CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT, ODISHA

SCHOOL OF PARAMEDICS AND ALLIED HEALTH SCIENCES

BACHELOR OF SCIENCE IN MEDICAL RADIATION TECHNOLOGY

(THREE YEARS PROGRAMME)

2024

SYLLABUS

B. SC. IN MEDICAL RADIATION TECHNOLOGY

Preface: Bachelor of Science in Medical Radiation Technology is a three-year graduate programme. In this course the health professionals are concerned with direct administration of radiation, primarily x-rays, in disease diagnosis and injury assessment. Medical imaging studies have been a cornerstone in medical diagnosis for decades; however, technological advances and the addition of new imaging modalities now place medical imaging among the most dynamic, expanding and high demand fields in clinical medicine.

Medical Imaging clinical practice includes: general radiography such as orthopedics, pediatrics and mammography, vascular imaging, cardiac catheterization studies, computerized tomography, and magnetic resonance imaging. Medical imaging professionals are employed in medical centers, community and private hospitals, clinics, and physicians' offices.

Programme: B. Sc. in Medical Radiation Technology

Duration: Three years (Six semesters) full-time programme with 6 months internship in the last semester.

Eligibility: +2 Science with Physics, Chemistry & Biology or DRIT from any recognized.

Examination: Examination rules will be as per guideline of CUTM Examination hand book.

Internship: A candidate will have to undergo internship for a period of six calendar months in a hospital/ Diagnostics Center equipped with modern Radiology & Imaging laboratory facility or in a fully equipped, which fulfills the norms decided by the University.

Degree: The degree of B. Sc. in Medical Radiation Technology (B. Sc. MRT) course of the University shall be conferred on the candidates who have pursued the prescribed course of study for not less than three academic years and have passed examinations as prescribed under the relevant scheme and completed 6 months of compulsory internship in the last semester. On successful completion of three-year programme, with a minimum credit load of **140 credits**, the candidate will be awarded with "**Bachelor of Science in Medical Radiation Technology (B.Sc. MRT)"** from Centurion University.

PROGRAMME STRUCTURE

Course POs: After completion of the programme the students will be able to:

PO	Outcomes
PO1	Possess a strong foundation of knowledge in the core concepts, theories, and principles of allied health.
PO2	Demonstrate competence in performing a range of clinical procedures and techniques.
PO3	Collaborate with professionals from different healthcare disciplines, demonstrating teamwork.
PO4	Exhibit professionalism, integrity, and ethical conduct in their interactions with patients, colleagues.
PO5	Apply critical thinking skills to analyze complex healthcare scenarios and solve problems.
PO6	Demonstrate leadership qualities and possess basic knowledge of healthcare management principles.
PO7	Provide compassionate and comprehensive patient care.
PO8	Embrace a commitment to lifelong learning and professional development.
PO9	Demonstrate effective verbal and written communication skills.
PO10	Promote health and wellness by educating individuals and communities about healthy lifestyles, disease prevention strategies, and the importance of early intervention.
PO11	Respect and appreciate the cultural diversity of patients and communities.
PO12	Understand the importance of research in advancing allied health practice.

Programme Specific Outcomes:

Programme Specific Outcome	Statement
PSO1	To understand the basic concepts, theories of applied sciences (physics, chemistry, Anatomy, physiology, biochemistry, pathology) relevant to radiological imaging techniques.
PSO2	To understand provisions for radiation safety by various national & international regulatory bodies and applying quality assurance measures, safety procedures and maintenance of radiological equipment.
PSO3	To demonstrate proficiency in performing a wide range of radiographic techniques used in medical imaging and interpret radiographs.

BSc Medical Radiation Technology

Choice Based Credit System (CBCS Structure)

Category	Minimum Credits to be completed	Minimum Credits to be completed
School (Core)	20	140
Discipline (Core)	73	
Skill Basket[#]	12	
Value Added[**]	6	
AECC	6	
Summer Internship[##]	4	
Project	10	
Internship	10	

[#]Skill course is to be registered by the student during 1st, 2nd and 3rd semester
[**]Value added course to be registered by the student one time in each year
[##]Summer Internship during summer vacation post 2nd semester and 4th semester

BASKET – I

SCHOOL CORE COURSE

S. No.	Subject Code	Subject	Subject Type (T+Pr+Pj)	Credit
SC - 1	CUTM4274	General Anatomy I	2+1+0	3
SC - 2	CUTM4275	General Anatomy II	2+1+0	3
SC - 3	CUTM1758	General Physiology	3+2+0	5
SC - 4	CUTM4327	Clinical Pathology	2+1+0	3
SC - 5	CUTM4286	Biochemistry	2+1+0	3
SC - 6	CUTM1721	Research Methodology	2+0+1	3
Total Credits				**20**

BASKET – II CORE DISCIPLINE CORE COURSE

S. No.	Subject Code	Subject	Subject Type	Credit
DC-1	CUTM4276	Radiation Physics - I	3+0+1	4
DC-2	CUTM4277	Radiation Physics - II	3+0+1	4
DC-3	CUTM4280	Darkroom Techniques	3+1+0	4
DC-4	CUTM4279	Radiation safety & Patient care	4+0+1	5
DC-5	CUTM1767	Radiographic Technique-1	3+2+0	5
DC-6	CUTM4278	Mammography and Advanced Imaging Techniques	3+0+1	4
DC-7	CUTM4281	Ultrasonography	3+0+1	4
DC-8	CUTM1772	Radiographic Technique-2	3+2+0	5

DC-9	CUTM2543	Basic of computed tomography	3+0+1	4
DC-10	CUTM4282	Computerized Tomography (CT Scanning) Method & Procedure	3+0+1	4
DC-10	CUTM2549	Interventional Radiology and Drug Diagnostic Radiology	3+2+0	5
DC-11	CUTM2542	Basic of nuclear medicine imaging	3+0+1	4
DC-12	CUTM1777	Image Interpretation of X-Ray Mammography, CT & MRI	3+2+0	5
DC-13	CUTM2544	Basic of Magnetic Resonance Imaging	3+0+1	4
DC-14	CUTM2545	MRI scanning and procedures	3+0+1	4
DC-15	CUTM4283	Orientation in Clinical Sciences	2+0+1	3
DC-17	CUTM1734	Medical Law and Ethics	2+0+1	3
DC-18	CUTM1742	Basic Computer and Information Science	0+2+0	2
Total Credits				**73**

BASKET-1

SCHOOL CORE COURSES

GENERAL ANATOMY-I

Subject Name	Code	Type of course	T-P-Pj	Credit
General Anatomy-I	CUTM4274	Theory + Practical	2-1-0	3

Course Objective:

- To provide a comprehensive understanding of the anatomy of the human body, including its divisions, organ systems, and anatomical terminology.
- To examine the structure, functions, and interrelations of key body systems such as the skeletal, muscular, nervous, cardiovascular, integumentary, and reproductive systems.
- To enable students to analyze the characteristics, classifications, and functions of cells, tissues, and organs, including their roles in maintaining body systems.
- To familiarize students with anatomical landmarks, joint movements, and systemic structures, fostering skills applicable to clinical and diagnostic practices.

Course Outcome:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Identify the basic structures and anatomical terminology of the human body systems.	PO1, PO2, PO10, PSO1
CO2	Describe the anatomical features of Skeletal system and joints of the bones.	PO1, PO3, PO4, PSO1
CO3	Understand the structure, origin and insertion of the muscles of the human body.	PO1, PO2, PSO1
CO4	Understand the anatomical features and relationship of the Integumentary and Reproductive system of the human body.	PO1, PO4, PO7, PSO1
CO5	Understand the complex anatomical features and relationship of the Nervous system and circulatory system of the human body.	PO1, PO5, PO7, PSO1, POS3

Course Outline:

Module I

Introduction to Anatomy, Cell and Tissues:

1. Introduction to Anatomy and its Division.
2. Cell: Definition, Parts, and Types.
3. Tissues: Definition, types and location.
4. Introduction to organ systems and their types.
5. Anatomical nomenclature, Body Planes, Positions, Body Membranes, Body cavities and movements.

Module II

Skeletal System & Arthrology

1. Introduction to the skeletal system and its parts.
2. Bone, ossification of bone, classification of bone based on structure, size, shape, and location.
3. Cartilage: Types of cartilage, their characteristics, features, and location in the body.
4. Introduction to axial & appendicular skeleton with bone features.
5. Introduction to Arthrology: Definition and classifications of joints with examples in detail.
6. Brief about Joints of superior extremity like shoulder joint, elbow joint, wrist joint and radioulnar joint.
7. Brief about Joints: Hip and Knee joint, subtalar, tibiofibular joints.

Module III

Muscular System

1. Introduction to Muscular system and Muscles, Classification of muscles and their characteristics, features and action of muscles.
2. Introduction to surface landmarks of superior extremity. Brief about Muscles and fascia of Pectoral region: Pectoral muscles, Scapular region and Back, Muscles of Arm, Forearm, and Hand, their action and nerve supply.
3. Introduction to surface landmarks of the lower extremity. Brief about Muscles and fascia of Thigh region, Gluteal region, Compartment of the leg, name of the muscles of leg, their action and nerve supply.

Module IV

Integumentary System & Reproductive System:

1. **Integumentary system**- Skin (Introduction, Structure, Function), hair, nails, exocrine glands.
2. **Reproductive System:** Introduction and classification.
3. **Male reproductive System-** Testes, Scrotum, penis, and glands.
4. **Female reproductive System-**External genitalia, & internal organs – Vagina, Cervix, Uterus, Fallopian tubes and Ovaries.
5. Breast structure with blood and nerve supply.

