VIT Vidyalankar Institute of Technology
Accredited A+ by NAAC

Vidyalankar Institute of Technology

An Autonomous Institute affiliated to University of Mumbai

Bachelor of Technology

in

Biomedical Engineering

First Year Scheme & Syllabus

(R-2025)

(As per NEP 2020, with effect from Academic Year 2025-26)

Preamble

The National Education Policy (NEP) framework aims to break the mould from teacher centric to student centric educational practices. It empowers the students with flexibility in terms of choosing courses across different faculties and mode of learning.

This multidisciplinary approach will encourage learners to follow their passion and inherent interests. The learner is free to learn at a pace that he is comfortable with and this enables lifelong learning. It also enhances the scope for holistic personality development.

This premise is truly reflected in preamble of the NEP document, "The future of nation is decided in the classrooms of the schools and colleges today".

Details of implementation:

NEP curriculum framework enables us to accelerate change, redesign systems with equity in mind, respond to feedback, encourage collaboration, catch and pollinate ideas and create a culture of research and development. It will allow us to offer the required academic flexibility which will focus on improving competency level of students with diverse strengths.

The curriculum planned by VIT has vertical **Program Courses** consisting of core courses (PCC) of branch of engineering positioned and sequenced to achieve sequential and integral learning of the entire breadth of the specific branch. This vertical also includes programme elective courses (PEC) which offer flexibility and diversity to learners to choose specialization from a basket of recent developments in their field of technology. The selection of unique programme elective courses based on industrial requirements and organizing them into tracks is a special feature of this curricula ensuring employability.

The vertical **Multidisciplinary Courses** consists of Open Elective (OE) courses and multidisciplinary minor (MD M) courses. Special vocational and skill development courses are included as a part of **Skill courses** vertical that make student capable to work in industrial environment.

The student is expected to demonstrate their ability through course in **Experiential Learning Courses** vertical like internships/On Job Training, Community Engagement Project, Real Industry Project/ research problem. Our curriculum also introduces Social Service Internship and Internship with institutes abroad along with courses like Design Thinking. This will lead to creation of products and/ or patents through this program.

For holistic development of students, apart from technical courses, Ability Enhancement Courses, Entrepreneurship/Economics/Management Courses, Indian Knowledge System and Value Education courses from vertical **Humanities and Social Science and Management** develop the required soft-skills and attitude amongst learners.

In **Liberal Learning** vertical. courses like Various Dance Forms, Global citizenship Education, Facets of Astronomy etc. aims to create balance in brain hemispheres and hence improve learners' clarity in thoughts and responses.

In addition to core courses, professional and open electives; our framework offers honor degree in each programme of engineering. It includes specialized courses along with field/ domain study that make student capable of working on industry relevant problems.

Chairman, Board of Studies
Department of Biomedical Engineering
Vidyalankar Institute of Technology

VIDYALANKAR INSTITUTE OF TECHNOLOGY, WADALA, MUMBAI-37. VIT Vidyalankar Institute of Technology

Chairman, Academic Council
Vidyalankar Institute of Technology

First Year B. Tech. Biomedical Engineering **Preferred Semester: I**

Course Structure and Assessment guidelines

Vertical_ Subvertical	Course		Head of Learning	Credits	Assessment guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
BESC_BSC	BSC02	Engineering Mathematics-I	Theory	3	20	30	50	100
BESC _ESC	ESC02T	Engineering Mechanics	Theory	2	15	20	40	075
BESC _ESC	ESC02P	Engineering Mechanics Lab	Practical	1	25	-	25	050
BESC _ESC	ESC06T	Basic Electrical Engineering	Theory	2	15	20	40	075
BESC _ESC	ESC06P	Basic Electrical Engineering Lab	Practical	1	25	-	25	050
PC_PCC	PCBM01T	Physics for Biomedical Engineering	Theory	2	15	20	40	075
PC_PCC	PCBM01P	Physics for Biomedical Engineering Lab	Practical	1	25	-	25	050
HSSM_AEC	AEC01T	Effective Communication	Theory	2	15	20	40	075
HSSM_AEC	AEC01P	Effective Communication Lab	Practical	1	25	-	25	050
SC_VSEC	VSEC01T	Structured Programming	Theory	2	15	20	40	075
SC_VSEC	VSEC01P	Structured Programming Lab	Practical	1	25	-	25	050
LLC_CC	CCXX*	Any LLC_CC course from the list	As per course	2	25	-	50	075
Total				**20**				

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination
*Selection based on the subset of GE courses made available by the Institute for the semester.

