

COURSE STRUCTURE AND SYLLABI

B.Tech in Mining Engineering

2025-26 Batch



Centurion
UNIVERSITY

Shaping Lives...
Empowering Communities...

SCHOOL OF ENGINEERING AND TECHNOLOGY
CENTURION UNIVERSITY OF TECHNOLOGY & MANAGEMENT
Odisha-761211, India

Web Site: - www.cutm.ac.in

**CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT,
ODISHA**

CERTIFICATE



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This is to certify that the syllabus of the Programme B.Tech in Mining Engineering of the School of Engineering and Technology is approved in the 15th Academic Council Meeting held on 22nd November 2025.

**Dean
School of Engineering and Technology,
CUTM, Odisha**

**Pro Vice Chancellor
CUTM, Odisha**

Centurion University of Technology and Management Odisha

B.Tech. in Mining Engineering
CHOICE BASED CREDIT SYSTEM

COURSE STRUCTURE & SYLLABUS

BASKET – I, II, III, IV & V



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School of Engineering & Technology

2025

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Programme Objectives; Job/Higher studies/Entrepreneurship

POs: Engineering Graduates will be able to;

- 1. PO1:** Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and Mining Engineering to the solution of engineering problems.
- 2. PO2:** Problem analysis: Identify, formulate, review literature and analyze Mining Engineering problems to design, conduct experiments, analyze data and interpret data.
- 3. PO3:** Design /development of solutions: Design solution for Mining Engineering problems and design system component of processes that meet the desired needs with appropriate consideration for the public health and safety, and the cultural, societal and the environmental considerations
- 4. 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 in Mining Engineering.
- 5. PO5:** Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to Mining Engineering activities with an understanding of the limitations.
- 6. PO6:** The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to Mining Engineering practice.
- 7. PO7:** Environment and sustainability: Understand the impact of the Mining Engineering solutions in societal and environmental contexts, and demonstrate the knowledge and need for sustainable development.
- 8. PO8:** Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the Mining Engineering practice.
- 9. PO9:** Individual and teamwork: Function affectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings in Mining Engineering.
- 10. PO10:** Communication: Communicate effectively on complex engineering activities with the engineering committee and with society at large, such as, being able to comprehend and write affective reports and design documentation, make effective presentations in Mining Engineering.
- 11. PO11:** Project Management and finance: Demonstrate knowledge & understanding of the Mining Engineering principles and 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 in Mining Engineering.
- 12. PO12:** Life- long learning: Recognize the need for, and the preparation and ability to engage in independent research and lifelong learning in the broadest contest of technological changes in Mining Engineering.

PEOs/PSOs

1. **PEO1:** Prepare students to build competency in current technology and its application to meet the industry need for skilled Engineer
2. **PEO2:** Provide students with strong foundational concepts and also domain knowledge to pursue research to build solutions or systems of varying complexity to solve the problems identified
3. **PEO3:** Enable graduates to innovate, bring new idea and become an entrepreneur
4. **PSO1:** Graduates will develop hands-on skills related to Manufacturing, Design, Welding and Automobile field.
5. **PSO2:** Build software competencies for product design, simulation, analysis, and manufacturing.
6. **PSO3:** Become a valuable technocrat to be fit for the industry or entrepreneur through manufacturing and management practices.

Course Outcomes	Attributes
CO1	Knowledge
CO2	Analytical skill and Critical Thinking
CO3	Problem Solving and Decision taking ability
CO4	Use of Tool, Design and Development (Hands-on/Technical skill)
CO5	Research

Bachelor of Technology (B. Tech in MINING)
Programme Structure – Graduate Study

Type of Course	4 Years
Major (Core)	80
Minor Stream	32
Multidisciplinary	9
Ability Enhancement Courses (AEC)	8
Skill Enhancement Courses (SEC)	9
Value Added Courses common for all UG	6-8
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TOTAL	160

Course Structure

Basket - I

Course Code	Course Title	Credits	Course Type T+P+PJ	NcRF Level
CUTM1001	Differential Equations and Linear Algebra	3	2+0+1	4.5
CUTM1002	Laplace & Fourier Transforms	3	2+0+1	4.5
CUTM1003	Complex Analysis & Numerical Methods	3	2+0+1	4.5
CUTM1004	Discrete Mathematics	3	2+0+1	4.5
CUTM1005	Probability & Statistics	3	2+0+1	4.5
CUTM1925	Calculus	3	2+0+1	4.5
CUTM1006	Mechanics for Engineers	3	2+1+0	4.5
CUTM1007	Optics and Optical Fibres	3	2+1+0	4.5
CUTM1008	Applied Analytical Chemistry	3	2+1+0	4.5
CUTM1009	Applied Engineering Materials	3	2+0+1	4.5
CUTM1674	Environmental Science	4	3+0+1	4.5

Differential Equations and Linear Algebra

Code	Course Title	Credit	T-P-PJ
CUTM1001	Differential Equations and Linear Algebra	3	2-0-1

Course Objectives:

- To introduce first and second order differential equations.
- To solve the system of linear equations appearing in the problems of electrical engineering, mechanical engineering etc.
- To use Eigen values and Eigen vectors in Control theory, vibration analysis, electric circuits, advanced dynamics problems.

Course Outcomes:

After the completion of the course students will be able to:

- **CO1:** Solve systems of linear equations using Gauss- elimination to reduce to echelon form.
- **CO2:** Describe and discuss the importance of linear functions in mathematics.
- **CO3:** Apply Gauss- elimination procedure to solve systems of linear equations reducing to echelon form.
- **CO4:** Analyse and test fundamental concepts of ODE theories and where and how such equations arise in applications to scientific and engineering problems.
- **CO5:** Formulate and competent in solving linear/non-linear 1st & higher order ODEs using analytical methods to obtain their exact

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3					1				1	2		1
CO2	2	3	2	2			2	2					2	2	1
CO3	2	3	2	2		2				2			2	3	
CO4	3	2	3	2	2						2		3	3	2
CO5	3	2	3	2	2			1					2		1

*High-3, Medium-2, Low-1

Course content

Module-I

First order linear differential equations and its applications (Kirchhoff's law)

Project-1: Some applications of differential equations in RL electrical circuit problems

Module-II:

Second order linear homogeneous differential equations (Real roots, Real equal roots, Complex conjugate roots) and its applications.

Project-2: RLC Circuit, Pendulum

Module-III:

Second order linear non-homogeneous differential equations, Finding particular integral consisting of exponential, trigonometric functions (Sine, cosine) using inverse operator method

Project-3: Simple mass-spring system, Damped vibration system

Module IV:

Basic concepts of a matrices, solution of linear system of equations by Gauss elimination method, linearly independent and dependent of a vectors, rank of a matrix.

Project-4

Report on finding the traffic flow in the net of one-way streets

Module V:

Determinants and Cramer's Rule, Fundamental theorem of linear system of equations.

Module VI:

Eigenvalues and Eigen vectors of a matrix

Project-5

(i) Find the limit states of the Markov process model.

(ii) Find the growth rate in the Leslie model

Module VII:

Symmetric, Skew-Symmetric , Orthogonal Matrices and Properties

Project-6

To make a report to show that the product of two orthogonal matrices is orthogonal, and so is the inverse of an orthogonal matrix. What does this mean in terms of rotations?

Text Books:

1. Advanced engineering mathematics by Erwin Kreyszig, 8th edition
Chapter-6 (6.1-6.6), Chapter-7 (7.1,7.2)
2. Higher Engineering by B.V. Ramana
Chapter-8(8.1,8.2,8.21), Chapter-9 (9.2,9.3,9.5)

Reference Books:

1. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi.
2. G.B. Thomas, M.D. Weir, J.R. Hass, Thomas' Calculus, Pearson Publication.
3. R.G. Bartle, D.R. Sherbert, Introduction to Real Analysis, Wiley Publication

Laplace and Fourier Transform

Code	Course Title	Credit	T-P-PJ
CUTM1002	Laplace and Fourier Transform	3	2-0-1

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.
- Introduce students about solution of Differential Equations with the help of Laplace Transform.

Course Outcomes:

After the completion of the course students will be able to:

- **CO1:** solve initial value problem and boundary value problem using Laplace transfer.
- **CO2:** describe and discuss properties, applications to the solution of ordinary and partial differential equations having constant co-efficient.
- **CO3:** apply the expansion of simple functions in Fourier series and half range series.
- **CO4:** analyze and test fundamental concepts of Fourier sine and cosine transform and their inversion.
- **CO5:** formulate and apply the Fourier Transform to solution of partial differential

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1				1				1	2		2
CO2	2	3	2	2			2	2					3	2	1
CO3	3	3	2	2		1				3			2	3	
CO4	2	3	3	2	2		2				2		2	3	2
CO5	3	2	2	2	2			1					2		1

*High-3, Medium-2, Low-1

Course content

Module-I (T-3-Pj-2)

Laplace Transforms, Properties of Laplace transforms, Unit step function.

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.

Module-II (T-2-Pj-2)

Second shifting theorem, Laplace transforms of Derivatives and Integrals

Project-2

Find the Laplace transform of the following functions

Module-III (T-3-Pj-2)

Derivatives and Integrals of Transforms, Inverse Laplace transform.

Project 3:

Application of Unit step function (RC- Circuit to a single square wave).

Module- IV (T-2-Pj-2)

Solution of Differential Equation by using Laplace Transform.

Project 4: Find the solution of differential equation by using Laplace Transform.

Module-V (T-4-Pj-2)

Periodic function, Fourier series, Fourier series expansion of an arbitrary period, Half range expansions.

Project-5

Find the Fourier series expansion of a 2π periodic function.

Module-VI(T-3-Pj-2)

Complex form of Fourier series, Fourier Integrals, Different forms of Fourier Integral.

Project-6

Find the Fourier sine and cosine integral of the following functions.

Module-VII(T-3)

Fourier Transforms, Fourier sine and cosine Transforms.

Text Books:

E. Kreyszig , Advanced Engineering Mathematics, Johnwiley& Sons Inc-8th Edition.Chapters:5(5.1 to 5.4(without Dirac's delta function)),10(10.1,10.4 and 10.7-10.9(definitions only , no proofs))

Higher Engineering Mathematics by B.V.Ramana, Tata McGraw-Hill Education India, Inc-8th Edition.

Reference Books:

- 1) Advanced Engineering Mathematics by P.V.O'Neil Publisher: Thomson
- 2) Mathematical Methods by Potter & Goldberg ; Publisher : PHI

Complex Analysis and Numerical Methods

Code	Course Title	Credit	T-P-PJ
CUTM1003	Complex Analysis and Numerical Methods	3	2-0-1

Course Objectives:

- To understand about Complex variables and complex functions.
- To acquire the skill of evaluating contour integrals using Cauchy's integral formula and Cauchy's integral theorem.
- 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.

Course Outcomes:

After the completion of the course students will be able to:

- **CO1:** Solve the problems related to analytic functions using the Cauchy-Riemann equations.
- **CO2:** Describe and discuss the importance of harmonic functions and analytical functions.
- **CO3:** Apply Cauchy integral theorem and Cauchy integral formula for evaluating complex contour integrals.
- **CO4:** Analyse and test the fundamental concepts numerical methods for finding out solutions of various mathematical problems arising in roots of linear and non-linear equations, solving differential equations with initial conditions and evaluating real definite integrals.
- **CO5:** Formulate and competent in solving numerical problems by using Runge-Kutta 2nd

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2					2				2	2		1
CO2	3	2	2	3			2	3					2	2	2
CO3	3	3	2	2		3				3			2	2	
CO4	2	3	2	2	2						2		3	3	3
CO5	2	2	3	3	2			1					2		1

*High-3, Medium-2, Low-1

Course Outline

Module I (T-3 hrs-P-0-hrs-P-0 hrs)

Functions of a complex variable, Analytic functions, Cauchy-Riemann equations (Without Proof), Harmonic and Conjugate harmonic functions, Cauchy's Integral Theorem (Without Proof).

Project-1 : Verification of Cauchy-Riemann equations for complex functions in Cartesian form and Polar form

Module II (T-3 hrs-P-0 hrs-P-2 hrs)

Cauchy's Integral Formula (Without Proof), Cauchy's Integral Formula for higher order derivatives (Without Proof), Taylor series.

Project-2 : Evaluation of contour integrals using Cauchy's Integral Formula

Module III (T-4 hrs-P-0 hrs-P-2 hrs)

Laurent series (Without Proof), Pole, Residue, Residue Theorem (Without Proof), Evaluation of Real integral Type-I.

Module – IV (T-2 hrs-P-0 hrs-P-2 hrs)

Interpolation, Lagrange interpolation polynomial.

Project-3 : Finding out the value of a given function at an interior point on an unequal interval using Lagrange interpolation polynomial

Module – V (T-3 hrs-P-0 hrs-P-2 hrs)

Forward and backward difference operators, Newton's forward and backward difference Interpolation formulae.

Project-4 : Finding out the value of a given function at an interior point on an equal interval using Newton's forward and backward difference interpolation formulae

Module – VI (T-2 hrs-P-0 hrs-P 2 hrs)

Numerical Integration, Trapezoidal rule, Simpson's one third rule.

Project-5 : Evaluation of real definite integrals using Trapezoidal rule and Simpson's one third rule

Module – VII (T-3 hrs-P-0 hrs-P-2 hrs)

Runge-Kutta 2nd & 4th order methods.

Project-6 : Finding out Numerical solutions of differential equations using Runge-Kutta 2nd & 4th order methods

Text Book:

1) Advanced Engineering Mathematics by E. Kreyszig Publisher: Johnwiley & Sons Inc-8th Edition Chapters : 12 (12.3, 12.4), 13 (13.2 to 13.4), 14.4, 15 (15.1 to 15.4 Only Type-I integral), 17 (17.3, 17.5), 19 (19.1).

Reference Books:

- 1) Advanced Engineering Mathematics by P.V. O'Neil Publisher: Thomson
- 2) Fundamentals of Complex Analysis (with Applications to Engineering and Science) by E.B. Saff & A.D. Snider Publisher: Pearson
- 3) Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S. R. K. Iyengar & R.K. Jain; New Age International Publishers.
- 4) Introductory Methods of Numerical Analysis by S.S. Sastry; Third Edition, Prentice Hall India.

Discrete Mathematics

Code	Course Title	Credit	T-P-PJ
CUTM1004	Discrete Mathematics	3	2-0-1

Course 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 understand different types of relations.
- To work with discrete structures such as graphs to study the structure of the world wide web, to model a computer network and to find the shortest path between two places in a transportation network

Course Outcomes

After the completion of the course students will be able to:

- **CO1:** Apply the logical structure of proofs and work symbolically with connective and quantifiers to produce logically valid, correct and clear arguments.
- **CO2:** Evaluate elementary mathematical arguments and identify fallacious reasoning
- **CO3:** Reformulate statements from common language to formal logic
- **CO4:** Apply truth tables and the rules of propositional and predicate calculus
- **CO5:** Model and solve real world problems using graphs ,both quantitatively an

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3					2				1	2		1
CO2	2	3	2	2		2			1				2	2	1
CO3	2	3	2	2		2				2			3	3	
CO4	3	3	3	2		2					3		2	3	
CO5	3	2	3	2	2			2					2		1

*High-3, Medium-2, Low-1

Course Outline

Module -I

(3Hours)

Propositional Logic, Connectives, Truth tables of compound propositions, Propositional Equivalence.

Project 1: Given the truth values of the propositions p and q , find the truth values of the conjunction, disjunction, implication, bi-implication, converse, contrapositive and inverse.

Module -II

(2Hours)

Theory of inference, Predicates and Quantifiers, Rules of Inference.

Project 2: Build valid arguments of a given set of propositional logics and quantified statements using rules of inferences.

Module -III

(3 Hours)

Relations and its properties, Partial Ordering, POSET, Totally Ordered Set.

Project 3: Define the properties of a relation on a set using the matrix representation of that relation with examples.

Module -IV

(3Hours)

Hasse Diagram, Maximal & Minimal Elements of a Poset, Greatest & Least Elements of a Poset, Supremum & Infimum of a Poset, Lattice.

Project 4: Find a Topological Sort of a Poset.

Module -V

(3 Hours)

Introduction to Graph Theory, Graph Terminology and Special types of Graphs, Representation of Graphs.

Project 5: Describe how some special types of graphs such as bipartite, complete bipartite graphs are used in Job Assignment, Model, Local Area Networks and Parallel Processing.

Module -VI

(3 Hours)

Graph Isomorphism, Connectivity, Euler and Hamiltonian Graphs, Planar Graphs, Graph Coloring.

Project 6(i): Describe the scheduling of semester examination at a University and Frequency Assignments using Graph Colouring with examples. Find also their Chromatic numbers.

Project 6(ii): List out 10 pairs of Non-isomorphic graphs and explain the reason behind it.

Project 6(iii): List out all features of Euler and Hamiltonian Graphs. Justify whether the given set of graphs are Euler and Hamiltonian. Construct a Gray Code where the code words are bit strings of length three.

Module -VII

(3 Hours)

Trees and their Properties, Spanning Trees, Minimum Spanning Trees, Kruskal's Algorithm.

Project 7: Find a minimum spanning tree in a given weighted graph using Kruskal's Algorithm.

Text Books:

1. Discrete Mathematics and its Applications by K.H.Rosen, Publisher: TMH, Sixth Edition, 2009.

Chapters: 1(1.1 ,1.2,1.3, 1.5); 7(7.1,7.6); 8(8.1 to8.5, 8.7, 8.8);9(9.1,9.4,9.5).

Reference Books:

1. Discrete Mathematical Structures with Applications to Computer Science, J. P. Trembkay, R. Manohar, Tata MC Graw – Hill Edition 38th reprint, 2010.

2. Discrete and Combinatorial Mathematics by R.P.Grimaldi Publisher: Pearson, 5th Edition, 2003.

3. Discrete Mathematics and Applications by Thomas Koshy Publisher: Elsevier, 2004.

4. Discrete Mathematical Structures by B. Kolman, R.C. Busby & S. Ross Publisher: PHI, 5th Edition, 2003

Probability and Statistics

Code	Course Title	Credit	T-P-PJ
CUTM1005	Probability and Statistics	3	2-0-1

Objective

- To translate real-world problems into probability models.
- 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 prediction and computer networks etc.

Learning outcome

After the completion of the course students will be able to:

- **CO1:** explain the concepts of sample space, events and compute the probability of different events.
- **CO2:** describe discrete and continuous random variables.
- **CO3:** implement the concept of expectation, variance and covariance of random variables.
- **CO4:** solve problems related to correlation and regression.
- **CO5:** compare Binomial, Poisson and Normal distributions.

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3.00		2.0	1			2.0	2.0				3.0	3.0	3.0	3.0
CO2	2.00	2.0	3.0	2.0	1.0		1.0	2.0				1.0	2.0	1.0	3.0
CO3	2.00	1.0	3.0	1.0			2.0	2.0				3.0	3.0	2.0	2.0
CO4			2.0	1.0	3.0		3.0	2.0				3.0	1.0	2.0	2.0
CO5		1.0	2.0	1.0			2.0	2.0				3.0	3.0	1.0	2.0

*High-3, Medium-2, Low-1

Course content

Module I :(3 hrs+2 hrs)

Sample spaces and events; axiomatic definition of probability; Axioms of Probabilities

Project-1

A Report on Application of probability to control the flow of traffic through a highway system, a telephone interchange, or a computer processor

Module II :(2 hrs +2 hrs)

Mutually Exclusive Events, Dependent and Independent Events. Conditional Probability

Project-2

A Report on Dependent and Independent Events with Examples

Module III:(3 hrs +2 hrs)

Discrete random variables and probability distributions, Continuous random variables and probability

distributions , Mean , Variance and Moment Generating Function of Distributions

Project-3

Application of random variables in Engineering Field

Module IV:(3 hrs +2 hrs)

Uniform Distribution, Binomial Distribution, Poisson Distribution

Project-4

Applications of Poisson distribution

Module V:(3 hrs +2 hrs)

Normal Distribution, Working with Normal Tables, Normal Approximation to the Binomial Distributions

Project-5

Normal Distribution utilized in statistics, business settings, and government entities.

Module VI:(3 hrs)

Statistics: Random Sampling, Population and Sample, Sample Mean and Variances, Point and Interval Estimations, Confidence Intervals

Module VII:(3 hrs +2 hrs)

Regression and Correlation Analysis: Correlation Coefficient, Co-variance independent random variables, linear regression of two variables

Project-6

Uses of Regression and Correlation Analysis in Business

Text Books:

1. Name of Author, Title, Publication, Edition

Advanced Engineering Mathematics by E. Kreyszig Publisher: John Willey & Sons Inc-8th Edition

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.

Calculus

Code	Course Title	T-P-PJ	Prerequisite
CUTM1925	Calculus	2-0-1	

Objective

- To apply the concepts of derivative to find curvature and radius of curvature of a curve.
- To apply concepts of Vector Calculus to the problems related to models in work, circulation and flux Problems, hydrodynamics and fluid dynamics etc.
- To introduce line, surface and volume integrals and their applications.