Module V

Nervous System & Cardiovascular System:

1. **Nervous System:** Introduction and subdivision of nervous system.
2. **CNS:** Structure and Characteristic features of Neurons, Brain, and Spinal cord.
3. **PNS:** Introduction to PNS, Classification of PNS and spinal nerves& cranial nerves.
4. **Cardiovascular System:** Introduction to CVS, structure of Blood vessels, Arteries &Veins with their major and minor branches in detail, Structure of heart along with blood and nerve supply, types of circulation.

Practice: -

1. Identification and description of all anatomical structures.
2. Learning of Anatomy by demonstration only through dissected parts, slides, models, charts, etc.

Suggested Readings: -

1. B D Chaurasia's Human Anatomy 9th ed
2. Textbook of Anatomy by Vishram Singh, 4th ed.
3. Principles of Anatomy and Physiology,16th ed by G.J. Tortora
4. Ross and Wilson- Anatomy and Physiology in health and illness
5. Fattana, Human Anatomy, (Description and Applied), Saunders & C P Prism Publishers, Bangalore

GENERAL ANATOMY-II

Subject Name	Code	Type of course	T-P-Pj	Credit
General Anatomy-II	CUTM4275	Theory + Practical	2-1-0	3

Course Objective:

- To provide in-depth knowledge of the structure, organization, and function of the respiratory, digestive, urinary, endocrine, and lymphatic systems.
- To explore the anatomical features of organs and their blood supply, nerve innervation, and relationships within their respective systems.
- To understand the clinical importance of anatomical structures, including the thoracic cage, gastrointestinal tract, kidneys, and lymphatic organs, and their role in maintaining physiological functions.
- To study the glands of the endocrine system, their hormones, and the lymphatic system's components, including lymph nodes and tonsils, with a focus on their structure, function, and regulatory roles in the body.

Course Outcome:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Identify the basic structures and anatomical relations of the Respiratory system.	PO1, PO3, PO4, PSO1, PSO3
CO2	Describe the spatial relationships among different anatomical structures of the digestive system.	PO1, PO5, PO7, PSO1
CO3	Use anatomical knowledge in Interpretation of the urinary or excretory system.	PO1, PO2, PO5, PSO1, PSO3
CO4	Break down complex anatomical systems into their component parts of the Endocrine system to the human body.	PO1, PO5, PO7, PSO1, PSO3
CO5	Understand the anatomical features and relationship of the Lymphatic system with other structures of the body.	PO1, PO2, PO4, PO7, PSO1

Course Outline:

Module I

Respiratory System:

1. Introduction to the system and organs, Orientation of Thoracic cage- boundaries, inlet, outlet & walls.
2. Nose, pharynx, Larynx extent, walls with associated cartilages & muscles with blood and nerve supply.
3. Trachea- extent & brief structure, Bronchi, Bronchioles and alveoli along with blood and nerve supply.
4. Lungs- Surfaces, borders, lobes, fissures, pleural cavity and fluid.
5. Intercostal muscles - origin, insertion, nerve supply
6. Diaphragm - origin, insertion, nerve supply.

Module II

Digestive System:

1. Introduction and parts of the system, Blood vessel and layers of GIT.
2. Oral cavities (boundaries), teeth, tongue, enumerate muscles & papillae, and salivary glands.
3. Pharynx (extent, parts & boundaries) and Oesophagus (parts, extent, constrictions, sphincters).
4. Stomach - location, parts, surfaces, curvatures, nerve supply.
5. Small Intestine parts, the difference between duodenum, jejunum & ileum, nerve supply.
6. Large intestine - parts & their features with blood and nerve supply.
7. Liver- location, surfaces, border, lobes, Gallbladder-location, parts & function, Pancreas - location, parts, surfaces, borders & its ducts.

Module III

Urinary/Excretory System

1. Introduction and Parts of the Urinary system.
2. Kidney- Structure (surfaces, poles, borders, hilum) & function.
3. Structure of nephron, Ureter (length, parts, constrictions), Urinary bladder (location, capacity, surfaces, borders, parts, openings) and Urethra (parts).

Module IV

Endocrine System:

1. Introduction of Gland and their types.
2. Pituitary gland locations, parts, enumerate types of cells & hormones secreted.
3. Thyroid gland- location, parts, features & blood supply.
4. Parathyroid S - location, enumerate types of cells & hormones secreted.
5. Adrenal gland locations, shape, enumerate its components & hormones.

Module V

Lymphatic System:

1. Introduction to Lymphatic System, Lymph, lymphatic capillaries and vessels.
2. Lymph nodes- structure and functions.
3. Spleen - location, surfaces, borders, poles, hilum.
4. Thymus - location, structure & functions.
5. Tonsil – types according to location, palatine tonsil in brief.

Practice:-

1. Identification and description of all anatomical structures.
2. Learning of Anatomy by demonstration only through dissected parts, slides, models, charts, etc.

Suggesteded Readings: -

1. B D Chaurasia's Human Anatomy 9th ed
2. Textbook of Anatomy by Vishram Singh, 4th ed.
3. Principles of Anatomy and Physiology,16thed by G.J. Tortora
4. Ross and Wilson- Anatomy and Physiology in health and illness
5. Fattana, Human Anatomy, (Description and Applied), Saunder's& C P Prism Publishers, Bangalore

GENERAL PHYSIOLOGY

Subject Name	Code	Type of course	T-P-Pj	Credit
General Physiology	CUTM1758	Theory+ Practical	3-2-0	**5**

Course Objective:

- To learn and understand the fundamental scientific concepts relating to a broad range of topics in human physiology.
- To obtain Knowledge about the general physiological systems and physiological terminology.
- To develop investigative skills and to become familiar with standard techniques of measurement.
- To help the students to gain practice and confidence in applying this knowledge, in a quantitative manner where appropriate, to actual experiments

Course Outcome:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand the mechanism of human body function.	PO1, PO5, PSO1
CO2	Interpret the functionality of different physiological systems.	PO1, PO5, PSO1, PSO3
CO3	Break down complex physiological processes, such as metabolic pathways and hormonal regulation, to understand the interactions between different organ systems.	PO1, PO5, PO7, PSO1
CO4	Analyze the interrelationships between different organ systems and their roles in maintaining overall body function and homeostasis.	PO1, PO5, PO7, PSO1, PSO3
CO5	Assess and interpret physiological data from laboratory experiments or clinical case studies to evaluate body function	PO1, PO5, PO6, PSO2

Course Outline:

Module I

Structure and properties of cardiac muscle, Cardiac cycle, Conductive system, ECG, Heart sounds, Heart rate and regulation, Cardiac output and regulation, Blood pressure and regulation, Coronary Circulation, Effect of exercise in Cardiovascular system.

Module II

Structure and function of the respiratory system. Mechanics of respiration – Muscles of respiration, Lung & Chest wall compliance, V/Q Ratio, Surfactant. Transport of gases- O2 & CO2. Nervous and Chemical regulation of respiration. Hypoxia, Cyanosis, Dyspnea. Acid Base Balance. Principles of Lung Function Test – Spirometer, Lung volumes and capacities. Effect of exercise on respiratory system. Defense mechanism of lungs

Module III

- Structure and function of the GI system. Mastication and Deglutition. Saliva – composition, function, regulation. Gastric secretion – composition, phases of secretion, function. Pancreatic secretion – composition, function, regulation. Bile – composition and function. Movements of the small and large intestine. Digestion in mouth, stomach, intestine and Defecation
- Structure and function of kidney and Nephron.
- Formation of urine – Filtration, Reabsorption, Secretion and Micturition

Module IV

- General organization of endocrine glands. General metabolism – Carbohydrate, Fat, Protein. Physiological action, regulation, disorder of hormones –Adrenal, Pancreatic, Parathyroid, Thyroid. Menstrual cycle and its different phases.
- Structure of muscle – Macroscopic & Microscopic (Myofibril, Myoneural junction) Properties of skeletal muscle Sliding filament theory. Effect of exercise on muscular system

Module V

General organization of the nervous system. Structure, type and function of neurons. Properties of neurons. Synapse and synaptic transmission. Neurotransmitters. Reflex – Properties and

types. Sensory – Receptors, sensory pathway, pain pathway, referred pain, modulation of pain. Motor – Basal ganglia, Cerebellum, Cortex –Function & Effect of lesion. Ascending and Descending pathway. Posture and Equilibrium. Muscle tone. ANS – organization, function of SNS & PSNS. CSF – composition, formation, circulation, function

Practice:

1. Identification of different organs and systems from charts
2. Identification of different blood cells, their normal and abnormal morphology from slides.
3. Examination of pulse, B.P., Respiratory rate.
4. Reflexes
5. Spirometry to measure various lung capacities & volumes, Respiratory rate, Tidal volume, IRV, IC,
6. ERV, EC, residual volume on Spirometry.

Suggesteded Readings: -

1. Textbook of medical physiology – Guyton Arthur
2. Textbook of Physiology – A. K. Jain.
3. Principles of Anatomy and Physiology,16th ed by G.J. Tortora
4. Ross & Wilson Anatomy and Physiology in Health Illness
5. Essential of Medical Physiology- K. Sembulingam

BIOCHEMISTRY

Subject Name	Code	Type of course	T-P-Pj	Credit
Biochemistry	CUTM4286	Theory+ Practice	2-1-0	3

Course Objective:

- To explore the processes and pathways involved in the metabolism of carbohydrates and their significance in energy production.
- To comprehend the structure, function, and importance of amino acids and proteins in biological systems.
- To analyze the function and mechanisms of enzymes in facilitating and regulating metabolic reactions.
- To understand the roles of carbohydrates, proteins, and lipids in maintaining metabolic balance and overall physiological functions.

