front by focusing on honesty and integrity
CO3	become self-disciplined, self-motivated and integrate theory and practice
CO4	display problem solving skills utilizing the theoretical framework learned in the classroom setting
CO5	develop appropriate work habits and attitudes necessary for job success.

MGGM2318 STRATEGIC MANAGEMENT AND ETHICS

4+0+0

Course Objective:

d) To familiarize the students about the basic concept of strategic management and the required tools and techniques for strategy analysis and implementation
e) To develop the skill of strategy analysis, choice and implementation for an organisation
f) To understand and apply the concept of ethics in a business

Course Outcome:

After the completion of this course, the students are expected to:

CO	Statements
CO1	conduct analysis of competitive situations of the enterprise they would be employed with, or the enterprise they world set up
CO2	demonstrate knowledge and ability to use different strategic frameworks and analytical tools
CO3	demonstrate knowledge and ability to formulate strategies and their

	implementation plans to improve organizational performance
CO4	understand the contemporary ethical and corporate governance standards and corporate social responsibility requirements

MGGM2317 APTITUDE AND CAREER ENHANCEMENT-II

0+1+0

Course Objective:

- To familiarize the students with the concepts of written test for corportae
- To provide fundamentals about English , Reasonig and Aptitude

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	Compete and qualify in the selection process conducted by different organizations
CO2	Solve the arithmetic problems in due duration
CO3	
CO4	

MGGM2314 CAREER COMMUNICATION & PROFESSIONAL SUCCESS LAB

0+0+2

Course Objectives

The course focuses on success in career and employment, the strategy to achieve success in job interview, the importance of presentation, the significance of verbal, vocal and visual elements in business presentation. This course also strengthens students' ability to write appropriate job-related messages.

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	communicate appropriately using the technology in organizational set up.
CO2	appear the interviews with confidence and become successfully
CO3	present the organization appropriately in business dealings
CO4	

MGMK2302 SALES AND DISTRIBUTION MANAGEMENT (SDM)

4+0+0

Course Objective:

- To expose course participants to the tools and strategies necessary for designing, motivating and evaluating sales and distribution management.
- To introduce course participants to national and international sales and distribution Problems and practices.

Course Outcome:
After completion of this course students will be able to:

CO	Statements
CO1	understand the roles and responsibilities of the Sales Managers.
CO2	manage and enhance the sales force productivity and performance.
CO3	design and implement distribution channel strategy.
CO4	manage the Channels efficiency and effectiveness; wholesaling, and retailing.

MGOM2302 LOGISTICS AND SUPPLY CHAIN MANAGEMENT (LSCM)

2+0+0

Course Objective:
This course is aimed at creating awareness on the desirability of supply chain management (SCM) concepts for the Indian Industry. The focus will be on integrated supply chain management systems. The integration of the physical (material flow) and virtual (information flow) value chain across multiple organizations will be highlighted. The emphasis will be on cross-functional approaches to supply chain management, including marketing, sales, research & development, finance and accounting, manufacturing/operations, and information technology. The participants will get a chance to rethink the way the organization integrates suppliers, production and distribution in the globally competitive economy.

Course Outcome:
After completion of this course students will be able to

-

CO	Statements
CO1	analyze the manufacturing operations of a firm
CO2	apply sales and operations planning, MRP and lean manufacturing concepts
CO3	apply logistics and purchasing concepts to improve supply chain operations
CO4	apply quality management tools for process improvement

MGGM2315 LEGAL ENVIRONMENT FOR ENTERPRISE

2+0+0

Course Objective:
To introduce the students to some of the most important laws of business, particularly in the areas of contract law, Company law for conducting business. To equip the students with the minimum legal framework for starting a business venture and running it successfully in conformity with legal parameters.

Course Outcome:
After completion of this course students will be able to

CO	Statements
CO1	pursue legal Career
CO2	go for Solo Practitioner
CO3	seek extracurricular opportunities to explore the intersection of entrepreneurship and law.
CO4	analyze business issues and to understand broader legal issues

MGGM2316 PROJECT MANAGEMENT Credits: 4
4+0+0

Course Objective:
Project Management is a fast-growing and increasingly 'professionalised' discipline with record numbers of practitioners now gaining the PMI certification. As a mainstream skill, critical to business success, and under closer scrutiny for the benefits it delivers, it's important the students of today – and practitioners of tomorrow – can rely on a comprehensive and contemporary text to support their learning. *It* takes a decision-making, business-oriented approach to the management of projects, which is reinforced throughout the text with current examples of project management in action. Upon completion of this course, attendees will be able to: Define and describe common project management terminology. Use a step-by-step process to manage projects faster while using fewer resources, Avoid common pitfalls and mistakes in managing projects, Apply the Tricks of the Trade® used by thousands of project managers around the world in the IT, IS, New Product Development, Financial Services, Manufacturing, Pharmaceutical and other industries.

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	describe a project life cycle, and can skilfully map each stage in the cycle and
CO2	develop an appropriate schedule
CO3	identify the resources needed for each stage, including involved stakeholders,
CO4	tools and supplementary materials
CO5	describe the time needed to successfully complete a project, considering factors

CO6	such as task dependencies and task lengths
Co7	provide internal stakeholders with information regarding project costs by
CO8	considering factors such as estimated cost, variances and profits
CO9	develop a project scope while considering factors such as customer requirements

MGMK2312 **RURAL MARKETING**

2+0+0

Course Objective:

1. To familiarize participants with environment, challenges, opportunities, strategies and methodology for emerging markets.
2. To develop skill sets to cater to the rural Indian market.

Course Outcome:

After completion of this course students will be able to

-

CO	Statements
CO1	Students will able to understand the concepts and techniques of marketing management and their application in rural marketing.
CO2	Understanding the rural marketing mix (4 A's) to meet the needs of rural consumers which will help the students in achieving employment in FMCG companies.
CO3	It will help any student who wants to become an entrepreneur and he/she wants its product would enter the rural market for promotion of his products and services.
CO4	It will help the students to enhance their skills so that they can become an excellent rural marketing executives.

3.

MGMK2302 SALES AND DISTRIBUTION MANAGEMENT (SDM)

4+0+0

Course Objective:

a) To expose course participants to the tools and strategies necessary for designing, motivating and evaluating sales and distribution management.
b) To introduce course participants to national and international sales and distribution Problems and practices.

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	Understand the roles and responsibilities of the Sales Managers.
CO2	Manage and enhance the sales force productivity and performance.
CO3	Design and implement distribution channel strategy.
CO4	Manage the Channels efficiency and effectiveness; wholesaling, and retailing.

MGMK2313 SERVICES MARKETING (SM)
2+0+0

Course Objective:
The course sensitizes participants about the services environment, competition, methods, strategies and methodologies. The aim is to impart skill sets that are required to understand, survive and flourish in the field of services marketing.

Course Outcome:
After completion of this course students will be able to

-

CO	Statements
CO1	explain the unique challenges of services marketing, including the elements of product, price, place, promotion, processes, physical evidence, and people.
CO2	understand the roles played by employees and customers during service delivery.
CO3	explain service blueprinting and its application across various service sectors.
CO4	design service quality measurements to build customer loyalty and evaluate the effectiveness and efficiency of customer service offerings.

1.

MGMK2314 CUSTOMER RELATIONSHIP MANAGEMENT (CRM)
2+0+0

Course Objective:
The course discusses the conceptual foundations of relationship marketing and its implications for further knowledge development in the field of business.It equips students with both a conceptual understanding and the knowledge pertaining to practical application of critical skills necessary for building and managing partnering relationships with customers and suppliers.

Course Outcome:

By the end of the course, the students should be able to:

-

CO	Statements
CO1	critically analyze any organization's relational strategies with stakeholder groups that affect how well it meets customer needs.

CO2	Formulate and assess strategic, operational and tactical CRM decisions.
CO3	Plan and conduct an investigation on aspects of CRM, and communicate findings in an appropriate format.
CO4	

MGMK2305 CONSUMER BEHAVIOR (CB)
2+0+0

Course Objective:
Understanding consumer behavior is a challenging & interesting experience, every marketer tries to know how consumers behave before, during and after purchasing any product or service. Insight gained from consumer behavior will lead the development of an effective marketing strategy that wins the heart & minds of today's discerning customer. The course will introduce course participants to the issues and models in consumer behavior help understand the diversity of the Indian market, the demographic & psychological differences that account for the same and how marketing strategies are crafted & executed based on a in depth understanding of Consumer Behavior.

Course Outcome:
After completion of this course students will be able to

-

CO	Statements
CO1	detect the relevance of consumer behaviour to the entire marketing process, the nature and stages of consumers' decision making and the factors influencing consumers' choices.
CO2	discover the knowledge of consumer behaviour on the development of marketing strategies including marketing communication, segmentation and target marketing.
CO3	apply the concepts and theories covered in the course to develop their own theories of consumer behaviour and devise effective solutions.
CO4	

MGMK2306 BRAND MANAGEMENT AND MARCOMM (BMM)
4+0+0

Course Objective:
a) To provides cutting edge knowledge about brand, branding & brand management
b) To gain knowledge about advertisement and its application in real world

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	understand and demonstrate knowledge on nature and processes of branding.
CO2	relate brand management activities across the overall organizational context and other business areas.
CO3	appraise key issues in managing brand portfolio and making strategic branding decisions.
CO4	

MGMK2307 BUSINESS TO BUSINESS MARKETING (B2BM)
2+0+0

Course Objective:
a) To understand the importantance of B2B marketing
b) To gain knowledge about analyzing business market & marketing suitable decisions

Course Outcome:
After completion of this course students will be able to

CO	Statements
CO1	Learn best practice frameworks and tools to succeed in rapidly evolving, complex B2B markets.
CO2	Sharpen critical analysis, problem-solving, and communication skills necessary to lead effective B2B marketing strategy design and execution.
CO3	Practice effectively choosing, creating and communicating customer value in B2B markets and converting that value into revenue growth and profitability.
CO4	

MGMK2315 RETAIL MANAGEMENT
4+0+0

Course Objective:
To learn the meaning of Retail and Retailing To provide emphasis on Retail Market Strategy and Consumerism To provide exposure to contemporary skills and practices in Retail Management To adopt the approaches, concepts, and theories to be more effective as a person and as a managerial leader.