Learning Outcome

- **CO1:** calculate curvature and radius of curvature for a given curve.
- **CO2:** determine the important quantities associated with scalar and vector fields.
- **CO3:** find gradient of a scalar point function, divergence and curl of a vector point function.
- **CO4:** implement the concept of line, double, and triple integrals to find out work done by a force, volume of regions in space, centre of gravity of a mass etc.
- **CO5:** transform double integral to line integrals, triple integrals to surface integrals, surface integrals to line integrals and vice versa.

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3.00	2.0		1.0	2.0							3.0	3.0	3.0	2.0
CO2	3.00	1.0		3.0	1.0		2.0					3.0	3.0	2.0	2.0
CO3	3.00	2.0		2.0	2.0		2.0					2.0	2.0	1.0	1.0
CO4	3.00			2.0			2.0					2.0	1.0	2.0	2.0
CO5	2.00	1.0		3.0	2.0		1.0					3.0	2.0	2.0	3.0

*High-3, Medium-2, Low-1

Course Outline

Module-I(3hr+0hr+2hr)

Curvature and Radius of curvature in Cartesian form.

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

Module-II(2hr+0hr+4hr)

Vector algebra: Algebraic operations, Scalar product, Inner product, Vector product, Scalar and vector triple product.

Project 2: Problems based on inner product, scalar and vector triple products.

Project 3: To find angle between two vectors, area of triangle and parallelogram, volume of parallelepiped and tetrahedron using vector algebra.

Module III(2hr+0hr+4hr)

Gradient of scalar point function, Directional derivatives, Divergence and curl of vector point functions, second order differential operator: the Laplacian operator.

Project 4: To prove the identities with regards to Gradient, Divergence and Curl.

Project 5: To find normal vector to a plane using Gradient of scalar point function.

Module-IV: (3hr+0hr+0hr)

Line Integrals (path dependence and path independence), double integrals.

Module-V: (3hr+0hr+0hr)

Surface Integrals, Triple Integrals

Module-VI: (4hr+0hr+2hr)

Green's and Gauss's Theorems (without proof) and their applications to evaluate the integrals.

Project 6: To find center of gravity and moments of inertia of a mass density

Module-VII: (3hr+0hr+0hr)

Stokes' Theorem (without proof) and its applications to evaluate the integrals.

Text Books:

1. A Text book of Calculus Part – II by Shanti Narayan, Publisher: S. Chand & Company Ltd. Chapters: 8 (Art. 24, 25 (only for Cartesian and parametric curves)).
2. Advanced Engineering Mathematics by E. Kreyszig, Publisher: John Willey & Sons Inc.- 8th Edition
Chapters: 8 (8.1 to 8.3, 8.9 to 8.11), 9 (9.1 to 9.7, 9.9).

Mechanics for Engineers (40 hours)

Course Code	Course Title	Credits	Type (T+P+Pj)
CUTM1006	Mechanics for Engineers	3	2+1+0

Course Objectives:

- To develop a fundamental understanding of the principles of statics and dynamics.
- To enhance problem-solving skills in engineering mechanics.
- To foster the application of engineering mechanics principles in real-world scenarios.

Course Outcomes:

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

- **CO1:** Understand the basic principles of statics and dynamics in engineering mechanics.
- **CO2:** Analyze and solve problems involving forces, moments, and equilibrium conditions in mechanical systems.
- **CO3:** Apply the principles of kinematics and kinetics to analyze the motion of particles and rigid bodies.
- **CO4:** Utilize energy and momentum methods to solve engineering problems involving impact, work, and energy principles.
- **CO5:** Demonstrate the ability to use modern engineering tools and software for modeling and solving engineering mechanics problems.

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2			1		1						1	
CO2	3	3	2	1		1		1						1	
CO3	3	3	2	1	1	1	1	1						1	
CO4	3	3	3	1	1	1	1	1						1	
CO5	3	3	3	2	2	1	1	1	2	1		1		1	

***High-3, Medium-2, Low-1**

Course Syllabus:

Module 1: Force and Moment (6 hours)

Theory

- Law of Transmissibility of a Force, Composition, and Resolution of Forces, Resultant and Equilibrant, Resultant of Two and Several Forces, Moment of a Force and a Couple, Varignon's Principle of Moment

Practice

- Experiment 1.1: Verification of laws of parallelogram law of forces.

Module 2: Equilibrium (6 hours)

Theory

- System Isolation and Free Body Diagram, Particle Equilibrium, Lami's theorem, General Conditions of Equilibrium, Types of Supports and Support Reactions, Rigid Body Equilibrium.

Practice

- Experiment 2.1: To verify the condition of equilibrium by finding reactions at the support of a beam.

Module 3: Friction (6 hours)

Theory

- Basic Terms used in Dry Friction, Laws of Coulomb Friction, Equilibrium of Bodies on an Inclined Plane, Ladder Friction, Belt Friction

Practice

- Experiment 3.1: Determination of Angle of Repose.

Module 4: Centroid (4 hours)

Theory

- Axis of Symmetry, Centroid of Lines, Areas, and Volumes, Centroid of Composite Section

Module 5: Moment of Inertia (6 hours)

Theory

Rectangular and Polar Moment of Inertia, Radius of Gyration, Parallel Axis Theorem and Perpendicular Axis Theorem, Moment of Inertia of Composite Section

Practice

- Experiment 5.1: Determination of the Moment of Inertia of a flywheel.

Module 6: Kinematics of Linear Motion (4 hours)

Theory

- Kinematics of a Particle, Uniform and Variable Acceleration, Motion under Gravity.

Module 7: Kinetics of Linear Motion (8 hours)

Theory

- Principles of Dynamics such as Newton's Second Law, Work-Energy Principle, Impulse-Momentum Principle, Law of Conservation of Momentum, and Energy

Practice

- Experiment 7.1: Verification of Newton's second law of motion.
- Experiment 7.2: Verification of conservation of momentum in a collision.

Text Books:

1. Engineering Mechanics; Statics and Dynamics by A. K. Tayal, Umesh Publications.

Reference Books:

1. Engineering Mechanics by S. Timoshenko, D.H. Young and J.V. Rao, Tata McGraw Hill.
2. A textbook of Engineering Mechanics by R. S. Khurmi, S. Chand Publications

Optics and Optical Fibres (33 hours)

Course Code	Course Title	Credits	Type (T+P+Pj)
CUTM1007	Optics and Optical Fibres	3	2+1+0

Course Objectives:

- To train the students for the applications of the solar cell, laser and optical Fibre in the field of engineering and technology.
- To learn and practice the techniques used by optical phenomena so that these can be applied to actual field studies.

Course Outcomes:

After the completion of the course students will be able to:

- **CO1:** Understand optical phenomena.
- **CO2:** Different light sources and their use.
- **CO3:** To understand the basic knowledge of solar cell, laser and optical fiber.
- **CO4:** To understand optical fiber principle, operations and its applications.
- **CO5:** To handle different tools and instruments used in optical experiments.

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3					2				1	2	2	1
CO2	3	1	2	3		3			1			1	1	2	2
CO3	1	3	2	3		2				2			1	2	
CO4	3	2	2	3		3					3		2	3	
CO5	2	2	3	3		2		3			3	1	2		3

***High-3, Medium-2, Low-1**

Course Syllabus:

Module I: Reflection and Refraction (Derivation is not required) (3 hours + 2 hours)

Reflection at plane surface, reflection at spherical mirrors, Paraxial rays and approximation Sign convention, Location of the image formation, Spherical mirror equation, Refraction, Total internal reflection, Dispersion by a prism, Refraction through a prism.

Practice: 1

To determine the refractive index of glass slab using travelling microscope

Module II: Lenses (Derivation is not required) (2 hours +2 hours)

Definition, Types of Lenses, Terminology associated with the Lens, Sign Convention

Location of the image formation by graphical method for Lenses, Lens formula.

Practice: 2

To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.

Module III: Interference (Derivation is not required) (2 hours +2 hours)

Superposition principle, definition of Interference, Coherence, Young's double slit experiment,

Newton's rings theory- Determination of wave length of light.

Practice: 3

Newton's Rings-Refractive index of liquid

Module IV: Diffraction and Polarization (Derivation is not required (3 hours +2 hours)

Types of diffraction, Fraunhofer diffraction at a single slit, Diffraction at N-parallel slits (plane diffraction grating) Polarisation, Types of polarized light and their representation, Brewster Law .Malus Law, polarization by double refraction, polarimeter, Applications of polarized light.

Practice: 4

To find grating element of a plan transmission diffraction grating.

Module V: Optical Properties and Laser (3 hours +2 hours)

Scattering, refraction, reflection, absorption & transmission, Introduction to optoelectronics, Concept of Light Emitting Diode, Stimulated and spontaneous emission, Basic principle of Lasers, Population inversion, Laser Pumping, Different levels of laser system, Ruby Laser, Applications of Lasers (Medicine, Metrology, Defenses, Nuclear energy, in communication, in consumer electronics industry)

Practice: 5

Wave length of LASER source by diffraction grating method

Module VI : Optical Fibers (4 hours +1 hours)

Introduction to fiber optics, structure of optical fibers, classification of optical fibers on the variation of refractive index, Classification of optical fibers on the variation of mode of transmission/core diameter, Numerical Aperture, Acceptance angle. Principle of optical fibers communication, optical communication (block diagram only),

Practice: 6

To find the numerical aperture of a given optic fiber and hence to find its acceptance angle.

Module VII: Optical Fibers (4 hours +1 hours)

Attenuation in optical fibers (Qualitative only-Scattering losses, Absorption losses, bending losses) Fiber Materials-Glass fibers, Plastic fibers, Light sources for fiber optics

V-number of an optical fiber, optical fiber cables design, optical fiber connection, fiber splices, fiber connectors. Application of optical fibers- Cable TV, Networking, Power companies, Imaging, Sensors, Medical (Dental surgery, Endoscopy, Surgery)

Practice: 7

Measurement of bending loss of optical fibers.

Text Books:

1. *A Text Book of Optics* by M.N. Avadhanulu, Brij Lal, N. Subrahmanyam, S Chand; 23rd Rev. Edn. [Module I&II]
2. *Engineering Physics*, by D.Thirupathi Naidu, M.Veeranjaneyulu, V.G.S Book links, 2017. [Module-III,IV]
3. *Principles of Engineering Physics-2* by Md.Khan, S.Panigrahi, Cambridge University Press 2016. [module-V,VI&VII]

Reference Books:

1. *Optics* by Ajoy Ghatak, McGraw Hill Education; 6 edition, 2017.
2. *Physics-I for engineering degree students* by B.B. Swain and P.K.Jena.
3. *Concepts in Engineering Physics* by I Md. N. Kha, 2016.

Note: 1 credit theory=10 hrs lecture, 1 credit practice =12.5 hrs lab in a semester

Applied Analytical Chemistry

Code	Course Title	Credit	T-P-PJ
CUTM1008	Applied Analytical Chemistry	3	2-1-0

Course Objectives

- To explain fundamental principles for hardness and their remediation in industrial scale.
- To get brief idea about fuels their classification, quality and application.
- To have hands on experimental expertise in quality analysis for water, soil and fuel.

Course outcome:

- **CO1:** Define the causes for the deterioration of water quality for industrial applications.
- **CO2:** Explain and identify essential parameters for industrial-scale water softening
- **CO3:** Interpret the causes of rusting of metallic parts and preventive methods
- **CO4:** Differentiate the qualities of various types of fuel, their calorific value, along with the causes of their deterioration.
- **CO5:** Design and sketch electrochemical cells with good efficiency.

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2					1		2	2	1	1
CO2	3	3	2	2	1					1		2	2	2	1
CO3	2	3	3	2	1					1		2	3	3	1
CO4	2	2	3	2	1					1		2	3	3	1
CO5	1	3	3	2	2					1		2	2	1	1

*High-3, Medium-2, Low-1

Course Content

Module-I (4Hrs)

Water softening processes: Lime-Soda, Zeolite and Ion exchange methods. Removal of DO and dissolved CO₂ from water by De-aeration method, Desalination of Brackish water by Reverse osmosis and electro dialysis process, Numericals on calculation of Temporary and Permanent hardness of water, Lime-Soda calculation

Practice

1. Determination of hardness of water by EDTA method. (V. lab)
2. Determination of alkalinity of water. (V. lab)
3. Determination of Dissolved Oxygen in water. (V. lab)
4. Determination of Biological Oxygen Demand. (V. lab)
5. Determination of Chemical Oxygen Demand. (V. lab)

Module-II (2Hrs)

Soil Analysis: Soil profile, Structure, and properties, Determination of soil properties

Practice

6. Determination of specific gravity of the soil by using pycnometer. (V. lab)
7. Determination of pH and electrical conductivity of soil sample. (V. lab)
8. Determination of moisture content in soil by oven drying method. (V. lab)

Module-III (3 Hrs)

Classification, combustion and chemical principles involved in fuel, calorific value: gross and net calorific values and their determination by bomb calorimeter, Proximate and ultimate analysis of coal and their importance. LPG, Water gas, producer gas, CNG.

Practice

9. Determination of calorific value of a fuel sample by using Bomb calorimeter.
10. Analysis of flue gases by Orsat's apparatus.

Module-IV (4 Hrs)

Petroleum: its chemical composition and fractional distillation, cracking of heavy oil residues – thermal and catalytic cracking, knocking and chemical structure, octane number, synthesis and applications of bio-fuels, Photovoltaic cell.

Practice

11. Synthesis of biodiesel by trans esterification process

Module-V (3 Hrs)

Corrosion-Mechanisms, Factors affecting Corrosion; Protection from corrosion.

Practice

12. Estimation of ferrous ion in the given solution using standard potassium dichromate.

Module-VI (2Hrs)

Electrochemical Phenomenon

Electrochemical cell, Electrode potential, Determination of pH of a solution Using Calomel/Quinhydrone Electrode.

Module-VII (2Hrs)

Error in Chemical analysis

Types of errors, Accuracy and precision, Absolute and relative uncertainty, mean and standard deviation.

Text Books

- Engineering chemistry By Jain & Jain-16th Edn, 2015, Dhanpat rai publications
- Engineering chemistry By Sashi Chawla, 3rd Edn, Dhanpati roy publications, 2011
- Industrial Chemistry By B.K. Sharma 21 st Edn-2018, Satya Publications4.

Reference Books

- Applied Chemistry By Aruna Kumari-2nd Edition, Paramount publications, 2016
- Engineering chemistry by OG Palanna, McGrahill Education (India) private Limited, 2009
- Engineering chemistry by K. Sessa Maheswaramma, Mridula. Chuch. Pearson India Education services pvt Ltd, 2016
- Engineering chemistry by Prasanth Rath, Cengage Learning India pvt Ltd, 2013
- Engineering chemistry by R.V. Gadag, A. Nityananda, Shetty, I.K. International Publishishing house, 2006
- Engineering chemistry –Fundamentals and applications, By Shika Agarwaal-Cambridge University Press Edition, 2017

Applied Engineering Material

Code	Course Title	Credit	T-P-PJ
CUTM1009	Applied Engineering Material	3	2-0-1

Objective

- To give an introduction to materials, ceramics, polymers, and electronic materials in the context of a molecular level understanding and their application in various field
- To provide brief idea about carbon based nanomaterials such as CNT, fullerene, graphene and their polymer nanocomposites with their practical applications
- To be able to get absorbed jobs in different industries processing with these materials.

Course outcome:

- **CO1:** Recall and relate nanomaterials, hybrid materials with their structure, mechanism of action and their improve performances.
- **CO2:** Describe and discuss the carbon-based nanomaterials and their applications
- **CO3:** Apply and demonstrate the knowledge of nanomaterials and hybrid materials on polymer composite with their enhanced applicabilities
- **CO4:** Analyze different properties of the composite materials.
- **CO5:** Formulate strategies to prepare composite materials and energy storage systems

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	3	2	2					1		2	2	1	1
CO2	3	3	2	2	1					1		2	2	2	1
CO3	2	3	3	2	1					1		2	3	3	1
CO4	2	2	3	2	1					1		2	3	3	1
CO5	3	3	3	2	2					1		2	2	1	1

*High-3, Medium-2, Low-1

Course content

Module I: New Materials/Nanomaterials (5hrs)

Nanostructures and Nanomaterials: classification (Dimensionality, Morphology/ shape/structure of nano-entities, New Effect/ Phenomena). Hybrid nanomaterials. Effect of size, structure, mechanism, and property on material performance. Applications of nanomaterials in catalysis, telecommunication and medicine.

Project

Synthesis of TiO₂ and ZnO nanoparticles by Sol Gel ,Sonication and Precipitaion method and study their application .

Module II: Carbon Nanomaterials (5hrs)

Carbon nanomaterials, such as graphene, carbon nanotubes (CNTs), crystalline diamond, and diamond-like carbon, Properties and application of fullerenes,

Project

Synthesis and Fabrication of Graphene and Graphene Oxide by sol-gel techniques

Module III: Polymer (5hrs)

Mechanism of polymerization and synthesis of polymers, Copolymerization, Viscoelasticity. Elastomers-structure, Conducting polymers and applications, Fabrication and moulding of polymers, Synthesis, properties and uses PMMA, formaldehyde resins, melamine-formaldehyde-urea resins

Project

Preparation of polystyrene by anionic/cationic/emulsion polymerization method

Module IV: Composites (5hrs)

Composites: characteristics, types and applications, Nanocomposites , Polymer/ Metal oxide nanocomposites and its application

Project

Fabrication of Ceramic matrix particulate composite by powder metallurgy route.

Module V: Adhesives Lubricants (4hrs)

Adhesives, adhesive mechanism and applications, Lubricants-physical and chemical properties, types and mechanism of lubrication. Additives of lubricants and freezing points of lubricants

Module VI: Energy Storages material-I (4Hrs)

Fundamental aspects related to energy storage and conversion, lithium ion batteries, Lead acid batteries; Nickel Cadmium batteries; advanced batteries

Module VII: Energy Storages material-II(4Hrs.)

Super capacitors, fuel cells and Photovoltaic, Future of battery technology

Project

Fabrication of Fuel cell and its application

Text Books:

1. A Textbook of Engineering Chemistry, by Shashi Chawla
2. Engineering Chemistry, by P. C Jain and M. Jain
3. Advanced Polymer Chemistry, by M. Chanda

Reference Books:

1. Surfactants and Polymers in Aqueous Solution, by K. Holmberg, B. Jonsson, B. Kronberg and B. Lindman
2. Energy Scenario beyond 2100, by S. Muthukrishna Iyer

Environmental Science

Code	Course Title	Credit	T-P-PJ
CUTM1674	Applied Engineering Material	4	3-0-1

Introduction

The National Education Policy (NEP) 2020 underlines the importance of making environmental education an integral part of curricula and encouraging environmental awareness and sensitivity towards its conservation and sustainable development. Environment Education, therefore, needs to include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development.

Course Objectives

- To understand the relationship among human being, natural resource and environment on the historical perspectives.
- To orient students towards the principles of sustainable development goals and train them for conserving Biodiversity and maintaining Ecosystem balance.
- To analyze environmental issues and problems critically, and develop strategic environmental management policies and practices.

Course Outcome

After the successful completion of the course, students should be able to:

- **CO1:** Explain the historical perspectives of human, natural resource and environment interactions
- **CO2:** Identify, classify, evaluate and prospect the natural resources integrated with Sustainable Development Goals
- **CO3:** Analyze issues and concerns of Biodiversity conservation and Ecosystem services at local, regional and global scales
- **CO4:** Demonstrate their environmental management competency to combat pollution, waste generation and climate change.
- **CO5:** Conduct independent project works and address current environmental challenges complying with Environmental agreements, treaties, act and laws.

Module-1: Human and Environment

6 Hours

Introduction to Human and the Environment: Overview of human-environment interactions throughout history; Importance of mastery of fire, the origin of agriculture, and the emergence of city-states; Discussion on the impact of ancient civilisations on the environment. Emergence of Environmentalism: Anthropocentric and eco-centric perspectives; Study of significant thinkers and their contributions to environmental philosophy; Environmental movements, Analysis of critical events such as the UN Conference on Human Environment 1972.

Module-2: Natural Resources and Sustainable Development

7 Hours

Understanding Natural Resources: Definition and classification of natural resources; Renewable and Non-renewable, Biotic and abiotic resources, Forest, Grasslands, Wildlife, Water, Mineral, Food, Land, Energy; Introduction to sustainable development: Sustainable Development Goals (SDGs), targets and indicators; Discussion on challenges and strategies for achieving sustainability. World commission on Environment and Development.

Module-3: Conservation of Biodiversity and Ecosystem

12 Hours

Levels and types of Biodiversity, Biodiversity in India and the world, Biodiversity Hotspots, Land Use and Loss of Biodiversity: deforestation, urbanisation, desertification; trends in biodiversity loss; Case studies on the impact of human activities on biodiversity hotspots. Conservation of Biodiversity and Ecosystems: Understanding biodiversity and its distribution; Discussion on major ecosystem types: forests, grasslands, agriculture, coastal and marine and their characteristics; Ecosystem services: Classification and significance; Exploration of threats to biodiversity and ecosystems; *in-situ* and *ex-situ* conservation, protected areas, traditional knowledge, sacred groves, community based conservation.