Course Outcome:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	List out the biochemical pathways leading to metabolism in the human body.	PO1, PO5 PSO1
CO2	Understand the significance of biomolecules in metabolic activities.	PO1, PO5, PSO1
CO3	Implement the knowledge of transformation of energy by the cells.	PO1, PO2, PO5, PSO1
CO4	Detects abnormal range of these molecules from patient samples.	PO5, PO5, PO7, PSO2
CO5	Evaluate the biochemical analysis of the patient samples.	PO1, PO2, PO4, PO5, PO7, PO9, PSO1, PSO2, POS3

Course Outline

Module- I

Structure of enzyme: Apoenzyme and cofactors, prosthetic group-TPP, coenzyme NAD, metal cofactors, Classification of enzymes.

Mechanism of action of enzymes: active site, transition state complex and activation energy. Lock and key hypothesis, and Induced Fit hypothesis.

Enzyme inhibition, enzyme kinetics.

Diagnostic value of serum enzymes: Creatinine kinase, Alkaline phosphatase, Acid phosphatase, LDH, SGOT, SGPT, Amylase, Lipase, Carbonic anhydrase etc.

Practice: Study of effect of temperature on enzyme activity

Study of effect of pH on enzyme activity

Module- II

Carbohydrates: Biomedical importance & properties of Carbohydrates, Classification.

Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Stereo isomerism of monosaccharides, epimers, Haworth projection formulae for glucose; chair and boat forms of glucose.

Practice: Estimation of Glucose in urine

Module- III

Metabolism: Glycogenesis & glycogenolysis, Glycolysis, citric acid cycle & its significance, Components of respiratory chain, energy relationships during cell respiration, types of respiration. HMP shunt & Gluconeogenesis, regulation of blood glucose level.

Practice: Estimation of Glucose in blood

Module- IV

Amino acids: Classification, essential & non-essential amino acids. Chemistry of Proteins & their related metabolism, Classification, biomedical importance.

Metabolism: Ammonia formation & transport, Transamination, Decarboxylation, Urea cycle, metabolic disorders in urea cycle, catabolism of amino acids.

Practice: Estimation of Protein in urine Estimation of Protein in blood

Module- V

Chemistry of Lipids & their related metabolism: Classification, biomedical importance, essential fatty acids. Brief outline of metabolism: Beta oxidation of fatty acids, fatty liver, Ketogenesis, Cholesterol & its clinical significance, Lipoproteins in the blood composition & their functions in brief, Atherosclerosis.

Diabetes mellitus: its types, features, gestational diabetes mellitus, glucose tolerance test, glycosuria, Hypoglycemia & its causes.

Practice: Estimation of Bile pigment in urine Estimation of Bile salts in urine

Suggested Readings:

1. Victor W. Rodwell, David A. Bender, Kathleen M. Botham, Peter J. Kennelly, P. Anthony Weil(2018) Harper's Illustrated Biochemistry. Mc Graw Hill.
   (e-Book link: https://www.pdfdrive.com/harpers-illustrated-biochemistry- d176838999.html)
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
   e-Book link: https://www.pdfdrive.com/lehninger-principles-of-biochemistry-5th-edition-d164892141.html)
3. Donald Voet, Judith G. Voet (2011) Biochemistry 4th Edition. Wiley Publishers.
   (e-Book link: https://www.pdfdrive.com/biochemistry-4th-edition-e165192126.html)
4. Jeremy M. Berg, John L. Tymoczko, LubertStryer. Biochemistry 7th Edition. W.H. Freemanand Company, New York.
   (e-Book link: https://www.pdfdrive.com/biochemistry-seventh-edition- e167675390.html)

Simulation links for labs:

1. Lecture (e-source link: https://app.lecturio.com/#/course/s/8014)
2. Labs for Life (e-source link: http://labsforlife.in/InstructionalVideo.aspx)

CLINICAL PATHOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
Clinical Pathology	CUTM4327	Theory & Practice	2+1+0	3

Course Objective:

- To develop a comprehensive understanding of the pathophysiological mechanisms underlying common diseases and disorders affecting different body systems.
- To acquire knowledge of various laboratory techniques and diagnostic tests used in clinical pathology, including hematological, biochemical, microbiological, and histopathological tests.
- To understand the principles of specimen collection, handling, processing, and the importance of quality control in clinical pathology.
- To apply theoretical knowledge to the identification of pathological changes in tissues and organs through microscopic and other diagnostic techniques.

Course Outcome:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Execute the technique of collection of pathological specimens.	PO1, PO10, PO11, PSO2
CO2	Understand preservation and processing of pathological samples.	PO1, PO2, PO11, PSO1
CO3	Identify the causative agents of infectious diseases.	PO1, PO5, PO13, PSO1, PSO2
CO4	Interpret Gram staining and ZN staining results to diagnose respiratory infections, differentiate between amoebic and bacillary dysentery, and assess the presence of pathogens in various body fluids.	PO1, PO2, PO5, PO10, PO11, PSO2
CO5	Evaluate human abnormalities through clinical investigations.	PO1, PO4, PO5, PO8, PO11, PSO3

Course Outline:

Module-I

Physical & Chemical Examination of Urine: Sugar, ketone bodies, diabetes, nephritis, UTI, etc. Microscopical Examination of Urine: Including operation of the urine analyzer.

Special Tests: Pregnancy test, multistep reagent strip, jaundice, albumin, phosphate, BJP, bile salt and pigment.

Lab & Practice: Benedict test, Roth era's test, Faucet's test, urine analyzer operation, and other urine tests.

Module-II

Respiratory Tract Infection: Gram staining, ZN staining, and DOT centers. Sputum Analysis: For diagnosis of Mycobacterium tuberculosis. Clinical Significance & Report Writing: Sputum and respiratory infections.

Throat Swab Analysis: Bacteriological examination and clinical significance.

Lab & Practice: Gram staining, ZN staining, sputum analysis. Throat swab examination.

Module-III

Physical, Chemical, and Microscopical Examination of Stool: Including differences between amoebic and bacillary dysentery. Clinical Significance of Stool Examination: For parasitic and bacterial infections.

Lab & Practice: Stool analysis, occult test, protozoa and helminth identification.

Module-IV

Pleural, Pericardial, and Synovial Fluids: Composition, collection, and routine laboratory investigation. Cerebrospinal Fluid (CSF): Related to meningitis, brain tumors, and other disorders.

Lab & Practice: Collection and examination of pleural, pericardial, synovial fluids, and CSF.

Module-V

Semen Examination: Composition, and analysis for male infertility disorders.

Lab & Practice: Semen analysis, chemical and microscopical examination

Suggesteded Readings: -

1. Textbook of Clinical laboratory methods and diagnosis by Gradwohls, Publisher Mosby
2. Medical laboratory technology Vol.1 by K. L. Mukherjee, 2007, Publisher Tata McGrawHill Textbook of medical laboratory technology by Praful B Godkar, Publisher Bhalan
3. Medical laboratory science theory and practice by J Ochei and Kolhatkar, 2002, Tata McGraw-Hill, Publisher TBS

BASKET – 2

RADIATION PHYSICS - I

Subject Name	Subject Code	Type	T-P-PJ	Credit
Radiation Physics - I	CUTM4276	Theory + Project	3+0+1	4

COURSE OBJECTIVES:

At the end of the course, the student should be able to comprehend the following:

- To describe the features, components, and functions of X-ray tubes, including the anode, cathode, cooling systems, and fault identification.
- To explain the properties of electromagnetic radiation, the electromagnetic spectrum, and factors affecting the intensity and quality of X-ray radiation.
- To understand atomic concepts, electron interactions, and the mechanisms of X-ray production, including thermionic emission and the effects of tube design.
- To investigate the interactions of X-rays with matter and the principles of attenuation, absorption, and the inverse square law in imaging.

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Define x-rays and components of x-ray-tubes.	PO1, PO5, PO9, PSO1
CO2	Understand the electromagnetic spectrum and its components.	PO1, PO10, PSO1
CO3	Apply basic physics to articulate x-ray production	PO1, PO2, PO5, PSO1, PSO3
CO4	Differentiate between various kinds of x-ray tubes.	PO1, PO2, PO5, PO9, PSO1, PSO3
CO5	Evaluate various interactions of x-ray with matter.	PO1, PO2, PO5, PO6, PSO1, PSO3

Course Content:

Module-I

X-ray tube: Features of X-ray tube, anode, cathode and filament, characteristics of target materials, cooling system, insulation and tube housing, filters, faults of X-ray tubes

Module-II

Electromagnetic Radiation: Electromagnetic waves & their properties, The Electromagnetic spectrum, Spectra: Emission, spectra - continuous, line & band spectra, Intensity & Quality of Electromagnetic Radiation

Module-III

The structure of the Atom, Nucleus, Atomic Number (Z), Mass Number (A), Ionization & Excitation. Interaction of electron beam with X-ray tube target characteristic radiation and bremsstrahlung radiation, X-ray beam intensity, Methods of X-ray tube cooling.

Module- IV

Production of X-rays: Discovery of X-rays, production & properties of X-rays, Thermionic emission, space charge effect, line focus principle, heel effect, saturation voltage, Gas tube, Hot cathode tube, fixed anode and rotating anode tube, dual focus tube, Metal/ Ceramic X-ray tube, grid-controlled X-ray tube.

Module- V

Basic interactions between X-Rays and matter: Coherent scattering, photoelectric Effect, Compton scattering, pair production & photodisintegration.

Attenuation and absorption: Reduction in intensity due to absorption & attenuation and the inverse square law (exponential formula), filtration, attenuation coefficients and half value layer.