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

First Year B. Tech. Biomedical Engineering **Preferred Semester: II**

Course Structure and Assessment guidelines

Vertical_ Subvertical	Course		Head of Learning	Credits	Assessment guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
BESC_BSC	BSC04	Engineering Mathematics-II	Theory	3	20	30	50	100
BESC_BSC	BSC11T	Engineering Chemistry	Theory	2	15	20	40	075
BESC_BSC	BSC11P	Engineering Chemistry Lab	Practical	1	25	-	25	050
BESC_ESC	ESC01T	Engineering Graphics	Theory	2	15	20	40	075
BESC_ESC	ESC01P	Engineering Graphics Lab	Practical	1	25	-	25	050
HSSM_VEC	VEC01T	Professional Skills	Theory	2	15	20	40	075
HSSM_VEC	VEC01P	Professional Skills Lab	Practical	1	25	-	25	050
HSSM_IKS	IKSXX	Any HSSM_IKS course from Basket	As per course	2	25	-	50	075
SC_VSEC	VSEC02T	Object-Oriented Programming	Theory	2	15	20	40	075
SC_VSEC	VSEC02P	Object-Oriented Programming Lab	Practical	1	25	-	25	050
LLC_CC	CCXX*	Any LLC_CC course from the list	As per course	2	25	-	50	075
Total				**19**				

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESA= End Semester Examination
*Selection based on the subset of GE courses made available by the Institute for the semester.

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

List of Indian Knowledge System Courses

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
IKS01	Indian Traditional Knowledge System	Theory	2	25	-	50	075
IKS02	Indian Constitution	Theory	2	25	-	50	075
IKS03	Exploring Indian Art	Theory	2	25	-	50	075

List of Liberal Learning_ Cocurricular Courses

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
CC01	Various Dance Forms	Theory	2	25	-	50	075
CC02	Corporate and Social Etiquettes	Theory	2	25	-	50	075
CC03	Global Citizenship Education	Theory	2	25	-	50	075
CC04	Wellness – Body, Mind & Spirit	Theory	2	25	-	50	075
CC05	IQ vs EQ	Theory	2	25	-	50	075
CC06	Nutrition and Physical Wellness	Theory	2	25	-	50	075
CC07	Facets of Astronomy	Theory	2	25	-	50	075
CC08	Railways - Wonders of Infrastructure	Theory	2	25	-	50	075
CC09	Financial Literacy for Engineers	Theory	2	25	-	50	075
CC10	Mastering Advanced Excel	Theory	2	25	-	50	075
CC11	Personal Grooming Essentials	Theory	2	25	-	50	075
CC12	Various Music Forms	Theory	2	25	-	50	075

Detailed Syllabus of First Year Semester-I

Course Name: Engineering Mathematics-I

Course Code: BESE_BSC_02

Vertical/ Sub-Vertical: BS_BSC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Nil

Pre-requisite for: BESE_BSC_06 and BESE_BSC_33 (Engineering Mathematics-III), and higher-level mathematical courses.

Recommended Semester: 1

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
BESE_BSC_04	3	-	3	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (BESE_BSC_04)	20 (~20%)	30 (~30%)	50 (~50%)	100 (100%)

Each course faculty may design a course-specific assessment strategy suitable for the content and pedagogy. All such methodologies must be approved by the institute-level panel and communicated to learners at the beginning of the semester.

Preamble

This course aims to provide learners with a comprehensive understanding of sustainability principles, strategies, and management practices enabling responsible organizational operations and long-term success.

Course Objectives

- Understand sustainability concepts and their significance globally and organizationally.
- Equip learners with frameworks for effective sustainability strategy formulation.
- Analyze environmental, social, and economic dimensions of sustainability.
- Develop leadership and ethical decision-making skills to manage sustainability initiatives.

Course Outcomes

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall key definitions, identities, and formulas related to complex numbers, hyperbolic functions, partial differentiation, matrix operations, series expansions, and numerical methods.	Remembering

CO2	Explain fundamental concepts across calculus, algebra, and numerical analysis, including partial derivatives, hyperbolic identities, matrix rank, and iterative algorithms.	Understanding
CO3	Apply techniques such as matrix reduction, Taylor/Maclaurin series, De Moivre's theorem, and iterative methods to solve mathematical and engineering problems.	Applying