Course Outcome:
After completion of this course students will be able to

CO	Statements
CO1	understand the concepts of effective retailing.
CO2	develop knowledge of various retail formats and understand the retail

	customer.
CO3	prepare to make merchandise plan and to procure right merchandise.
CO4	to acquire the required competencies for effective managerial communication and decision making with respect to retail sector.

MGMK2316 INTERNATIONAL MARKETING
4+0+0

Course Objectives:

a) To provide an exposure to the area of Marketing in the International perspective
b) To gain sound knowledge about international market ,marketing mix and practices

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	develop an understanding of major issues related to international marketing.
CO2	develop skills in researching and analyzing trends in global markets and in modern marketing practice.
CO3	assess an organization's ability to enter and compete in international markets
CO4	

MGMK2310 SOCIAL MARKETING
2+0+0

Course Objective:

This course is designed to provide students a general understanding to the discipline of social marketing. The course provides an acquaintance with basic concepts and techniques that social marketer would use to sketch a step-by-step process, so that any individual working for a cause in the area of public health and safety, environment, or community involvement and so forth, can plan and execute more effective social marketing campaigns.

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	understand key principles of "connected consumers" from psychological and sociological perspectives, and how these principles can be leveraged when developing social media marketing strategies.

CO2	understand how to use various social marketing channels to publish and disseminate relevant branded content in order to engage consumers and to increase social impact, influence, and value.
CO3	develop a strategic plan for identifying opportunities for implementing social marketing in a company.
CO4	

MGMK2311 DIGITAL MARKETING

2+0+0

Course Objectives:

1. To understand various concepts and importance of digital marketing
2. To visualize various application in diverse areas of sales & marketing.

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	use the Digital Marketing tools as a basic level.
CO2	propose the Digital Marketing communication programs.
CO3	evaluate the effectiveness of the Digital Marketing communication program.
CO4	

MGMK2317 GIS FOR MARKETING

2+0+0

Course Objective:

- To familiarize students with GIS technology and its application in recent business scenario
- To develop skill sets to cater to the Indian and Global market.

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	understand customers' demographics, behaviors, and purchasing patterns increase the chances of retaining them and finding more like them.
CO2	focus on customer marketing applications such as acquisition, marketing, messaging, purchasing, and retention.
CO3	

CO4	

MGMK2318 SERVICE MARKETING MANAGEMENT (SMM

4+0+0

Course Objective:

The objective of this course is:

a) To supplement basic marketing and marketing strategy courses by focusing on problems and strategies specific to marketing of services.
b) Problems commonly encountered in marketing services -- such as inability to inventory, difficulty in synchronizing demand and supply, difficulty in controlling quality -- will be addressed.
c) Strategies used by successful services marketers to overcome these difficulties will be discussed through case studies.

Course Outcome:

After this course the students shall be able to:

-

CO	Statements
CO1	explain the unique challenges of services marketing, including the elements of product, price, place, promotion, processes, physical evidence, and people.
CO2	understand the roles played by employees and customers during service delivery.
CO3	explain service blueprinting and its application across various service sectors.
CO4	design service quality measurements to build customer loyalty and evaluate the effectiveness and efficiency of customer service offerings.

MGFM2310 ADVANCE MANAGERIAL ACCOUNTING

4+0+0

Course Objective:

- To equip the students with various concepts, tools and techniques of management accounting which is essential for managerial decision making process.
-
- To understand budgetary control, marginal costing, preparation of cost sheet, standard costing. It will increase the managerial skills of the students.
- Students can analyse the financial statements by using ratio analysis, common size statement analysis, comparative analysis, funds flow statement analysis and also cash flow statement analysis.
- This course intends to involve students to apply different financial statement analysis techniques for evaluating live projects

Course Outcome:

After completion of this course students will be able to

CO	Statements
CO1	increase the analytical skills in finance which will help the students to start their own business or join in different companies as finance manager.
CO2	understand financial statement analysis will give them added advantages to increase the profit of the company, which is the main objective of any company.
CO3	develop skills in controlling the cost and maximising the profit of the company.
CO4	provide recommendations to improve the operations of organisations through the application of management accounting techniques.
CO5	manage accounting methods for both manufacturing and service industries.

MGFM2311 FINANCIAL DERIVATIVES (FD)
4+0+0

Course Objective: The purpose of this course is to provide the basic knowledge on derivative products such as forward, future, option & swap and to make the students aware about the on line trading on futures and options.

Course Outcome:
After completion of this course students will be able to

CO	Statements
CO1	demonstrate an understanding of the uses of financial engineering and risk management approaches and techniques used by modern organizations.
CO2	apply their knowledge of derivatives in solving problems involving financial risks including foreign exchange risk, interest rate risk, credit risk and portfolio risks.
CO3	make informed judgements on the use of derivative instruments.
CO4	evaluate, synthesise and communicate the ethical implications of financial risk management policies and practices to an intended audience.

MGFM2305 FINANCIAL INSTITUTIONS, MARKETS & SERVICES (FIMS)
4+0+0

Course Objective:

- To offer a comprehensive exploration of the revolutionary developments occurring in the Financial markets and institutions i.e., innovation, globalization and deregulation - with a focus on the real practices of financial institutions, investors, and financial instruments.

- Extensive coverage of different products and services operates in Indian Industrial Market.
- To provide a scope to analyze the Indian financial system in a broader prospective.

Course Outcome:

On successful completion of this course, the students will be able to

CO	Statements
CO1	understand financial system of Indian, banking and non-Banking Institutions, different financial and securities Markets and also the key terminology of financial market & financial services, which will help in employment opportunity.
CO2	apply various types of financial products and services provided by financial institutions for investment advisor's perspective to the various kinds of investors, which will help in enhancing the skill in the area of finance which will help in becoming an entrepreneur.
CO3	analyse and frame out the profitability of different investment alternatives to create different portfolios for client and company helping in enhancement of critical thinking and analysis skills.
CO4	

MGFM2306 COMMERCIAL BANKING AND ALM

4+0+0

Course Objective:

- To give a comprehensive overview of commercial banking and to understand the functioning of a Bank.
- To provide a thorough treatment of the emerging trends in Indian Banking especially Banking sector reforms, Basel-II, ALM .

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	understand the Regulatory Framework in the Indian Banking system, Regulatory Environment, Evaluation of Bank Performance.
CO2	analyse Asset/Liability Management (ALM) and apply various Techniques of Asset/Liability Management for smooth operation of the Bank. This will help in employability in Banking Sector.
CO3	examine the Investment Management, Lending Management: Liquidity Management and, Capital Management.
CO4	

MGFM2307 **INSURANCE AND RISK MANAGEMENT**

2+0+0

Course Objective:

- To understand the concept of risk and techniques for identifying, measuring and managing it.
- Insurance as a risk management tool will be discussed with references to its role, functions and basic principles as applicable to different classes of insurance.
- To understand the role of IRDA.
- To know different types of insurance prevailing in the insurance market.
- The course aims to provide the students with a broad understanding of risk and insurance as a means to manage it.

Course Outcome:

After completion of this course students will be able to

CO	**Statements**
CO1	make their carrier in Insurance sector as Risk manager, Compliance officer, Claims manager, Actuary and also as Loss control consultant.
CO2	use their skills to manage insurance entities, and can able to understand the economic implications of organizational design and structure in Insurance Sector.
CO3	to facilitate the students in their further studies on insurance and to make their carrier in Insurance sector.
CO4	

MGFM2308 **SECURITY ANALYSIS AND PORTFOLIO MANAGEMENT**

4+0+0

Objective:

- Students will develop the ability to make a choice of Equity & Debt instruments in a given situation.
- They will understand fundamental analysis and also different techniques of technical analysis.
- They will learn different models of portfolio management.
- They can Construct and Manage a Portfolio with a Long Term Investment Time Horizon with an end objective to maximize the Return and minimize Risk of the Portfolio.

- To understand the empirical and theoretical implications of the financial environment and valuation techniques on optimal portfolio management.

Course Outcome:
After completion of this course students will be able to

CO	Statements
CO1	start their own broking firm and can be an entrepreneur or join in a company as broker, financial analysist or financial advisor as per their interest.
CO2	use their analytical skill on valuations of financial instruments to analyse the market timings, so that the investors can earn high return with low risk.
CO3	evaluate financial markets, how securities are traded and also investor behavior.
CO4	understand the implications of the market efficiency on active portfolio management.

MGFM2309 PROJECT APPRAISAL & FINANCING (PAF)

4+0+0

Course Objective:

- To enable the students to acquire the skills necessary to prepare different projects & business plans.
- To focus on the analysis of technical and financial viability of starting, financing and managing the projects for its success.
- To explain identification of a project, feasibility analysis including market, technical and financial appraisal of a project.
- To make the students understand the relevance of alternative project appraisal techniques, financial structuring and financing alternatives.
- This course intends to involve students to apply appraisal techniques for evaluating live projects.

Course Outcome:
After completion of this course students will be able to

CO	Statements
CO1	do the feasibility analysis like market, technical and financial appraisal of a project. They can start up their own business.
CO2	prepare the DPR (Detailed Project Report). By submitting the DPR to the bank or financial institutions, they can get a loan for their start up project.
CO3	join in a company to manage the projects.

CO4	use their skills to evaluate live projects. They will be able to adopt appropriate techniques for Capital Budgeting decisions.

MGFM2312 CORPORATE RESTRUCTURING (CR)

4+0+0

Course Objective: To make students learn how to analyse the mechanisms underlying the creation of value in mergers, acquisitions and corporate restructuring. They will also study some instances of corporate restructuring.

Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements
CO1	understand how the various forms of corporate restructuring could impact shareholder value creation.
CO2	enhance their knowledge in the area of the role of Merchant Banks in Merger and Acquisition will help in employment opportunities.
CO3	apply financial models and formulae to evaluate key parameters in the restructuring analysis.
CO4	gain knowledge in the areas of powers of inquiry, logical thinking, and critical analysis of arguments and evidence. Interpret and evaluate theoretical arguments and empirical evidence.

MGFM2313 FINANCIAL PLANNING & WEALTH MANAGEMENT (FPWM)

4+0+0

Course Objective: To familiarize the students with various theories and practices of financial planning and wealth management.

Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements
CO1	understand the need and aspects of personal financial planning and the investment options available to an individual.
CO2	apply and identify the skill of risk and return of managing the financial planning.