PROJECT TOPICS

- History of X-rays
- Electromagnetic Spectrum
- Types of X Ray tubes
- Formation of Characteristic Radiation
- Interaction of radiation with matter

Suggested Readings: -

1. *Christensen's physics of diagnostic radiology- T.S, Curry III, J.E Dowdey*
2. *Basic of Radiological Physics by K.Thalayan, Publisher Jaypee brothers*
3. *Radiologic science for technologist- physics, biology and protection – S.C Bushong*
4. *Advance Medical Physic by Rehani, Publisher Jaypee brothers*

RADIATION PHYSICS - II

Subject Name	Subject Code	Type	T-P-PJ	Credit
Radiation Physics - II	CUTM4277	Theory+Project	3+0+1	4

COURSE OBJECTIVES:

At the end of the course, the student should be able to comprehend the following:

- To study the principles, components, and functions of transformers, rectifiers, and safety mechanisms in X-ray generators.
- To familiarize with modern X-ray technologies, including mammography, Straton X-ray tubes, and portable/mobile X-ray machines.
- To analyze methods to minimize secondary radiation, including the use of filters, beam restrictors, and grids.
- To comprehend fluoroscopy techniques, image intensification, and viewing/recording systems for real-time imaging.

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Identify the various components in an x-ray circuitry.	PO1, PO2, PO5, PSO1, PSO3
CO2	Classify the advancements of x-ray tubes.	PO1, PO5, PO8, PSO1, PSO3
CO3	Apply the concept of image quality and secondary radiation	PO1, PO2, PO5, PO6, PSO1, PSO3
CO4	Connect basic working of x-ray instruments with fluoroscopic imaging.	PO1, PO2, PO5, PO9, PSO1, PSO3
CO5	Evaluate the factors affecting image quality	PO1, PO2, PO5, PO6, PO10, PSO1, POS3

Module-I

X-ray generators: Transformers and its types, laws of transformers, transformer losses, Filament circuit, high voltage circuit

Rectification**:** transformers, half-wave and full-wave rectifications, semiconductors, Types of

fuses, switches and exposure timers, circuit breakers, Earthing, insulation, high tension cables construction & design.

Module- II

Advancements of x-ray tubes: Components of Mammography X-ray tube; Straton x-ray tube, Portable x-ray & Mobile X-Ray machine

Module-III

Control of secondary radiations:

Filters- inherent filters, added filters, heavy metal filters;

X-ray beam restrictors- aperture diaphragms, cones, cylinders and collimators

Grids- evaluation of grid performance, grid cutoff, types of grids, Air gap technique

Module-IV

Fluoroscopic imaging: Direct fluoroscopy, fluoroscopy image, Image intensifier, Image characteristics in fluoroscopy, automatic brightness control, Multifield image intensifiers, Viewing and recording the fluoroscopic image- closed circuit television, vidicon, plumbicon camera, charged coupled device, cathode ray tube

Module-V

Physical Principles of X-ray Diagnosis: Radiological images: Unsharpness, resolution, Contrast, scattered radiation, grids, fluoroscopy.

PROJECT TOPICS

- Types of Generators
- High tension Cables
- Construction of Mammography tube
- Air gap Technique
- Image formation process in Fluoroscopy

Suggesteded Readings: -

1. *Christensen's physics of diagnostic radiology- T.S, Curry III, J.E Dowdey*
2. *Basic of Radiological Physics by K.Thalayan, Publisher Jaypee brothers*
3. *Radiologic science for technologist- physics, biology and protection – S.C Bushong*
4. *Advance Medical Physic by Rehani, Publisher Jaypee brothers*

DARKROOM TECHNIQUES

Subject Code	Subject Name	Type	T-P-PJ	Credit
CUTM4280	Darkroom Techniques	Theory+Practical	3+1+0	4

COURSE OBJECTIVES:

- To explain the components and characteristics of X-ray films, emulsions, film speeds, and the formation of latent images in radiographic imaging.
- To describe the construction, types, and factors affecting the performance of intensifying screens, and their role in radiographic image quality.
- To understand the construction, types, and care of X-ray cassettes, as well as techniques for testing film-screen contact and light leakage.
- To explore the design and operation of X-ray darkrooms and the chemical processes involved in film development and fixation, including methods for silver recovery.

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Discuss the formation of latent images.	PO1, PO5, PSO1, PSO3
CO2	Apply fluorescence in radiography.	PO1, PO2, PO5, PSO1, PSO3
CO3	Analyze X-ray cassettes.	PO1, PO2, PO5, PO6, PSO1, PSO2, PSO3
CO4	Design the layout for a dark room.	PO1, PO5, PO6, PO9, PSO1, PSO2
CO5	Interpret chemical processing in radiography	PO1, PO2, PO5, PO6, PSO1, PSO2, PSO3

Module -I

PHOTOGRAPHIC ASPECTS IN RADIOGRAPHY:

Light sensitivity salts of silver; photographic emulsion; Emulsion preparation, Formation of the latent image, x-ray film; construction of X-ray film; characteristics and control; screen films; non-screen film; dental films; occlusal film; duplicating films; single coated and double coated films; speed of the film; Anti abrasive super coating; Base material; substratum; coating; emulsion, Fogs; types of fogs

Module -II

INTENSIFYING SCREENS:

Fluorescence; application of fluorescence to radiography, construction of an intensifying screen; Intensifying factor; relative speeds of intensifying screen; factor affecting the speed of screens; Mounting-sharpness relative to the speed of the screens, Identification; cleaning and general care of intensifying screens.

Module-III

X-RAY CASSETTE:

Basic construction and functional requirements, Types of cassettes, identifying of cassettes; records necessary for cassettes; general care of cassettes and storage; testing a cassette for light leakage; Testing for film screen contact, Sensitometry; Principles of sensitometry, Characteristic curve; Measurements from the characteristic curve.

Module-IV

THE X-RAY DARK ROOM:

Layout plan of a dark room for a small medium and big hospital; Size of darkroom; light proof entrances; cassette hatches, General construction of room to provide light-proofing, Chemical; Radiation; disposition of equipment; loading-bench-design; film hoppers; safe light types; test for safe light; hangers types Care of hangers; ventilation; darkroom illumination and colour schemes; testing safety of illumination; Darkroom procedure.

Module-V

CHEMISTRY OF PROCESSING:

Developers: basic constituents, types of developer for manual processing; automatic processing; effects on development of time; temperature, agitation, developer activity;

X-ray fixers; basic constituents and function of fixer, inclusion of hardening and other agents, Fixing.

Methods of silver recovery; economic reasons.

Suggesteded Readings: -

1. *Basic Radiologic Physics – K.Thayalan ,*
2. *Radiographic Imaging – D.N & M O Chesney,*
3. *Textbook of Radiology for Residents &Technicians (English, Paperback, Bhargava Satish K.*

RADIATION SAFETY & PATIENT CARE

Subject Name	Subject Code	Type	T-P-PJ	Credit
Radiation Safety & Patient Care	CUTM4279	Theory + Project	4+0+1	5

COURSE OBJECTIVES:

- To learn effective communication, patient education, responsibilities, consent acquisition, and patient safety techniques in radiological practices.
- To explore the chemical and biological effects of radiation, including radiation-induced mutations, stochastic and non-stochastic effects, and radiation impacts on the body.
- To understand radiation units, permissible exposure levels, and safety guidelines for radiation protection, including ALARA/ALARP principles.
- To examine the construction and safety protocols for exposure rooms, radiation shielding, and the use of monitoring devices for personal and area radiation protection.

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understanding the importance of patient care	PO1, PO3, PO4, PO7, PSO1, PSO2
CO2	Demonstrate the chemical and biological effects of radiation	PO1, PO2, PO5, PO7, PSO1, PSO2
CO3	Analyze the radiation units used to measure radiation	PO1, PO2, PO5, PO6, PSO1, PSO2
CO4	Evaluate the parameters for the construction of an imaging room	PO1, PO5, PO6, PO9, PSO1, PSO2
CO5	Implement knowledge on radiation monitoring devices	PO1, PO2, PO5, PO6, PO8, PSO1, POS2

Module I

Introduction to Patient Care: Communication with the patient, Patient education, Responsibilities of Medical Imaging Technologist, Obtaining Consents and history for different radiological examinations, Patient transfer and Restraining techniques, Obtaining vital signs, Ergonomics and body mechanism, Emergency cart, Emergency drugs.

Module II

Biological effects of radiation: Chemical effects of radiation - radiolysis of water; production of free radicals, radicals' reactions. Stochastic and non-stochastic effects, chromosome aberrations and mutations, cellular effects, genetic effects. early effects and late Radiation effects on whole body, oxygen enhancement ratio, relative biological effectiveness

Module III

Basic radiation units and quantities, Exposure, absorbed dose, equivalent dose, Tissue weighting factor, ICRP Regulations, ALARA/ALARP, Maximum Permissible Dose (MPD), Radiation in Pregnancy and children.

Module IV

Construction of exposure rooms in the Radiology Department: workload, Use factor, Occupancy factor, ICRP guidelines for room design in radiological modalities, Scatter and Leakage radiation, Radiation Signage, Protection in fluoroscopy, mammography, mobile X-ray, and CT.

Module V

Radiation monitoring devices: Personal monitoring devices (TLD, Film Badge, Pocket Dosimeter, OSLD), Area monitoring devices- Gas-filled detectors (ion chambers, proportional counters and G M counters), scintillation detectors

PROJECT TOPICS

- Latent image formation
- Film construction and types of films
- Regulatory bodies & their guidelines
- Radiation Symbols
- Radiation monitoring devices

Suggested Readings: -

1. *Basic of Radiological Physics by K.Thalayan, Publisher Jaypee brothers*
2. *Patient Care in Radiography by Ruth Ann Ehrlich – 9th edition*

RADIOGRAPHIC TECHNIQUE -1

Subject Name	Subject Code	Type	T-P-PJ	Credit
Radiographic technique -1	CUTM1767	Theory+Practical	2+2+0	4

COURSE OBJECTIVES:

- To develop proficiency in standard and supplementary radiographic techniques for imaging the upper and lower limbs, including joints and bones.
- To understand and apply appropriate techniques for chest and vertebral column imaging, including supplementary projections for specific conditions and anatomical details.
- To acquire skills in radiographic techniques for pelvic, hip, and skull imaging, including techniques for congenital conditions and advanced anatomical projections.
- To gain expertise in dental radiography, including intraoral, extraoral, and orthopantomography, as well as abdominal and specialized radiographic techniques for emergency and intensive care settings.