Mapping of Course Outcomes with Learning Outcomes

Module No.	Module Name	Content	No of Hours
1	Complex Numbers	**Learning Objective:** Understand the use of De Moivre's Theorem and the operations on complex numbers. (CO1 to CO3) **Contents:** De Moivre's Theorem, expansion of sinnθ and cosnθ, powers and roots of complex numbers. **Self-Learning Topics**: Geometric representation of complex numbers **Learning Outcomes:** A learner will be able to: 1.1 Recall De Moivres Theorem and related expansions. (P.I.- 1.1.1) (CO1) 1.2 Explain power and roots of complex numbers. (P.I.- 1.1.1) (CO2) 1.3 Apply De Moivres theorem to trigonometric identities. (P.I.- 2.4.1) (CO3)	7
2	Hyperbolic & Logarithmic Functions	**Learning Objective:** Understand circular, hyperbolic and logarithmic functions for real and complex inputs. (CO1 to CO3) **Contents:** Circular and hyperbolic functions, inverse functions, separation of real and imaginary parts, logarithmic functions. **Learning Outcomes:** A learner will be able to: 2.1 Recall definition of circular and hyperbolic functions. (P.I.- 1.1.1) (CO1) 2.2 Explain inverse and logarithmic functions. (P.I.- 1.1.1) (CO2) 2.3 Apply separation of real/imaginary parts in problems. (P.I.- 2.4.1) (CO3)	7
3	Partial Differentiation and Applications	**Learning Objective:** Apply partial derivatives and Euler's theorem to understand functions of several variables. (CO1 to CO3) **Content:** Partial derivatives (first and higher order), composite functions, Euler's theorem, maxima and minima of two-variable functions. **Learning Outcomes:** A learner will be able to:	8

		3.1 Recall formulae for partial derivatives. (P.I.- 1.1.1) (CO1) 3.2 Explain Eulers theorem and conditions for maxima and minima. (P.I.- 2.1.1) (CO2) 3.3 Apply partial derivatives in two variable problems. (P.I.- 2.4.1) (CO3)	
4	Successive Differentiation & Expansion of Functions	**Learning Objective:** Understand the techniques of successive differentiation and expansion of functions using Taylor and Maclaurin series. (CO1 to CO3) **Contents:** Successive differentiation: nth derivative of standard functions. Leibnitz's Theorem (without proof) and problems. Taylor's Theorem (Statement only) and Taylor's series. Maclaurin's series (Statement only). Expansion of sin(x), cos(x), tan(x), sinh(x), cosh(x), tanh(x), log(1+x). **Learning Outcomes:** A learner will be able to: 4.1 Recall the nth derivative of standard functions. (P.I.- 1.1.1) (CO1) 4.2 Explain the concept of Taylor and Maclaurin expansions. (P.I.- 1.2.2) (CO2) 4.3 Apply Taylor and Maclaurin series to expand given functions. (P.I.- 2.4.1) (CO3)	7
5	Matrices	**Learning Objective:** Understand matrix transformations and solve systems of linear equations using matrix techniques. (CO1 to CO3) **Contents:** Rank of a matrix using echelon forms, reduction to normal form and PAQ form. System of homogeneous and non-homogeneous equations, their consistency and solutions. **Learning Outcomes:** A learner will be able to: 5.1 Recall methods for finding rank of a matrix. (P.I.- 1.1.1) (CO1) 5.2 Explain the PAQ form and consistency of systems. (P.I.- 1.2.2) (CO2) 5.3 Apply Gaussian elimination and echelon form to find rank. (P.I.- 2.1.3) (CO3)	8
6	Numerical Solutions of Transcendental and Linear Algebraic Equations	**Learning Objective:** Apply numerical techniques to solve transcendental and system of linear algebraic equations. (CO1 to CO3) **Contents:** Solution of Transcendental Equations using Newton-Raphson method and Regula-Falsi method. Solution of system of linear algebraic equations using Gauss-Jacobi Iteration Method and Gauss-Seidel Iteration Method.	8

		Learning Outcomes: A learner will be able to: 6.1 Recall iterative methods for root finding and linear systems. (P.I.- 1.1.1) (CO1) 6.2 Explain convergence criteria of Newton-Raphson, Regula-Falsi, Gauss-Jacobi, and Gauss-Seidel methods. (P.I.- 1.2.2) (CO2) 6.3 Apply Newton-Raphson and Regula-Falsi for root approximation. (P.I.- 2.1.3) (CO3)	
Total			**45**

Performance Indicators:

P.I.–1.1.1: Applying, Understanding: Apply knowledge of discrete structures, linear algebra, statistics, and numerical techniques.
P.I.–1.1.2: Applying, Understanding: Apply concepts of probability, statistics, and queuing theory in modeling.
P.I.–1.2.1: Applying: Apply laws of natural science to an engineering problem.
P.I.–1.3.1: Applying: Apply engineering fundamentals to solve engineering problems.
P.I.–1.4.1: Applying: Apply theory and principles of computer science and engineering to solve engineering problems.
P.I.–2.1.1: Analyzing: Evaluate problem statements and identify objectives.
P.I.–2.1.2: Analyzing: Identify processes, modules, and algorithms of a system and parameters to solve the problem.
P.I.–2.2.1: Analyzing, Applying: Reframe the computer-based system into interconnected subsystems.
P.I.–2.2.2: Analyzing: Identify functionalities and computing resources for the system.
P.I.–2.2.3: Analyzing: Identify existing solutions or methods to solve the problem, including justified approximations.
P.I.–2.3.1: Applying: Apply engineering principles to formulate modules of a system.
P.I.–2.4.1: Applying: Apply engineering mathematics to implement the solution.
P.I.–3.1.1: Defining, Applying: Define a precise problem statement with objectives and scope.
P.I.–3.1.2: Defining: Identify and document system requirements from stakeholders.
P.I.–3.1.3: Evaluating: Review state-of-the-art literature to synthesize system requirements.
P.I.–3.1.4: Evaluating: Choose appropriate quality attributes as defined by ISO/IEC/IEEE standards.
P.I.–3.1.5: Analyzing, Evaluating: Synthesize requirements from larger social and professional concerns.
P.I.–3.2.1: Creating, Evaluating: Explore design alternatives and analyze solutions.
P.I.–3.2.2: Creating, Evaluating: Produce a variety of potential design solutions to meet functional requirements.
P.I.–3.3.1: Evaluating: Perform systematic evaluation of design concepts based on criteria.
P.I.–3.3.2: Evaluating, Creating: Consult with domain experts to select the candidate engineering design for further development.
P.I.–3.4.1: Applying, Evaluating: Refine architecture design into a detailed design within the existing constraints.
P.I.–3.4.2: Applying, Creating: Implement and integrate modules into the design.
P.I.–3.4.3: Evaluating, Applying: Verify functionalities and validate the design.

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1, 2.1, 3.1, 4.1, 5.1, and 6.1

CO2	1.2, 2.2, 3.2, 4.2, 5.2, and 6.2
CO3	1.3, 2.3, 3.3, 4.3, 5.3, and 6.3

Mapping of Course Outcomes with Programme Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO7	PO8	PO9	P010	PO11	PO12
CO1	6/18	-	-	-	-	-	-	-	-	-	-
CO2	5/18	1/18	-	-	-	-	-	-	-	-	-
CO3	-	6/18	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Programme Specific Outcomes:

Course Outcome	PSO1	PSO2	PSO3
CO1	SAME AS PO mapping (As per Performance Indicators of PSOs)		
CO2			
CO3			

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria:** The Learner can:	**Evaluated under ISA/MSE/ESE/LAB**
LO 1.1: *Recall De Moivres Theorem and related expansions. (P.I.- 1.1.1) (CO1)*	• The student can state De Moivre's Theorem accurately. • The student can apply De Moivre's Theorem to find powers and roots of complex numbers. • The student can recall and use identities related to trigonometric expansions from De Moivre's form.	MSE ISA ESE
LO 1.2: *Explain power and roots of complex numbers. (P.I.- 1.1.1) (CO2)*	• The student can express a complex number in polar form. • The student can calculate powers of complex numbers using De Moivre's Theorem. • The student can find all nth roots of a given complex number.	MSE ISA ESE
LO 1.3: *Apply De Moivres theorem to trigonometric identities. (P.I.- 2.4.1) (CO3)*	• The student can derive trigonometric identities using De Moivre's Theorem. • The student can express multiple-angle formulas using powers of complex numbers. • The student correctly applies identities in solving trigonometric problems.	MSE ESE ISA

LO 1.4: *Analyze different forms of complex numbers. (P.I.- 2.4.2) (CO4)*	• The student can identify and convert between rectangular, polar, exponential, and trigonometric forms. • The student can compare advantages of using different forms in solving problems. • The student can interpret geometric meaning of complex numbers in various forms.	MSE ISA ESE
LO 1.5: *Evaluate powers and roots using De Moivres. (P.I.- 2.4.1) (CO5)*	• The student can write a complex number in polar/trigonometric form. • The student can correctly apply De Moivre's Theorem to compute powers of complex numbers. • The student can determine all nth roots and represent them geometrically.	MSE ISA ESE
LO 1.6: *Design Identities using Complex Numbers. (P.I.- 3.2.1) (CO6)*	• The student can construct trigonometric identities (e.g., cosnθ,sinnθ using De Moivre's Theorem. • The student is able to develop expressions for $cos^n\theta, sin^n\theta$etcetc., in terms of multiple angles. • The student can apply designed identities to simplify or solve trigonometric expressions.	MSE ISA ESE
LO 2.1: *Recall definition of circular and hyperbolic functions. (P.I.- 1.1.1) (CO1)*	• The student can define circular functions • The student can define hyperbolic functions • The student can write fundamental identities of both circular and hyperbolic functions. • The student can differentiate between circular and hyperbolic function definitions.	MSE ISA ISA ESE
LO 2.2: *Explain inverse and logarithmic functions. (P.I.- 1.1.1) (CO2)*	• The student can define inverse trigonometric and inverse hyperbolic functions. • The student can explain properties and domains/ranges of inverse and logarithmic functions. • The student can simplify expressions involving inverse and logarithmic functions	MSE ISA ESE
LO 2.3: *Apply separation of real/imaginary parts in problems. (P.I.- 2.4.1) (CO3)*	• The student can express a complex function in terms of its real and imaginary parts. • The student is able to separate and simplify real and imaginary components in expressions involving	MSE ISA