CO3	analyse and determine the ways of personal tax planning, retirement and estate planning for an individual and design a financial plan. This will help in employability and entrepreneurship as well.
CO4	create a financial plan for a variety of individuals.

MGFM2314 CURRENT ASSETS MANAGEMENT

4+0+0

Course Objective: The purpose of this course is to acquaint the students with the techniques of managing corporate finance, the current assets and its components.

Course Outcome:
After Completion of this Paper students should be able to:

CO	Statements
CO1	evaluate comparative current asset management policies and their impact on the firm's profitability, liquidity, risk and operating flexibility.
CO2	evaluate the importance of effective current asset management and its role in meeting the firm's strategic objectives and its impact in value creation.
CO3	investigate funds flow cycles and their impact on current asset management objectives.
CO4	compare and contrast the relative merits of alternative current asset management policies and the likely short-term and long-term impact on the firm.

MGFM2315 Financial Analytics

4+0+0

Course Objectives:

1. Enable the students to acquire the skills necessary to evalute, interpret and project financial information by different analytical tools of finance.
2. Understand how to analyze and interpret the financial statements for various decision making purposes.
3. Learn the different tools and techniques for evaluating project involve in Capital Budgeting.
4. Evaluate and forecast stock market by using financial econometrics.

Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements

CO1	acquire the necessary skills to frame project financial statement and Forecasting by using different financial ratios and different analytical tools of finance.
CO2	use the different tools and techniques of Capital Budgeting for accepting or rejecting the projects. This will help in employability of the students.
CO3	apply tools of financial econometrics for evaluating and forecasting share prices in the stock market which will enhancing the skill in the area of financial analytics and will help in becoming an entrepreneur.
CO4	work comfortably with Microsoft Excel, Format spreadsheets in a professional way, Work with large amounts of financial data without difficulty for analysing and interpreting the financial statements for various decision making purposes.

MGOM2303 **SERVICE OPERATIONS MANAGEMENT (SOM)**
2+0+0

Course Objective:
Service Operations management is set within the wider business context, recognising the impact of other management functions and covering wider issues, such as organisational culture and design, people issues, and customer relationships. It Includes issues service management issues on different types of organizations, such as: the Internet, public and voluntary sectors, mass transport services, professional services, retailers, internet services, tourism and hospitality.

Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements
CO1	analyse different types of operations process on which operational capability can be based and the strategic implications of the process choice decisions can be made
CO2	understand how operational levers can be applied to the management of service operations and the proactive management of customer experience.
CO3	demonstrate knowledge and skills required to determine and optimal inventory management policy.
CO4	demonstrate knowledge and skills in the application of key operations scheduling methods to various types of processes.

MGOM2302 **LOGISTICS AND SUPPLY CHAIN MANAGEMENT (LSCM)**
2+0+0

Course Objective:
This course is aimed at creating awareness on the desirability of supply chain management (SCM) concepts for the Indian Industry. The focus will be on integrated supply chain management systems. The integration of the physical (material flow) and virtual (information flow) value chain across multiple organizations will be highlighted. The emphasis will be on cross-functional approaches to supply chain management, including marketing, sales, research & development, finance and accounting, manufacturing/operations, and information technology. The participants will get a chance to rethink the way the organization integrates suppliers, production and distribution in the globally competitive economy.

Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements
CO1	explain the important role of supply chain management in today's business environment.

CO2	become familiar with current supply chain management trends
CO3	understand and apply the current supply chain theories, practices and concepts utilizing case problems and problem-based learning situations.
CO4	

1.

MGOM2311 **TOTAL QUALITY MANAGEMENT (TQM)**

2+0+0

Course Objective:

Total Quality Management has ushered in a new philosophy into management thinking for successful running of organizations. It emphasizes organizations focus towards the customer and towards meeting their needs and aspirations. It focuses on bringing about continuous improvement in all its activities through involvement and empowerment of its employees, to understand the Total Quality Management concept and principles and the various tools available to achieve Total Quality Management, to understand the statistical approach for quality control, to create an awareness about the ISO and QS certification process and its need for the industries.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	evaluate the principles of quality management and to explain how these principles can be applied within quality management systems.
CO2	identify the key aspects of the quality improvement cycle and to select and use appropriate tools and techniques for controlling, improving and measuring quality.
CO3	critically appraise the organisational, communication and teamwork requirements for effective quality management
CO4	critically analyse the strategic issues in quality management, including current issues and developments, and to devise and evaluate quality implementation plans

MGOM2312 **TECHNOLOGY MANAGENT**

2+0+0

Course Objectives:

This is an introductory course on management of technology. Thus, most of the important issues and aspects of management of technology will be touched. At the end of the course,

students are expected to understand why technology is important, and how technology needs to be managed at organization/business level, sector/industry level and national level for competitive advantage of an organization and human development.

Course Outcome:

On successful completion of the course the learner will be able to

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CO	Statements
CO1	analyse the issues around defining 'technology', 'innovation' and 'innovation management'
CO2	able to identify appropriate technology for the organization after analysing the strength and weakness of the organization
CO3	guide the organization for technology transfer
CO4	

MGOM2305 PURCHASING AND MATERIALS MANAGEMENT

4+0+0

Course Objective:

The course facilitate learner to have exposure on concept and objectives of purchasing decision viz; classification, codification, specifications and standardization of materials, aid in effective purchasing in view of their economic importance. It gives a better understanding of topics such as negotiating skills, break-even analysis, and make-or-buy decision.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	understand the materials requirement planning technique (MRP)
CO2	analyse about the process of purchasing
CO3	identify the effects of overstocking and under stocking
CO4	take appropriate purchasing decisions

MGOM2306 ENVIRONMENT & INDUSTRIAL SAFETY

4+0+0

Course Objective:

The course interprets and simplifies the current thinking of the world?s leading safety management experts. The course is meant for safety professionals, line managers, trainers, HR professionals and heads of industrial establishments. From identification of common potential hazards, associated with entry into a confined space, falls and slips, electrocution, uncontrolled release of hazardous energies, material handling, disposal of waste materials, working with tractors, forklifts, gas cylinders and corrosive substances- the book is a repository of experiences, hazards and lapses.

Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements
CO1	identify, formulate, and solve broadly-defined technical or scientific problems by applying knowledge of mathematics and science and/or technical topics to areas relevant to the safety and health field.
CO2	formulate or design a system, process, procedure, or program to meet desired needs.
CO3	an ability to communicate effectively with a range of audiences.
CO4	understand ethical and professional responsibilities and the impact of technical and/or scientific safety and health solutions in global, economic, environmental, and societal contexts.

MGOM2307 BUSINESS PROCESS REENGINEERING AND SIMULATIONS
4+0+0

Course Objective:
To Understand what and how business processes can be radically improved, dramatically reducing process cycle time and cost, improving the quality of the process products or outcomes. To Emphasize challenges and opportunities for BPE/BPR across the process life cycle using *Electronic Commerce* (read Chapter 2) and *Intranet and Extranet technologies* To Understand and apply knowledge-based concepts, techniques, and tools for BPE/BPR centered on Electronic Commerce and network information system applications.

Course Outcome:
On successful completion of the course the learner will be able to

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CO	Statements
CO1	appreciate how BPR bridges the business operations and engineering of systems.
CO2	introduce BPR to reduce process cycle time and cost, and improving the quality of the process products or outcomes.

CO3	model current business processes and diagnose problems
CO4	model and develop improved business processes that require IT and organizational redesign

1.

MGOM2308 ENTERPRISE RESOURCE PLANNING (ERP)

4+0+0

Course Objective:

To familiarize participants with conceptual model of ERP and its evolution over a period of time; to be exposed to various world-class practices and their practical implications, and provide generalized understanding of the core logic of ERP culture; To understand the current ERP market scenario and strategies played by ERP vendors globally, especially in the Indian context.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	classify different processes of the organization and relationship among all processes.
CO2	examine systematically the planning mechanisms in an enterprise, and identify all components in an ERP system and the relationships among the components
CO3	describe the Generic Model of ERP and General ERP Implementation Methodology
CO4	apply the concepts of BPR, SCM and CRM

MGOM2309 PRODUCTION PLANNING AND INVENTORY CONTROL

4+0+0

Course Objective:

This course offers an up-to-date look at production systems, the dynamic backbone of modern manufacturing and service. Based upon their experience as teachers, engineers in industry, and consultants, the authors provide a problem-driven approach to planning, controlling, and integrating production in a changing global environment. It include the evolution of production systems, problem solving, forecasting, aggregate planning, inventory, materials requirements, planning, scheduling, project management, and integrated production planning and control.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	understand the major production planning and control issues in both service and manufacturing industries.
CO2	present and illustrate qualitative and quantitative forecasting techniques and their influence on production planning and control.
CO3	solve inventory control and planning issues using either deterministic or stochastic modelling
CO4	identify, judge and give suggestions of the management of maintenance related risks

MGOM2310 SUPPLY CHAIN MODELLING

2+0+0

Course Objective;

Supply Chain Modelling illustrates the key drivers of good supply chain management in order to help students understand what creates a competitive advantage. This also provides strong coverage of analytic skills so students can gauge the effectiveness of the techniques. In order to help students see how all the pieces of the supply chain fit together, the strategic framework in this text identifies facilities, inventory, transportation, information, sourcing, and pricing as the key drivers of supply chain performance. Overall, the aim is to convey how these drivers may be used on a conceptual and practical level during supply chain design, planning, and operation to improve performance.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	understand the structure of supply chains and the different ways through which supply chains can become competitive in the market
CO2	explain how to use the levers of the logistics strategy to redefine the points necessary to make this harmonization
CO3	analyse the importance of the term “value creation” and to propose actions in the field of management of logistics costs towards the creation of value
CO4	

MGHR2302 INDUSTRIAL RELATION AND LABOUR LAWS

4+0+0

Course Objective:

a) This course is designed to develop in the students an understanding of the concept of Industrial Relations and the Labour laws and their applications.
b) The course objective is to expose the students to the industrial relations and labour laws with thrust on welfare, wages, industrial relations and social security laws.
c) Further, an attempt will be made to expose the students in select laws relating to unorganized sector. Knowledge of law is highly essential as minimum compliance of Law will be expected from HR managers. It becomes imperative for handling unions and meeting the statutory compliances.
d) The Course shall emphasize on the institutional framework for protection of labour rights (including collective bargaining, trade unions, and dispute settlement mechanisms), foundational concepts like industry, workmen and industrial dispute and the key substantive rights guaranteed to the organised sector workers in India.