Module-4: Environmental Pollution and Management

10 Hours

Pollution and its impact; Overview of pollution: air, water, soil, noise, solid waste, hazardous waste; Discussion on transboundary pollution and its consequences; Understanding environmental issues at micro, meso, synoptic, and planetary scales; Case studies highlighting the adverse effects of pollution on human health and ecosystems. Addressing Environmental Pollution and Health: Strategies for pollution control and management; Examination of air, water, soil, and noise pollution and their health impacts; Introduction to waste management practices and their significance. Introduction to environmental management systems such as ISO 14001 and the role of organizations like UNEP and IPCC in global environmental governance; Case studies on the implementation of environmental policies and regulations in different contexts.

Module-5: Environmental Policies and Practices

10 Hours

Introduction to environmental laws and regulation: Constitutional provisions - Article 48A, Article 51A(g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; Noise Pollution (Regulation and Control) Rules, 2000; National Green Tribunal; Climate Change policies, Greenhouse gas emissions and their impact on global climate; Climate change mitigation measures and practices: UNFCCC, Concept of NET ZERO. Environmental Treaties: Major international environmental agreements, conventions and their significance: CBD, CITES, UNCCD, Analysis of India's status and commitments under these agreements.

SUGGESTED READINGS

- Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
- Sinha, N. (2020) Wild and Wilful. Harper Collins, India.
- Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK.
- Kanchi Kohli and Manju Menon (2021). Development of Environment Laws in India, Cambridge University Press.
- Ministry of Environment, Forest and Climate Change (2019). A Handbook on International Environment Conventions & Programmes. <https://moef.gov.in/wp-content/uploads/2020/02/convention-V-16-CURVE-web.pdf>
- Headrick, Daniel R. (2020). Humans versus Nature- A Global Environmental History, Oxford University Press.
- Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future. 10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.
- Harper, Charles L. (2017). Environment and Society, Human Perspectives on Environmental Issues 6th Edition. Routledge.
- Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
- Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.

THRUST AREA OF PROJECTS

Theme-1: Human and Environment

- 1.1 Environmental awareness level of students, faculties and staffs of Centurion University through a questionnaire assessment
- 1.2 Hygiene and sanitation: An important factor of Environment and Women Health
- 1.3 Environmental movements in India and their role in Environmental Protection
- 1.4 Study on major civilizations along river banks: A few case studies
- 1.5 Critical study and analysis of the first world conference on the Human Environment, Stockholm, 1972

Theme-2: Natural Resources and Sustainable development

- 2.1 Plant resource, diversity and their utility in Centurion University campus
- 2.2 Water resource use, management and conservation strategies in Centurion University campus
- 2.3 Energy audit of Centurion University campus
- 2.4 A study on the planning, execution and implementation of Sustainable Development Goals (SDGs) in Centurion University
- 2.5 Critical study and analysis of the World Commission on Environment and Development, 1983

Theme-3: Conservation of Biodiversity and Ecosystem

- 3.1 Biodiversity assessment of Centurion University campus
- 3.2 *Ex-situ* Biodiversity conservation initiatives taken in Centurion University
- 3.3 Identification and documentation of food chain and food webs in Centurion University campus including Pollinators' Paradise
- 3.4 Land use and land cover analysis across campuses of Centurion University in Odisha
- 3.5 Identification, documentation and analysis of micro ecosystems of Centurion University

Theme-4: Environmental Pollution and Management

- 4.1 Water quality assessment with isolation, characterization and application of pollutant-degrading microbes from contaminated and waste water sources
- 4.2 Soil quality assessment within and Outside Centurion University campus
- 4.3 Ambient Air Quality Assessment within and outside of Centurion University campuses using High Volume Air Sampler
- 4.4 Assessment of Noise pollution within and outside of Centurion University campuses using Sound Level Meter
- 4.5 Waste to wealth Management adopted in Centurion University Campus

Theme-5: Environmental Policies and Practices

- 5.1 Provisions for Environmental protection in the Constitution of India: Prospects and Retrospects
- 5.2 A few case studies handled and heard by National Green Tribunal (NGT), India
- 5.3 Green House gases and their impact on Global climate: Role of UNFCCC
- 5.4 A critical analysis of Convention on International trade in Endangered species of Wild Fauna and Flora (CITES) to combat Wild life loss
- 5.5 Best environmental policies and practices of Centurion University across campuses in Odisha

Course Structure Basket - II

Course Code	Course Title	Credits	Course Type T+P+PJ	NcRF Level
CUTM1011	Optimisation Techniques	2	0-2-0	4.5
CUTM1012	Engineering Economics and Costing	3	2-0-1	4.5
CUTM1013	Project Management	3	2-0-1	4.5
CUVA4060	Gender, Human Rights and Ethics	3	3-0-0	4.5
CUVA4056	Climate Change, Sustainability and Organisation	3	2-0-1	4.5
CUTM1016	Job Readiness	6	0-6-0	

Syllabus

Optimization Techniques (50 hours)

Code	Course Title	Credit	T-P-PJ
CUTM1011	Optimization Techniques	2	0-2-0

Course Objectives

- To learn to translate real-world scenarios into mathematical optimization models.
- To develop a deep understanding of the basic principles and mathematical foundations of optimization.
- To create an Engineering design methodology using a mathematical formulation.

Course Outcomes

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

- **CO1:** Gain knowledge on optimization methods and algorithms to develop different types of optimization problems.
- **CO2:** Understand various real life optimization problems by using computer software.
- **CO3:** Apply optimization techniques in problems of Engineering and Technology.
- **CO4:** Evaluate optimization solutions for feasibility, efficiency, and practicality.
- **CO5:** Develop new optimization models or improve existing algorithms for specific applications.

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1									2	1		1
CO2	2	2	2		3								1	2	1
CO3	1	2	3										1	3	
CO4	2	3	3		3								3	3	
CO5	3	3	3		3								2		1

*High-3, Medium-2, Low-1

Course Syllabus:

- Experiment 1: Practice of linear programming problems
- Experiment 2: Practice of Graphical method
- Experiment 3: Practice of Simplex method
- Experiment 4: Practice of Penalty Method
- Experiment 5: Transportation models
- Experiment 6: Assignment Models
- Experiment 7: Practice of Sequencing problems
- Experiment 8: Scheduling Models by Johnson's Algorithm

Text Books

- Harvey M. Wagner, *Principles of Operations Research*, Englewood Cliffs, Prentice-Hall, 1969
- S D Sharma and Himansu Sharma, *Operations Research: Theory, Methods and Applications*, 15 Edition, KedarnathRamnath & Co

External Links:

<https://www.informs.org/Resource-Center/INFORMS-Student-Union/Consider-an-Analytics-OR-Career>

<https://www.informs.org/>

https://en.wikipedia.org/wiki/Operations_research

ENGINEERING ECONOMICS AND COSTING (56 hours)

Course Code	Course Title	Credits	Type (T+P+Pj)
CUTM1012	ENGINEERING ECONOMICS AND COSTING	3	2+0+1

Course Objectives:

- To facilitate students' foundational understanding of economic theories and principles relevant to engineering, enabling them to apply these concepts in real-world scenarios.
- To develop the ability to conduct detailed cost-benefit analyses, ensuring students can evaluate the financial implications of engineering projects and make informed decisions.
- To teach students how to use various investment appraisal techniques, such as Demand & Supply, production theory, and The Time Value of Money, to assess the viability and profitability of engineering investments.
- To strengthen students' decision-making capabilities by providing them with the tools to analyze economic data, forecast future trends, and strategically plan for the financial success of engineering projects

Course Outcomes:

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

CO1: Understand the fundamental concepts of engineering economics, demand and supply, and production theory of the Market.

CO2: Develop awareness and understanding of the cash flow statements and the time value of money.

CO3: Evaluate the financial performance of engineering projects using various financial analysis methods.

CO4: Understand and apply cost concepts and cost sheets to analyse common business management decisions such as pricing a product and services.

CO5: Understand the overview of Indian baking system and Indian financial systems

Course Outcome to Program Outcome Mapping:

COP	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O1	PS O2	PS O3
CO1	3	1	2	-	1	-	-	1	1	1	1	1	3	1	2
CO2	3	2	1	1	1	-	-	1	1	1	2	2	2	2	2
CO3	3	2	2	1	1	-	-	1	1	1	3	2	2	3	1
CO4	3	2	2	1	1	-	-	1	1	1	3	2	3	2	1
CO5	3	1	1	-	1	-	-	1	1	1	3	2	3	2	1

*High-3, Medium-2, Low-1

Course Syllabus

Module-I

Engineering Economics – Nature and scope, General concepts on micro & macroeconomics. The Theory of demand, Demand function, Law of demand and its exceptions, Elasticity of demand, Law of supply, and elasticity of supply.

Theory of production, Law of variable proportion, Law of returns to scale.

Module-II

Time value of money: Simple and compound interest, Cash flow diagram, Principle of economic equivalence.

Evaluation of engineering projects: Present worth method, Future worth method, Net present value method, internal rate of return method, Cost-benefit analysis in public projects.

Depreciation: Meaning Causes, Factors affecting depreciation, Methods of providing depreciation, Straight Line Method & Diminishing Balance Method

Module-III

Cost concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into fixed and variable costs. Break-even analysis (Simple numerical problems to be solved)

Indian Banking System: Banks: Meaning, nature, characteristic of the Indian banking system, functions of commercial banks, functions of Reserve Bank of India, Overview of Indian Financial System.

Text Books:

1. Riggs, Bedworth, and Randhwa, “Engineering Economics”, McGraw Hill Education India.
2. D.M. Mithani, Principles of Economics. Himalaya Publishing House

Reference Books:

1. Sasmita Mishra, “Engineering Economics & Costing “, PHI
2. Sullivan and Wicks, “Engineering Economy”, Pearson
3. R.PaneerSeelvan, “ Engineering Economics”, PHI
4. Gupta, “Managerial Economics”, TMH
5. Lal and Srivastav, “Cost Accounting”, TMH

PROJECT MANAGEMENT (56 Hours)

Course Code	Course Title	(Credit)	Type (T+P+Pj)
CUTM1013	Project Management	3	2+0+1

Course Objectives:

- Develop and implement all project procedures.
- Learn project management methodology to initiate and manage projects efficiently and effectively
- Acquire key project management skills and strategies for productive guidance, efficient communication, and supervision of the project's team
- Achieve the project's main goal within the given constraints

Course Outcomes:

CO1: Acquire 10 knowledge area identified by PMI and its application while working on a real project.

CO2: Apply managerial skill to procure a project, plan, schedule, hire and allocate resource and deliver a project

CO3: Will build soft skill to lead and comply and communicate with all stakeholders' expectation

CO4: Will be able to prepare a WBS structure

CO5: Able to prepare a DPR

CO-PO Mapping

Course Outcomes (CO)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	3	3	-	-	2	-	2	3	-	-	-
CO2	3	3	3	-	2	-	-	-	-	2	-	-
CO3	-	3	-	3	3	-	-	-	-	-	-	2
CO4	3	3	3	-	-	2	-	-	3	-	-	-
CO5	3	3	3	-	-	2	-	-	3	2	-	-

Course Outline

Module: I

Project Management framework; Introduction to Project Management: Project Life Cycle and Organisation, Project vs. Operational work, Stakeholders, Organisational Influences Project Management Process for a Project, groups, Initiating, planning, executing, monitoring & controlling and closing process groups., Project management Knowledge area; Project Integration Management; Develop project charter, develop project management plan, direct and manage project execution, monitor and control project work, perform integrated change control, close project or phase.

Module: II

Project Scope Management: collect requirements, define scope, create WBS, verify scope, control scope, Project Time Management; Define activities, sequence activities, estimate, develop and schedule, Project Cost Management; Estimate costs, determine budget, control costs

Module: III

Project Quality Management: Plan quality, perform quality assurance, perform quality control, Project HR Management; Develop HR plan, acquire project team, develop and manage project team, Project Communications Management; Identify stakeholders, plan communication, distribute information, manage expectation of stake holders, report performance.

Module: IV

Project Risk Management; Plan risks: identify risks, perform quality and quantitative risk analysis, plan risk responses, monitor and control risks, Project Procurement Management; Plan procurements, conduct procurements, administer procurements, close procurements, Project Stakeholders Management; Identifying stakeholders, stakeholder analysis, engagement.

Text Books:

- Project Management: A Managerial Process, Clifford F Gray & Eric W Larson, Tata McGrawHill
- A Guide to the Project Management Body of Knowledge, 6th Edition, PMI
- Project Management- A system Approach to Planning, Scheduling and Controlling (Harold Kerzner). CBS Publishers and Distributors, New Delhi.

Reference Books:

- Projects, Preparation, Appraisal and Implementation (Prasanna Chandra), 3rd Edition, Tata Mc Graw Hill, New Delhi.
- Project Management (Nagarajan, K), New Age Publishers, New Delhi.
- Project Management. A Managerial Approach (Meredith, R.J and Mantel, S.J), Wiley (India).

Links

- 1) <https://www.youtube.com/watch?v=qjwDQhbbWdI>
- 2) <https://www.youtube.com/watch?v=rMVEUoANT64>
- 3) <https://www.youtube.com/watch?v=oacSSamqP6s>
- 4) Preparation of project plan in Excel: <https://www.youtube.com/watch?v=kpLnxV3a1bE>
- 5) Gantt Chart for project management:
<https://www.youtube.com/watch?v=4H77Lvx2pQc>
- 6) <https://www.youtube.com/watch?v=ACjTnkTT7v4>
- 7) <https://www.youtube.com/watch?v=8xxkA20ycck>
- 8) https://www.youtube.com/watch?v=o_vexQUWH4s
- 9) <https://www.youtube.com/watch?v=aqEKLOxIUEY>
- 10) <https://www.youtube.com/watch?v=k8KjFuhzBaQ>
- 11) <https://www.youtube.com/watch?v=bbi2diraL8M>
- 12) <https://www.youtube.com/watch?v=ne7zwSYmWus>
- 13) <https://www.youtube.com/watch?v=SPj-Luod9tl>
- 14) Bitrix:(https://www.bitrix24.in/tasks/free_online_project_management.php?utm_source=google&utm_medium=cpc&utm_campaign=19998176636-149585073993&gclid=EAAlaIQobChMI5vCVoKGe_wIVnpJmAh3QYARAaAYASAAEgIYrfD_BwE)
- 15) Bitrix24 Project Management Tutorial
(<https://www.youtube.com/watch?v=0MhGIWcMvKQ>)

List of Projects

1. Internet of Things (IoT) Integration for Smart Homes
2. Wearable Technology for Health Monitoring: Design a wearable device or application that tracks and analyzes vital signs, physical activity, sleep patterns, or overall well-being.
3. Sustainable Packaging Solutions: Design an innovative product solution that reduces waste, improves recyclability, or uses eco-friendly materials.
4. Virtual Reality (VR) or Augmented Reality (AR) Applications: Develop a product that utilizes VR or AR technology for entertainment, education, training, or immersive experiences.
5. Energy-Efficient Appliances: Design and prototype an energy-efficient appliance that reduces power consumption without compromising performance or functionality.

6. Smart Agriculture Technology: Create a solution that integrates sensors, automation, and data analytics to optimize crop yield, reduce resource usage, or improve farming practices.
7. Renewable Energy Solutions: Innovate a product (Developing a Solar Dryer) that harnesses renewable energy sources such as solar, wind, or hydroelectric power to address energy needs or provide clean energy alternatives.
8. Smart Transportation Systems: Design a product or solution that enhances transportation efficiency, reduces traffic congestion, improves safety, or promotes sustainable transportation options.
9. Assistive Technologies for Disabilities: Create a product that assists individuals with disabilities in improving their mobility, communication, accessibility, or quality of life.
10. Advanced Healthcare Devices: Develop a medical device or technology that improves diagnosis, treatment, monitoring, or patient care in a specific area of healthcare.
11. Personalized Nutrition Solutions: Design a product or service that leverages data analytics and individualised recommendations to promote healthy eating habits and personalized nutrition plans.
12. Sustainable Fashion or Textile Innovations: Explore eco-friendly materials, manufacturing processes, or circular economy principles to develop sustainable fashion or textile products.
13. Home Automation for Aging in Place: Create a solution that enables older adults to live independently and safely in their own homes through automation, monitoring, and assistive technologies.
14. Water Conservation Technologies: Develop a product or system that helps conserve water resources, improves water management, or enhances water quality.

Gender, Human Rights and Ethics (63 Hours)

Course Code	Course Title	Credits	Type (T+P+Pj)
CUVA4060	Gender, Human Rights and Ethics	3	3+0+0

Course Objectives:

This course is about gender, human rights, and ethics in which the student will be sensitized and exposed to related issues in the context of business and organizations in India. The specific objectives are:

- To develop an understanding of gender, human rights, and ethics in an unequal society like India
- Sensitization of how gender, human rights, and ethics are significant in organizations.
- Integrating concerns related to gender, human rights, and ethics in organizations.

Course Outcomes:

- **CO1:** Students will analyse the differences between sex and gender, the social construction of gender, and its outcomes, including gender roles, labour division, and power hierarchies.
- **CO2:** Students will evaluate gender implications in workplace practices, management, and leadership
- **CO3:** Will gain an understanding of human rights concepts, types, and their relevance in organizations. They will explore international human rights laws, the Universal Declaration of Human Rights, and organizational challenges related to social discrimination and inequality.
- **CO4:** Develop knowledge of Indian and Western ethical systems, including utilitarianism, duty ethics, virtue ethics, and ethical relativism.
- **CO5:** Investigate the persistence of social discrimination, efforts to address past violations, and the ongoing struggle for justice and accountability.

CO-PO Mapping

CO/PO	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11	PO-12
CO1	3	3	2	2	2	3	2	1	2	3	1	2
CO2	3	3	2	2	2	3	3	2	2	2	1	2
CO3	3	3	2	3	2	3	2	1	2	3	2	2
CO4	3	2	2	3	2	3	1	1	2	1	2	2
CO5	3	3	2	3	2	3	2	2	2	2	1	2

Course Contents:

Module: I

Difference between sex and gender; social construction of gender and its outcomes in the form of behavior, roles, gender based division of labour, hierarchy; gender relations. Gender issues in organisations - significance of relations between structures, practices, context, interactions, and power for construction of gender at organisational level Gender implications at workplace, management and leadership, Laws and Acts Comparing different types of organisations; how to create a gender sensitive organisation.

Module: II

Introduction to human rights, Meaning and Definition, Types Human Rights Law: Protection, violation and the legal framework for their protection - International Human Rights Law, Universal Declaration of Human Rights Conflicts of Rights and its Significance to Organisations: Challenges of the past and challenges for the future. Persistence of social discrimination and inequality; efforts in the search for justice for past violations, continued struggle for human rights and accountability in an organisational context.

Module: III

Introduction to and study of ethics; Indian and Western ethics Different ethical systems and perspectives; ethical relativism and its implications, utilitarianism, duty ethics and virtue ethics in organisations Critique of various ethical positions and develop their own position in an organizational context.

References:

- “Why Gender is a Development Issue”, Handout 4, Oxfam Gender Training Manual (1994)
- Freedman, Jane. (2002), “Introduction: Feminism or Feminisms?” in *Feminism*, Viva Books, N. Delhi.
- Chafetz, J.S. (1990), “The Coercive Bases of Gender Inequality”, in *Gender Equity: An Integrated Theory of Stability and Change*, Sage.

Climate Change, Sustainability and Organisation (63 Hours)

Course Code	Course Title	Credits	Type (T+P+Pj)
CUVA4056	Climate Change, Sustainability and Organisation	3	2+0+1

Course Objectives:

- To develop an understanding about climate change in general, responses and debates
- To create awareness about the impact of climate change on organisations in performance, growth and sustainability
- To facilitate in developing reference points to factor in aspects of climate change in organizational planning and development
- To develop an understanding of sustainable development, SDGs and their relevance for sustainability of organisations
- To comprehend the application of the Integrated Reporting Framework for Sustainability in business.

Course Outcomes:

- CO1: Develop foundational knowledge of climate change, its impacts on various sectors such as agriculture, forestry, transportation, energy, and manufacturing, and its broader implications, including migration, disasters, and pandemics.
- CO2: Evaluate the sustainability challenges and opportunities presented by climate change for business organizations.
- CO3: Examine the concept of sustainable development, including debates around it and the importance of SDGs.
- CO4: Gain knowledge of the regulatory environment, international policies, and frameworks such as Integrated Reporting for Sustainability.
- CO5: Explore sustainable production and consumption practices, the role of design and technology in sustainability, and strategic communication and marketing for promoting sustainability.