	exponential, trigonometric, or hyperbolic forms. • The student can apply Euler's formula to extract real and imaginary parts. • The student accurately solves problems involving separation and interpretation of parts.	 ISA ESE
LO 2.4: *Analyze properties of complex numbers). (P.I.- 2.4.2) (CO4)*	• The student can state and verify properties of complex numbers (e.g., conjugate, modulus, argument, additive and multiplicative properties). • The student can analyze operations (addition, subtraction, multiplication, division) with respect to these properties. • The student can justify the behavior of complex numbers under transformation (rotation, scaling). • The student can solve problems by applying these properties meaningfully.	MSE ISA ESE ISA
LO 2.5: *Evaluate Complex logarithmic problems. (P.I.- 2.4.1) (CO5)*	• The student can define and interpret the logarithm of a complex number. • The student can express complex logarithms in standard form using modulus and argument. • The student can evaluate principal values and branches of complex logarithmic expressions. • The student can solve problems involving logarithmic identities and conversions.	MSE ISA ISA ESE
LO 3.1: *Recall formulae for partial derivatives. (P.I.- 1.1.1) (CO1)*	• The student can define a partial derivative of a function of two or more variables. • The student can state standard formulae for first and second-order partial derivatives. • The student can differentiate functions partially with respect to one variable, treating others as constants. • The student can recall and apply symmetry of mixed partial derivatives under continuity conditions.	MSE ISA ISA ESE
LO 3.2: *Explain Eulers theorem and conditions for maxima and minima. (P.I.- 2.1.1) (CO2)*	• The student can state and explain Euler's theorem for homogeneous functions. • The student can verify Euler's theorem for given functions.	MSE ISA

	• The student can apply first and second derivative tests to identify maxima and minima of functions of two variables. • The student can justify the use of conditions (like the discriminant test) in classifying critical points.	ISA ESE
LO 3.3: *Apply partial derivatives in two variable problems. (P.I.- 2.4.1) (CO3)*	• The student can compute partial derivatives for functions of two variables. • The student can apply partial derivatives to solve problems involving total derivative, chain rule, and tangent planes. • The student can solve engineering-related problems using two-variable functions and partial differentiation.	MSE ISA ESE
LO 4.1: Recall the nth derivative of standard functions. (P.I.- 1.1.1) (CO1)	• Identify the nth derivative of exponential, trigonometric, and logarithmic functions. • Use general formulas for successive differentiation. • Apply Leibniz's rule in product differentiation problems.	MSE ISA ESE
LO 4.2: Explain the concept of Taylor and Maclaurin expansions. (P.I.- 1.2.2) (CO2)	• State Taylor and Maclaurin Theorems and their assumptions. • Identify the order of approximation for a given function expansion. • Explain the convergence behavior of these series near x = 0 or expansion point.	MSE ISA ESE
LO 4.3: Apply Taylor and Maclaurin series to expand given functions. (P.I.- 2.4.1) (CO3)	• Use series to approximate functions such as sin(x), log(1+x), tanh(x). • Expand a given function up to the nth term using Taylor or Maclaurin series. • Apply series to compute numerical values of functions near expansion points.	MSE ISA ESE
5.1 Recall methods for finding rank of a matrix. (P.I.- 1.1.1) (CO1)	• Identify rank of a matrix using echelon and reduced row forms. • Perform elementary row operations to reduce matrices. • Use PAQ transformation for finding equivalent matrices.	MSE ISA ESE
5.2 Explain the PAQ form and consistency of systems. (P.I.- 1.2.2) (CO2)	• Explain consistency conditions for homogeneous and non-homogeneous systems. • Define PAQ form and its significance in simplifying systems. • Discuss the role of rank in determining solution uniqueness.	MSE ISA ESE

5.3 Apply Gaussian elimination and echelon form to find rank. (P.I.-2.1.3) (CO3)	• Apply Gaussian elimination to solve systems of linear equations. • Use echelon and row-reduced form to determine solutions.	MSE ESE
6.1 Recall iterative methods for root finding and linear systems. (P.I.-1.1.1) (CO1)	• Describe the steps in Newton-Raphson and Regula-Falsi methods. • Identify suitable starting points for iterative methods. • Recall limitations and advantages of each method.	MSE ISA ESE
6.2 Explain convergence criteria of Newton-Raphson, Regula-Falsi, Gauss-Jacobi, and Gauss-Seidel methods. (P.I.-1.2.2) (CO2)	• Compare the rate of convergence of numerical methods. • Explain conditions for divergence or slow convergence. • Discuss how method selection affects solution accuracy.	MSE ISA ESE
6.3 Apply Newton-Raphson and Regula-Falsi for root approximation. (P.I.- 2.1.3) (CO3)	• Set up and implement the Newton-Raphson and Regula-Falsi algorithms for given transcendental equations. • Perform iterative steps manually or computationally and interpret convergence toward the root. • Compare the results of both methods and justify the choice of method based on accuracy and iteration count.	MSE ISA ESE