COURSE OUTCOMES:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand different imaging techniques and procedures in Radiology.	PO1, PO5, PO12, PSO1
CO2	Application of contrast media.	PO2, PO4, PO7, PO9, PSO2
CO3	Examine various radiographic positions	PO2, PO3, PO7, PSO3
CO4	Evaluate the image and do the post-processing.	PO5, PO6, PO9, PSO3
CO5	Examine special projection	PO1, PO2, PO5, POS3

Module I

Upper limb: Technique for hand, fingers, thumb, wrist joint carpal bones, forearm, elbow joint, radio ulnar joints and humerus supplementary techniques for the above. eg. carpal tunnel view, ulnar groove, head of the radius, Technique for shoulder joint and modifications, scapular, calvicle, acromio clavicular joints, sterno-clavicular joint.

Lower limb: Technique for foot, toes, great toe, tarsal bones, calcaneum, ankle joint, lower leg, knee, patella & femur.

Supplementary technique: Stress view for torn ligaments -- Subtalar joint and talo-calcaneal joint, Inter condylar projection of the knee.

Module II

Thorax and vertebral column:

Technique for routine chest projections: - Supplementary projections - antero posterior, obliques, lordotic and apical projection. Use of high kV technique, Expiration technique - Technique for pleural fluid levels and adhesions. Diaphragm: Inclusion of diaphragm on chest and abdominal films.

Vertebral column: Technique for Atlanto-occipital joint, cervical spine, cervico thoracic spine, thoracic spine, thoraco- lumbar spine, lumbo sacral spine, sacrum and coccyx.

Module III

Pelvic girdle and hip region: Technique for whole pelvis, sacroiliac joint, symphysis pubis, hip joint, acetabulum, neck of femur.

Supplementary technique- Congenital dislocation of hips, Lateral projections for hip joints to show femoral head and neck relationship.

Skeletal survey: Skeletal survey for metabolic bone disease, metastases, hormonal disorder, renal disorders.

Skull: Basic projections for cranium, facial bones, nasal bones and mandible. - Technique for- petrous temporals for mastoids - Internal auditory canal - Accessory nasal sinuses- Tempero - mandibular joint - Orbits and optic foramen - Zygomatic arches. - Styloid process. - Pituitary fossa - Jugular foramen.

Module IV

Dental radiography: Technique for intra oral, Occlusal projections, Extra oral projections including orthopantomography.

Module V

Lungs and mediastinum: Abdominal viscera: Technique for plain film examination, Projection for acute abdomen patients Radiography using mobile x-ray unit: Radiography in the ward - Radiography in the specialized unit. eg. - Intensive care unit - Coronary care. - Neonatal unit - Radiography in the operation theater.

Suggesteded Readings: -

1. Clarks Positioning in Radiography- 13th Edition

2.Radiology of Positioning and Applied Anatomy for Students and Practitioners.

MAMMOGRAPHY AND ADVANCED IMAGING TECHNIQUES

Subject Name	Subject Code	Type	T-P-PJ	Credit
Mammography and Advanced Imaging Techniques	CUTM4278	Theory+Project	3+0+1	4

COURSE OBJECTIVES:

- To gain knowledge of imaging techniques and procedures in Echocardiography, DEXA, and Mammography to achieve optimal quality
- To prepare patients and contrast media for imaging procedures
- To deliver clear instructions to patients for effective imaging outcomes.
- To execute radiology procedures proficiently as required by the radiologist.

COURSE OUTCOMES:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand different imaging techniques and procedures of DEXA, Echocardiography, mammography etc.	PO1, PO5, PO8, PO12, PSO1, PSO3
CO2	Execute the ingestion of radiological contrast agents in patients.	PO2, PO4, PO7, PO9, PSO2
CO3	Examine a patient for general radiologic procedures.	PO2, PO3, PO7, PSO3
CO4	Evaluate the indications and contra indications of various studies	PO1, PO4, PO5, PO9 PSO1
CO5	Judge different modalities	PO1, PO5, PO6, PO12, PSO1, POS3

Module-I

Echocardiography: Principles, patient preparation and probe usage, views and pathologies

Module-II

DEXA Scan: History of DEXA, Bone mineral density, Preparation of patient, t-score, z- score, osteopenia, osteoporosis, Units of BMD, Standard deviation.

Module-III

Anatomy and Positioning:

Anatomy of the breast tissue, Mammography views: Cranio-caudal, Medio-lateral oblique, 90-degree lateral, medio-lateral, and latero-medial, Latero-medial oblique, Caudal-cranial. Exaggerated cranial-caudal, Spot compression, Cleavage, Tangential, Axillary tail, BIRADS

Module IV

Mammography equipment:

Image receptor, screen//film combination; cathode (purpose, effect on focal spot, orientation), focal spot size; anode/target (purpose, material, anode angle, line focus principle, heel effect); window material, filtration, source-to-image distance; use of grids, magnification; compression, Automatic exposure control, Digital Breast Tomosynthesis

Module-V

Special radiological equipment: computed radiography, digital radiography, PACS.

PROJECT TOPICS

- Use of Echocardiography in detection of cardiac pathologies
- Importance of DEXA Scanning in Indian women
- Importance of screening mammography in Indian women
- Technical considerations in a mammography equipment
- Picture Archival and Communications System

Suggested Readings:

1. *Principle and Practice of Nuclear Medicine and Correlative Medical Imaging by CT Imaging, Satish K Bhargava*
2. *Atlas of Human Anatomy on CT Imaging by Singh Hariqbal*
3. *CT Scan by Euclids Seeram*

ULTRASONOGRAPHY

Subject Name	Subject Code	Type	T-P-PJ	Credit
Ultrasonography	CUTM4281	Theory+Project	3+0+1	4

COURSE OBJECTIVES:

- To gain a foundational understanding of the basic principles, physics, and characteristics of ultrasound, including how it interacts with matter and its instrumentation.
- To learn the principles, types, and applications of Doppler ultrasound, including its advantages, disadvantages, and how to handle related artifacts.
- To develop knowledge of the biological effects of ultrasound, safety considerations, regulatory standards (PCPNDT Act), and the importance of quality assurance in ultrasound practice.
- To acquire skills in advanced ultrasound techniques, including Extended Field of View (EFOV), Harmonic Imaging, and 3D/4D ultrasound for enhanced diagnostic capabilities.

COURSE OUTCOMES:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand about ultrasound and related equipment's	PO1, PO5, PO8, PO12, PSO1, PSO2
CO2	Implement the use of ultrasound and doppler techniques, to work with patients in real time.	PO2, PO4, PO7, PO9, PSO2, PSO3
CO3	Analyse the interpretations with respect to different positioning of patients.	PO1, PO5, PO6, PSO3
CO4	Evaluate the indications of ultrasound imaging	PO1, PO4, PO5, PSO1
CO5	Examine various USG protocols for different body parts	PO2, PO5, PO9, PSO3

Module-I

Introduction to ultrasound; Basic principle and physics of ultrasound; Characteristics of ultrasound; Interaction of ultrasound with matter; Instrumentation; Piezoelectric effect; Transducers; Ultrasound display modes; Ultrasound controls

Module - II

Principle and physics; Doppler Instrumentation; Doppler – types, uses, advantages, disadvantages and comparison; Ultrasound Artifacts and Doppler artifacts

Module -III

Biological effects of ultrasound and safety considerations; PCPNDT Act, Quality assurance in ultrasound, USG contrast media

Module IV

Advanced imaging in ultrasound - Extended Field of View (EFOV), Harmonic Imaging, 3D and 4D ultrasound

Module V

Ultrasound protocol for different body parts

PROJECT TOPICS

- Advancements in USG instrumentation
- USG Artifacts
- USG contrast agents and quality assurance
- Harmonic Imaging
- Protocol for abdomen USG

Suggested Readings:

1. *Basic Radiology Physics –K.Thayalan,*
2. *Full Field Digital Mammography [Print Replica] Kindle Edition by A. Jain (Author),*
3. *Step by Step Ultrasound Hardcover – 1 January 2010 by Satish K. Bhargava (Author)*

RADIOGRAPHIC TECHNIQUE-2

Subject Name	Subject Code	Type	T-P-PJ	Credit
Radiographic Technique-2	CUTM1772	Theory+Practical	3+2+0	5

COURSE OBJECTIVES:

- To enable the students to interpret the radiographic images & find out the abnormalities if any like fractures, tumors etc.
- To train and inform students about special investigative techniques in imaging because after completion of this course they are working as CT/MRI/Cath Lab technologists.
- To upgrade students about all tools and techniques in these imaging modalities to competently assist the radiologist.
- To help students to produce better images and understand the images when produced.

COURSE OUTCOMES:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand the basic knowledge of techniques and investigations available	PO1, PO5, PO8, PO12, PSO1
CO2	Interpret abnormalities, disease and pathological conditions on Fluoroscopy.	PO1, PO5, PO7, PO9, PSO3
CO3	Analyse the special procedures in diagnostic radiology	PO1, PO2, PO5, PSO1, PSO3
CO4	Evaluate the effect of contrast medium in radiological imaging.	PO2, PO4, PO5, PSO2, PSO3
CO5	Deal with different modalities with different organs	PO1, PO5, PO6, PSO1, POS3

Module-I

RADIOLOGICAL CONTRAST AGENTS:

General principles Opaque agents and gasses, Relationship of x-ray transmission to density and atomic number of the elements of contrast medium. Types of Barium sulfate solutions, concentration and its particular uses, additional modifications activators, Routes, Dosage, Double contrast

Module-II

GI Tract: Barium swallow, Barium meal, BMFT, small bowel enema, Barium enema,

Module-III

Renal Tract: Intravenous urography, Retrograde pyelography, Micturating cystourethrography

Module-IV

Intravenous cholangiography Percutaneous cholangiography, post- operative cholangiography (T-tube Cholangiography)

Module-V

Hysterosalpingography, FTR, Myelography, Vertebroplasty, Sialography, Dacrocystography

Suggested Readings:

- *Radiological Procedures - A Guideline, Textbook of Radiology for residents and technicians - BHARGAVA S. K*

BASIC OF COMPUTED TOMOGRAPHY

Subject Name	Subject Code	Type	T-P-PJ	Credit
Basic of Computed Tomography	CUTM2543	Theory+Project	3+0+1	4

COURSE OBJECTIVES:

- To gain knowledge of the fundamental physical principles of CT imaging.
- To learn the working principles and components involved in CT equipment construction.
- To acquire technical expertise in CT image reconstruction techniques.
- To learn to recognize and analyze artifacts in CT images for accurate interpretation.