Course Outcome:

After the completion of this course students will be able to

CO	Statements
CO1	handle industrial disputes with detailed knowledge of actual organization scenarios and long-term impact of resolutions of problems both for employees and employer
CO2	Provide compensation benefits to in case of employment injury.
CO3	apply the skills of negotiations and persuasions effectively
CO4	create conducive atmosphere for participatory management and employee satisfaction in organizations

MGHR2315 COMPENSATION AND REWARD MANAGEMENT (C&RM)

2+0+0

Course Objective

1. The purpose of this course is to provide students a solid understanding of the art of compensation practice and its role in promoting companies' competitive advantages.
2. The focus of the course will be to examine the content of compensation practice, the criteria used to compensate employees, compensation system design issues, employee benefits, and contemporary challenges in compensation management that professionals will face well in the 21st century.

Course Outcome:

After completion of the course, the students will be able to

CO	Statements

CO1	Carry out compensation management effectively relating to behavioural theories and concepts
CO2	Identify the internal and external environmental factors that have an impact on the pay structure
CO3	Designing a pay structure taking account of the company environment
CO4	

MGHR2314 PERFORMANCE MANAGEMENT (PM)
2+0+0

Course Objective:

a) The objective of this course is to develop a generic understanding of the various human resource management systems and processes in place which coordinates and facilitates the strategic as well as day-to day operations of the organization.
b) The course aims to provide the students with a firm grasp of the building blocks of HRM and also looks to provide a strong platform to the students for undertaking HR policy formulation and implementation, irrespective of the fact whether the students work in the HR domain or in non-HR sectors.

Course Outcome:

After successful completion of this course, students will be able to

CO	Statements
CO1	Design an organization's performance management process that is compliant with law and supports organizational mission and strategy
CO2	Compare and contrast various organizational performance management programs and best practices and define attributes of effective performance management systems
CO3	Employ job-related performance standards and performance indicators that reflect the employees range of responsibilities
CO4	

MGHR2305 ORGANIZATION CHANGE AND DEVELOPMENT

4+0+0

Course Objective:

a) It is often said that change is the only reality, rest is subject to change. History has time and again proven that the process of change is inevitable in the progress of mankind.
b) The ability of the human race to innovate has brought about radical transformation of society. All the countries of the world are undergoing some kind of change which is especially true in the context of organizations. At the same time we do notice resist to change due to its displacing effect overtime.
c) As change in organization is inevitable, it's the primary responsibility of the managers to manage change towards development not deterioration.

d) The purpose of this course is to learn to plan and implement change at the individual, group and organizational level.
e) The course is designed to help the students to develop as potential change agents and organization development professionals.

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Bring out appropriate changes in the organization focusing on theories and models of change
CO2	Become change agent in the organization and lead the changing process
CO3	Carry out turn around management
CO4	Introduce specific interventions in organization analysing the situation in the organizations

MGHR2307 INTERNATIONAL HUMAN RESOURCE MANAGEMENT

2+0+0

Course Objective:
1. The current economic climate as a result of globalization forcing many companies to see trans frontier operations as a logical, even unavoidable step in developing their own competitive potential.
2. Cross-border operations require not only students understand a sound strategy, but also the people and the organization that can implement it. In this context, the course is designed to help the students understand the consequences of the internationalization and human resource management and to make the students acquainted with internationalization process and complexity associated with unstructured, often paradoxical circumstances and events for organizations to operate effectively.

Course Outcome:

On successful completion of the course students will be able to:

CO	Statements
CO1	Differentiate between domestic and international HRM
CO2	Handle the role of the HR Manager in an International context
CO3	Design Human Resource activities in an International Context
CO4	become culturally sensitive in an international assignment
CO5	critically appraise the impact of cultural and contextual factors in shaping human resource practices in MNCs

MGHR2308 KNOWLEDGE MANAGEMENT

2+0+0

Course objective :

- The course will enable the students to understand the underlying perspective of knowledge management.
- The course will expose the students to understand the various theories related to creation and management of knowledge.
- The student will be exposed to the practices adopted by knowledge organizations.

Course Outcome:

After completion of the course students will be able to

CO	Statements
CO1	Critically apply theories and models to organisations
CO2	Design and implement successful strategies for leveraging them
CO3	analyze and discuss issues related to information and knowledge management infrastructure
CO4	

MGHR2312 HUMAN RESOURCE PLANNING & SOURCING

4+0+0

Course Objective:

a) The students will be able to understand the techniques for analysing the requirements & the availability of employees at all times throughout the organization.
b) To apply principles related to the demand & supply of labour.
c) To identify the role & responsibility in employee development process.

Course Outcome:

After completion of the course students will be able to

CO	Statements
CO1	Forecast the demand and supply of human resources to the organization
CO2	Contribute to the development, implementation, and evaluation of employee recruitment, selection, and retention plans and processes.
CO3	

CO4	

MGHR2311 TRAINING AND DEVELOPMENT
2+0+0

Course Objective :

1. The course will enable students to understand and appreciate the basic concepts and related terminology associated with training and development.
2. The course will enable a comprehensive understanding of training as a strategic stimulator of organization performance.
3. The course will enable the students to understand and explain the different stages of the training process and the challenges associated with it.
4. The course will enable students to design a training Unit and impart training in selected areas

Course Outcome:
Course Outcome:
Upon successful completion of this course, the student will demonstrate the ability to:

CO	Statements
CO1	explain the role of training and development in human resources management
CO2	describe the psychology of the learning process on which training is based
CO3	analyze the training needs of an organization
CO4	assess, design and implement various methods, techniques and sources of training

MGHR2313 LEADERSHIP DEVELOPMENT

2+0+0

Course Objective:

a) To facilitate the students to develop them as business leaders.
b) To gain an insight into leadership styles and behavior.
c) To learn the attributes to become successful team leaders.

Course Outcome:

After completion of this course, students will be able to

CO	Statements
CO1	develop critical thinking skills and lead the organization
CO2	develop an understanding of change processes and be able to think critically about obstacles to change.
CO3	Demonstrate organizational leadership capacity
CO4	

MGHR2310 **ORGANIZATION STRUCTURE & DESIGN (OSD)**
2+0+0

Course Objective:

a) This course aims to help the participants acquire a keener appreciation of organizations.
b) The organization theorists invariably clarify to the new enthusiasts that organization theory is not a collection of facts and are not useful techniques. However this course helps us to appreciate organizations, more deeply and comprehensively than one otherwise would. This is largely based upon patterns and regularities in organization design and performance.

Course Outcome:

Upon completion of this course the students will be able to:

CO	Statements
CO1	explain principles of organization structure and design; environment, strategy, technology, organizational culture, change, organizational and inter-organizational relationships, decision making hierarchies, bureaucracy, power, and politics.
CO2	explain various organization theories which enable managers to understand, predict, and influence organizational design/structure and development.
CO3	link organizational design to global business strategies and practices.
CO4	

MGHR2316 **HR Analytics**
4+0+0

Course Objective:

- To understand the concepts, tools and techniques of HR Analytics that could be applied as resource management evidence based.
- To understand HR reports & to understand the decisions technologies.
- Recognize the fundamental strategic priorities of the business and learn how to provide enhanced decision support leveraging analytics.
- Develop a structured approach to apply judgment, and generate insight from data for enhanced decision making.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	
CO2	
CO3	

CO4	

MGRM2305 RURAL IMMERSION PROGRAM (RIP)
4+0+0

Course Objective:

a) To have an experiential learning of the realities of the life of poor communities in rural areas and urban slums
b) To apply the management concepts and study the development organization
c) To undertake development action

Course Outcome:

This is practical course. After completion of this course students will be able to

- Communicate effectively with the community
- Carry out participatory planning with the community
- Develop strategies for intervention to solve social issues

CO	Statements
CO1	Analyse appropriate internal and external human resource metrics benchmarks and indicators.
CO2	Operate relational databases and make recommendations regarding the appropriate HRIS to meet organization's human resource needs.
CO3	Employ appropriate software to record, maintain, retrieve and analyse human resources information (e.g., staffing, skills, performance ratings and compensation information).
CO4	Apply quantitative and qualitative analysis to understand trends and indicators in human resource data; understand and apply various statistical analysis methods

MGRM2306 SUSTAINABLE LIVELIHOOD SYSTEM (SLS)
4+0+0

Course Objective:

To understand the basic livelihood systems of the people in rural and urban areas in general and that of poor people in particular

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Analyse the prevalent livelihood system operating in a community
CO2	Introduce and train people on alternative livelihood options.
CO3	
CO4	

MGRM2307 PUBLIC SYSTEM MANAGEMENT (PSM)
2+0+0

Course Objective:
To familiarise students with concept, policies and issues of public system management.

Course Outcome:
Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements
CO1	Analyse the theoretical foundations of the evolution of the concept of public systems management
CO2	Examine the nature and scope of public systems management
CO3	comprehend the basic principles of traditional public administration model and its limitations
CO4	Examine the changing character of public service

MGRM2308 MICRO FINANCE MANAGEMENT (MFM)
4+0+0

Course Objective:
To understand the principle and operation of micro finance industry.

Course Outcome:
Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements
CO1	utilize to accelerate the expansion of local microbusinesses
CO2	handle the process of finding loan recipients and delivering a microfinance pitch
CO3	measure the effects and value of individual microloans to businesses
CO4	

MGRM2309 NATURAL RESOURCE MANAGEMENT

2+0+0

Course Objective:

To familiarize the students with the complexities of Natural Resource Management (NRM), the role of NRM in people's life support system and economic development and the tools and techniques used in NRM.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Describe ecological processes, including human impacts that influence ecosystems change, natural succession and the future sustainability of natural resources.
CO2	Characterize natural resources and be able to quantify at least one of these resources.
CO3	Describe how the use, management and allocation of natural resources are affected by: laws, policies, economic factors (both market and non-market), and characteristics of private and public resource owners and users
CO4	Work effectively with, and within, interdisciplinary and diverse groups to resolve management problems and achieve management objectives.