Tools/ Technologies/ Programming Languages learnt:



- Python
- MATLAB
- MS Excel
- Desmos
- Scientific Calculator

Text Books:

1. Ramana B.V.,"Higher Engineering Mathematics",12th Edition, Tata MCGraw Hill,2017

Reference Books:

1. Dr. B.S. Greswal ,"Higher Engineering Mathematics",9th Edition, Khanna Publication,2012
2. Erwin Kreysziq ,"Advanced Engineering Mathematics",9th Edition, Wiley Eastern limited ,2012
3. Srimanta Pal and Subidh C. Bhunia ,"Advanced Engineering Mathematics", UK Edition, Oxford Press, 2015
4. H.K. Das," Advanced Engineering Mathematics",17th Edition, S.Chand,2008
5. Howard Anton and Christ Rorres "Elementary Linear Algebra with Applications",5th Edition, John Wiley 2012

Related/ Equivalent MOOC and Associated Certification:

1. MATLAB on Ramp
    - Platform: MATLAB
    - Link: https://matlabacademy.mathworks.com/details/matlab-onramp/gettingstarted
2. MATLAB Fundamentals
    - Platform: MATLAB
    - Link: https://matlabacademy.mathworks.com/details/matlab-fundamentals/mlbe
3. Advanced calculus for Engineers
    - Platform: NPTEL (Swayam)- IIT Kharagpur
    - Link: https://onlinecourses.nptel.ac.in/noc25_ma77/preview
4. Advanced Engineering Mathematics
    - Platform: NPTEL (Swayam)- IIT Roorkee
    - Link: https://onlinecourses.nptel.ac.in/noc25_ma85/preview

Course Name: Engineering Mechanics

Course Code: ESC02T & ESC02P

Vertical/ Sub-Vertical: Engineering Science

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: -

Pre-requisite for: Computer Graphics, Robotics and Biological Modelling and Simulation

Recommended Semester: 1

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
ES02T	2	-	2	-
ES02P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (ES02T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (ES02P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

To improve the skill sets of students for understanding forces and motions associated with particles and rigid bodies. This course also imparts and inculcates students to understand force system and its effects.

Course Objectives:

- To develop a fundamental understanding of force systems and their applications in engineering structures and machines.
- To enhance the ability to apply concepts of equilibrium, free-body diagrams, and support reactions for analysing static systems.
- To enable learners to compute centroids of simple and composite shapes and understand their practical implications in structural design.
- To impart knowledge on the laws of friction and its applications in mechanical systems, emphasizing real-life engineering scenarios.
- To provide an in-depth understanding of particle motion and its types, enabling learners to apply kinematic equations in various engineering and technological contexts.

- To introduce the motion analysis of rigid bodies using concepts like Instantaneous Centre of Rotation (ICR) and relate angular and linear velocities.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Ability to understand and analyse forces, force systems and equilibrium.	*Understand* & *Analyse*
CO2	Understand and verify law of Moments	*Understand* & *Apply*
CO3	Determine the centroid of plane lamina	*Apply*
CO4	Understand and apply basic concepts of Kinematics of particles and kinematics of rigid bodies.	*Understand* & *Apply*
CO5	Evaluate co-efficient of friction between the different surfaces in contact	*Evaluate*

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	System of Coplanar Forces	***Learning Objective:*** *This topic provides learner with the knowledge to find the resultant of a Coplanar force system. (C01, CO2).* **Contents:** Introduction to Force and Force systems (Concurrent, Parallel and General coplanar force system), resolution composition and resultant of force systems. Principle of transmissibility of a force, Moment of force about a point, Couples, Varignon's Theorem. Force couple system ***Self-Learning Topics***: *Newton's Laws of Motion* ***Learning Outcomes:*** *A learner will be able to:* *1.4 Analyze and resolve different types of coplanar force systems. (PI 1.1.1) (CO1)* *1.5 Apply the principle of transmissibility and calculate moment of force and couples. (PI 2.1.3) (CO2)* *1.6 Determine resultant of concurrent, parallel, and general force systems using analytical methods. (PI 2.2.3) (CO1)* *1.7 Use Varignon's Theorem to simplify moment calculations. (PI 1.3.2) (CO2)* *1.8 Relate Newton's Laws of Motion to static force systems. (PI 1.1.1) (CO1)*	6