COURSE OUTCOMES:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand the basic physical Principles of CT.	PO1, PO5, PO8, PSO1
CO2	Interpret the functionality, physical structure and componential alignments in the equipment.	PO1, PO5, PO12, PSO1, PSO2
CO3	Evaluate and identify adequate image quality	PO2, PO5, PO7, PSO2, PSO3
CO4	Design and reconstruct the CT images	PO1, PO2, PO5, PSO3
CO5	Implement various software details within CT	PO5, PO8, PO9, PSO1, POS3

Module-I

Introduction to CT:

Introduction and history, CT principle, CT generations, CT Instrumentation, CT detectors, Axial & Helical CT – Slip ring technology.

Module-II

Data acquisition, Image pre-processing/reconstruction techniques, Algorithms for image reconstruction, Image display-HU Units, WW and WL, Image post-processing techniques.

Module-III

Advancements in CT: Multi-detector CT, Isotropic imaging, Cardiac CT, Advanced CT scanners, Dual energy & Dual Source Scanners, CT-fluoroscopy

Module-IV

Image quality- intrinsic and extrinsic parameters

Module-V

Safety consideration, Documentation in CT, Role of Medical Imaging technologist in CT scan procedures, Quality assurance in CT

PROJECT TOPICS

- Slip ring technology
- Post-processing techniques used in CT
- Advancements in CT scanning
- Role of Medical Imaging technologist in CT scan procedures

Suggested Readings:

1. *Christensen's Physics of Diagnostic Radiology, Basic Radiological Physics- K. Thayalan*

COMPUTERIZED TOMOGRAPHY (CT SCANNING) METHOD AND PROCEDURE

Subject Name	Subject Code	Type	T-P-PJ	Credit
Computerized Tomography (CT Scanning) Method and Procedure	CUTM4282	Theory+Project	3-0-1	4

COURSE OBJECTIVES:

- To gain knowledge of CT contrast media types, proper administration techniques, patient preparation, and the significance of flow rates in CT imaging.
- To learn and apply CT imaging protocols for various body regions such as brain, neck, abdomen, pelvis, spine, and extremities, including high-resolution techniques like HRCT.
- To develop expertise in performing contrast-enhanced CT scans for brain, thorax, abdomen, liver, pancreas, and renal imaging.
- To understand the causes and remedies for CT artifacts and gain proficiency in CT angiography for coronary, cerebral, abdominal, peripheral, and pulmonary assessments.

COURSE OUTCOMES:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand imaging methods and techniques.	PO1, PO2, PO8, PSO1
CO2	Implement the technique in diagnosis of muscle and bone disorders, such as bone tumors and fractures.	PO2, PO5, PO7, PSO1, PSO3
CO3	Organize procedures for surgery, biopsy, and radiation therapy.	PO2, PO3, PO6, PSO2, PSO3
CO4	Investigate conditions such as cancer, heart disease, lung nodules and liver masses	PO1, PO5, PO7, PSO1, PSO3
CO5	Differentiate CT with other modalities	PO1, PO5, PO8, PSO1, PSO3

Module-I

CT Contrast media, administration of contrast media and patient preparation, Flow rate and its importance

Module-II

CT Protocols for different body parts- brain, Neck, shoulder, thorax, upper limb, abdomen-and phases, HRCT, KUB, pelvis, lower limb, knee, foot, Ankle, spine

Module-III

CECT- Brain, neck, thorax, abdomen- liver, pancreas, renal.

Module-IV

CT Artifacts- appearance, cause, remedy

Module-V

CT ANGIOGRAPHY:

Coronary angiography, Cerebral angiography, Abdominal angiography, Peripheral angiography, Pulmonary angiography, perfusion

PROJECT TOPICS

- Types of CT contrast media and its modes of administration
- Film construction and types of films
- Care and maintenance of Intensifying screens
- Types of Cassettes
- Darkroom equipment and layout

Suggested Readings:

1. *Computed Tomography: Physical Principles, Clinical Applications, and Quality Control - Euclid Seeram*

INTERVENTIONAL RADIOLOGY & DRUGS USED IN DIAGNOSTIC RADIOLOGY

Subject Name	Subject Code	Type	T-P-PJ	Credit
Interventional Radiology & Drug Diagnostic Radiology	CUTM2549	Theory+Practical	3-1-0	4

COURSE OBJECTIVES:

- To familiarize with the various equipment used in the cath lab, including C-arm, digital subtraction angiography units, pressure injectors, stents, and endoscopes.
- To gain proficiency in arterial and venous access methods, including the femoral and arm approaches, as well as the use of catheters, guide wires, dilators, and balloons using the Seldinger technique.
- To learn universal and standard precautions for infection control in the cath lab, including understanding hospital-acquired infections and sterilization protocols.
- To develop the skills necessary for performing various angiography procedures (coronary, peripheral, cerebral, etc.), as well as biopsy techniques and advanced procedures like MR/CT-guided biopsies and vascular interventions.

COURSE OUTCOMES:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understanding of role of anesthesia in diagnostic radiology	PO1, PO2, PO7, PSO1
CO2	Applications of equipment in Cath-Lab.	PO1, PO2, PO5, PSO2
CO3	Analysis of health condition of blood vessels through various types of angiographies	PO1, PO2, PO5, PSO1, PSO3
CO4	Evaluation of anesthetic problems associated with specific techniques.	PO1, PO4, PO7, PSO1
CO5	Implement knowledge on angiography	PO1, PO2, PO5, PO8, PSO3

Module-I

EQUIPMENT:

Equipment in Cath lab units; C-Arm, Digital Subtraction Angiographic Units, Pressure Injectors, Contrast media, Introduction to Stents, Endoscopes

Module -II

EQUIPMENT'S USED IN ACCESS:

Arterial and Venous access (Femoral approach, Arm approach), Equipment and Instruments used for access (Catheters, Guide wires, Dilators, Balloons) Seldinger technique.

Module-III

sterilization in the cath lab- universal precautions, standard precaution, infection cycle, infection control, hospital-acquired infection

Module-IV

ANGIOGRAPHY:

Coronary angiography, Peripheral angiography, Carotid angiography, Renal angiography, Cerebral angiography, Selective Aortography, Catheter Embolization, CT Angiography, MR Angiography.

Module-V

BIOPSY & SPECIAL PROCEDURES:

CT Guided Biopsy, MR Guided Biopsy, US Guided Biopsy, Endogenous Ablation of Varicose veins, Transjugular Intrahepatic Portosystemic Shunts, Introduction to Vascular Ultrasound

Suggested Readings:

1. *Radiological Procedures - A Guideline, Textbook of Radiology for residents and technicians - BHARGAVA S. K*

BASIC OF NUCLEAR MEDICINE IMAGING

Subject Name	Subject Code	Type	T-P-PJ	Credit
Basic of Nuclear Medicine Imaging	CUTM2542	Theory+Project	3-0-1	4

COURSE OBJECTIVE:

- To gain knowledge of atomic models, radioactive decay, half-life, and radioisotopes, and their role in nuclear medicine imaging.
- To understand the production of radioisotopes using nuclear reactors and cyclotrons, and to familiarize with their characteristics and applications.
- To learn the components, advantages, and preparation techniques of radiopharmaceuticals, with a focus on Tc99m-based imaging.
- To study the functioning of PET scans, SPECT, gamma cameras, collimators, and the design and safety protocols of nuclear medicine facilities.

Course Outcome:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand about the basic equipments of nuclear medicine labs, gamma cameras, radiopharmaceuticals and their preparations.	PO1, PO2, PO3, PO10
CO2	Demonstrate the handling of equipments in nuclear imaging labs.	PO1, PO5, PO8, PO10, PSO1
CO3	Relate and work with the patient in real-time.	PO1, PO2, PO9
CO4	Design Nuclear medicine layout and reconstruction.	PO1, PO3, PO5, PO11
CO5	Understand & follow radiation protection & safety	PO1, PO10, PO12, PSO2

Module-I

BASICS OF NUCLEAR MEDICINE IMAGING:

Atomic models, Half-life, Radioactive decay and modes of decay, Radioisotopes, law of radioactivity

Module-II

RADIOISOTOPES:

Introduction, Nuclear generators, nuclear reactor, Cyclotron based production of radioisotopes. Characteristics of radioisotopes

Module-III

RADIOPHARMACEUTICALS:

Cold kits their components and advantages, Preparation of radiopharmaceuticals, commonly used radiopharmaceuticals, Tc99m based Imaging

Module-IV

PET Scan, SPECT, Gamma Cameras, Collimators and its types

Module-V

Nuclear Medicine Layout and construction, fume heads, Radiation protection.