CO-PO Mapping

CO/PO	PO-01	PO-02	PO-03	PO-04	PO-05	PO-06	PO-07	PO-08	PO-09	PO-10	PO-11	PO-12
CO1	3	3	2	3	2	3	2	1	2	3	1	3
CO2	3	3	2	2	3	3	2	2	3	2	1	3
CO3	3	3	2	3	3	3	1	2	2	3	1	3
CO4	3	2	2	3	2	3	1	2	2	2	2	3
CO5	3	3	2	3	3	3	2	2	2	3	2	3

Course Contents:

Module-I:

Basics of climate change; impacts on various sectors; responses and mitigation efforts by the state agencies; debates and non-state and critiques, Sectoral implications of climate change: Agriculture and Forestry; Transportation; Buildings; Energy; Industry and Manufacturing, Climate change: specific impacts (Migration, Disasters and Pandemics), Mitigation and adaptation keeping the sustainability of business organisations

Module-II:

Sustainable development, debates, SDGs, challenges and opportunities; The business case and leadership for action, Regulatory environment and International policy; Integrated Reporting Framework for Sustainability, Production and consumption; Design, technology, and planning for sustainability, Communication and marketing; Collaboration and partnerships

References:

- Climate Change- Law, Policy and Governance by Usha Tandon, Eastern Book Company, 2018
- Climate Change: A Very Short Introduction by Mark Maslin, Oxford University Press, 2014
- Sustainable Development Goals Series by Zachary Romano, Springer Publication, 2024.

Job Readiness

Code	Course Title	Credit	T-P-PJ
CUTM1016	Job Readiness	6	0-6-0

Course Objectives:

The objectives of the course are

- Develop competent level of English proficiency, i.e., 6.5 band on the CELTS Test
- Enhance proficiency in verbal, quantitative aptitude and logical reasoning skills aiming for Level 4 mastery in My Perfectice
- Strengthen students' employability skills through communication, analytical and problem-solving abilities

Course Outcomes:

After completion of the course students will be able to:

- **CO1.** Achieve competency in English language (6.5 band on the CELTS Test)
- **CO2.** Apply English proficiency in real-world scenarios such as profe presentations
- **CO3.** Exhibit verbal ability, strong quantitative aptitude and advanced logical reasoning (Level 4 mastery in MyPerfectice)
- **CO4.** Develop and apply enhanced employability skills, including effective communication, sharp analytical thinking and problem- solving abilities in various professional contexts.
- **CO5.** Commitment to lifelong learning fostering a mindset of continuous improvement in English proficiency and employability skills.

CO, PO Mapping Matrix															
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			3											
CO2				3	3										
CO3			2	3											
CO4			1	2	3										
CO5			2		3										

Course Contents

Course I: CELTS - Listening, Speaking, Reading and Writing

Module I: CELTS Listening

- Notes/ Form/Table completion
- Label the Map/Passage, Multiple Choice Questions
- Complete the Sentences, listening to Find Information
- Assessment on Listening Skills

Module II: CELTS Speaking

- Speaking about self, family, hobbies, interests
- Introduction & Interview
- Topic Discussion (e.g, Environment, Post Covid 19, Job)
- Assessment on Speaking Skills

Module III: CELTS Reading

- Skimming and Scanning
- Sentence Completion
- Choose the Correct options (A, B, C, D)
- Locating the Specific Information
- Assessment on Reading Skill

Module IV: CELTS Writing

- Summarising the chart, table or graph
- Comparing and contrasting graphs and tables
- Describing maps & diagrams
- Agreeing & disagreeing
- Expressing a personal view & opinion
- Assessment on Writing Skill
- Job Application: CV & Cover Letter (2nd year)
- Letter Writing
- Email Writing (2nd year)
- Getting Started –writing an introduction

Course II: CELTS Verbal

Module I: Grammar (4 Hrs)

- Articles
- Prepositions
- Subject-Verb
- Spotting Errors
- Sentence Correction

Module II: Vocabulary (5 Hrs)

- Synonyms
- Antonyms
- Contextual Vocabulary

Module III: Reading Comprehension (3 Hrs)

- Paragraph/ Sentence Completion
- Jumbled Sentences/ Jumbled Paragraph
- Reading Comprehension

Module IV: Verbal Analogies (3 Hrs)

References Recommended:

Books

- The Official Cambridge Guide to Ielts Student's Book With Answers with DVD Rom
- Simone Braverman's Target Band 7
- Focus on IELTS Foundation Coursebook.

Course Structure Basket - III

Course Code	Course Title	Credits	Course Type T+P+PJ	NcRF Level
CUTM1017	Industrial IOT and Automation	6	3-2-1	5
CUTM1018	Data Analysis and Visualisation using Python	4	0-1-3	4.5
CUTM1019	Machine Learning using Python	4	1-2-1	5
CUTM1020	Robotic automation with ROS and C++	4	1-2-1	5
CUTM1021	Basics of Design Thinking	2	0-0-2	5
CUTM1022	System Integration with DYMOLA	2	0-0-2	5
CUTM1023	Smart Engineering Project (G2M)	3	0-0-3	5.5

Industrial IoT and Automation

Code	Course Title	Credit	T-P-PJ
CUTM1017	Industrial IoT and Automation	6	3-2-1

COURSE OBJECTIVES

- To provide the student with basic skills useful in identifying the concepts of automation using hydraulics, pneumatic and PLC.
- To impart knowledge on robot kinematics and programming for a given application.
- To provide an introduction to Industry 4.0 its applications in industry.

COURSE OUTCOMES

- **CO1:** design pneumatic and hydraulic circuits
- **CO2:** program PLC for a given application
- **CO3:** choose appropriate materials handling devices and perform robot programming for a given application
- **CO4:** solve direct and inverse kinematics and choose appropriate Robot for given application
- **CO5:** apply IOT to different applications

COURSE OUTCOME TO PROGRAM OUTCOME MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1	3			2	2	2	3	2	3
CO2	3	3	1	1	3	2	2		2	2	2	1	3	3	2
CO3	2	3	1	3	3	2	2		2	1	1	3	3	2	2
CO4	3	3	1		3	2	2		2	2	1	3	2	2	2
CO5	3	3	1	2	3	1	1		3	1	1	3	1	1	1

*HIGH-3, MEDIUM-2, LOW-1

COURSE CONTENT

MODULE 1: Introduction & Architecture

Theory

What is IIoT and connected world? The difference between IoT and IIoT, Architecture of IIoT, IOT node. Challenges of IIOT

Hands-On

1. Introduction to Arduino, ES8266, Introduction to raspberry Pi.

MODULE2: IIOT Components

Theory:

Fundamentals of Control System, introductions, components, closed loop & open loop system.

Introduction to Sensors (Description and Working principle): What is sensor? Types of sensors, working principle of basic

Sensors -Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11).

Digital switch, Electro

Mechanical switches.

Practice:

2. Measurement of temperature & pressure values of the process using raspberry pi/node mcu.
3. Modules and Sensors Interfacing (IR sensor, ultrasonic sensors ,Soil moisture sensor) using raspberry pi/node mcu.
4. Modules and Actuators Interfacing (Relay, Motor, Buzzer) using raspberry pi/node mcu.

MODULE 3: Communication Technologies of IIoT

Theory:

Communication Protocols: IEEE 802.15.4, ZigBee, Z Wave, Bluetooth, BLE, NFC, RFID

Industry standards communication technology (LoRAWAN, OPC UA, MQTT), connecting into existing Modbus and Profibus

Technology, wireless network communication.

Practice:

5. Demonstration of MQTT communication
6. Demonstration of LoRa communication.

MODULE 4: Visualization and Data Types of IIoT

Theory:

Front end EDGE devices, enterprise data for IIoT, emerging descriptive data standards for IIoT, cloud data base, cloud

Computing, fog or edge computing,

Connecting an Arduino /raspberry pi to the Web: Introduction, setting up the Arduino/raspberry pi development

Environment, Options for Internet connectivity with Arduino, configuring your Arduino/raspberry pi board for the IoT.

Practice:

7. Visualization of diverse sensor data using dashboard (part of IoT's 'control panel')
8. Sending alert message to the user.

MODULE 5:

Theory

Extraction from Web: Grabbing the content from a web page, sending data on the web, troubleshooting basic Arduino

issues, types of IoT interaction, Machine to Machine interaction (M2M).

Practice

9. Device control using mobile Apps or through Web pages.
10. Machine to Machine communication

MODULE 6: Control & Supervisory Level of Automation

Theory

Programmable logic controller (PLC), real-time control system, Supervisory Control & Data Acquisition (SCADA).

HMI in an automation process, ERP &MES

Practice

11. Digital logic gates programming using ladder diagram
12. Implementation of Boolean expression using ladder diagram
13. Simulation of PLC to understand the process control concept.

Module 7: Application of IIOT

Case study: Health monitoring, Iot smart city, Smart irrigation, Robot surveillance

Text Books:

1. Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (editor)
2. Internet of Things with Arduino Cookbook, Marco Schwartz, ISBN 978-1-78528-658-2

Reference Books:

1. The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.) (Springer Publication)
2. Industrial Internet of Things: Cybermanufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat (Springer Publication)
3. Internet of Things- A Hands on Approach, Arshdeep Bahga and Vijay Madiseti , Universities Press , 2015.

Data Analysis and Visualization Using Python (70 Hours)

Code	Course Title	Credit	T-P-PJ
CUTM1018	Data Analysis and Visualization Using Python	4	0-1-3

Course Description: This course emphasizes the use of tools and techniques to collect, analyze, and interpret data.

Course Objectives:

- Understand how to read, store and display each data type.
- Get skill to quickly and easily draw plot or visualize the information through visualization technique.
- The ability to develop visualization to tell the story.

Course Outcomes (COs):

- **CO1:** Able to gain knowledge on visualization with good story line and perform job of a data analyst. (Understand)
- **CO2:** Able to analyse and visualize the dataset. (Analyze)
- **CO3:** Ability to design dashboard. (Create)
- **CO4:** Analyze Text data and gain insights. (Analyze)
- **CO5:** Select appropriate data visualization technique for given data. (Understand)

CO-PO-PSO Mapping:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	-	-	2	2	2	3	3	3
CO2	3	3	3	3	3	-	-	2	2	2	3	3	3
CO3	3	3	3	3	3	-	-	2	2	2	3	3	3
CO4	3	3	3	3	3	-	-	3	2	3	3	3	3
CO5	3	3	3	3	3	-	-	3	2	3	3	3	3

Course Syllabus:

Module 1: STORY BOARD DEVELOPMENT (20 hours)

- The objective and flow of the story to be understood through cases

Module 2: DATA READING USING PYTHON FUNCTIONS (23 hours)

- Python libraries: Pandas, NumPy, Plotly, Matplotlib, Seaborn, Dash
- Data collection from online data sources, Web scrap, and data formats such as HTML, CSV, MS Excel, data compilation, arranging and reading data, data munging

Module 3: DATA VISUALSATION USING PYTHON LIBRARIES (27 hours)

- 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>

Machine Learning using Python (98 Hours)

Course Code	Course Title	Credits	Type (T+P+Pj)
CUTM1019	Machine Learning using Python	4	1-2-1

Course Description: This course deals with various machine learning algorithms, strategies for model generation and evaluations are covered as per the industry requirement.

Course Objectives:

- Understand the meaning, purpose, scope, stages, applications, and effects of ML.
- Explore important packages of python, such as numpy, scipy, OpenCV and scikit-learn.
- To apply and design ML algorithms on given data and interpret the results obtained

Course Outcomes (COs):

- **CO1:** Develop a good understanding of fundamental principles of machine learning (Understand, Create)
- **CO2:** Invention of a Machine Learning problem. (Create)
- **CO3:** Develop a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering. (Design)
- **CO4:** Design and Concrete implementations of various machine learning algorithms to solve a given problem using languages such as Python. (Create)
- **CO5:** Evaluate performance of various machine learning algorithms on various datasets of a domain. (Apply, Evaluate)

CO-PO-PSO Mapping:

CO/PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1		-	-	2	2	2	3	3	3
CO2	3	3	2	2	1	-	-	-	2	2	3	3	3
CO3	3	3	3	2	2	-	-	2	-	2	3	3	3
CO4	3	3	3	3	3	-	-	2	2	2	3	3	3
CO5	3	3	3	3	1	-	-	2	2	3	3	3	3

Course Syllabus:

Module 1: Application and Environmental-setup (24 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 (24 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 (26 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 (24 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

Course Content:

1. Robotic Automation Introduction
2. Sensors & Controllers
3. Sequential robot control
4. ROS & C++
5. Project

Course Objectives

- To upgrade knowledge levels of robotic application in modern industries
- Project based training

Course Outcomes

After the completion of the course students will be able to:

- Advanced knowledge on robotic automation
- Design different types of circuits using devices which are connected to robotic modules
- To write code using C++ for various types of robotic applications.
- Simulate Robotic Modeling with MATLAB and Simulink
- Apply the concepts in Industry based project & advanced learning.

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1	2								3	1	1
CO2	1	2	3	2	1								3	2	1
CO3	1	1	3	2	2								3	2	1
CO4	1	2	3	2	3								3	2	2
CO5	1	2	2	3	3								3	2	2

*High-3, Medium-2, Low-1

COURSE SYLLABUS

TOTAL HOURS-60 HOURS

Module – 1 (12 Hours)

Robotic Automation Introduction

- 1.1 Basic's of automation
- 1.2 Use of robots in industry.

Module – 2 (12 Hours)

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
- P2.2 BLUETOOTH, ESP8266, GPS, GSM

Module – 3 (12 Hours)

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

Module- 4 (12 Hours)

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.

Module- 5 (12 Hours)

ROS & C++

- 5.1 What is Ubuntu & ROS?
- 5.2 Requirement and application of ROS.
- 5.3 ROS based simulation of Turtlebot.
- 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 Turtlebot 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. 3. Location targeted robot

Basics of Design Thinking (60 hrs)

Code	Course Title	Credit	T-P-PJ
CUTM1021	Basics of Design Thinking	2	0-0-2

Course Objectives

- Learning the five key stages of Design Thinking—Empathize, Define, Ideate, Prototype, and Test—and understand how they contribute to solving complex problems creatively and effectively.
- Gaining the ability to approach challenges with a user-centric mindset, focusing on the needs, pain points, and perspectives of users to design innovative and impactful solutions.
- Acquiring practical knowledge of tools such as empathy mapping, brainstorming techniques, rapid prototyping, and iterative testing to foster collaboration and enhance creative problem-solving in diverse contexts.

Course Outcomes:

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

- **CO1:** recall and describe the key stages of the Design Thinking process (Empathize, Define, Ideate, Prototype, and Test) and their importance in problem-solving.
- **CO2:** explain the principles of human-centered design and how it applies to addressing user needs and solving complex problems.
- **CO3:** apply Design Thinking tools and techniques (e.g., empathy mapping, brainstorming, prototyping) to real-world or simulated problems to generate innovative solutions.
- **CO4:** analyze user feedback, identify patterns, and use insights to refine problem definitions and proposed solutions during the iterative process.
- **CO5:** design and develop innovative, user-centered solutions to complex challenges, showcasing their ability to integrate all stages of the Design Thinking process effectively.

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1		3							2		3	
CO2	3	1	3		1							2	3		
CO3	2	2	3	3	2							1		2	2
CO4	3	2	3		3							1			
CO5	3	2	3		1							1		2	3

***High-3, Medium-2, Low-1**

Course Syllabus:

Projects

1. Basics of Design Thinking
2. Developing a customer friendly insulin pump design
3. Develop a new customer experience for buying a diamond ring online
4. Develop a new disease monitoring device for health workers working in remote areas.
5. Designing an integrated machinery for end-to-end farm activities for small and marginal farmers.
6. Design a Fund-raising campaign

Text Books:

1. 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 modelling of complex integrated systems.
- To design intuitive modelling i.e. advanced, formally defined object-oriented modelling language.

COURSE OUTCOMES

- **CO1** It can improve the Knowledge to better understand the behavior of systems and to work and communicate accurately with partners and suppliers.
- **CO2** DYMOLA is not only capable of supporting an ad-hoc modelling level, such as functional behavior or detailed design, but is also able to convert these predictive models into real-time models.
- **CO3** Future Centurions are ready for operating in many industries including automotive, aerospace, architecture, Motorsport, energy, and high tech.
- **CO4** To enable users to easily build their own components or adapt existing ones to match their unique needs.
- **CO5** Build custom components or adapt existing ones

COURSE OUTCOME TO PROGRAM OUTCOME MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3				1			1	3	2	1
CO2	3	3	1	1	3				1			1	3	3	2
CO3	3	3	1	3	3				2	1		1	3	2	3
CO4	3	3	1		3				2	1		3	2	2	2
CO5	3	3	1	2	3				1			2	1	1	3

*HIGH-3, MEDIUM-2, LOW-1

COURSE SYLLABUS

Module 1 - Introduction Dymola and Modelica library

Package Browser, Component Browser, Parameter and Variable Editor Simulation Window, Modelling, and Simulation.

The Modelling window is used to compose models and model components.

The Simulation experiment on the model, plot results and animate the behaviour.

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 - Modelling of animated projects using the MultiBody library.

<https://www.youtube.com/watch?v=c9Ar2b4X5rQ>

<https://www.youtube.com/watch?v=k7ILBASaEJg>

Session Plan

Session 1

Project

1

Simulating a model – Modelling of Integrated circuits

Description: Use of Electrical and Electronics components.

Workbench Use: Behaviour 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: Behaviour 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: Behaviour 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: Behaviour 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: Behaviour Modelling, Functional and Logical Design. Part design and Assembly Design.

Session 6

Project

6

Simulating a model – Bicycle Behaviour Modelling

Description: Design Power Train, Driving Cycle, part design, and Simulation.

Workbench Use: Behaviour 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 models the airflow through the door of a refrigerator or freezer compartment.

Workbench Use: Behaviour 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: Behaviour Modelling.

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: Behaviour 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: Behaviour Modelling, Arduino based System Design, Functional, and logical design.

Session 11

Project

11

Simulating a model – Implementation of Model using Python Library

Description: Modelling using python library, validation and optimization in the 3Ds platform.

Workbench Use: Behaviour 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: Behaviour 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: Behaviour Modelling.

https://www.youtube.com/watch?v=zz-_crJOG0&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: Behaviour 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_Stream using temperature sensors.

Workbench Use: Behaviour 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: Behaviour Modelling.

https://www.youtube.com/watch?v=P_YI3RiT114

SMART ENGINEERING PROJECT (G2M)

Code	Course Title	Credit	T-P-PJ
CUTM1023	Smart Engineering Project (G2M)	3	0-0-3

COURSE OBJECTIVES

- The main objective of this course is that students from various branches can learn different tools and collaborate to build a smart live project.
- To make the centurions think beyond engineering.
- To provide the platform to express the imagination to reality.

COURSE OUTCOMES

- **CO1:** Able to identify and formulate the research problem
- **CO2:** Able to design and develop solutions to the problem
- **CO3:** Able to analyze and solve the complex problems
- **CO4:** Able to plan, implement and execute the project
- **CO5:** Able to write an effective technical reports and demonstrate through the presentation

COURSE OUTCOME TO PROGRAM OUTCOME MAPPING:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3				1			1	3	2	1
CO2	3	3	1	1	3				1			1	3	3	1
CO3	3	3	1	3	3				2	1		1	3	2	2
CO4	3	3	1		3				2	1		3	2	2	2
CO5	3	3	1	2	3				1			2	1	1	3

***HIGH-3, MEDIUM-2, LOW-1**

COURSE SYLLABUS

- Interdisciplinary
- Product Based
- Industry 4.0
- Go to Market Based

Project categories:

- Software/Hardware Based
- Real-Time
- Multidisciplinary

Basic Project Requirements:

As per the Project requirements you can select any available boards/software.

Some selected and regular used embedded boards as listed below for your reference.

Hardware

1. Arduino (Uno, Mega, Nano)
2. Node MCU/ESp32
3. Raspberry pi Zero W/Raspberry pi Pico
4. Micro Python
5. Raspberry pi 3b+
6. FPGA Board
7. STM32

Simulation Software's

Some selected and regular used software as listed below for your reference.

8. Proteus Professional
9. MATLAB/Simulink
10. LabVIEW
11. Xilinx ISE
12. Ansys
13. Fusion 360
14. Autodesk
15. Dymola
16. Simulia

17. Maplesoft
18. Modelica
19. Python

Projects In Track:

- Analysis Design of G+10 Building using STAAD Pro
- Automated water irrigation controller for rice field
- Automatic Microgrid System
- Automation in Light and Fan in Classroom
- Speed Control Of Dc Motor using Arduino
- Bench Tapping Machine
- Modular E-Rickshaw Design using Catia
- Renewable Energy using Compressor
- Wireless Control Robotic car through MATLAB GUI
- Water Level and Temperature Indicator
- Speech Recognition using Python
- IOT Based Air Pollution Quality Monitoring with ESP8266
- Plant Disease Detection using Image Processing
- IOT Based Air Quality and Monitoring By Using Arduino
- Automatic agriculture field monitoring device
- IOT Based Weather Station Using GY-BME280 Sensor Module and ESP8266-12E Node MCU LUA Wi-Fi Module
- Bluetooth Controlled Car Using ARDUINO
- Crimes Against Women in India
- A Presentation on Analysis of QUAD COPTER
- Collecting Data and Visualizing of a Mobile Sensors of Android Device
- Manufacturing of Knuller Tool

- Smart Product Sanitization and Packaging System

Product In Track

- Insulin Pump Prototype Design
- Electronic Controller Design
- Battery Management System Design
- Poly House
- Apparel Tracking using Apriso webservice
- Android app development using android studio and Java
- Modular E-Rickshaw variant Design
- Autonomous Navigating Vehicle
- Smart Transformer Control Panel Design
- 3-Phase BLDC Motor Driver Design

Session Plan

Session 1

- Allocation of projects.
- Defined the gate zero process.