MGRM2310 SOCIAL ENTREPRENEURSHIP

4+0+0

Course Objective

a) To familiarize the students about the basic concept of social entrepreneurship and Characteristics of leading social entrepreneurs
b) Understanding basic frameworks how social entrepreneurs effect change in poor communities
c) Developing business model of a social enterprise

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Differentiate between social entrepreneurship is and how it differs from business entrepreneurship
CO2	Identify areas of our economy/society where social entrepreneurs work
CO3	Identify characteristics of successful social entrepreneurs
CO4	Identify methods one can use to identify what one wants to do

MGRM2311 GENDER AND DEVELOPMENT

2+0+0

Course Objective:

1. Develop an understanding of perspectives on gender and development
2. Understand gender question in selected development sectors and globalisation
3. Familiarise with the different tools and techniques for gender planning, analysis and evaluation in the development sector

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Identify, categorize, and distinguish elements of the main theories associated with Women's and Gender Studies
CO2	Recognize societal institutions and power structures that occur within patriarchal society, and analyze the ways in which these institutions and structures impact the material realities of women's and men's lives differently
CO3	Carry out gender planning effectively
CO4	

MGHM2301 **HOSPITAL ADMINISTRATION**
4+0+0

Course Objective:

This subject will provide knowledge about the administration of hospitals

Course Outcome:

On successful completion of the course the learner will be able to

CO	**Statements**
CO1	Analyze the structure and interdependence of healthcare system elements and issues using critical thinking to formulate innovative system designs.
CO2	Create policy and processes and execute decisions in compliance with the legal, regulatory and ethical considerations inherent in managing healthcare systems and organizations
CO3	Integrate concepts of ethics, privacy, law and regulation to achieve optimal organizational effectiveness
CO4	

MGHM2302 **MANAGEMENT INFORMATION SYSTEMS FOR HOSPITAL**
2+0+0

Course Objective:

This subject will provide models of HIS and help the student develop a subsystem for healthcare management. It will be based OIL experiential learning where the student will develop a subsystem in all its aspects.

Course Outcome:

On successful completion of the course the learner will be able to

CO	**Statements**
CO1	Analyze existing systems and design technology solutions appropriate to the hospital
CO2	Effectively utilize database and database management systems to organize, store and retrieve data
CO3	Apply project management methods in complex systems
CO4	Work effectively in project teams to implement information technology- based

	solution

MGHM2303 **MANAGEMENT OF OUT-PATIENT DEPARTMENT**

4+0+0

Course Objective:

This subject will provide management of out patients in Hospitals

Course Outcome:

On successful completion of the course the learner will be able to

CO	**Statements**
CO1	Handle the outpatient department effectively
CO2	Deal the issues effectively in emergency services
CO3	Can plan, organize and supervise the activities of Minor Operation Theatre
CO4	Manage treatments of referral & cross referral cases

MGHM2304 **RISK AND DISASTER MANAGEMENT**

4+0+0

Course Objective:

Subject is intended to cover the Operations and Maintenance aspects with reference to minimum Utilization of resources in a hospital.

Course Outcome:

On successful completion of the course the learner will be able to

CO	**Statements**
CO1	Handle Security Management Effectively in Hospitals
CO2	Control and Prevent hospitals from getting infected
CO3	Plan and design fire protection in hospitals
CO4	Handel radioactive waste collection and disposal in hospitals

MGHM2305 **MANAGEMENT OF QUALITY**

4+0+0

Course Objective:

To provide basic knowledge on the concepts of Healthcare Quality Management towards continuous improvement of quality patient care.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Prepare quality policy and objectives for hospitals
CO2	Plan and organize quality accreditation
CO3	
CO4	

MGHM2306 **LEGAL AND ETHICAL ISSUES FOR HOSPITALS**

4+0+0

Course Objective:

To acquaint the students with various legal aspects concerning type and character of the health care organizations and its duties towards patients and its employees. To familiarize the students in matters of liability of hospital medical negligence and medical malpractice in diagnosis, administration of drugs, surgery etc.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Handle medico-legal issues effectively
CO2	Ensure appropriate patient relationship
CO3	Handle trade unions
CO4	

MGHM2307 **HEALTH INSURANCE**

2+0+0

Objective:

The primary aim of this subject is to acquaint students to the concept of health insurance, product development, and various health insurance products-both at individual and group level, the economic services of health insurance, underwriting .of health .insurance policies, marketing of insurance policies, claims management, third-party administration etc., so that the students are ready for the challenges of the healthcare insurance which is emerging as a sector holding great promise.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Ensure hassle free insurance facility in hospitals
CO2	Build appropriate relation with insurance providers
CO3	
CO4	

MGHM2308 **PROJECT MANAGEMENT IN HEALTH CARE**

4+0+0

Course Objective:

The primary aim of this subject is to acquaint students to the concept of Healthcare & Hospital Project

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Plan and implement health sector projects
CO2	Carry out feasibility analysis of health sector projects
CO3	Carry out demand analysis in health care sector
CO4	

MGHM2309 **MARKETING OF HOSPITAL SERVICES**

4+0+0

Course Objective :

This subject will give the insight into the application of marketing principles in various

situations in a Hospital environment

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Handle challenges in hospital services marketing
CO2	Design new hospital services
CO3	Engage appropriate channels for hospital service marketing
CO4	

MGHM2310 **CLINICAL, DIAGNOSTIC & THERAPEUTIC SERVICES**

4+0+0

Course Objective:

The primary aim of this subject is to acquaint students to Various Clinical Services provided hospitals

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Design and manage secondary and tertiary systems of medicine
CO2	Maintain hospital records appropriately
CO3	Handle specialist services effectively
CO4	

MGHM2311 **PATIENT CARE AND BEHAVIOUR**

4+0+0

Course Objective:

The primary aim of this subject is to acquaint students about Study of patient behaviour

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Motivate patients and instrumental in shaping positive attitude towards hospital

CO2	Carry out audit on patient behaviors
CO3	Handle the role of hospital administrator effectively
CO4	

MBDM2201 **WEB TRAFFIC GENERATION**

0+0+2

Objective: This value added course is designed to inclucate the practical skills, with the help of an instructor, in order to generate prospects to a brand or business in order to build engagement activities that will result in conversion of the prospect to a consumer.

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Understand how web traffic generation is important for business development.
CO2	Know the ways to get and increase traffic in any website.
CO3	Popularizing websites.
CO4	

MBDM2202 LINK BUILDING & EWOM

0+0+2

Objective:

With the help of a trainer / an instructor, this course would provide insights and practical hands-on experience in buildinglistings and references for a brand and/or business through the usage of their websites, so as to generate more audience and usersdiscuss about it, follow and eventually, promote the site directly or indirectly.

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Understand how link building is important for business development.
CO2	Know the ways to get and increase links through web.
CO3	Building relationships through the web.
CO4	

MBDM2203 SOCIAL MEDIA MARKETING

4+0+0

Course Objectives:

Understand and plan content for online marketing. Learn how to use social media to meet organisation's acquisition and brand objectives; Learn to incorporate best social media practices into marketing campaign.

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Understand evolution of social media marketing and identify related ethical issues to communicate its impact on businesses.
CO2	Know how to develop effective social media marketing strategies for various types of industries and businesses.
CO3	Evaluate a company's current situation, isolate social media issues and provide solutions by identifying appropriate social media marketing portals to influence consumer and improve the company's reputation.
CO4	

MBDM2204 BRANDED CONTENT AND THE FUTURE OF MEDIA

4+0+0

Course Objective:
Media are evolving and branded communication must keep pace. This will cover the innovations in this area. Given the power of media to influence consumer beliefs, knowledge and attitudes to brands and businesses, this is a vital link; it will also explore the latest trends of media & content; user generated content and its impact on media monetisation and the entire media business model.

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Understand the ways to develop and market branded contents.
CO2	Know the future and importance of media in marketing branded contents.
CO3	
CO4	

MBDM2205 IDEAS, BRANDS AND BUSINESS

2+0+0

Course Objective:
To help students gain conceptually deep understanding of branding and associated factors. To also make the students aware of the latest trends in branding in domestic and global front.

Course Outcome:
By the end of the course, the students should be able to:

CO	Statements
CO1	Understand processes of branding and relate them to business.
CO2	Know key issues in managing and making strategic branding decisions.
CO3	
CO4	

MBDM2206 BRAND PLANNING AND CONSUMER INSIGHTS
4+0+0

Course Objective:
To teach the students how to constantly design and execute intelligent and innovative research studies to scan the environment, identify consumer insights, and use those insights to manage the brand.

Course Outcome:
By the end of the course, the students should be able to:

CO	Statements
CO1	Enumerate the functions of account planning and role of various stakeholders involved in account planning.
CO2	Understand how advertising campaigns are designed for different media channels.
CO3	Know the ways to make media selection that aligns with organizational goals.
CO4	

MBDM2207 DIGITAL STRATEGIES AND PLANNING

4+0+0

Course Objective:
Create a digital marketing plan and budget; Identify suitable measures to set objectives and evaluate digital marketing; Review and prioritise strategic options for increasing customer acquisition, conversion and retention.

Course Outcome:
By the end of the course, the students should be able to:

CO	Statements
CO1	Understand and create e-business plan.
CO2	Make e-business risk analysis and justify it.
CO3	
CO4	

MBDM2208 MOBILE & E-MAIL MARKETING

4+0+0

Course Objective:

1. This course would familiarize the student with the basic understanding of Mobile and eMail customers and help gain insights in the areas of technology adoption, various devices, changing nature of services and ecosystems.

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Understand and construct marketing strategies that revolve around email and mobile communications.
CO2	Know enticing advertisements to promote your products.
CO3	Build a loyal customer base, create brand awareness and trust through mobile and e-mail marketing.
CO4	

MBDM2209 SEARCH ENGINE OPTIMIZATION Credits: 2

2+0+0

Course Objective:

To explore the underlying theory and inner workings of search engines..