PROJECT TOPICS

- Types of radioactive decay
- Nuclear generators and Cyclotrons
- Preparations of Radiopharmaceuticals
- Uses of PET Scan in cancer diagnosis
- Radiation protection in nuclear medicine

Suggested Readings:

1. *Code of practice for radiation protection in nuclear medicine by MOHAMMED IBRAHIM HAMED.*

BASICS OF MAGNETIC RESONANCE IMAGING

Subject Name	Subject Code	Type	T-P-PJ	Credit
Basic of Magnetic resonance imaging	CUTM2544	Theory+Project	3+0+1	4

COURSE OBJECTIVES:

- To explore the principles of magnetism, types of magnetism (ferromagnetism, paramagnetism, etc.), and concepts such as Larmor frequency and resonance.
- To familiarize with MRI instrumentation, including gradient coils, RF coils, and shim coils, as well as the operation of the patient table.
- To understand spatial encoding, frequency encoding, phase encoding, and the process of k-space filling in MRI imaging.
- To explore different MRI pulse sequences (T1, T2, spin echo) and identify common MRI artifacts like aliasing, motion, and susceptibility.

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understanding basics of MRI, MRI scans of different organs.	PO1, PO5, PO9
CO2	Demonstrate proper patient positioning during the MRI procedures.	PO1, PO2, PO7, PO10
CO3	Analyze MRI images for proper diagnosis of disease.	PO1, PO3, PO4, PSO2
CO4	Able to evaluate the MRI report format.	PO3, PO6, PO11
CO5	Implement knowledge on MRI.	PO1, PO10, PO12, PSO1

Module-I

Basics of magnetism, Types of magnetism: Ferromagnetism, Para magnetism, Superparamagnetism, Diamagnetism, Superconductivity, strength of external magnet, Tesla unit, Concept of proton unit, Larmor Frequency, Concept of resonance

Module-II

MRI Instrumentation: Basic instrumentation of Coils Gradient Coils, RF Coils: Surface coil, Pair Saddle Coil, Helmholtz Pair Coil, Bird, Cage Coil, Shim coils, Patent Table,

Module-III

ENCODING:

Spatial encoding, frequency encoding, and Phase encoding and K space and types of k space filling.

Module-IV

MRI PULSE SEQUENCES:

T1, T2, Proton Density, Spin Echo, Inversion Recovery, Gradient echo.

Module-V

MRI ARTEFACTS:

Aliasing, Zipper, Motion, Metal, Chemical shift, Beam Hardening, Gibbs, Magic angle, Slice overlap, Susceptibility.

PROJECT TOPICS

- Lung MRI
- Safety precaution of MRI
- Open MRI
- MRI Artifact
- Role of communication and team interaction to improvement patients' experiences, quality of care and through put in MRI

Suggested Readings:

1. *MRI at Glance westbrook 5th edition.*

MRI SCANNING AND PROCEDURES

Subject Name	Subject Code	Type	T-P-PJ	Credit
MRI Scanning and Procedure	CUTM2545	Theory+Project	3-0-1	4

COURSE OBJECTIVES:

- To gain a foundational working knowledge of MRI as an imaging modality.
- To develop the ability to effectively use MRI techniques in clinical practice.
- To acquire technical proficiency in operating MRI equipment confidently.
- To build confidence to function competently in an MRI unit or department.

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand patient positioning during the MRI procedure.	PO1, PO2, PO5
CO2	Demonstrate well defined images for proper diagnosis of MRI films.	PO1, PO3, PO9, PO12
CO3	Analyze MRI scans of different organs.	PO1, PO6, PO8, PSO2
CO4	Appraise MR angiography.	PO2, PO4, PO9
CO5	Understand basic working knowledge of the Imaging modality of MRI	PO1, PO5, PO10, PSO1

Module-I

Counselling the patient for MRI, preparing the patient for MRI, prescription reading, identifying Coils, Operating the MRI, and selecting Protocols.

Module-II

Physiologically controlled imaging: Cardiac triggering, ECG signal, Triggered measurements, tracking SAT, Fat, and water saturation, contrast agents in MRI

Module-III

Cardiac Imaging; Whole body MRI Protocols

Module-IV

MR Angiography: Flow related Enhancement, Time of flight, Phase contrast MR Angiography, MR Spectroscopy, Magnetization Transfer Contrast, Functional MRI, DWI.

Module-V

MRI safety- Implants and pace-makers, Electrical safety, Metallic safety, Instrumental safety, Bio-effects of MRI; Documentation; Quality assurance in MRI

PROJECT TOPICS

- Operation of MRI- Identification of Coils.
- Physiologically controlled imaging: Cardiac triggering & measurements, ECG signal
- MRI scan spine, Cardiac MRI, MRCP, MRI Brain (Stroke & Epilepsy), MRI Shoulder, MRI Knee
- MR Angiography, MR Spectroscopy, Functional MRI
- MR safety, Bio-effects of MRI, Quality assurance in MRI

Suggested Readings:

1. *Cross Sectional Anatomy CT and MRI by Chauhan, publisher Jaypee Brothers Medical Publishers; first edition*
2. *Step by Step MRI by Jagan Mohan Reddy.*

IMAGE INTERPRETATION OF X-RAY MAMMOGRAPHY, CT & MRI

Subject Name	Subject Code	Type	T-P-PJ	Credit
Image Interpretation of X-Ray Mammography, CT & MRI	CUTM1777	Theory+Practical	3+2+0	5

COURSE OBJECTIVES:

- To understand anatomical terminology, skeletal system structure, and the radiographic appearance of major bones, joints, and related pathologies.
- To learn the structure and function of the heart, blood vessels, and respiratory organs, along with their pathologies and radiographic diagnostic methods.
- To explore the anatomy and pathologies of the digestive and urinary systems, along with their radiographic imaging techniques.
- To study the structure, function, and diseases of the endocrine and nervous systems, and the corresponding radiographic investigations.

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understanding the anatomy and pathology of different body parts.	PO1, PO2, PO7, PO9
CO2	Determine topography related to organs for radiographic positioning.	PO1, PO2, PO3, PO10
CO3	Students will be able to use various image analysis techniques.	PO1, PO5, PO9, PSO2
CO4	Evaluate visual data, medical scans for the information they contain.	PO3, PO4, PO5
CO5	Interpret different images like X ray, mammography, Ultrasound, CT and MRI	PO1, PO6, PO9, PSO1

Module-I

REVIEW OF ANATOMY & SKELETAL SYSTEM:

General anatomical terminology, surface anatomy, surface landmarks and topography in relation to the organs of the body for radiographic positioning, positioning terms, Anatomical

terminology with regard to location. All major bones and joints of skeleton i.e., extremities, skull, thorax and vertebral column and pathologies/diseases related to them and their radiographic appearance

Module-II

HEART AND BLOOD VESSELS & RESPIRATORY SYSTEM:

Structure, Function, Blood circulation and Purification, Blood supply to heart, major vessels of circulatory system and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it. Nasal passage, Accessory nasal sinuses, Pharynx, Larynx, Trachea, Bronchus, Lungs, Pleura, the Blood supply to organs, Nature and function of respiration and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.

Module-III

ALIMENTARY SYSTEM:

Function of mouth, tongue, teeth, salivary glands, pharynx and esophagus, smooth muscle, small intestine, large intestine, liver and biliary tract, pancreas, digestion and absorption of food, metabolism and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.

Module-IV

URINARY TRACT AND REPRODUCTIVE SYSTEM:

Kidneys, Ureters, Bladder, urethra, Urinary secretion, and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.

Module-V

ENDOCRINE SYSTEM & NERVOUS SYSTEMS:

Anatomical location of pituitary, thyroid, parathyroid, adrenal, thymus, pancreas, gonads and their function and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it. Main subdivision, lobes of ventricles of brain, spinal cord, meninges and CSF and pathologies/diseases related to them and their radiographic appearance and names of radiological investigations related to it.

Suggested Readings:

1. *Radiology & Imaging for students & Practitioners – Gupta & Gupta.*
2. *Radiology Interpretation Made Easy-G.Balachandiran.*

ORIENTATION IN CLINICAL SCIENCES

Subject Name	Subject Code	Type	T-P-PJ	Credit
Orientation in Clinical Sciences	CUTM4283	Theory + Project	2+0+1	3

COURSE OBJECTIVES:

- To develop foundational knowledge of cardiovascular, respiratory, gastrointestinal, renal, and abdominal disorders, including their clinical features and diagnostic criteria.
- To gain insights into central nervous system disorders, including cerebrovascular diseases, meningitis, and encephalitis, as well as various orthopedic conditions such as fractures, arthritis, and bone tumors.
- To understand the pathophysiology, complications, and potential management strategies for common medical conditions across different body systems.
- To build the ability to identify, differentiate, and analyze disorders through their symptoms, diagnostic approaches, and complications for effective patient care.

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Remember the basic concept of different diseases and medicines	PO1, PO6, PO7, PO11
CO2	Classify diseases of various body systems and how they manifest clinically and histopathologically.	PO5, PO8, PO9, PO10
CO3	Implementation of knowledge of Orthopedics related problems.	PO1, PO3, PO7, PSO2
CO4	Distinguish different clinical conditions.	PO2, PO4, PO5
CO5	Correlate the anatomical pathology with major clinical symptoms and signs.	PO1, PO8, PO9, PSO1

Module-I

CARDIOVASCULAR & RESPIRATORY DISORDERS:

Pericarditis, pericardial effusion, Valvular heart diseases, Heart failure (clinical features and diagnosis) Chronic bronchitis, Emphysema, Pneumonia, Tuberculosis, Pulmonary effusion, Spontaneous pneumothorax, bronchiectasis

Module-II

GASTROINTESTINAL DISORDERS

1. Peptic ulcer disease, 2. Achalasia cardia, 3. Intestinal obstruction, 4. Chron's disease, 5. Ulcerative colitis, 6. Pancreatitis, 7. portal hypertension, 8. ascites 9. Cirrhosis, 10. Cholecystitis.