Session 2

- Review of gate zero process

Recent Comments

- Harolddyday on Dr. Amrutha Gopan
- Fakaza on Dr. Amrutha Gopan
- впр математика 8 класс on Domain course template
- Michaeljab on Dr. Amrutha Gopan
- EdgarWab on Dr. Amrutha Gopan

Course Structure

Basket IV

Mining Engineering

COURSE CODE	COURSE TITLE	CREDITS	TYPE T+P+PJ	NcRF Level
CUTM1910	MINE SURVEYING	2	2-0-0	5.5
CUTM1105	GEOLOGY FOR MINING ENGINEERING	4	2-2-0	5
CUTM1107	MINE ENVIRONMENT AND HAZARD	3	2-1-0	5
CUTM1116	MINE VENTILATION	3	2-1-0	6
CUTM1111	DRILLING AND BLASTING	3	2-0-1	5
CUTM1109	SURAFACE MINING	3	2-0-1	5
CUTM1106	ROCK MECHANICS	3	2-1-0	5.5
CUTM1108	UNDERGROUND COAL MINING	3	2-0-1	5
CUTM1110	UNDERGROUND METAL MINING	3	2-0-1	6
CUTM1113	MINE ECONOMICS	2	2-0-0	6
CUTM1115	MINERAL DRESSING	2	2-0-0	6
CUTM1912	MINE ELECTRICAL TECHNOLOGY	3	2-1-0	5
CUTM1114	MINE LEGISLATION AND GENERAL SAFETY- I	3	3-0-0	5.5
CUTM1911	MINE LEGISLATION AND GENERAL SAFETY -II	3	3-0-0	5.5
CUTM1909	MINE MANAGEMENT	2	2-0-0	5.5
CUTM1058	PROGRAMING IN JAVA	3	2-1-0	6
CUTM1059	DATABASE MANAGEMENT SYSTEM	3	2-1-0	6
CUTM1062	THEORIES OF FAILURE ANALYSIS USING FINITE ELEMENT ANALYSIS	4	2-2-0	6
CUTM1908	COMPUTER AIDED DRAFTING	3	0-2-1	5.5
CUTM1112	ELECTRONICS DEVICES AND SYSTEM	3	2-0-1	4.5



Mine Surveying

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1910	Mine Surveying	2-0-0	

Course Objectives:

- *To Understand correlation and stope survey methods and know and limitations of photogrammetry and modern survey methods.
- *To be Familiar with dip and strike problems and surveyor responsibility in underground.
- *Develop skills in remote sensing, GIS, GPS/DGPS, and photogrammetry for precise mine mapping and monitoring.

Course Outcomes:

After the completion of the course students will be able to:

- *CO1: Explain the Correlation of surface and underground survey.
- *CO2 : Explain the setting out of surface & underground curves by chords & offsets, chords and angle, tangent and offset, plate layers method.
- *CO3: Explain the setting out of surface & underground curves by chords & offsets, chords and angle, tangent and offset, plate layers method.
- *CO4: Conduct underground and open-cast mine surveys ensuring safety and accuracy.
- *CO5: Analyze survey data to support decision-making in excavation, drilling, and blasting activities

Course Outcome to Program Outcome Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1				2									
CO2	3		3		1										

CO3	1	2		1			1								
CO4				3			1								
CO5	3		2				1								

COURSE CONTENT

Module I

Correlation of surface and underground survey:

State direct correlation by traversing & optical methods. Describe orientation by wires in two shafts. Explain correlation by mines in vertical shafts. State co-planning/ alignment, Welsbach triangle Weiss-quadrilateral methods, precise magnetic correlation.

Module II

Setting out curves:

State elements of curves. Define designation of curves, simple, compound & reverse curves. Explain setting out of surface & underground curves by chords & offsets, chords and angle, tangent and offset, plate layers method.

Describe various setting out by chain & one theodolite, two theodolites. Define super elevation, transition and vertical curves.

Module III

Stop Surveying:

Explain tape triangulation, instrumental survey.

Determine stope face. State preparation of stope planes, plotting the stope station, plotting of stope face to the mine plan.

Find out area of extraction by Planimeter and calculation of triangle thereof.

Module IV

Simple problems on Dip, Fault, Strike, Borehole, Drifts: Solve various numerical problems related to dip, strike, fault, borehole & drifts.

GPS, DGPS and total station – Definition, working principle and its applications.

RECOMMENDED BOOKS

1. Plane & Geodetic Survey – D.Clerk
2. Surveying E. Mason – Vol.I& II
3. Metalliferous Mine Surveying– F.Winniberg
4. U.M.S. Vol.-III & Extra Lesions.



Geology for Mining Engineer

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1105	Geology for Mining Engineer	2-2-0	

Course Objectives:

- *Introduction of basic concepts of geology
- *Prioritize the understanding of geological issues related to the mining industry.
- *Enhancing the knowledge on mineral characterization

Course Outcomes:

- ***CO1:** Explain the physical and chemical properties of minerals, classification of minerals and identification of different types of rocks.
- ***CO2:** Explain the Concepts of palaeontology, Principles of stratigraphy, coal belts and oil fields of India and Introduction and scope of economic geology.
- ***CO3:** Concept the Mineral Exploration, Classification and origin of coal, characteristics of Indian coals.
- ***CO4 :** Interpret geotechnical and hydrogeological conditions for safe and efficient mine design.
- ***CO5:** Integrate geological knowledge with mining technologies for sustainable resource extraction.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1													
CO2				1	1		1								
CO3	1		1			2									
CO4		3		2											
CO5	3		1				2								

COURSE CONTENT

MODULE I

Mineralogy

Minerals: Physical and chemical properties; Crystal, crystal classes and systems; Classification of minerals

PRACTICE:

Identification of rock forming minerals in hand specimens(Part-I)

Identification of rock forming minerals in hand specimens(Part-II)

Igneous Rocks:

Magma and lava, extrusive and intrusive forms, textures; Classification of igneous rocks.

PRACTICE:

Megascopic identification of igneous rocks-granite,pegmatite,basalt,gabbro,diorite.

Sedimentary rocks:

Sedimentation processes; Classification of sedimentary rocks

PRACTICE:

Megascopic identification of sedimentary rocks- sandstone, limestone, conglomerate, breccia, bituminous coal.

Metamorphic rocks:

Processes of metamorphism, textures and structures of metamorphic rocks.

PRACTICE:

Megascopic identification of metamorphic rocks- marble, gneiss, schist, quartzite, anthracite coal.

Concepts of paleontology:

Fossils, their mode of preservation and significance as indices of age and climate; Concept of index fossils.

Principles of stratigraphy:

Broad stratigraphic subdivisions and associated rock types of important ore provinces, coal belts and oil fields of India.

MODULE II

Structural geology

Unconformities, folds, faults and joints - their nomenclature, classification and recognition. Effects of folds and fractures on strata/orebodies and their importance in mining operations.

Forms of igneous intrusions - dyke, sill and batholith.

PRACTICE:

Determination of Dip and Strike of bed using Brunton or Clino Compass.

MODULE III

Introduction and scope of economic geology

Ore and gangue; Processes of ore formation; Major Indian mineral deposits (Iron, Manganese, Copper, Lead, Zinc) distribution and mode of occurrence.

Mineral Exploration

Concepts and methods viz. surface and subsurface; Exploration strategy and design; Stages of exploration; Resource and reserves.

MODULE IV

Coal and Petroleum Geology

Rank, characteristics and important constituents of coal; Classification and origin of coal; Chief characteristics of Indian coals;

Geology of the principal coalfields of India.

Concept of organic constituents of petroleum origin, migration, accumulation, concept of traps and important petroliferous basins of India.

REFERENCES:

1. Structural Geology -M.P.Billings
2. Economic Geology – U. Prasad
3. Exploration Geology – Exploration and mining geology – W.C.Peters
4. Coal and petroleum geology – elements of petroleum geology – R.C.Shelly and S.A.Sonnenberg
5. Rutley's elements of mineralogy Petrology – Tyrrell
6. Textbook of paleontology – M.S. Chatwal



Mines Environment and Hazards

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1107	Mines Environment and Hazards	2-1-0	

Course Objectives:

- *Students will be able to understand the environmental factors that concerns with the mines.
- * Students will have an understanding on mine Gas.
- *Students will have an understanding on the mine’s hazards, airborne respirable dust and illumination survey.

Course Outcomes:

- * **CO1:** Understand the physical and chemical characteristics of mine environments and their impact on safety.
- ***CO2:** Identify various mining hazards including gas emissions, dust, noise, and heat stress.
- ***CO3:** Analyze ventilation systems and their role in mitigating underground risks.
- ***CO4:** Apply safety protocols and emergency response strategies in hazardous mining conditions.
- ***CO5:** Evaluate environmental regulations and sustainable practices in mining operations.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1				1	2								
CO2				1	1										
CO3	2	2						1							
CO4			2			1									
CO5	3				1		2								

COURSE CONTENT

Module I Mine air (6 hrs)

Atmospheric air composition, mine air composition and comparison, Mine gases-origin, occurrence, physiological effects, detection, monitoring and control. Methane layering, degasification of coal seams, production, assessment, physiological effects and control.

Practice:

Determination of CO, CH₄, H₂S, SO₂, O₂, CO₂, Nitrous fumes by corresponding detectors.
Detection of methane by different types of methanometer & flame safety lamp.

Module II: Mine climate (6hrs)

Sources of heat in mines, effects of heat and humidity in mines, testing methods and devices: psychrometry, kata thermometer, control methods or improving of cooling power of mine air: Air conditioning basic vapor cycle, representative layout.

Module III Mine Explosions (6 hrs)

Explosions: Types, mechanism, ignition temperature, lag on ignition, Causes and preventive measures of underground explosions (Fire damp and coal dust explosions) causes and preventive measures. Stone dusting, stone dust and water barriers, investigation after explosion.
Case studies related to the Indian mines.

Module -IV: Spontaneous Heating (6hrs)

Spontaneous heating: Mechanism, factors governing spontaneous heating, stages of spontaneous heating, symptoms of spontaneous heating in underground mines, detection and prevention of Spontaneous heating, interpretation of mine air samples, Graham's index, and problems on Graham's index. Incubation period

Practice:

Detection of different gases by Gas – Chromatograph.

Module V: Mine Inundation (6hrs)

Causes of inundation by surface and underground water by opencast and underground mines, Design and construction of Boundary barriers, Panel barriers, and Water dams.

Case studies related to the Indian mines.

Module VI: Airborne respirable dust (6hrs)

Generation, dispersion, measurement, and control; physiological effects of dust, dust-related diseases.

Module VII: Rescue & Recovery

Rescue & Recovery and its Scope. Rescue organization, Rescue stations, Rescue teams Selection Initial & refresher training. Rescue apparatus self-contained portable breathing apparatus, Gasmasks, Smoke helmets, Self-Rescuers, Reviving apparatus with actual rescue operations

Textbooks:

1. Elements of Mining Technology Vol 2, Deshmukh DJ, Denett& Company.
2. Mine Environmental Engineering, Volume I MritunjoySengupta, CRC Press

Reference Books

1. Environmental Engineering in Mines R. D. Lama, Cambridge University Press.
2. Mine Environmental Engineering H Rabia, British Library.
3. **Shortnotes**on Mine explosions from NIOSH
<https://www.cdc.gov/niosh/mining/features/coalmineexplosion.html>
4. [/https://www.sciencedirect.com/science/article/pii/B9780081004579000213%20%20%20pgno%20352](https://www.sciencedirect.com/science/article/pii/B9780081004579000213%20%20%20pgno%20352)



Mine Ventilation

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1116	Mine Ventilation	2-1-0	

Course Objectives:

- Understand the concept of ventilation in Underground mine
- Understand different types of ventilation system in Underground mine
- Practical knowledge on different equipment's used for calculation and implementation in Underground mine.
- To understand different aspects of ventilation survey and ventilation planning in Underground mine.

Course Outcomes:

***CO1:** Assess and manage mine air quality by identifying and monitoring hazardous gases, dust, heat, and humidity.

***CO2:** Apply fluid dynamics principles to analyze, design, and optimize complex mine ventilation circuits.

***CO3:** Select and operate ventilation equipment, including primary, booster, and auxiliary fans, and various control devices (stoppings, regulators, doors).

***CO4:** Conduct practical ventilation surveys (quantity, pressure, and quality) using specialized instruments and interpret the collected data.

***CO5:** Ensure regulatory compliance with relevant health and safety legislation and develop effective emergency response plans.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1				2	1								
CO2	2		1		1										
CO3		1			1										
CO4			3				3								
CO5	2		3		1										

COURSE CONTENT

Module I: (5 Hrs)

Ventilation:

Necessity of ventilation, different ventilation systems, principles on different basis and its related calculations, factors effecting selection ventilation system, mechanism of airflow through mine openings.

Laws of air flow, resistance of airways, equivalent orifice, Distribution of air flow and control devices. Natural ventilation calculation of NVP, thermodynamic aspects, artificial aids to natural ventilation

Module II: (4 Hrs)

Mechanical ventilation: different types of mine fans installation, operation details, applicability, limitations, efficiencies and characteristic, factors for effecting selection of mine fan, testing and output control of fans, operation of mine fans (Series and parallel).

Fan laws, drives, Evasee, diffusers, booster fans, auxiliary ventilation. Reversal of air currents and controlled recirculation.

Module III

Ventilation planning and design:

ventilation survey both quantity and pressure and related calculations. Mine ventilation design criteria and factors, Accessional, declensional, homotropical, anti – tropical ventilation plan. Central and boundary ventilation systems – layouts and comparisons.

Standard of ventilation including permissible air velocities.

Module IV:

Ventilation survey:

Importance of ventilation survey, types: - qualitative surveying, pressure survey and quantity survey. Simple problems.

Module V:

Elements of Ventilation Planning:

Objective, steps in ventilation planning, desirable features of a ventilation system, types of ventilation system, quantity requirement, analysis of ventilation cost.

Textbooks:

1. Techno Publication, Nagpur, 1998.
2. Mine Environment and Ventilation – G.B. Mishra, Oxford University Press, 1994.

Reference BOOKS:

1. Mine ventilation and air conditioning – Howard L. Hartman. Wiley International, 1976.
2. Environmental Engineering in Mines – Vutukuri & Lama, Cambridge University Press, Cambridge, 1992. Legislation in Indian mines a critical appraisal Vol. I and Vol. II – Prasad and Rakesh. Vivek Publications, Varanasi 1999.
3. Mine Ventilation Vol. – II, S. Ghatak, Coalfield Publishers, 1993.
4. Numerical Problems on Mine Ventilation, L.C. Kaku, Lovely Prakashan, Dhanbad



Drilling and Blasting

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1111	Drilling and Blasting	2-0-1	

Course Objectives:

- Understand the different approaches to design a perfect blast design in surface and underground mines depending upon different geotechnical properties of rock and explosives
- Select a suitable method of working for exploitation of ore body economically and safely.
- Grasp process of mine production

Gain knowledge about the various technical and economical and safety issues to be considered in mine designing.

Course Outcomes:

***CO1:** Understand and comply with all safety regulations, procedures, and legal requirements for handling, transporting, and storing explosives.

***CO2:** Analyze geological conditions to design appropriate surface and underground blast patterns and predict outcomes like fragmentation and muck pile displacement.

***CO3:** Select the correct explosives, initiation systems, and drilling equipment for specific project requirements, considering both technical and economic feasibility.

***CO4:** Execute drilling operations and implement controlled blasting techniques to minimize adverse environmental effects, such as ground vibrations, air blast, and fly-rock.

***CO5:** Perform post-blast evaluations, troubleshoot issues, and maintain accurate documentation in compliance with industry standards and regulations

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1			3										
CO2	1			2			1	1							
CO3	1				1		1	1							
CO4			2												
CO5		3				2		1							

COURSE CONTENT

Module I: (5 Hrs)

Explosives and Initiating Systems:

Types of explosives, their composition and properties, classification; Selection of explosives; Manufacture, transport, storage and handling of explosives; Testing of explosives

PROJECT:

- 1.1 selection of explosive
- 1.2. storage and handling of explosives

Types of initiating systems:

Electrical Detonators, Detonating Fuse, Detonating Relays, NONEL, Electronic Detonators, Blasting accessories, exploders.

PROJECT:

- 1.3 Electronic detonator.

Module II: (4 Hrs)

Drilling:

Blasthole drills types, classification, applicability and limitations; Modern drill machines with safety features, Mechanics of drilling, performance parameters, drilling cost, compressed air requirement for hole cleaning; Selection of drilling systems, drilling errors, organization of drilling.

PROJECT:

1. Selection of drilling systems
 2. Estimation of performance of a drill machine
- Blasting:

Mechanics of rock fragmentation; Livingstone theory of crater formation; Factors affecting blasting, Blast design estimation of burden and spacing, estimation of charge requirement; Initiation patterns; Secondary blasting pop and plaster shooting; Problems associated with blasting, Ground vibration and air over pressure, Control blasting and Blast instrumentation

PROJECT:

1. Control blasting
2. Blast instrumentation

Module III:

Drilling & Blasting in Underground Mines(6 Hrs)

Coal mines: Drilling systems and their applicability, blasting off solid, different blasting cuts - wedge cut, drag cut, fan auto romantic cut, burn cut, pyramid cut, ring drilling, ring hole blasting, calculation of specific charge, specific drilling and detonator factor, initiation patterns.

PROJECT:

Drilling systems and their applicability for u/g coal mine.
Metal mines:

Drilling systems and their applicability, blast design for horizontal drivages, different blasting cuts, long hole blasting, vertical crater retreat blasting.

PROJECT:

Drilling systems and their applicability for u/g metal mine

Module IV:

Exploration Drilling:(6 Hrs)

Boring for exploration; Various types of exploratory drills and their applicability Auger, Cable tool, Odex, Core Drills; Core recovery: single and double tube core barrels, wire line core barrel; Storage of cores; Interpretation of borehole data.

Module V:

Drilling & Blasting in Surface Mines:

Drilling: Blasthole drills types, classification, applicability and limitations; Mechanics of drilling, performance parameters, drilling cost, compressed air requirement for hole cleaning; Selection of drilling systems, drilling errors, organization of drilling.

PROJECT:

1. Selection of drilling systems
2. Estimation of performance of a drill machine

Textbooks:

1. Explosive and blasting practices in mines By Dr. Sameer Das
2. Elements of mining technology By D.J.Deshmukh

Reference Books

1. Metalliferous mining methods By Y.P. Chacharkar.

Surface Mining

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1109	Surface Mining	2-0-1	

Course Objectives:

- Provide a detailed description of the proposed surface mining method and related equipment and support infrastructure.
- Design and evaluate materials handling and transport options.
- Conduct productivity analysis for the selected mining system.
- Identify and evaluate core risks in each mining method.
- Appraise mining systems with respect to safe, efficient, economic and environmentally and socially responsible operations.

Demonstrate awareness of major technological trends.

Course Outcomes:

***CO1:** Analyze and select suitable surface mining methods and design the associated layouts and infrastructure.

***CO2:** Plan and manage core operations, including drilling, blasting, excavation, and material handling systems.

***CO3:** Conduct productivity and cost analysis for selected mining systems and perform economic evaluation of projects.

***CO4:** Identify, evaluate, and mitigate safety, environmental, and social risks associated with surface mining operations, including pit slope stability and waste management.

***CO5:** Apply modern engineering tools and technologies to solve complex mining problems while adhering to professional ethics and principles of sustainable development.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2		1		1			1							
CO2	3		1		1		2								
CO3	1	1		1				3							
CO4			3		2										
CO5		1					3								

COURSE CONTENT

MODULE I

Introduction

Basic concepts, applicability, advantages and disadvantages, Surface mining terminology, Stripping ratio and Breakeven stripping ratio, its importance, Surface mining unit operations, Surface mining systems vis-à-vis equipment systems – classification, applicability, advantages and disadvantages, Role of surface mining in total mineral production.

PROJECT:

Role of surface mining in total mineral production

MODULE II

Opening of Deposits

Box cut – objective, types, parameters, methods; Factors affecting selection of box cut site, Production benches – formation, parameters and factors affecting their selection.