2	Centroid	***Learning Objective:*** *This topic provides knowledge of centroid of plane area. (CO3)* **Contents:** First moment of Area, Centroid of Regular composite plane Laminas ***Self-Learning Topics****: NIL* ***Learning Outcomes:*** *A learner will be able to:* *2.1 Compute the centroid of regular and composite laminas using the concept of the first moment of area. (PI 1.1.1) (CO3)* *2.2 Develop mathematical models for centroidal calculations. (PI 2.3.4) (CO3)* *2.3 Solve real-life problems involving centroid locations (e.g., stability of structures). (PI 3.1.3) (CO3)* *2.4 Apply the concept of centroid to structural and mechanical applications. (PI 1.3.2) (CO3)*	4
3	Equilibrium	***Learning Objective:*** *On completion of this topic, students will be able to define the concept of equilibrium, understand various types of supports, and explain different types of loads. (CO1, CO2)* **Contents:** Equilibrium of rigid beams: Free body diagrams. Conditions of equilibrium. Types of supports & types of loads. Determination of supports reactions for different types of loads on the beams. ***Learning Outcomes:*** *A learner will be able to:* *3.1 Draw free-body diagrams for various support conditions. (PI 2.1.3) (CO1, CO2)* *3.2 Identify and classify types of supports and loads in a system. (PI 1.3.2) (CO1, CO2)* *3.3 Analyze equilibrium conditions of beams under various loading systems. (PI 2.2.3) (CO1, CO2)* *3.4 Calculate support reactions using conditions of equilibrium. (PI 2.3.4) (CO1, CO2)* *3.5 Correlate theoretical results with practical structural applications. (PI 5.2.6) (CO1, CO2)*	5
4	Friction	***Learning Objective:*** *On completion of this topic, students will be able to understand the concept of friction, evaluate the frictional forces needed for static equilibrium, and recognize its significance in everyday applications. (CO5).* **Content:**	4

		Coefficient of static and dynamic friction, Laws of friction, Angle of Friction, Angle of Repose. Concept of Cone of friction. Equilibrium of bodies on horizontal & inclined plane. ***Learning Outcomes:*** *A learner will be able to:* *4.1 Understand and differentiate between static and dynamic friction. (PI 1.1.1) (CO 5)* *4.2 Apply laws of friction in analyzing equilibrium on horizontal and inclined planes. (PI 2.2.3) (CO5)* *4.3 Evaluate the coefficient of friction and its effect on motion and design. (PI 3.2.4) (CO 5)* *4.4 Use real-world case studies to appreciate design considerations involving friction. (PI 6.1.5) (CO 5)* *4.5 Utilize simulation tools to visualize frictional effects. (PI 5.2.6) (CO 5)*	
5	Kinematics of particles	***Learning Objective:*** *This topic provides knowledge of the geometry of motion, enabling students to analyze various types of motion and apply this understanding in contexts such as video game development. (CO4).* **Content:** Uniformly accelerated motion along straight line, motion under gravity, Projectile Motion ***Learning Outcomes:*** *A learner will be able to:* *5.1 Analyze rectilinear motion with uniform and non-uniform acceleration. (PI 1.2.2) (CO 4)* *5.2 Apply equations of motion to particles under gravity. (PI 2.2.3) (CO 4)* *5.3 Evaluate projectile motion and trajectory paths. (PI 3.2.4) (CO 4)* *5.4 Solve kinematic problems using analytical and graphical approaches. (PI 2.3.4) (CO 4)* *5.5 Relate motion concepts to applications such as gaming, automation, or ADAS systems. (PI 6.2.5) (CO 4)*	7
6	Kinematics of rigid bodies	***Learning Objective:*** *This topic provides knowledge of the geometry of motion, enabling students to locate the Instantaneous Centre of Rotation (ICR) and establish the relationship between linear and angular velocity. (CO4).* **Contents:** Introduction to different types of motion a Rigid body performs viz. Translation, Rotation and General Plane motion. Concept of Instantaneous Centre of rotation (ICR) for the finding velocity. Locating ICR for multiple	4