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Understand the meaning of search engine optimization and make search engine optimization plan.
CO2	Know making the website highly relevant by use of search engine optimization.
CO3	Attract traffic by search engine optimization.
CO4	

MBDM2210 SEARCH ENGINE MARKETING Credits: 4

4+0+0

Course Objective:

To explore the marketing aspects of search engine and understand the importance of Google AdWords and other elements of Search Ad

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Understand the meaning of search engine marketing and make search engine marketing plan.
CO2	Know making the website highly relevant by use of search engine marketing.
CO3	Attract traffic by search engine marketing.
CO4	

MBDM2211 TECHNOLOGY OF E-COMMERCE Credits: 2

2+0+0

Objective:

This course aims to strengthen and wider the technical knowledge of students as they will be encouraged to research on emerging technological innovations related to the net. Students will also be expected to understand the integration of distributed database technologies within the internet architecture

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Recognize the impact of Information and Communication technologies, especially of the Internet in business operations.
CO2	Recognize the fundamental principles of e-Business and e-Commerce.
CO3	Distinguish the role of Management in the context of e-Business and e-Commerce and explain the added value, risks and barriers in the adoption of e-Business and e-Commerce.
CO4	

MBDM2212 ONLINE REPUTATION MANAGEMENT

4+0+0

Course Objective:

The world-wide-web is an ever-growing platform. Quality websites and portals have been in discussion throughout the world for a very long time. In Online Reputation Management, we learn about various techniques to know the effectiveness of businesses online.

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Remember the important role humans play in the digital world and understand how to minimize accidental and intentional human errors.

CO2	Apply the knowledge gained in solving real-world and scenario-based problems in online reputation management.
CO3	
CO4	

MBDM2213 AFFILIATE MARKETING

2+0+0

Course Objectives:
This course aims to teach the basics of affiliate marketing.

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Understand the meaning of affiliate marketing and its importance in digital world.
CO2	Know how to set up an affiliate website and make it relevant to business.
CO3	
CO4	

MBDM2214 WEB CONTENT WRITING

2+0+0

Course Objective:
Art has been in place ever since knowledge was born. In the modern world, writing, i.e., 'content' has taken a highly significant position as it involves creativity along with technicality. Here, we learn the methods and techniques to know, practice and develop web content writing.

Course Outcome:
By the end of the course, the students should be able to:

CO	Statements
CO1	Know the essentials of content writing and storytelling in the web.
CO2	Understand the psychology of readers of digital content writings.
CO3	
CO4	

MGPM2301 **POWER DISTRIBUTION MANAGEMENT**
4+0+0

Course Objective:
To familiarize participants regarding efficient working and developing economics aiming at transmission, electric losses.
Communication system in grid management and regulatory mechanism.

Course Outcome:

By the end of the course, the students should be able to:

CO	Statements
CO1	Understand and create e-business plan.
CO2	Make e-business risk analysis and justify it.
CO3	
CO4	

MGPM2302 **POWER PLANT SYSTEMS**
4+0+0

Course Objective:
To provide the students a basic understanding about different Power Plants, steam cycle, co-generation etc.. To demonstrate how we produce electricity using steam Generator, Turbine and Nuclear station in brief..With large scale addition of generating capacities and associated Bulk transmission system, interconnection network system for communication.`

Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements
CO1	Plan and administer policies for power plants
CO2	Handle usages of equipment in power plants effective
CO3	Carry out job designing appropriately
CO4	

MGPM2303 **PROJECT PLANNING, ANALYSIS & MANAGEMENT**
4+0+0

Course Objective:
Visualization of a Power Plant – sizing of units.Availibility of raw materials. Project planning involves a series of steps that determine how to achieve organizational goal. Introduction, concept, characteristics of project, classification etc.

Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements
CO1	Carryout feasibility analysis of projects (Market, Technical, Financial and Economic)
CO2	design project plan
CO3	Apply the risk management plan and analyse the role of stakeholders
CO4	

MGPM2304 ELECTRICITY INDUSTRY STRUCTURE & ACT

4+0+0

Course Objective:

To familiarize with world and Indian Scenario, Act in context of Indian Scenario. To protect and develop the electricity industry, protect interest of investors /consumers. Act Governs the investment, generation & supply of Electricity.

Course Outcome:
On successful completion of the course the learner will be able to

CO	Statements
CO1	Handle power generation, transmission, and distribution process effectively
CO2	Manage legal aspects
CO3	Introduce technological changes required in the organization
CO4	

MGPM2305 INTEGRATED ENERGY MANAGEMENT & POWER PLANNING

4+0+0

Course Objective:

What is integrated management? Primary goal of this approach is to go for energy supply expansions, construction of Giant hydro electric dams, fossil fuel based power plants. Improving renewable energy system-maximiz efficiency.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Develop plan for sustainable use of alternative sources of energy
CO2	Plan for generation and sharing of load
CO3	Central power system and grid plan
CO4	

MGPM2306 FINANCING ENERGY SECTOR PROJECTS

4+0+0

Course Objective:

Demand for energy efficient Investment, with respect to Micro, Small and Medium Enterprise. Clusters to build their capacity for commercial support. Green house effect in India and World scenario.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Carry out feasibility study of projects for micro, small and medium enterprises
CO2	Handle legal issues effectively
CO3	Handle project financing
CO4	

Course Content:

MGPM2307 POWER PRICING & POWER PURCHASE AGREEMENT

4+0+0

Course Objective:

What is a PPA? Power Purchase agreement .Key features of Power and Energy Purchase agreements, sample agreement papers. When to use agreement?

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Develop agreements for power purchase
CO2	Calculate capital cost operational cost, development cost
CO3	
CO4	

MGPM2308 **POWER TRADING**

4+0+0

Course Objective:

Electricity trading in competitive Power market.Robust trading system for free and fair competitive electricity market, trading arrangement, financial risk, hedging etc.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Study the power market appropriately
CO2	Design and develop the power market engaging modern technology
CO3	
CO4	

MGPM2309 **POWER STATION MANAGEMENT**

2+0+0

Course Objective:

Goals and objective Aiming for high quality,effective and safe technologies,Creating best tradition,Extend design life and upgrade electric Power equipment. Integrated approach to improve co ordination of Research..Design, Implement and develop new technologies and possibility of Retro fitting

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Utilise safe technology
CO2	Handle the challenges in power generation, transmission and distribution
CO3	Develop strategies for production
CO4	

MGPM2310 **RENEWABLE ENERGY FOR A SUSTAINABLE FUTURE**

4+0+0

Course Objective:

Energy conservation measures in industrial, commercial and domestic building for environmental benefits. To harness the environmental friendly sources and enhance their contribution for socio & economic development.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Plan for utilization of renewable energy
CO2	Design facilities for solar, wind and tidal energy
CO3	
CO4	

MGPM2311 RISK, HAZARD & ENVIRONMENT MANAGEMENT

2+0+0

Course Objective:

Harmony between human kind and environment, vulnerability in social groups – Assising risk scientific need for measurement at risk.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Establish first aid facilities
CO2	Plan for risk reduction
CO3	Develop hazardous waste management
CO4	

MGPM2312 ENERGY CONSERVATION & AUDIT

4+0+0

Course Objective:

To achieve and maintain optimum energy procurement and utilization to minimize energy cost, waste without affecting production**.**

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Carry out energy audit
CO2	Plan for efficient use of technology
CO3	
CO4	

MGPM2313 MAINTENANCE MANAGEMENT & INVENTORY CONTROL

4+0+0

Course Objective:

Maintenance is the function to ensure availability of equipment. Utilities related to quality, safety and protection system for the power plant system. The basic purpose is to ensure all equipments are available for 100% efficiency. To maintain the desired level of inventory relating to cost efficient operation. Relation between inventory, procurement, lead time, safe level etc.

Course Outcome:

On successful completion of the course the learner will be able to

CO	Statements
CO1	Handle inventory properly
CO2	Job designing
CO3	Manage production maintenance
CO4	

MGDA1109 **Data Analysis through Excel**

0+1+1

Course Objective:

To familiarize the basic concepts of excel and enable quantitative analysis by using excel worksheet.

Course Outcome:

CO	Statements
CO1	To create dynamic reports by mastering one of the most popular tools in excels - PivotTables, Pivot chart, If, Vlookup, Index, and Match etc.
CO2	
CO3	
CO4	

MGDA1110 **Data base & Data warehouse**

4+0+0

Course Objective:

- To identify the scope and essentiality of Data Warehousing and Mining.
- To analyze data, choose relevant models and algorithms for respective applications.
- To study spatial and web data mining.
- To develop research interest towards advances in data mining.

Course Outcome:

CO	Statements
CO1	Understand Data Warehouse, Data Mining Principles
CO2	Can access the data from different files like Excel, Word, SQL, PDF etc
CO3	
CO4	

MGDA1210 **Information System in Business**

4+0+0

Course Objective:

This course will introduce the fundamental concepts of information systems and how they support management and operations in the modern business environment. The spectrum of information technology tools used in business will be discussed, along with selected applications. The roles of

technology and eBusiness across various business disciplines will be examined. Topics will include strategic applications of technology, technology trends, management of information resources, integration of business processes through Enterprise Resource Planning systems, e Business models and strategies, building and protecting information systems and others.

Course Outcome:

CO	Statements
CO1	Students understand effective planning and implementation.
CO2	
CO3	
CO4	

MGDA1216 **Data Visualisation with Power BI and Tableau**

0+3+1

Course Objective:

The objective of this course is to help students to develop visualization tools & concepts.

CO	Statements
CO1	
CO2	
CO3	
CO4	

MGDA1217 **Python**

0+3+1

Course Objective:

- To understand data crunching and data presentation
- To build predictive models using Python libraries.

Course Outcome:

CO	Statements
CO1	To perform different operation in python with set, dict. tuples, list etc
CO2	Ability to do data wrangling.
CO3	
CO4	

MGDA1218 **R Programming**

0+3+1

Course Objective:

To master the basics of data analysis by manipulating common data structures such as vectors, matrices, and data frames.

Course Outcome:

CO	Statements
CO1	Ability to define and manage data structures based on problem subject domain.
CO2	Ability to handle possible errors during program execution.
CO3	
CO4	

MGDA1221 **Artificial Intelligence, Machine learning & Unstructured Data analytics**
0+2+2

Course Objective:

- Understand the meaning, purpose, scope, stages, applications, and effects of ML.
- Explore important packages of python, such as numpy, scipy, OpenCV and scikit-learn.

Course Outcome:

.CO	Statements
CO1	Students will able to Create and incorporate ML solutions in their respective fields of study
CO2	
CO3	
CO4	

MGDA1200 **Project (Project Mode in Organization)**

0+0+6

Course Objective:

To give real time field experience on different learned concept in the course.