Module-III

RENAL AND ABDOMINAL DISORDERS

Glomerulonephritis, Nephrotic syndrome, Hydronephrosis, Urinary caliculus, Polycystic kidney disease, Hematuria, Cholelithiasis, Peritonitis, Appendicitis, Benign Hypertrophic Prostate

Module-IV

CENTRAL NERVOUS SYSTEM DISORDERS:

Cerebrovascular disorders 2. Meningitis 3. Encephalitis

Module-V

ORTHOPEDICS:

Fracture – Type, Healing Mechanism, Delayed Union, Non- union, complication, Osteo arthritis, Rheumatoid arthritis, Paget's Disease, Ankylosing spondylitis, bone Tumor-Benign & Malignant.

PROJECT TOPICS

- Pericarditis, Chronic bronchitis, Tuberculosis.
- Pancreatitis, Cholecystitis, Ascites
- Glomerulonephritis, Poly cystic kidney disease, Urinary calculus, Appendicitis
- Meningitis, Encephalitis
- Fracture- types & healing, Bone Tumor- Benign & Malignant

Suggested Readings:

1. Textbook of Medicine, Krishna Das.

2. Essentials of clinical medicine, Kathale.

3. Handbook of Orthopedics, Gopalan.

4. Essential of Orthopedics, Shenoy.

MEDICAL LAW AND ETHICS

Subject Name	Code	Type of course	T-P-Pj	Credit
Medical Law and Ethics	CUTM1734	Theory+ Project	2-0-1	3

Course Objective:

- To provide students with a foundational understanding of ethics, with a particular focus on medical ethics, and to explore key ethical principles such as autonomy, which significantly influence medical law.
- To examine the general principles of medical law that govern the legal relationship between medical practitioners and their patients, ensuring that students grasp the legal dynamics in healthcare settings.
- To analyze the legal implications of providing medical advice, diagnosis, and treatment, enabling students to understand the legal responsibilities and potential liabilities in medical practice.
- To investigate selected medico-legal issues over the course of human life, including reproductive technologies, fetal rights, research on human subjects, organ donation, rights of the dying, and the legal definition of death.

Course Outcomes:

After completion of the course, the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand the Legal Framework Governing Medical Practice.	PO4, PO5, PSO1
CO2	Recognize Professional Responsibilities and Legal Obligations of Medical Practitioners.	PO4, PO9, PSO1
CO3	Analyze different types of medical negligence.	PO4, PO5, PSO3
CO4	Evaluate Legal Processes in Medical Malpractice Litigation.	PO4, PO5, PO9, PSO3
CO5	Assess the Medico legal risks in Healthcare Practice	PO4, PO5, PO10, PSO1

Course Outline:

Module-I

1. The Indian medical council act, 2. Medical council of India (functions), 3. Functions of state medical councils, 4. The declaration of Geneva, 5. Association of Healthcare Providers (AHPI) India

Module-II

1. Duties of medical practioners 2. Regarding Red Cross emblem 3. Professional secrecy
4. Privileged communication.

Module-III

1. Professional negligence 2. Medical mal occurrence 3. Contributory negligence 4. Criminal negligence 4. Corporate negligence 5. Ethical negligence 6. Precautions against negligence 7. difference between professional negligence and infamous conduct.

Module-IV

1. Malpractice litigation involving various specialties 2. Prevention of medical negligence 3. supremecourt of India guidelines on medical negligence 3. The therapeutic misadventure 4. Vicarious liability

Module-V

1. Products liability 2. Medical indemnity insurance 3. Medical records 4. Consent in medical practice, 4. Euthenesia 5. Deaths due to medical care 6. Malingering

Suggested Readings:

1. Medical Law and Ethics by Shaun D Pattinson, 5 th edition, 2017.
2. Medical Law and Ethics in India" by KK Singh, 1st Edition (2018).
3. Medical Ethics Manual for Students" by Dr. Vijayaprasad Gopichandran and Dr. S.S. Lal, 1st Edition (2016).

RESEARCH METHODOLOGY

Subject Name	Subject Code	Type	T-P-PJ	Credit
Research Methodology	CUTM1721	Theory+ Project	2-0-1	3

COURSE OBJECTIVES:

- To gain a solid understanding of the fundamental concepts, types, and importance of research in scientific inquiry and academic fields.
- To learn how to formulate research problems, hypotheses, and objectives, as well as how to design and structure research projects.
- To understand and apply various methods of data collection, including surveys, experiments, interviews, and observation, while ensuring accuracy and reliability.
- To become proficient in using statistical tools and techniques for analyzing and interpreting data.

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Identify the key components of research, including its definition, scope, limitations, types, and objectives	PO1, PO6, PO12, PSO3
CO2	Understand the steps involved in developing a health research proposal.	PO2, PO3, PO4, PO9, PSO3
CO3	Implement the methods of data collection.	PO1, PO2, PO10, PO11, PSO2
CO4	Interpret the concepts of sampling designs, the theory of estimation and hypothesis testing, and the significance tests based on t, F, Z, and Chi-Square tests	PO2, PO5, PO13, PSO2, PSO3
CO5	Evaluate the importance of tabulation, coding, editing, interpretation, and report writing in the research process.	PO7, PO9, PO12, PSO3

Course Outline

Module- I

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

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

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.

Project: Writing a review on Nosocomial urinary tract infection.

Writing a research article on antibiotic resistance patterns in wound infections.

Writing a review on Virus culture

Literature survey on Covid-19

Suggested Readings:

- *Research Methodology by C.R. Kothari (3rd Ed)*
- *Research Methodology In the Medical & Biological Sciences by Petter Laake et al.*
- *Essentials of Research Design and Methodology by Geoffrey Marczyk et al.*
- *WHO, Health Research Methodology: A guide for training in research Methods, 2nd Edition, WHO- WIPRO*
- *A Student's Guide to Methodology by Clough P and Nutbrown C. Sage Publication. National Ethical Guidelines for Health Research in Nepal, Available at Nepal Health Research Council.*

BASIC COMPUTER AND INFORMATION SCIENCE

Subject Name	Subject Code	Type	T-P-PJ	Credit
Basic Computer and Information Science	CUTM1742	Practical	0-2-0	2

COURSE OBJECTIVES:

- To gain knowledge of computer characteristics, types of input/output devices, and the functioning of the CPU, memory, and storage devices.
- To develop skills in using MS Word, Excel, and PowerPoint for document creation, editing, formatting, and presentation design.
- To learn the history, features, and basic commands of MS-DOS, and the functionalities of the Windows operating system including file management and navigation.
- To understand the basics of computer networking, types of networks, and internet applications like email, FTP, and the World Wide Web.

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand the fundamental hardware components.	PO1, PO5, PSO3
CO2	Apply the concept in preparing documents.	PO8, PO9, PSO1, PSO3
CO3	Organize data available digitally.	PO5, PO9, PSO3
CO4	Create presentations, formatting and enhancing texts	PO5, PO9, PSO3
CO5	Utilize the concepts and software skills in data handling.	PO5, PO8, PSO1, PSO2

Course Outline:

Module- I

Introduction to computer: introduction, characteristics of computer, block diagram of computer, generations of computer. Types of Input output devices. Processor and memory: The Central Processing Unit (CPU), main memory. Storage Devices.

Module- II

Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.

Module- III

Introduction to MS-DOS: History of DOS, features of MS-DOS, MS-DOS Commands (internal and external). Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing, and maximizing, etc.). Computer networks: introduction, types of networks (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid). Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW), www browsers, use of the internet.

Suggested Readings:

1. Objective Computer Awareness

2. Computer Networking (Global Edition)

PROJECT

Name of the Subject	Subject Code	Credit
Project	CUTM4339	10

Course Objective:

- To contribute to the advancement of knowledge in the field of microbiology by conducting original research or exploring innovative approaches
- To apply theoretical knowledge gained during the academic coursework to real-world optometry scenarios.
- To develop skills in data collection techniques, data analysis, and interpretation, which are essential for evidence-based practice
- To develop effective communication skills through oral presentations, written reports, and patient record

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Understand ethical and legal considerations associated with radiological practice.	PO3, PO8, PO9, PO12
CO2	Apply comprehensive knowledge in radiographic techniques.	PO1, PO4, PO10, PO11
CO3	Evaluate different case studies.	PO6, PO7, PSO2
CO4	Design and address a research problem.	PO8, PO10, PO11
CO5	Presentation of project	PSO3, PSO4, PSO7

Suggested Project title

1. A survey of radiation protection awareness in non-radiation workers.

2. Comparative Study of Imaging Techniques for Stroke Diagnosis.

3. Radiation Dose Optimization in CT Scanning protocols.

4. Evaluation of radiation protection and measure for female patients of child bearing age using many medical colleges in Odisha as case study.

INTERNSHIP

Name of the Subject	Subject Code	Credit
Internship	CUTM4340	10

Course Objective:

- To gain hands-on clinical experience in conducting comprehensive diagnosis of the specimen.
- To become familiar with advanced instrumentation and technology used in the field of diagnosis
- To operate specialized diagnostic tools, imaging devices, and diagnostic instruments, enhancing their skills in evaluating health and providing accurate diagnosis.
- To develop effective patient interaction and communication skills

COURSE OUTCOMES:

After completion of this course the students will be able to-

COs	Statements	Cos with POs and PSOs Mapping
CO1	Select relevant scientific literature.	PO1, PO8, PO12, PSO3
CO2	Execute appropriate data collection techniques and tools.	PO9, PO10, PO12, PSO3
CO3	Analyze data with appropriate statistical techniques.	PO5, PO9, PO12, PSO3
CO4	Design a research proposal.	PO6, PO8, PO12, PSO3
CO5	Integrate theoretical concepts and practical skills gained from their coursework to design and execute a research project	PO1, PO2, PO5, PO12, PSO1, PSO3

COURSE OUTLINE:

1. Case record.

2. Lab management and ethics.

3. Evaluation -Guide(internal) -Industries guide(external) -University-project report/ Viva.