MODULE III

Mine Machinery (Ripper)

Types, classification, applicability and limitations; Method and cycle of operation, Estimation of output; Concept of rip ability,

PROJECT:

Estimation of output of ripper

Mine Machinery (Dozer)

Pusher dozer and push-pull operation, Applicability and limitations; Types and classification; Types of blade and corresponding merits and demerits; Method and cycle of operation

Mine Machinery (Shovel and Dumper)

Applicability and limitations of electric shovel, hydraulic excavators and dumpers, Cycle time and productivity calculation for shovel and dumper; Estimation for equipment (shovel, dumper and other

heavy earth moving machines) required for a given mine production, Method of work for subsurface bedded and massive deposits and for hilly massive deposits by shovel – dumper combination,

PROJECT:

Productivity calculation of shovel and dumper, Estimation for equipment required for a given mine production

Mine Machinery (Dragline)

Applicability and limitations, different modes of operation; Side cast diagram and calculation of reach; Cycle time and productivity calculation,

PROJECT:

Productivity calculation of Dragline

Mine Machinery (Bucket wheel excavator)

Operations, applicability and cycle time and productivity calculation

PROJECT:

Productivity calculation of Bucket wheel excavator.

Mine Machinery (Surface Miner)

Surface miner: Applicability and limitations, method and cycle operation,

Mine Machinery (Front end-loaders)

Front end-loaders: Applicability and limitations; Method and cycle of operation.

Material transportation

Conveyor belt: applicability and limitations, Aerial rope ways: applicability and limitations, Stacker and spreader: applicability and limitations, Reclaimer: applicability and limitations.

MODULE IV

Dimensional Stone Mining and High-wall Mining

Types, occurrences and uses; Methods vis-à-vis equipment for extraction of primary blocks in granite and marble quarries.

High-wall Mining

PROJECT:

Methods vis-à-vis equipment for extraction of primary blocks in granite and marble quarries.

Slope Stability

Types of mine slope – high wall and waste dumps; Common modes of slope failure; Factors influencing stability of slopes, Waste dumps - types and formation methods; Slope protection.

pit-slope and dump designs and management and monitoring of pit-slope & dump slopes.

Dump-slopes.

PROJECT:

Slope protection

MODULE V

Environmental Impacts

Relevant provisions of coal mines and metalliferous mines regulation; Environmental problems due to surface mining and their remedial measures. Recent developments in the deployment of heavy earth moving machineries in the surface mines.

PROJECT:

Environmental problems due to surface mining and their remedial measures
Recent developments in the deployment of heavy earth moving machineries in the surface mines.

REFERENCES

1. Surface mining technology by Sameer Ku. Das
2. Elements of mining technology by D.J. Deshmukh
3. Surface mining technology by T.N. Singh
4. SME Mining Engineering Handbook / edited by Peter Darling, 2011. Society for Mining, 5.
5. Metallurgy, and Exploration (U.S.) ISBN 978-0-87335-264-2.
6. Kennedy, B. A., Editor, 1990. Surface Mining, 2nd edition, Society for Mining, Metallurgy, and Exploration, Littleton, Colorado. ISBN 0-87335-102-9



Rock Mechanics

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1106	Rock Mechanics	2-1-0	

Course Objectives:

- Develop an understanding of the engineering properties of rocks, geological and engineering rock classifications
- Understand rock failure theories
- Learn about in-situ stresses in rock

Know about the fundamental concepts and principles of rock mechanics.

Course Outcomes:

***CO1:** Explain the fundamental physical and mechanical properties of intact rocks and rock masses.

***CO2:** Analyze the stress distribution in rock strata, both in situ and induced by engineering activities, including failure mechanisms.

***CO3:** Evaluate and apply various laboratory and field testing methods to determine relevant rock properties for engineering design.

***CO4:** Design safe and stable civil and mining structures, such as slopes, foundations, and underground openings (tunnels, caverns).

***CO5:** Select appropriate ground control and reinforcement techniques (e.g., rock bolts, shotcrete) to ensure the long-term stability of rock excavations.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2			1		1		3							
CO2	2		2	1											
CO3	2					1	1								
CO4		3		2				2							
CO5	3		2			1		1							



COURSE CONTENT

Module I

Definition, history, source of information and field of application of rock mechanics. Concept of stress and strain in rock Analysis of stress, strain and constitutive relations in isotropic an anisotropic rock.

Module II

Physico-mechanical properties of rock(8 HOURS):

Physical Properties: Density, unit weight and specific gravity, Moisture, content, degree of saturation, Porosity, Void ratio, Permeability, Velocity of elastic waves, Electrical resistivity.

Thermal properties, Durability

PRACTICE:

Determination of rock density and unit weigh Mechanical Properties:

Uniaxial compressive strength, Tensile strength, Point load strength, Triaxial strength, Direct shear Strength.

Rock strength and failure mode

PRACTICE:

Estimation of unconfined compressive and tensile strength

MODULE II

Dynamic properties of rock and rock mass (3 HOURS):

Propagation of elastic wave in rock media; Determination of dynamic strength and elastic constants of rock.

Time dependent properties of rocky (4 HOURS)

Creep deformation and strength behavior; Creep test and rheological models.

Strength and Deformability of Rock Mass: In situ shear tests; Evaluation of shear strength; In situ bearing strength test; In situ deformability tests-Plate Loading Test, Plate Jacking Test and Borehole Jack Tests

MODULE III

Failure criteria for rock and rock mass (4 HOURS):

Theories of rock failure; Coulomb, Mohr and Griffith criteria; Empirical criteria.



Rock mass classification (5 HOURS)

Introduction, TERZAGHI'S rock mass classification, Rock quality designation (RQD), Classification based on UCS, Geomechanics classification, Tunnelling quality index (Q), Rock structure rating (RSR).

The geological strength index (GSI), Rock mass classification in support design.

MODULE IV

Pre-mining state of stress (1 HOUR):

Sources, methods of determination including over coring, hydro-fracturing methods and other methods.

Pillar stability, instrumentation for rock mass movement monitoring system.

Stresses around underground openings (4 HOURS)

Introduction, Stress around the underground openings.

Rock slope stability(5 HOURS)

Introduction- failure modes, plain failure, wedge failure, circular failure, toppling failure

Rock slope stabilization.

REFERENCES

- 1.Fundamentals and applications of rock mechanics By Debashis Deb
- 2.Elements of mining technology By D.J.Deshmukh



Underground Coal mining

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1108	Underground Coal mining	2-0-1	

Course Objectives:

*Understand the fundamental concepts and various methods of underground coal mining, including bord and pillar and longwall mining.

*Gain knowledge of essential auxiliary operations such as ground control, roof support, ventilation, and material transport systems.

*Learn and adhere to all relevant statutory provisions and safety regulations to ensure a healthy and safe working environment.

*Be able to select appropriate mining and stowing methods based on specific site conditions and design efficient mine layouts.

Course Outcomes:

***CO1:** Explain different mining methods such as board and pillar and longwall, including their applicability, merits, and demerits.

***CO2:** Design and implement support systems to ensure ground control and maintain stability within mine workings.

***CO3:** Plan and manage essential services including mine ventilation, transportation, and water handling systems.

***CO4:** Describe and implement safe working procedures, understanding statutory provisions and risk management processes to ensure a safe working environment.

***CO5:** Analyze and select suitable coal extraction methods based on site-specific geological conditions and economic considerations.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2		1			2									
CO2	3				1		3								
CO3	1	2		1			1								
CO4		1			2										
CO5	2		3				2								

COURSE CONTENT

Module I

Bord and Pillar Mining:

Choice of methods of mining coal seams; factors affecting choice of mining methods.

General principles of Bord and Pillar (B&P) development, different schemes of development and associated merits/demerits; Design of B&P workings, statutory provisions related to B&P workings, Semi-mechanized and mechanized schemes of B&P development; Mechanized face loading. Conditions suitable for mechanical loaders and continuous miners.

Module II

Pillar Extraction:

Preparatory arrangement for depillaring operation, statutory provisions on depillaring; principles of designing pillar extraction, factors affecting choice of pillar extraction; partial and full extraction; depillaring with caving and stowing; mechanization in depillaring operation. Local and main fall, indications of roof weighting, measures to bring down roof at regular interval; air blast and measures to minimize its effects; precautions during depillaring operation against fire and inundation; multi-section and contiguous workings. Extraction of pillars in seams prone to bumps.

Case studies related to- Indian coal mines.

Module III

Longwall Mining:

Factors affecting longwall mining, longwall face layouts, advancing and retreating faces, single versus double unit longwall faces, orientation of longwall faces; single versus multiple heading gate roads, factors affecting length and width of longwall panel. Extraction of Longwall panel, working with shearer and plough, support system of longwall face and gate roads, monolithic packing in longwall advancing gate roads; case studies of longwall faces in India.

Case studies related to- Indian coal mines.

Module IV

Thick seam mining:

Board and pillar and long wall mining in multi section, multi slice method, incline slicing, horizontal slicing and cross slicing in ascending and descending order, under winning method, sub level caving, integral caving – horizontal slicing with caving / stowing – blasting gallery. Method – sub level caving with mechanizes long wall. horizon mining – merit – demerit – application & limitation. Modern method – applicable condition of plough, method of working by plough, unidirectional ploughing method, bi – directional ploughing method over passing hydraulic mining merit & demerit applicable condition of underground gasification of coal merit, demerit of gasification of coal, method of extraction of gasification & contiguous seam.

Case studies related to- Indian coal mines.

Module V

Roof Supports:

Timber props and cogs; friction/hydraulic props and chocks; other steel supports; types of roof bolts; function, applicability and advantage of roof bolting and cable bolting; powered supports; systematic support rules; supporting scheme of development gallery, B&P and L/W faces, depillaring district; withdrawal of support. Conditions requiring stowing in mines; types of stowing; suitable materials for hydraulic stowing; stowing plant and stowing range; hydraulic gradient and hydraulic profile.

Text book

1. Element of mining: D.J Deshmukh vol 1, Bennet & Co. Nagpur
2. Winning and working coal: R.T Deshmukh & D.J Deshmukh vol 1 & 2
3. Long wall mining: Smair Kumar Das, Lovely Prakashan Dhanbad
4. Modern coal mining technology: Lovely Prakashan Dhanbad, Smair Kumar Das
5. Principles & practices of coal mining: R.D. Singh, New Age Intl. Pvt.Ltd, New Delhi

Underground Metal mining

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1110	Underground Metal mining	2-0-1	

Course Objectives:

To make the students have understanding on:

- Concept on underground metal mining
- Concept on development
- Stopping

Mine support

Course Outcomes:

***CO1:** Students learn to describe and design various methods for accessing an ore body, including adits, inclines, and shafts.

***CO2:** Graduates can classify, select, and supervise appropriate stopping methods (e.g., open, supported, caving) based on geological conditions and economic factors.

***CO3:** The course outcomes ensure proficiency in planning and implementing necessary infrastructure, including ground support systems (rock bolts, pillars), ventilation, and material transport.

***CO4:** Students are able to identify, explain, and apply relevant safety protocols, manage hazards like rock bursts, and adhere to statutory mining regulations.

***CO5:** Participants gain knowledge of different mining machinery, mechanization processes, and the ability to integrate modern technologies for efficient and safe operations.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1			3		1								
CO2				1	1		3								
CO3	1	2	1					2							
CO4		3			1		3								
CO5	2			2				2							

COURSE CONTENT

Module I

Introduction:

Present status of Indian metal mining industry; Scope and limitations of underground mining.

Module II

Development:

Choice of level interval and back/block length; Shape, size, position, excavation and equipping of shaft station/plat, grizzly, ore/waste bin, main ore pass system, underground crushing and loading stations, underground chambers, sump and other subsidiary excavations; Arrangements for dumping into main ore pass; Underground crushing, loading and hoisting.

Cross cuts and drifts, their shape, size and position, review of excavation process, ground breaking, mucking, ventilation and support, track extension and car switching, Use of modern drilling and loading equipment in drifting, raises and winzes, their shape, size and position, excavation process, ground breaking, mucking, ventilation and support;

Modern methods of raising – Alimak and Jora-lift raising, long hole method including vertical crater retreat method of raising; raise boring, systems and their details, modern methods of winzing, secondary breaking at grizzly, conventional and mechanized methods, waste handling systems in underground workings.

Module III

Stopping:

Selection of stoping methods; Classification of stoping methods; Stopping of narrow ore bodies by underhand, overhand, breast, longhole and raise mining methods; Resuing; Mining of parallel veins; Room & pillar, sublevel, large diameter blast hole/DTH, cascade, shrinkage and vertical crater retreat methods, their applicability, stope layouts, stope preparation, ground breaking, mucking, ventilation and supporting.

Haulage and dumping; Supported methods – horizontal overhand and underhand cutand-fill methods, square-set method and its variations, details of stope layouts, ground breaking, supporting, mucking, ventilation, haulage and dumping.

Module IV

Mine supports:

Timber support: Post, drift-set of various types, square-set, crib-set, cog, stull and chock/chock mat supports; fore poling/piling; load bearing capacity of timber supports; bulkheads, steel support: steel set, rigid and yielding types, tubbing, wire mesh, steel lining, screw jacks and ratchet jacks; improvised steel props, friction props, hydraulic props; link bars and chocks, powered supports.

Cement support:

Poured monolithic and reinforced concrete lining; monolithic pump packing, concrete blocks, concrete slabs, geniting and shotcreting. Rock support: Pillars of ore and waste, pack walls, masonry, walls and arches, building materials and construction, fill support: materials of backfill and their procurement;

Theoretical aspects of slurry transportation; preparation, transport and placement of hydraulic backfill with and without cement; Paste fills; rock and concrete fills; surface arrangement for storage and mixing; pneumatic and mechanical methods of backfilling.

Reinforcement systems:

Materials and techniques; rock bolts and dowels – different types and uses; mechanics of bolting; point anchored rock bolts – Slot and wedge type, expansion shell type, grouted point anchor type.

Text Books/References

1. Howard, L.Hartman. Introductory Mining Engineering, Pub: John Willey & Sons.
2. Cummins & Givens. SME Mining Engineering Handbook, Vol. I & II, Pub: A.I.M.M. New-York.
3. Ramlu et al, Computer in mineral industry. Pub: Oxford & IBH, New-Delhi.
4. W.A. Hustrulid. Underground mining methods handbook, Pub: Society of mining engineers of the American Institute of Mining Metallurgical and Petroleum Engineers, Inc. New-York.

Mine Economics

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1113	Mine Economics	2-0-0	

Course Objectives:

- Exposure to National Mineral policy, pricing Exports and imports.
- Fundamental principles of Mine economics
- Estimation of reserves, classification of reserves, tenor, grade etc.

Mine Valuation, factors affecting mine evaluation.

Course Outcomes:

***CO1:** Students can evaluate the economic viability and profitability of mineral properties and mining projects using techniques like discounted cash flow (DCF) analysis and net present value (NPV).

***CO2:** Students are able to estimate and manage both capital and operating costs associated with various stages of mining operations.

***CO3:** Graduates can calculate and classify mineral reserves and resources, and understand the importance of sampling and grade determination in an economic context.

***CO4:** The course enables students to analyze and mitigate risks related to fluctuating commodity prices, as well as comprehend national and international mineral policies and their economic implications.

***CO5:** Students learn to integrate economic principles with environmental, social, and safety considerations, including mine closure planning and sustainable development practices.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1		2		1		2							
CO2		3		1	1		3								
CO3	1		1		1			3							
CO4		3		3			3								
CO5		1		2		2		1							



Module I: (6hrs)

Introduction: Role of mining and mineral industry in national economy, special features of mineral industry, essential and strategic minerals of India and their economic significance.

Module: II

National Mineral Policy: Appraisal of Mineral Resources, Pricing policy, Exports and Imports, taxation and subsidies, conservation of Minerals.

Module: III

Time Value of Money: Value at constant point, discontinued cash flow analysis, discount factors (risk and uncertainty), inflation.

Module IV

Capital and Operating Cost:

Machine Life and Operating Cost first principal cost modeling.

Module V

Cost Effective Mining Scheme:

Systematic planning process and economic data at each phase of Mining cycle.

Text Books:

1. Mine and Mineral Economics -Subash C.Ray, Indra N Sinha.



Mineral Dressing

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1115	Mineral Dressing	2-0-0	

Course Objective:

- Exposure to various aspects of beneficiation of ores and industrial minerals for value addition.
- To introduce mineral processing characteristics of minerals.
- To introduce Concentrations, Physico-chemical principles.
- To introduce Flowsheets for the beneficiation of various minerals.

Course Outcomes:

***CO1:** Students learn the basic characteristics of minerals and the physico-chemical principles behind their separation.

***CO2:** Graduates can explain and apply core mineral processing techniques, including comminution (crushing and grinding), sizing (screening and classification), and dewatering.

***CO3:** The course enables the selection and operation of various separation technologies, such as gravity separation, magnetic separation, and froth flotation.

***CO4:** Students gain the ability to develop practical beneficiation process flow sheets for upgrading low-grade ores and industrial minerals.

***CO5:** The curriculum ensures an understanding of how mineral dressing reduces processing costs and minimises waste, thereby improving the economic and environmental efficiency of mining operations.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1		2			1								
CO2		2		1	1		1	22							
CO3	2		3	2		3									
CO4				2											
CO5		2		1		3		3							



COURSE CONTENT

MODULE I

Introduction

Scope, objectives, and limitations of mineral processing, liberation, and beneficiation characteristics of minerals and coal.

MODULE II

Comminution and Classification

Comminution: Theory and practices of crushing and grinding.

Liberation- importance, and determination of liberation size, Crushing fundamentals, construction, and operational features of primary and secondary crushers, Jaw, Gyratory, cone, and roll crushers. Grinding-theory and practice.

Ball & Rod Mills construction, and operation.

MODULE III

Unit operations

Study on mineral concentration technologies including, magnetic and electrostatic separation, gravity separation, and flotation.

Studies on industrial practices on gravity concentration methods (Jigging, heavy media separation, flowing film concentrator's theory, application and limitations), magnetic separators, electrostatic separators.

MODULE IV

Metallurgical Accounting

Sampling, Definition, objectives, different types of sampling methods. Hand sampling, mechanical and electrical sampling.

Study on dewatering and drying in industrial perspective.

Project: Flow-sheet development on iron beneficiation and coal preparation

MOUDLE V

Fuel technology

Wood, peat, lignite, coal, anthracite; proximate and ultimate analyses.

Coal characteristics for different industrial uses; characteristics of Indian coals; caking and coking properties; low and high temperature carbonization.

References

1. Introduction to Mineral Processing – V. MalleswarRao
2. Mineral Processing – B A Wills
3. Ore Deposits of India – Their distribution and processing. Rao, T C and Gokhale, KVG.

Mine Electrical Technology

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1912	Mine Electrical Technology	2-1-0	

Course Objectives:

*Provide knowledge on the planning, distribution, and control of electrical power in both surface and underground mines.

*Ensure awareness of specific electrical hazards, such as the need for flameproof enclosures and intrinsic safety apparatus, to reinforce safety concepts and comply with regulations like those from DGMS (Directorate General of Mines Safety).

*Develop skills for selecting, operating, and maintaining various types of mining electrical equipment, including transformers, switchgear (gate end boxes, drill panels), motors, generators, and communication systems.

*Cover practical applications like earthing practices, cable selection, electrical braking systems, and the principles of basic electronics as they apply to a mining environment.

Course Outcomes:

***CO1:** Students will understand the principles of electrical power supply, transmission, and distribution systems specific to surface and underground mines.

***CO2:** Graduates will be able to identify and select appropriate electrical equipment, such as motors, switchgears, and cables, considering safety features and operational requirements.

***CO3:** Students will learn to implement and maintain safety standards, including earthing practices, flameproof enclosures, and intrinsic safety apparatus, in compliance with relevant electrical rules and regulations.

***CO4:** Learners will develop the ability to draw and analyze single-line diagrams of mine power distribution systems and troubleshoot common electrical engineering problems in the field.

***CO5:** The course prepares individuals to work effectively as an electrical engineer or technician in a multidisciplinary mining team, managing projects and ensuring reliable and safe power supply.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1					1								
CO2				1	1			3							
CO3	1		1			1	1								
CO4				3											
CO5	2		2			2		1							



COURSE CONTENT

MODULE I

Introduction (6hrs.)

Scope and importance of electrical engineering in mining, Role of electrical engineer in mining. Indian Electricity Rules Applicable to Mining.

MODULE II

Electrical cables for Mining use(6hrs.)

Classify cables for mining use. Constructional features of high tension and low-tension cables armored & trailing cables. State size of cables & their use. State procedures of cable laying at surface, underground roadway & in shafts. Describe cable joint box mining type.

Practice:

Identify the different part of given cable and find fault on the cable.

MODULE III

Protective Systems (6hrs.)

Fuses: Fuses, Rewireable Fuses and HRC Fuse, Circuit Breakers: Minimum Oil Circuit Breaker, Vacuum Circuit Breaker, SF6 circuit breaker. Essential qualities of good protective system. Relays: Types of Relays, Latching relay, frequency relay, overload relay.

Practice:

Study of Relays: Buccoz relay and Overcurrent relay.