Course Outcome:

CO	Statements
CO1	Students should be able to do and explain different project.
CO2	
CO3	
CO4	

MGGM1106 **Anatomy, Physiology & Health Education**

4-0-0

Course Objectives:

This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms.

Course Outcome:

CO	Statements
CO1	The subject provides the basic knowledge required to understand the various disciplines of pharmacy.
CO2	
CO3	
CO4	

MGPH1201 **Pharmacology**

4-0-0

Course Objectives:

This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay.

Course Outcome:

CO	Statements

CO1	It is helpful for pharmaco-managers to understand the basics of drugs.
CO2	
CO3	
CO4	

MGPH1202 **Basic Epidemiology**

2-0-0

Course Objectives:

Measurement of health related data, their analysis and re-presentation is major contents of this course. Course is useful to understand basic tools used for estimation health related data.

Course Outcome:

CO	Statements
CO1	Disease surveillance
CO2	Critically review published epidemiological studies.
CO3	Discuss the key components of epidemiology (population and frequency, distribution, determinants, and control of disease)
CO4	Understand and be able to explain concepts of determinants of health and how they affect the health of a population.

MGPH1203 **Selling and Reporting Skills of Pharmaceutical Product**

4-0-0

Course Objectives:

This subject is intended to impart the fundamental knowledge on pharmaceutical marketing.

Course Outcome:

CO	Statements
CO1	Contributes to team effort by accomplishing related results as needed.
CO2	Provides historical records by maintaining records on area and customer sales.
CO3	Recommends changes in products, service, and policy by evaluating results and competitive developments
CO4	Focuses sales efforts by studying existing and potential volume of dealers.

MGPH2101 **Pharmaceutical Brand Management**

4-0-0

Course Objectives:

This course enables students to learn about the basics of brand and development of brand of a product. There is a difference between the general marketing and pharmaceutical marketing. This course enables students to learn about the channel of pharmaceutical marketing, effects of promotional strategies, and physician‟s prescriptions.

Course Outcome:

CO	**Statements**
CO1	Analytical tools to discover key leverage points from patient-centric and stakeholder insights.
CO2	Best practices drawn from pharma and other industry sectors.
CO3	To design effective, efficient and agile tactics for Red Ocean (highly competitive) markets.
CO4	

MGPH2102 **Pharmaceutical Sales and Distribution Management**

4-0-0

Course Objectives:

Study of pharmaceutical sales is different from study of general sales, various factors like physicians behaviour, promotional strategy, marketing reputations of organizations

Course Outcome:

CO	**Statements**
CO1	This course enables students to understand about selling of medicines and pharmaceutical market dynamic.
CO2	
CO3	
CO4	

MGPH2104 **Drug Regulatory Affairs & Intellectual Property Rights**

4-0-0

Course Objectives:

This course is designed to impart basic knowledge on regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals.

Course Outcome

CO	Statements
CO1	Critically examine and evaluate scientific data and conclusions intended for regulatory review.
CO2	Enable improvement of the regulatory environment by implementing and upholding good regulatory practices.
CO3	Take independent responsibility for own professional development.
CO4	

MGPH2105 **Manufacturing Management**

2-0-0

Course Objectives:

This course is designed to impart basic knowledge on planning, designing, and production systems and subsystems.

Course Outcome

CO	Statements
CO1	Differentiate among general management decisions that are beyond strictly manufacturing, and includes skills to manage projects, energy, costs and budgets.
CO2	Generate written, oral, and graphic communications, including the use of current technology, persuasively and accurately in a professional manner.
CO3	Formulate the principles and practice of team-building in an interdisciplinary setting, and integrate negotiation and problem-solving skills.
CO4	

MGPH2106 **Financial Reporting & Analysis**

2-0-0

Course Objectives:

This course is designed to impart basic knowledge on reviewing and analyzing financial statements.

Course Outcome

CO	Statements
CO1	Read, understand, interpret and analyse general purpose financial reports;
CO2	Understand differing accounting policies and their impact on financial statements;
CO3	Evaluate different types of performance measurement systems in accounting and commonly used financial control systems;

CO4	Demonstrate knowledge of management accounting concepts and techniques

MGPH2107 **Pharmaceutical Advertising & Service Management**
2-0-0

Course Objectives:

This course is designed to impart basic knowledge on managerial process designed to oversee and control the various advertising activities involved in a program to communicate with a firm's target market and which is ultimately designed to influence the consumer's purchase decisions.

Course Outcome:

CO	**Statements**
CO1	Discuss Principles of key concepts related to operational management
CO2	Set up their own business in the pharmaceuticals sector and Create the concepts learned into personal practice focusing on professionalism
CO3	Identify and integrate effective management methods that focus on quality assurance
CO4	

MBA (DM & ABM)

Programme Objectives

MBA in Development Management and Agribusiness Management is a two-year residential program. The basic objective of the MBA –DM specialization is to promote sustainable and equitable socio-economic development of the people in general and that of underprivileged sections of the society in particular and empower the communities through professionally managed institutions. The focus of the program is management of development within the spirit of justice, liberty, equality, equity, fraternity and environmental sustainability. Most of the organisations of, by and for poor are often undermanaged, mis-managed and working in cross-purpose. The professionals graduating from this program will be equipped to strengthen such institutions and also create new institutions for realizing the above objective. The focus of MBA-ABM is to provide opportunities for students to become professionals in the food, agribusiness and allied sector by either joining as employees or choose a path of self-employment to lead the agribusiness revolution. The present course has been developed in collaboration with Norwegian University of Science and Technology (NTNU) Norway keeping in mind the requirements of knowledge and skills in the Indian context.

Program Outcomes:

PO1: Apply the knowledge of management/ development theories

PO2: Foster analytical and critical thinking for evidence/data based decision making.

PO3: Develop value based leadership ability.

PO4: Understand, analyze and communicate effectively

PO5: able to identify and address ethical issues and apply them in organizational settings

PO6: demonstrate entrepreneurial skills to generate innovative solutions for challenges faced by less developed societies.

PO7: Apply the leaning into understanding the development of the organization, thereby being mindful of retaining a balanced decision-making process.

PO8: Carry out research and lifelong learning in the domain

Program specific Outcome

PSO1: To demonstrate an understanding of the basic concepts, principles and theories in development management and agri-business management

PSO2: solve the problems related to less developed communities and focus on Agribusiness Management to take appropriate decision

PSO3: able to lead a team at the work front with a vision to transform the less developed region and agricultural sector

PSO4: Communicate the ideas and vision effectively in the relevant field

PSO5: Respect the cultural diversity and ethical practices

PSO6: able to set enterprises in less developed society and agricultural sector

PSO7: take appropriate decision for development of the organization and the society

PSO8: Carry out research in the domain area and continue gaining knowledge lifelong in the specified domain

Mapping PSOs with POs (Correlation)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
PSO1								
PSO2								
PSO3								
PSO4								
PSO5								
PSO6								
PSO7								
PSO8								

Course Outcomes:

Course Outcomes (COs)	**Competency/skill**
CO1	Knowledge
CO2	Analytical and Creative Thinking
CO3	Problem Solving
CO4	Leadership & Management
CO5	Domain Skill/Competency
CO6	Ethical
CO7	Information Literacy

CO8	Employability skill/ Higher study/ Entrepreneurship
CO9	Use of ICT and digital platform

MGDM0101 **Introduction to Indian Society**
2-0-0

Course Objective:

- To introduce students to the society and culture of India
- To understand the social structure
- To critically examine the challenges in society
- To analyze social and rural institutions

Course Outcome:
After completion of the course students will be able to

CO	**Statements**
CO1	Critically examine the challenges in society form a multi stakeholder perspective
CO2	Develop appropriate intervention to mitigate the challenges
CO3	
CO4	

MGAM0101 **Micro and Macro Economics**
4-0-0

Course Objective:

- To provide students with a basic understanding of the economic principles, methodologies and analytical tools that can be used in business decision making problems.
- To provide an understanding of the economic environment and its impact on business and society.
- Describe and differentiate between major economic systems

Course Outcome:
After completion of the course students will be able to

CO	**Statements**
CO1	Analyze the economic environment of the country
CO2	Take appropriate decision for growth and expansion of the organization
CO3	Think critically about the demand and supply gap for forecasting business opportunities
CO4	

MGDM1103 **IT Enabled Communication (Workshop Mode)**
0-0-4

Course Objective:

- Improving general communication
- Improving communication with the help of IT tools

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Communicate appropriately with all stakeholders
CO2	Prepare report with graphic designing
CO3	Use IT for developing blogs
CO4	Carry out business correspondence

MGFM1101 **Accounting for Managers**
4-0-0

Course Objective:

This course 'Accounting for Managers' has been designed to enable the students to acquire the skills necessary to prepare, use, interpret and analyze financial information

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	prepare financial statements
CO2	critically analyse financial statements
CO3	interpret balance sheets
CO4	calculate costs

MGMK1101 **Marketing Management**
4-0-0

Course Objective:

- To familiarize the students with the concepts, theories and strategies of marketing

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Analyse the dynamic nature of environment
CO2	Make appropriate marketing decisions
CO3	Apply marketing concepts in various marketing contexts
CO4	Utilize emerging areas of marketing for the benefit of organizations

MGDA1103 **Individual and Group Behaviour**

2-0-0

Course Objective:

- Todevelop students' knowledge and competence to deal with human problems of management and developing students' awareness and insight for personal and professional growth

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Analyze dynamics of individual, interpersonal and group behavior in organizational setting
CO2	Modify the behavior of individuals as per the requirement
CO3	Foster appropriate behavior in organizational set up
CO4	

MGDM0102 **Socio-Economic and Political History of India**
4-0-0

Course Objective:

To impart relevant knowledge on social, economic and political background of India

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Analyze Indian culture, civilization, and heritage
CO2	Think critically about the process of modern India and categorize different school of thoughts about Modern India
CO3	Develop appropriate interventions
CO4	

MGFM1202 **Financial Management (DM and ABM)**
4-0-0

Course Objective:

- Developing skills for preparation and interpretation of business information apartfrom application of financial theory in investment decisions, with special emphasison working capital management, Capital Budgeting and other concepts

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Utilize the concepts of financial management in investment, financing, working capital and dividend policy decisions
CO2	Use techniques for minimizing risk in investment, techniques of leverage
CO3	
CO4	