MODULE IV

Typical Power equipment in mines (6hrs)

Power distribution in mines, Surface and Underground power distribution in mines, Main Lighting equipment, Surface auxiliaries, Fundamentals of Transformers (without numerical)

MOUDLE V

Mine Communication (6hrs)

Principles of underground signaling systems, Wire system communication, Wireless communication system -RFID, Trapped Miner communication, Shaft Communication system. Use of Megger check the continuity of windings, body to winding, body to earth of an 3-Phase induction Motor.

Module VI

Miscellaneous topics (6hrs)

Electrical Braking system, Intrinsic safe apparatus and Flame Proof apparatus. Electrical drives, advantages of electric drives.

Text Books

1. Basic Electrical Technology by BL Therija
2. Electrical Engineering in Mines by Nil K Dutta

References

1. Mine Power Systems Vol 1 Lloyd A. Morley



Mine Legislation and general safety I

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1114	Mine Legislation and general safety I	3-0-0	

Course Objectives:

- Describe various aspects of Mines Act 1952.
- Describe various aspects of Mines Rule 1955.
- Describe various aspects of Coal Mines Regulations 1957.

Describe various aspects of mine safety.

Course Outcomes:

***CO1:** Understand and apply the provisions of key legislation like the Mines Act, 1952, and associated rules and regulations (e.g., CMR 2017, MMR 1961).

***CO2:** Recognize inherent mining dangers, conduct hazard identification and risk assessment (HIRA), and implement effective control measures and a Safety Management Plan (SMP).

***CO3:** Formulate and follow Standard Operating Procedures (SOPs), ensure proper ventilation, lighting, personal protective equipment (PPE) usage, and establish safety committees to prevent accidents.

***CO4:** Understand the legal requirements for health, sanitation, medical facilities, working hours, and leave with wages for mine workers.

***CO5:** Develop comprehensive emergency response plans (ERP), including fire prevention, rescue operations, and investigation procedures for accidents and dangerous occurrences.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1				3		2							
CO2				1	1										
CO3	1		1		1		1	1							
CO4				2				1							
CO5	2		1				2								

COURSE CONTENT

Module I:

Mines Act 1952:

Meaning of the terms, Mine Act, Regulations, Rules, Bye-laws, standing order and situations under which act does not apply. Provisions of Mines Act in respect of Drinking water health and hygiene conservancy, Medical Appliances, Hour and limitations of Employment – Leave with wages.

Module II:

Mines Rules 1955:

Mine Rules related to drinking water, lavatories, urinals with on surface and in underground first aid, - Ambulance, Hours, and limitations of Employment - leave with wages with wages and over time.



Module III:

Coal Mines and Metalliferous Mines Regulations:

Important definitions, regulations related to notice of accidents duties of managers, Asst/under Managers, Overman, foreman and surveyor, Mine plans and sections. Means of Access and egress ladder and Ladder ways under M.M.R.

Transport of men and material by Haulage mine.

Working precautions against dangers from gas and water Mine ventilation, mine lighting and safety equipment and types of fences (Miscellaneous).

Module IV:

Safety Aspects in Mines:

Accident's classification and analysis-safe condition- unsafe condition- mine safety- safety objectives- major factors to be considered for safety - safety week- pit safety committee safety organization and safety policy.

Mine Legislation and general safety II

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1911	Mine Legislation and general safety II	3-0-0	NIL

Course Objective:

- To give comprehensive knowledge on Mine Rescue RULES, MCR and MMDR act.
- To give knowledge on Mines VT rules 1966 and CEAR.

To give concepts and discussions on risk assessment and safety management plan

Course Outcomes:

CO1: Explain various provisions of Metalliferous Mines Rescue rule, VT rules 1966.

CO2: Understand about the Risk assessment and safety management plan.

CO3: Explain different types Mineral conservation, development rules and Central Electricity Authority Regulations, 2010.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1				3		3							
CO2				1	1										
CO3	1		1		1	1	1								
CO4	2				4		2								
CO5			2			2		1							

COURSE CONTENT

Module I

The Mines Rescue Rules, 1985;

Module II

Mines Vocational Training Rules, 1966,

Module III

Central Electricity Authority Regulations, 2010

Module IV

Mineral Concession Rules, 1960, and Mineral conservation and Development Rules.

Module V

Risk Assessment & Safety Management Plan

Text books

1. Mine Act - 52 by B. K. Kejriwal
2. DGMS Circulars.



References

1. Mines Act, Mine regulations, Mine rules Govt. of India Publication
2. Legislation in Indian Mines - Critical Appraisal by Prasad.



Mine Management

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1909	Mine Management	2-0-0	

Course Objectives:

- Demonstrate an awareness of management theory and processes.
- Recognise the factors that motivate people's behaviour in the mine working environment.

Apply the principal performance measures used in mine management.

Course Outcomes:

***CO1:** Graduates can identify, analyze, and manage workplace risks and implement robust safety management systems in strict adherence to relevant mining laws and regulations.

***CO2:** Students learn to design efficient mine layouts, select appropriate equipment, plan production schedules, and manage the technical aspects of rock excavation and mineral processing.

***CO3:** The course outcomes cover understanding the environmental impact of mining activities and implementing mitigation, reclamation, and sustainable development plans.

***CO4:** Students acquire skills in managing human and material resources, project management principles, financial accounting, and cost estimation to ensure economically viable operations.

***CO5:** Graduates are prepared to function effectively as leaders or team members in multidisciplinary settings, utilizing strong communication and decision-making skills to guide human efforts toward common goals.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	1			1				1							
CO2		2		1	1		1								
CO3	1		1					3							
CO4			2		2		2								
CO5		3				2									

COURSE CONTENT

Module I

Brief History of Management:

Evolution of Management, traditional management, Scientific management, Contribution of pioneers to scientific management, Functions of management, Principles of Management. Mine management: Duties and responsibilities of mines manager.

Personal Management:

Functions of personnel management, recruitment and selection of employees. Education and training: mines vocational training center. Communication: formal and informal communication, barriers in communication and techniques to overcome barriers and improve communication.

Industrial Psychology and Human Relation:

Definition, scope of industrial psychology, aims of industrial psychology. Group Dynamics. Motivation: definition, characteristics of motivation, kinds of motivation, factors affecting motivation, motivational techniques.

Module II

Industrial Relations and Legislation:

Introduction, basic requirement of industrial –relation programme. Trade unions: definition, functions of trade unions. Industrial disputes: causes, settlement of industrial disputes, handling of workers' grievances. Workers participation in management, work of ILO. Necessity of labour legislation, principles of labour legislation. Important provisions of factories act, payment of wages act, Workmen's Compensation act, Employee state insurance Act.

Work Study:

Definition, productivity and work study, position of work study department in the organization, work study man, work study and the workers, work study and the management. Motion Study: Definition, aims of motion study, procedure for motion study.

Time Study:

Definition, uses of time study, procedure, performance rating number of cycles to be timed, allowances, uses of time study data for wage incentives. Standard Data: Advantages, Basic Motion Time Study.



Management Information System (MIS):

Introduction, Need for Information System, Characteristics of Good MIS, Sources of Information, application of MIS, design of MIS, development, Implementation of MIS.

TEXTBOOKS:

1. Mine Management, Legislation and General Safety, S. Ghatak, Coal Field Publishers, Asansol, 1999
2. Roy,P., Blasting in Underground excavations and mines, CMR Dhanbad, 1993.

Programming in Java

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1058	Programming in Java	2-1-0	

Course Objective:

- This course provides an introduction to object-oriented programming (OOP) using the Java programming language.
- Its main objective is to teach the basic concepts and techniques which form the object-oriented programming paradigm.
- Students completing the course should know:
- The model of object-oriented programming: abstract data types, encapsulation, inheritance and polymorphism
- Fundamental features of an object-oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
- How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.

How to test, document and prepare a professional looking package for each business project using Javadoc

Course Outcomes:

CO1: Will gain Knowledge on object-oriented java programming.

CO2: Identify and fix defects the common safety issues in code.

CO3: Read and make elementary modifications to Java programs that solve real-world problems.

CO4: Design and develop several applications with hands-on

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1			3	3		1							
CO2	2			1	1										
CO3	1		3			3		2							
CO4	1		2			3									
CO5															



COURSE CONTENT

Module I

Introduction: Basic Concept of Object Oriented Programming: Object & Class, Data Abstraction & Encapsulation, Inheritance, Polymorphism, Dynamic Binding and Message Communication. Evaluation of JAVA: features of JAVA. Java & Internet.

Assignment 1: Explain Basic Concept of Object Oriented Programming ?

MODULE II (5 HRS)

Java Environment: JDK, JRE, JAVA Programming
Structure, Implementing a JAVA Program. JVM, Constant Variable and Data type,

Command Line Argument.

Type Casting, Operator and Expression, Operator Precedence & Associativity.

Decision making and Branching,

Looping (While, do while, for).

Assignment 2: Explain JDK JRE and JVM ?

Practice:

1. Program using Command Line Argument
2. Programming with looping & Control structure



MODULE III (5 HRS)

Classes and Object: Defining a class, Creating Object, Constructor, MethodOverloading, Static Members, Inheritance, Method Overriding, Final Variable, final methods and Final Class, Garbage Collection & finalize () method.

Assignment 3: Explain Method Overloading Vs Method Overriding ?

Practice:

Programming with class and Object
Programming with Inheritance

MODULE IV (2 HRS)

Abstract Method and Class, Visibility Control.Array, String, Vectors, Wrapperclasses.

Assignment 4: Explain Abstract Method and Class ?

MODULE V (5 HRS)

Interfaces: Defining Interfaces, Extending Interfaces, Implementing Interfaces,

Packages: Creating & Accessing Packages.Exception Handling (try, catch, throw,throws, finally)

Assignment 5: Explain for Creating & Accessing Packages

Practice:

5. Programming with Package
6. Programming with Intefaces
7. Programming with Exception Handling

MODULE VI (3 HRS)

Multithreading: Creating Threads, Thread Life Cycle, Thread Priorities, Synchronization, Inter Thread Communication

Assignment 6: Explain Thread Life Cycle ?

Practice:

8. Programming with Thread

MODULE VII (5 HRS)

Applet Programming: Applet Life Cycle,
Write & Running Applet Program. Managing Input and Output file: Stream classes,

Byte Stream Classes & Character Stream Classes, Reading & Writing Files.

Assignment 7: Explain Applet Life Cycle ?

Practice:

9. Programming with Applet concept
10. Programming with the concept of File

Text Book:

1. Programming with JAVA by E. Balagurusamy Tata McGraw - Hill Education
2. Core Java for Beginners, RashmiKanta Das, 3rd Edition Vikas Publishing House PvtLtd.

Reference Book:

1. Java complete Reference, Herbert Schildt
2. Big Java: Horstman, Willey India, 2nd Edition.
3. Java How to Program: H.M. Deitel& Paul J. Deitel, PHI, 8th Edition



Database Management Systems

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1059	Database Management Systems	2-1-0	

Course Objectives:

- 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 Properties 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.

Course Outcomes:

***CO1:** Acquire the knowledge on different database implementation for various applications.

***CO2:** Solving different problems such as to convert the entity-relationship diagrams into relational tables, normalization and SQL queries.

***CO3:** Design database models and the entity-relationship diagrams of different databases using MySQL Workbench.

***CO4:** To develop an understanding of essential Properties of DBMS concepts such as: database security, integrity, concurrency

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1	2			1		2							
CO2				1	1			1							
CO3	1		1		1		3								
CO4			2		1			3							
CO5															

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

[CLICK HERE FOR 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

[CLICK HERE FOR TABLE](#)

BRANCH

[CLICK HERE FOR TABLE](#)

CUSTOMERS

[CLICK HERE FOR TABLE](#)

BORROW

[CLICK HERE FOR TABLE](#)

- (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 number 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_nemp_nameemp_salemp_commdept_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.

[CLICK HERE FOR TABLE](#)

Insert following values in the table deposit.

[CLICK HERE FOR TABLE](#)

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 karolbaghbranch
- (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 vrc
 - (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's 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**

VIRTUAL LAB

TEXT BOOKS

- 1.Database Management Systems: Raghu Ramakrishnan
- 2.ORACLE PL/SQL Programming – Scott Urman BPB Publications.

REFERENCES

- 1.Database Systems Concepts – Henry F Korth, Abraham Silberschatz.
- 2.Database Management Systems – Alexis Leon, Mathews Leon – Leon, Vikas Publications



Theories of Failure Analysis using FEA

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1062	Theories of Failure Analysis using FEA	2-2-0	

Course Objectives:

- To educate the students on basic theories behind mechanics of solids.
- To educate the students on Finite Element Analysis concept applicable to Practical conditions.
- To educate the students on Failure Criterion which will be useful for designing Practical problems.

To educate the students on using 3D Experience Tools for analysis of various mechanical structures and load transmitting elements.

Course Outcomes:

***CO1:** Understand fundamental theories of material failure for both ductile and brittle materials under various loading conditions.

***CO2:** Apply failure criteria (e.g., von Mises, Tresca, Mohr-Coulomb) to practical engineering problems using FEA software.

***CO3:** Analyze complex stress and strain states in mechanical components to predict load capacity and potential failure points.

***CO4:** Develop and validate FEA models for structural analysis, ensuring designs are safe and reliable based on material properties and industry standards.

***CO5:** Propose design solutions and improvements to prevent future failures, combining theoretical knowledge with practical simulation skills.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	2			1										
CO2		3		1	1			2							
CO3	1		1		3		2	3							
CO4	2		1			2									
CO5		1		2				3							

COURSE CONTENT

Module I

Introduction to Finite Element Analysis (FEA) and 3D Experience Platform - (4(T)+5(P)) –(9 Hours)

Introduction to FEA: Need for Studying FEA; Types of Analysis; Discretization of a Structure; Element Shapes, Nodes and Degrees of Freedom; Mesh Refining, Element Aspect Ratio, Use of Symmetry, Principle of Convergence; General Procedure of FEA.

Material failure Behaviour: Stress–Strain Diagrams for Ductile and Brittle Materials. Equivalent stresses for varying orientations, Principal stresses, maximum shear stress, Mohr's circles.

Practice:

1. Introduction to 3D Experience Platform: About the Apps and their Applications from Engineering Point of View.
2. Analysis of Steel Bridge – Simulation using 3D Experience Tool.
3. Tensile Test using Simulation 3D Experience Tool.
4. Stress Strain Curve of a Ductile Material (Mild Steel) using Universal Testing Machine

Module II

Mesh Generation and Modelling of Truss Structure (1(T)+ 4(P) - (5 Hours)

Mesh Generation and Methods of Meshing and Types of Meshing. Procedure for selecting the method of meshing and type of meshing.

Importance and application of Stiffness Matrix for different types of elements and the procedure forgetting the result.

Practice:

5. 3D Experience Simulia – Modelling and Meshing of Transmission line tower.

Module III

Stresses and Deflection Criteria: (5(T)+4(P)-(9Hours)

Procedure for Drawing Shear Force and Bending Moment Diagrams, Point of Contra Flexure.

Stresses (No Derivation): Simple or Pure Bending, Flexure Formula, Section Modulus, Neutral Axis, Determination of Bending Stresses, Shear Stress Distribution for Different Sections.

Deflection: Equation of Elastic Curve, Direct Integration Method

Practice:

6. 3D Experience Simulia – Modelling and Finite Element Analysis of Framed Structure subjected Earthquake Loads.

Module IV:

Theories of Failure: (2(T)+ 4(P) - (6 Hours)

Theories of Failure: Failure Under Biaxial Loading, Rankine's Theory, Guest's or Tresca's Theory, Von Mises Theory, Graphical Representation of Failure, Safety Factors, Prevention of Failure in Design Stage, Diagnosis of Failure In Post-Manufacturing Stage.

Practice:

7. 3D Experience Simulia: Bicycle Frame Structural Analysis

Module V:

Torsion: (3(T)+ 4(P) - (7 Hours)

Torsion: Torsion Equation, Design of Shafts, Power Transmitted by Shafts, Composite Shafts, Combined Bending and Torsion, Closed-Coiled Helical Springs, Spring Connected in Series and Parallel.

Dynamic Analysis: Fundamentals of Vibration; Evaluation of Natural Frequencies and Mode Shapes (Eigen values and Eigenvectors); Non-linear Analysis, Fatigue Analysis. Structures Subjected to Blast Loads.

Practice:

8. Simulation: Static and Dynamic Analysis of Shaft

Module VI

Pressure Vessels (1(T)+2(P)-(3Hours))

Longitudinal and Hoop Stress in Thin-walled Pressure Vessels Subjected to Internal Pressure.

Practice:

9. Simulation: Crack Analysis of Thin-walled Pressure Vessels.

Module VII

Fatigue and Fracture: (3(T)+ 4(P) - (7 Hours))

Fatigue: Failure Under Cyclic Loading, Endurance Limit. S-N Curve, Stress Concentration, Goodman and Soderberg Criteria.

Fracture: Types of Failure, Brittle and Ductile Fracture, Basic Modes of Fracture. Griffith's Analysis, Crack Growth and Stress Intensity Factor.

10. Fatigue Analysis of Crankshaft of Two-Wheeler

Text Books:

1. Strength of Materials, S.S. Rattan, Tata Mc-Graw Hill Publication.
2. Advanced Mechanics of Materials, A.P. Boresi and R.J. Schmidt, Willey India

Reference Books:

1. Elements of Fracture mechanics, Prashant Kumar, McGraw Hill Education (India)
2. Engineering Mechanics of Solids, Egor P. Popov, Pearson publication
3. Strength of Materials, R.K. Bansal, Laxmi Publications.
4. Course outline Prepared by; Sudheer Choudari Date: 7.6.2020



Source of reference:

1. NPTEL, Udemy, 3D Experience Tools.
2. [Link1 - Edx Course](#)
3. [Link2 - Edx Course](#)
4. Practical Introduction and Basics of Finite Element Analysis



Computer Aided Drafting

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1908	Computer Aided Drafting	0-2-1	

Course Objectives:

- How to create simple parts, assemblies and drawings.
- How to use different feature-based tools to build, review and modify a model.
- How to create and analyze assemblies and how to produce a drawing with different views.

Learn how to dimension the drawing and annotate the views.

Course Outcomes:

***CO1:**Create and edit technical 2D and 3D geometry using specialized software commands.

***CO2:**Apply industry-standard drafting conventions including appropriate dimensioning, text, layers, and symbols.

***CO3:**Generate multi-view drawings such as orthographic projections, sectional views, and isometric views from 3D models.

***CO4:**Produce professional, scaled hard copies (prints/plots) of digital drawings using proper layout and plotting parameters.

***CO5:**Enhance design visualization, communication, and efficiency compared to manual drafting methods, often in a collaborative team environment.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1				2									
CO2	1			1	1			3							
CO3	1		3			2	3								
CO4					2			3							
CO5		1		2			2								

COURSE CONTENT

Module I: Sketcher - Creating Profiles 2 (hrs)

PLM Objects, Sketch Support, Simple elements, constraining sketches, simple and complex profiles, transforming sketches, saving documents.

Practice-1 : Hands on Session on Sketcher Workbench

Module II:

Part Design -Creating Basic Features 5 (hrs)

Extruded Features, revolved features, holes, threads, taps, drafts, fillets, chamfers, shelling and stiffeners, relational dimensions,

Practice-2 : Hands on Session on Sketch Based Features & Dress Up Features

Practice-3: Hands on Session on Transformation Features

Module III:

Reviewing & Modifying 2 (hrs)

Measuring the model, re using the data, editing features

Practice-4: Hands on Session on Measuring Tools & Editing Features

Module IV:

Finalizing Design 5 (hrs)

Adding parameters, reusing features, rendering, weight calculation,

Practice-5: Hands on Session on Parametric Design

Practice-6: Hands on Session on Rendering, Material Addition

Module V:

Creating & Managing Products 6 (hrs)

Positioning Components, constraining Components, Analyzing weight distribution, replacing and revising parts

Practice-7: Hands on Session on Assembly Design

Practice-8 : Hands on Session on Digital Mock Up



Module VI:

Creating Drawings 4 (hrs)

Creating Drawing, Modifying, dimensioning, Annotations, Finalizing & Printing

Practice-9 : Hands on Session on Drawing Conventions

Practice-10: Hands on Session on Creating Drawings

Module VII:

Master Exercise (5 hrs)

Heat Sink, PC Card Slide

Practice-11: Modelling of Heat Sink

Practice-12: Modelling and Assembly of PC card Slide

Text Books/ Reference Books/ Reference Material

1. Mechanical Design Fundamentals: Dassault Systems Companion Learning Space Material



Electronic Devices and Systems

Code	Course Title	T-P-Pj (Credit)	Prerequisite
CUTM1112	Electronic Devices and Systems	2-0-1	

Course Objectives:

*The course is designed to be a broad introduction to electronic systems for students from diverse engineering disciplines. Completing the course will provide the necessary foundation to understand the role, capabilities and constraints of electronics in contemporary engineering systems.

*This course develops a basic understanding of the fundamentals and principles of analog and digital circuits and electronic devices. This understanding is a critical step towards being able to design new electronic circuits or use them appropriately as part of a larger engineering system.