MGDM0103 **Sustainable Entrepreneurship Development (DM&ABM)**

4-0-0

Course Objective:

Overall, the objective is to inspire and train change agents with a broad understanding of sustainability and to provide them with the practical skills needed to question existing solutions and develop solutions for sustainability in organizations and enterprises

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	promote sustainable enterprises
CO2	focus on sustainability issues
CO3	prepare appropriate strategies
CO4	

MGDM0104 **Skill Ecosystem Development(DM)**
4-0-0

Course Objective:

To develop students' ability to understand the concept of skill ecosystem, analyse the skill need and gap of a socioeconomic sector and suggest appropriate strategy

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Appraise the skill ecosystem and its dimensions
CO2	Determine the skill gap
CO3	Train the employees with appropriate skills
CO4	

MGDM0105 **Financial Inclusion and Micro-finance (DM&ABM)**
4-0-0

Course Objective:

- To understand the role and operation of financial inclusion
- To understand the principle and operation of micro finance industry

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Promote financial inclusion and manage them effectively
CO2	Promote and develop micro-finance institutions
CO3	Introduce appropritae micro-finance model by analyzing the context
CO4	

MGDM0106 **Innovation and Regional Development(DM)**
4-0-0

Course Objective:

Gives a perspective of different aspects of development from the regional (national /state) context and innovative approaches to deal with it

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Analyze different aspects of development from the regional (national/state) context
CO2	develop innovative approaches for sustainable development
CO3	Develop interventions for regional development
CO4	

MGAM0102 **Project Management (DM&ABM)**
4-0-0

Course Objective:

To learn the craft of managing projects through a decision-making, business-oriented approach to the managementof projects

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Identify project goals, constraints, deliverables, performance criteria, resource requirements in consultation with stake holders
CO2	Implement project management knowledge processes, life cycle and the embodied concepts, tool, techniques for effective implementation
CO3	

CO4	

MGAM1204 **Economic Environment for Agriculture (ABM)**
4-0-0

Course Objective:
- To acquaint the learner with introductory Agricultural Economics and development of agriculture in India
- Provide orientation to the students regarding the agricultural policies and its effect on sustainable agricultural development
- To expose the students to the various kinds of risk in farming, risk management strategies and mechanisms and insurance policies
- To acquaint the students with agricultural cooperatives in India

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Develop aggregate capacity plans and agricultural policies for sustainable agriculture practices
CO2	Develop Comprehensive risk management strategies and MPS in operation environments
CO3	
CO4	

MGAM1102 **ICT in Agriculture (ABM)**
2-0-0

Course Objective:
- Concepts for the enhancement of agricultural and rural development through improved information and communication processes

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Application and promotion of information and communication technology in various fields of agriculture
CO2	Handle emerging issues in ICT
CO3	
CO4	

MGAM1203 **Agricultural Marketing (ABM)**
2-0-0

Course Objective:
- The objective of the course is to inform and sensitize students about different aspects of Agricultural marketing

- Fundamental knowledge of marketing in the domain of agriculture and discusses the nuances involved in agricultural marketing

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Effectively evaluate the challenges and prospects of agri marketing system
CO2	Take critical decisions for marketing of products
CO3	
CO4	

MGDM0801 **Summer Internship**
0-0-8

CO	Statements
CO1	
CO2	
CO3	
CO4	

MGDM0107 **Development and Globalisation (Both DM&ABM)**
7.5-0-0

Course Objective:

- This is a theory course, dealing with fundamental issues of development and globalization and how development and globalization are related
- Different theories and key concepts will be introduced and examined with respect to development challenges of our times
- The course draws on a wide range of practical and empirical knowledge, as the lecturers represent different areas of specialization within the social sciences

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Analyze the manufacturing operations of a firm dealing with fundamental issues of development and globalization
CO2	Scan the environment for opportunities
CO3	Develop strategies for growth or organizations
CO4	

MGDM0108 **Global Production Network (DM)**
7.5-0-0

Course Objective:

This is a theory course, dealing with the terrain of globalization and production networks in the new world order

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Provide comprehensive insight into the relations between processes of economic globalization and state policies and strategies of the companies
CO2	Analysis of impact of neoliberal globalization on the production and trade chains
CO3	
CO4	

MGAM0103 **Research Methods (Both DM&ABM)**
7.5-0-0

Course Objective:

The course is concerned with systematic gathering and analysis of information needed either to understand or to solve a managerial problem or a phenomenon. The objective of the course is to sensitize students with an appropriateresearch design, several research techniques, to enable them to conduct investigations within and outside their organizations

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Apply modern analytical tools and techniques for managerial decision making
CO2	Prepare research designing, sampling, analysis of data, hypothesis formulation and testing
CO3	Carryout independent research
CO4	

MGDM0109 **Gender Issues in Development (DM)**
3.5-0-0

Course Objective:

- Perspective about women related issues in India with specific emphasis in the development sector

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Sensitive towards perspectives on gender and development
CO2	Utilize different tools and techniques for gender planning, analysis and evaluation in the development sector
CO3	

CO4	

MGDM0110 **Natural Resource Management (Both DM& ABM)**
4-0-0

Course Objective:

The course familiarises the students with the complexities of natural resource management, their role and contribution in economic development and people's life support systems especially, in the context of increasing depletion of resources and currently with liberalization, privatisation and globalisation.

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	use, manage and allocate natural resources appropriately
CO2	Follow the laws, policies
CO3	Analyze the economic factors (both market and non-market)
CO4	

FCMG0116 **Introduction to Ethics (Both DM&ABM)**
1-0-0

Course Objective:
- Introduce to the meaning of ethics and the historical development – utilitarianism, ethical relativism and virtue ethics
- Examine some current ethical issues

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Introduce ethical practices based on moral philosophy
CO2	appraise ethical issues and challenges in the organization
CO3	
CO4	

MGAM2108 **Post-harvest and Processing Management (Theme Based) ABM**

2-0-0

Course Objective:
- Aims to understand and resolve post-harvest losses and enhance food security

Course Outcome:
After completion of the course students will be able to

CO	Statements

CO1	Introduce interdisciplinary approach to post-harvest management
CO2	Develop post-harvesting processes to reduce wastage
CO3	
CO4	

MGAM2203 **Live-stock management (Theme Based) ABM**
2-0-0

Course Objective:

- To acquaint students on basic aspects of dairying in India, problems and prospects of dairying
- Aspects of care and management of different classes of dairy cattle and buffaloes

Course Outcome:
After completion of the course students will be able to

CO	**Statements**
CO1	Develop professional opportunities in animal sciences relating to keeping of animals for food and fiber production
CO2	Handle issues related to animal production, nutrition, and genetics
CO3	
CO4	

MGAM2103 **Sales and Distribution Management (Theme Based) ABM**
2-0-0

Course Objective:

- To acquaint the students with the concepts that help in developing sales and distribution policy
- Organizing and managing sales force and marketing channels

Course Outcome:
After completion of the course students will be able to

CO	**Statements**
CO1	Analyze the various variables affecting the sales and distribution function
CO2	Develop a sales and distribution plan for products/services
CO3	
CO4	

MGAM2209 **Commodity market and trading (Theme Based) ABM**
2-0-0

Course Objective:

- To acquaint students with the regulations of the marketplace
- Nuances of trading, exchanges and trading participants, trading strategies and systems

Course Outcome:
After completion of the course students will be able to

CO	Statements
CO1	Utilize the knowledge of commodity markets, interpreting commodity trading standard and ecosystem
CO2	Prepare strategies for minimizing risk through trade strategies
CO3	
CO4	

MGDM0802 **Development Internship For DM**
0-0-10

Course Objective:
Develop and improve business skills in communication, technology, quantitative reasoning, and teamwork. Observe and participate in business operations and decision-making. Meet professional role models and potential mentors who can provide guidance, feedback, and support.

Course Outcome:
This is practical course. After completion of this course students will be able to

CO	Statements
CO1	communicate effectively (written and oral) in organizations
CO2	handle pressure at the work front by focusing on honesty and integrity
CO3	become self-disciplined, self-motivated and integrate theory and practice
CO4	display problem solving skills utilizing the theoretical framework learned in the classroom setting
CO5	develop appropriate work habits and attitudes necessary for job success.

MGDM0301 **Development Action Research Thesis for DM**
0-0-10

Course Objective:
Develop and improve business skills in communication, technology, quantitative reasoning, and teamwork. Observe and participate in business operations and decision-making. Meet professional role models and potential mentors who can provide guidance, feedback, and support.

Course Outcome:
This is practical course. After completion of this course students will be able to

CO	Statements
CO1	communicate effectively (written and oral) in organizations
CO2	handle pressure at the work front by focusing on honesty and integrity

CO3	become self-disciplined, self-motivated and integrate theory and practice
CO4	display problem solving skills utilizing the theoretical framework learned in the classroom setting
CO5	develop appropriate work habits and attitudes necessary for job success.

MGAM0802 **Agricultural Internship**
0-0-10

Course Objective:
Develop and improve business skills in communication, technology, quantitative reasoning, and teamwork. Observe and participate in business operations and decision-making. Meet professional role models and potential mentors who can provide guidance, feedback, and support.

Course Outcome:
This is practical course. After completion of this course students will be able to

CO	**Statements**
CO1	communicate effectively (written and oral) in organizations
CO2	handle pressure at the work front by focusing on honesty and integrity
CO3	become self-disciplined, self-motivated and integrate theory and practice
CO4	display problem solving skills utilizing the theoretical framework learned in the classroom setting
CO5	develop appropriate work habits and attitudes necessary for job success.

MGAM0301 **Agricultural Action Research Thesis**
0-0-10

Course Objective:
Develop and improve business skills in communication, technology, quantitative reasoning, and teamwork. Observe and participate in business operations and decision-making. Meet professional role models and potential mentors who can provide guidance, feedback, and support.

Course Outcome:
This is practical course. After completion of this course students will be able to

CO	**Statements**
CO1	communicate effectively (written and oral) in organizations
CO2	handle pressure at the work front by focusing on honesty and integrity
CO3	become self-disciplined, self-motivated and integrate theory and practice
CO4	display problem solving skills utilizing the theoretical framework learned in the classroom setting
CO5	develop appropriate work habits and attitudes necessary for job success.


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