Course Outcomes:

***CO1:** Knowledge on understanding operation of semiconductor devices.

***CO2:** Design and analyze of electronic circuits.

***CO3:** Analyze dc circuits and relate ac models of semiconductor devices with their physical Operation.

* **CO4:** To verify the theoretical concepts through laboratory and simulation experiments .Implement mini projects based on concept of electronics circuit concepts.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	2	1				3		1							
CO2			2	1	1			3							
CO3	1		1		2		3								
CO4		2				1									
CO5		1		2		3		1							

COURSE CONTENT

Module I:

Semiconductor Diodes, Diode Applications (5 Hrs)

Semiconductor Physics, Semiconductor Diode and analysis, Zener Diodes, Light-Emitting Diodes, realization of logic gates using diodes, rectifier circuits.

Practice:

- 1.1 V-I Characteristics of PN Junction diode and ZENER diode. (Both hardware and MULTISIM)
- 1.2 Implementation of Full-Wave rectifier. (Both hardware and MULTISIM).
- 1.3 Implementation of AND/OR gates. (Both hardware and MULTISIM)

Module II:

Bipolar Junction Transistors, Field-Effect Transistors (4 Hrs)

Transistor Construction and characteristics, Construction and Characteristics of JFETs, MOSFET

Practice:

- 2.1 Input - Output Characteristics of CB/CE/CC configuration BJT. (Both hardware and MULTISIM)
- 2.2 Output and transfer Characteristics of FET. (Both hardware and MULTISIM)

Module III:

DC Biasing-BJTs. BJT AC Analysis, FET Biasing, FET Amplifiers, BJT and JFET Frequency Response (6 Hrs)

Load-Line Analysis, Operating Point, biasing techniques, AC analysis of BJT and FET, General Frequency Considerations, Low-Frequency Analysis of BJT, FET

Practice:

- 3.1 Frequency response of self-biased BJT amplifier. (Both hardware and MULTISIM)
- 3.2 Frequency response of CS FET amplifier. (Both hardware and MULTISIM)

Module IV:

Operational Amplifiers, Op-Amp Applications, Linear-Digital ICs (6 Hrs)

Practical Op-Amp Circuits and various parameter analyses, various applications, Timer and PLL ICs



Practice:

- 4.1 Design and implement of Adder, Sub tractor using IC 741. (Both hardware and MULTISIM)
- 4.2 Design and implement of Integrator and Differentiator using IC 741. (Both hardware and MULTISIM)
- 4.3 Design and implement of Any oscillator using IC 741. (Both hardware and MULTISIM)

Module V:

Power Amplifiers, Feedback and Oscillator Circuits (5 Hrs)

Various classes of power amplifier and their characteristics, design of various oscillators and its applications

Practice:

- 5.1 Design and implement of Class-C power amplifier (Both hardware and MULTISIM)
- 5.2 Design and implement of RC Phase shift oscillator (Both hardware and MULTISIM)
- 5.3 Design and implement of UJT relaxation oscillator (Both hardware and MULTISIM)

Module VI:

Power Supplies (Voltage Regulators) (4 Hrs)

Various filters, Voltage regulator, Design and different IC voltage regulators.

Practice:

- 6.1 Regulation characteristics of transistor voltage regulator.(Both hardware and MULTISIM).
- 6.2 Regulation characteristics of IC7805/7912 voltage regulators.(Both hardware and MULTISIM).

Module VII:

Other Two-Terminal Devices, *pnpn* and Other Devices (4 Hrs)

Varactor diode, photodiode, solar cell, tunnel diode, LCD, thermistors, SCR construction, applications, UJT

Text Books:

- 1.Electronic Devices and Circuit Theory, Eleventh Edition: Robert L. Boylestad. Louis Nashelsky
- 2.Electronic Principles and Applications, Ninth Edition: Charles A. Schuler



Reference Books

1. Electronic Devices and Circuits: GSN Raju
2. Electronic Devices: Systems and Applications: Robert Diffenderfer.

Link for Text Book

1: www.rtna.ac.th/departments/elect/Data/EE306/Electronic%20Devices%20and%20Circuit%20Theory.pdf

Link for Text Book

2: http://dl.booktolearn.com/ebooks2/engineering/electrical/9780073373836_Electronics_Principles_and_Applications_9th_7d8d.pdf

Software Applications in Mines

Subject Name	Code	Type of course	T-P-P Credit	Prerequisite
Software Applications in Mines	CUTM1919	P+Pj	0-2-1	

Course Objectives:

- Students gain knowledge about personal management
- Industrial relation, legislation and management information system.
- Understand the different approaches to design a perfect Mine design in surface and underground mines.
- Grasp process of mine production.
- Gain knowledge about the various technical and economical and safety issues to be considered in mine designing.

Course Outcomes:

***CO1:** Acquire the knowledge on different data implementation for various applications in mines such as Geovia Surpac and Slide.

***CO2:** Solving different problems such as 3D Modeling, Block Modeling, Data Base Creation.

***CO3:** Design Geological database models and the entity-relationship diagrams of different databases using Geovia Surpac, MySQL, Workbench and Ms Access.

***CO4:** Implement and manage databases, data structures, and algorithms for efficient data storage and processing.

***CO5:** Test, debug, and maintain software applications to ensure quality, reliability, and security in a professional environment.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3	1		1		1									
CO2				1	1			1							
CO3	1	3	1				2								
CO4	1	3		2				3							
CO5			1			3		1							

1. **Course Contents**

Data acquisition, data representation and processing.

Database creation and management.

Computations of various parameters, digital terrain model (DTM).

Interpolation of data on triangular or rectangular grid points.

Reduction of data into presentable form, sectioning, compositing.



Solid Modeling, auto plotting and 3D Modeling.

Block Modeling and determination of ultimate pit configuration.

Fundamentals and Applications of MATLAB, Python in Mining.

Reference:

Software Tutorial (Geovia Surpac)

Basket V

Course Code	Course Title	Credits	Course Type T+P=PJ	NcRF Level
CUTM1905	Internship	2	0+0+2	6
CUTM1906	Minor Project-I	2	0+0+2	5.5
CUTM1913	HEMM Maintenance	6	1+4+1	5.5
CUTM1914	Introduction to Mechatronics	4	1+2+1	5.5
CUTM1915	Mine Machinery I	2	2+0+0	5
CUTM1916	41I	2	2+0+0	5
CUTM1917	Mine Planning and Design	2	2+0+0	6
CUTM1918	Mine Planning and Design Practical	2	2+0+0	6
CUTM1919	Software Application in Mines	3	0+2+1	6
CUTM1920	Mine Excursion -I	1	0+0+1	5.5
CUTM1921	Mine Excursion -II	1	0+0+1	6
CUTM1922	Internship I	2	0+0+2	5.5
CUTM1923	Internship II	2	0+0+2	6
CUTM1924	Project	3	0+0+3	6

Basket-V
(Mining Engineering)

DOMAIN

Aerial Surveying and Remote Sensing Applications

Course Title	Type of course	T-P-PJ	Prerequisite
Aerial Surveying and Remote Sensing Applications	Theory + Practice + Project	4 - 10 - 6	Nil

Courses Division:

Sl. No.	Code	Subject Name	T-P-P	Credits	Hrs.
1.	CUAS2020	Remote Sensing & Digital Image Processing	2-2-0	4	45
2.	CUAS2021	Geospatial Technology and Its Application	2-2-0	4	45
3.	CUAS2026	Photogrammetry and Its Application	0-2-2	4	45
4.	CUAS2023	Lidar Remote Sensing and Its Applications	0-2-0	2	25
5.	CUAS2024	Hyperspectral Remote Sensing and Its Application	0-2-0	2	25
6.	CUAS2025	Project	0-0-4	4	54
Total				20	

Course 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.
- Pursue research and develop capabilities to handle multi-disciplinary field projects. Work in teams and demonstrate leadership skills with professional ethics

Course Outcomes: At the end of the program, students will be able to

- **CO1:** Identify specific data knowledge and analysis methodology for effective mapping and evaluation resources.
- **CO2:** Understand the geospatial model's skills to address social and engineering problems.
- **CO3:** Design multi-criteria geospatial systems for decision-making.
- **CO4:** Work in a team using geospatial tools and environment to achieve project objectives.
- **CO5:** Pursue lifelong learning for professional advancement.

Remote Sensing and Digital Image Processing (84 Hours)

Code	Course Title	Credit	T-P-PJ
CUAS2020	Remote Sensing and Digital Image Processing	4	2+2+0

Course Objective

- Able to learn the procedures and techniques involved in data acquisition for remote sensing, as well as image interpretation methods.
- Understand of the various types of satellite platforms used for land and marine observation including image rectification and geometric correction processes in remote sensing.
- Understand of image classification techniques.

Course Outcomes: At the end of the program, students will be able to

- **CO1:** Understand the fundamental principles of remote sensing.
- **CO2:** Gain knowledge and skills necessary to acquire, process, and interpret remote sensing data effectively.
- **CO3:** Understand the diverse applications of satellite data in various fields.
- **CO4:** learn methods for assessing the quality of satellite imagery.
- **CO5:** Equipped with the knowledge and skills necessary for image classification.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3														
CO2		2			2										
CO3						2							2		
CO4								3							
CO5			3											2	

Course Syllabus

Module I: Basic Concept of Remote Sensing (12 Hours)

Theory

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**

- Experiment 1.1: Installation of Image Processing software's
- Experiment 1.2: Download satellite data from GLOVIS / Earth Explorer / Bhuvan etc.
- Experiment 1.3: Layer stacking
- Experiment 1.4: LUT and Image Subset
- Experiment 1.5: Spectral Signature mapping (soil, vegetation, water)

Module II: Digital Image (12 Hours)

Theory

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

- Experiment 2.1: FCCs and TCC
- Experiment 2.2: Resolution
- Experiment 2.3: Image Interpretation

Module III: Satellite Information and Principles (8 Hours)

Theory

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

- Experiment 3.1: Image filtering and Band ratioing
- Experiment 3.2: Mosaicking

Module IV: Image Acquisition and Format (12 Hours)

Theory



Digital Image Processing; Export and import, Data formats; BSQ, BIL, BIP, Run length encoding, Image Compression Data products.

Practice

- Experiment 4.1: Export and Import
- Experiment 4.2: Histogram
- Experiment 4.3: Subset using AOI

Module V: Image Processing (12 Hours)

Theory

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)

- Experiment 5.1: Geometric correction
- Experiment 5.2: Radiometric correction
- Experiment 5.3: Atmospheric correction

Module VI: Image Classification (16 Hours)

Theory

IMAGE CLASSIFICATION; Classification techniques, types, Supervised and Unsupervised; Principal Component Analysis (PCA); Image Enhancement; Accuracy assessment. **Practice**

- Experiment 6.1: PCA analysis (spectral Python and ENVI)
- Experiment 6.2: NDVI, DVI, NDWI calculation
- Experiment 6.3: Image classification in Spectral Angel Mapper
- Experiment 6.4: MNF Rating
- Experiment 6.5: Supervised Classification (spectral Python and ENVI)
- Experiment 6.6: Un-supervised Classification (spectral Python and ENVI)
- Experiment 6.7: Image Enhancement (ENVI)
- Experiment 6.8: Accuracy Assessment (ENVI)

Module VII: Remote Sensing and Its Application (12 Hours)

Theory

Microwave RS and its application; Thermal RS and its application; Optical RS and its application; Sensor and its types.

Practice

Using Spectral Python

- Experiment 7.1: Application of microwave remote sensing (Structural Trend line mapping)
- Experiment 7.2: Application of thermal remote sensing and case study (Land surface Temp. estimation)
- Experiment 7.3: Application of optical remote sensing and case study

Geospatial Technology and its Application (85 Hours)

Code	Course Title	Credit	T-P-PJ
CUAS2021	Geospatial Technology and its Application	4	2+2+0

Course Objective

- Understand of Geographic Information Systems (GIS) and Cartography. Apply Knowledge and skills necessary to perform advanced spatial analysis and data manipulation tasks using GIS.
- Understand of multi-criteria decision-making (MCDM) principles and techniques • Understand the principles behind DEMs, and generate DEMs using various techniques.

Course Outcomes: At the end of the program, students will be able to • **CO1:** Understand the fundamentals of GIS.

- **CO2:** Learn advanced data analysis tools and techniques in GIS software.
- **CO3:** Learn multi-criteria decision-making techniques, including AHP, to solve complex spatial analysis.
- **CO4:** Gain knowledge of Digital Elevation Models (DEMs), their generation techniques, derivatives, integration with satellite data, sources, limitations, and future trends. • **CO5:** Gain Knowledge and skills necessary to apply geospatial technology in various applications.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3					2									
CO2		2			2										
CO3			2										3		
CO4				3											



CO5											3					
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Course Syllabus

Module I: GIS & Cartography (14 hours) Theory

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 cartography, Characteristics of Map; Categories of maps, Methods of mapping, relief maps, thematic maps.

Practice

- Experiment 1.1: 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
- Experiment 1.2: 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 (15 hours)

Theory

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

- Experiment 2.1: 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
- Experiment 2.2: Buffering and Creation of Contour
- Experiment 2.3: Network Analysis

Module: III multi-criteria analysis and decision making (15 hours)

Theory

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:**

- Experiment 3.1: Mapping accident locations using Linear Referencing technique.
- Experiment 3.2: Preparation of raster layers for Multicriteria Analysis
- Experiment 3.3: Solving a spatial problem using Multicriteria Analysis (Spatial AHP)

Module IV: Digital Elevation Model (DEM) (14 hours)

Theory

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:

- Experiment 4.1: Google Earth to DEM, 3D Map preparation, Contour to DEM, TIN, and Aspect
- Experiment 4.2: DEM-based surface Hydrology modeling,
- Experiment 4.3: LiDAR classification, DEM from LiDAR

Module V: Geospatial Technology for Water Resources Engineering (14 hours)

Theory

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 groundwater studies.

Practice:

- Experiment 5.1: Mapping of catchment, command area
- Experiment 5.2: Drainage network analysis
- Experiment 5.3: Morphometric analysis
- Experiment 5.4: Mapping of Groundwater potential zones

Module VI: Geospatial Technology for Environmental Engineering Theory (13 hours)

Monitoring atmosphere constituents, air pollution, industrial activity, GIS modeling, Resource development in remote areas, Impacts of anthropogenic activity, Solid Waste management, Water Pollution, Shortest path Identification, and Network analysis.

Practice

- Experiment 6.1: Air pollution mapping
- Experiment 6.2: Solid waste management
- Experiment 6.3: Water pollution

Photogrammetry and Application (115 Hours)

Code	Course Title	Credit	T-P-PJ
CUAS2026	Photogrammetry and Application	4	0+2+2

Course Objective

- Hands-on experience and practical skills in various aspects of aerial photography and photogrammetry.
- Generating digital elevation models (DEMs), orthoimages and mosaics.
- Integrating photogrammetry with Geographic Information Systems (GIS)

Course Outcomes: At the end of the program, students will be able to

- **CO1:** Understand the aerial photography and photogrammetry principles.
- **CO2:** Gain practical Skills in Photogrammetric Techniques.
- **CO3:** Learn techniques for processing satellite imagery.
- **CO4:** Acquire knowledge in Integration of photogrammetry and GIS.
- **CO5:** Learn about aerial mapping using drones.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3					2									
CO2		2			2										
CO3				2											
CO4			3										2		
CO5						3									

Practice

- Experiment 1.1: Scale determination from aerial photo

- Experiment 1.2: Aerial Photo Interpretation
- Experiment 1.3: Use of Parallax bar and determination of Height from stereo pair
- Experiment 1.4: Satellite DEM and ortho Image generation
- Experiment 1.5: Primary and additive color creation
- Experiment 1.6: Stereo test
- Experiment 1.7: Mosaic
- Experiment 1.8: Stereoscopic vision
- Experiment 1.9: Relief displacement
- Experiment 1.10: Analog to digital conversion, Orientation of stereo model and Determination of Height
- Experiment 1.11: Aerial mapping using DRONE
- Experiment 1.12: Mosaicking of aerial Photo
- Experiment 1.13: Correction and rectification
- Experiment 1.14: DTM generation Image correction, Link between GIS and Digital Photogrammetry, and Ortho Image generation

Theory

Introduction to Drones, Parts of Drones, Digital Sky Platform, Different flying Zones, and Different forms (D1 to D5)

Practice

- Experiment 2.1: Flight Simulator Training and Checklist for before and after flying.
- Experiment 2.2: Take-off, Cruise flight, and Landing
- Experiment 2.3: Mission Planner
- Experiment 2.4: Drone Data processing and pre-processing
- Experiment 2.5: DEM, DTM, DEM, and contour generation
- Experiment 2.6: Drone data analysis



4. LIDAR Remote Sensing and Application (60 Hours)

Code	Course Title	Credit	T-P-PJ
CUAS2023	LIDAR Remote Sensing and Application	2	0+2+0

Course Objective

- Practical skills in downloading LIDAR data, processing, validating, and analyzing it to generate accurate and reliable geospatial products.
- Understanding of LIDAR data processing techniques.
- Utilization of LIDAR data for a wide range of applications.

Course Outcomes: At the end of the program, students will be able to

- **CO1:** Understand the LIDAR Data acquisition technique.
- **CO2:** Learn techniques for layer stacking and georeferencing of LIDAR data.
- **CO3:** Understand the LIDAR data processing techniques.
- **CO4:** Learn 3D modeling using LIDAR data.
- **CO5:** Use LIDAR data across various applications.

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3			2											
CO2		2	2												
CO3				2											
CO4						3									
CO5												3			

Practice Experiments:

Experiment 1.1: Download of LIDAR data

Experiment 1.2: Layer stacking

Experiment 1.3: Data Validation

Experiment 1.4: Georeferencing Technology

Experiment 1.5: Boresight Calibration - Lidar Data Pre-processing



Experiment 1.6: Project Coverage Verification - Review Lidar Data against Field Control

Experiment 1.7: Lidar data errors and rectifications, - processes calibration of Lidar data - artifacts and anomalies - Lidar Error Budget.

Experiment 1.8: Noise Removal and other sensor-related artifacts - Layer Extraction - Automated Filtering

Experiment 1.9: Manual Editing and Product Generation – Surface Editing - Hydrologic Enforcement

Experiment 1.10: Breaklines, Contours, and Accuracy Assessment

Experiment 1.11: Topographic Mapping, flood inundation analysis, line-of-sight analysis

Experiment 1.12: Forestry, various types of LIDAR sensors-, vegetation metric calculations - specific application software.

Experiment 1.13: Corridor mapping system, data processing and quality control procedures.

Experiment 1.14: Modelling

5. Hyperspectral Remote Sensing and Application (60 Hours)

Code	Course Title	Credit	T-P-PJ
CUAS2024	Hyperspectral Remote Sensing and Application	2	0+2+0

Course Objective

- Basic understanding of hyperspectral remote sensing
- Data processing and interpretation of hyperspectral imagery using software tools like ENVI and Python.
- Applications in agriculture, forestry, urban studies, and geological studies.

Course Outcomes: At the end of the program, students will be able to

- **CO1:** Understand the hyperspectral remote sensing principles.
- **CO2:** Gain Practical skills in data processing, analysis, and interpretation using ENVI and Python
- **CO3:** Understand the principles and techniques of atmospheric correction for hyperspectral imagery
- **CO4:** Learn supervised and unsupervised classification techniques for hyperspectral imagery.
- **CO5:** Use this methodology in geological studies for mineral identification, lithological and geological mapping.

Course Outcome to Program Outcome Mapping:

COs / Pos / PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
CO1	3			2											
CO2		2			2										
CO3				2											
CO4			3												
CO5						3									

Practice:

- Experiment 1.1: Introduction to ENVI, Python and Downloading, Displaying, and Analyzing Hyperspectral Imagery
- Experiment 1.2: Atmospheric Correction of Hyperspectral Imagery.
- Experiment 1.3: MNF rationing from Hyperspectral (EO1)



- Experiment 1.4: Hyperspectral Image Classification Using Spectral Angle Mapper (SAM) & Spectral Feature Fitting (SFF).
- Experiment 1.5: Hyperspectral Imagery Classification Using an Unsupervised Neuron fuzzy System.
- Experiment 1.6: Application of Hyperspectral Imagery in Geological Studies.
- Experiment 1.7: Hyperspectral Signatures & Feature Fitting.
- Experiment 1.8: Hyperspectral Remote Sensing for Agriculture and soil Studies.
- Experiment 1.9: Hyperspectral Remote Sensing for Forestry Applications.
- Experiment 1.10: Hyperspectral Remote Sensing for Urban Studies.
- Experiment 1.11: Mineral identification from Hyperspectral imagery
- Experiment 1.12: Python Programming for Hyperspectral data analysis.

6. Project (115 Hours)

Subject Name	Code	Type of course	Credit	T-P-P	Prerequisite
Project	CUAS2025	Project	4	0-0-4	NIL

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 of 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. Groundwater 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



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.