		link mechanism. Velocity analysis of rigid body using ICR. ***Learning Outcomes:*** *A learner will be able to:* *6.1 Classify types of rigid body motion: translation, rotation, and general plane motion. (PI 1.3.2) (CO 4)* *6.2 Locate the Instantaneous Centre of Rotation (ICR) for velocity analysis. (PI 2.2.3) (CO 4)* *6.3 Apply velocity analysis methods to multi-link mechanisms. (PI 3.2.4) (CO 5)* *6.4 Correlate angular and linear motion in rigid bodies. (PI 2.3.4) (CO 4)* *6.5 Use ICR concepts in real-life applications such as robotics or vehicle systems. (PI 6.2.5) (CO 4)*	
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Verification of principle of moment / Bell crank lever using simulation software ***Learning Outcomes:*** *A learner will be able to verify the principle of moments and analyze torque in practical systems. (P.I. – 1.4.1 and 2.1.3) (CO 2)*
2.	Determination of support reactions of simply supported beam using simulation software ***Learning Outcomes:*** *A learner will be able to analyse support conditions and calculate reactions for beams. (P.I. – 2.1.3 and 2.1.4) (CO 1).*
3.	Determination of coefficient of friction using inclined plane method ***Learning Outcomes:*** *A learner will be able to determine and analyze frictional forces acting on inclined surfaces. (P.I. – 2.2.2 and 2.1.3) (CO 5).*
4.	Projectile Motion – By using simulation software ***Learning Outcomes:*** *A learner will be able to analyze the motion of particles under gravity and determine projectile parameters. (P.I. 1.3.2 and 2.1.2) (CO 4)*
5.	Verification of Law of Polygon of Coplanar Concurrent Forces ***Learning Outcomes:*** *A learner will be able to apply polygon laws to solve coplanar force systems. (P.I. – 1.4.1 and 2.2.3) (CO 1)*
6.	Determine the Centroid of plane lamina using simulation software ***Learning Outcomes:*** *A learner will be able to compute centroids of various plane shapes and composite laminas. (P.I. - 1.4.2 and 1.3.1) (CO 3)*
7.	Determination of coefficient of kinetic friction using D-Alembert Principle ***Learning Outcomes:*** *A learner will be able to apply D'Alembert's Principle for dynamic friction analysis. (P.I. – 2.2.2. and 2.1.2) (CO 5)*

8	Determination of stiffness of spring ***Learning Outcomes:*** *A learner will be able to determine stiffness using load-deformation characteristics. (P.I. – 1.3.2. and 2.1.4) (CO 1)*
9	Verification of Law of Polygon of Coplanar Non-Concurrent & Non-Parallel Forces ***Learning Outcomes:*** *A learner will be able to analyze and resolve general force systems using graphical methods. (P.I. – 2.1.4. and 2.2.3) (CO 1)*
10	Motion Curves – By using simulation software ***Learning Outcomes:*** *A learner will be able to interpret velocity-time and acceleration-time curves for linear motion. (P.I. – 1.4.4. and 1.3.2) (CO 4)*

Performance Indicators:

P.I. – 1.1.1: **Remembering**: Recall key mathematical formulas and concepts relevant to engineering problems.
P.I. – 1.2.2: **Understanding**: Interpret physical meaning and mathematical representation of engineering concepts.
P.I. 1.3.2: **Understanding**: Demonstrate understanding of engineering concepts through appropriate application in problem-solving.
P.I. – 1.3.2: **Understanding**: Illustrate engineering principles using examples, diagrams, or simulations.
P.I. – 1.4.3: **Applying:** Conduct experiments or use simulation tools to validate engineering principles.
P.I. – 1.4.4: **Analyzing**: Analyze results obtained from experiments or simulations for interpretation and validation.
P.I. – 2.1.3: **Applying**: Apply fundamental engineering and scientific principles to analyze real-world force systems.
P.I. – 2.1.4: **Analyzing**: Analyze systems using engineering fundamentals like equilibrium and motion.
P.I. – 2.1.3: **Applying**: Develop and interpret free body diagrams and apply to static systems.
P.I. – 2.1.3: **Applying**: Use suitable mathematical tools and methods to solve force and motion-related problems.
P.I. – 2.2.3: **Applying**: Solve particle motion problems using appropriate equations of motion.
P.I. – 2.2.3: **Applying**: Analyze forces considering friction and dynamic conditions.
P.I. – 2.2.4: **Analyzing**: Solve and interpret force and motion problems involving multiple force systems.
P.I. – 2.3.4: **Analyzing:** Construct and solve mathematical models for mechanical and structural systems.
P.I. – 3.1.3: **Applying**: Apply engineering knowledge to assess centroid and stability in real-life systems.
P.I. – 3.2.4: **Analyzing**: Apply motion analysis to dynamic systems like linkages and rigid bodies.
P.I. – 3.2.5: **Evaluating**: Evaluate effects of friction or projectile motion in system design or operation.
P.I. – 5.2.6: **Creating**: Use modern tools or simulations to visualize and verify engineering solutions.
P.I. – 6.1.5: **Evaluating**: Assess the significance of friction, stability, and safety in societal or design context.
P.I. – 6.2.5: **Evaluating**: Relate engineering mechanics concepts to applications in technology or industry (e.g., robotics, gaming, ADAS).

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1.1, 1.3.1, 2.1.2, 2.2.3, 2.3.2, 5.2.1
CO2	1.3.1, 2.1.1, 2.1.2, 2.2.3, 2.3.2, 5.2.1
CO3	1.1.1, 1.3.1, 2.3.2, 3.1.5
CO4	1.1.1, 2.2.3, 3.2.3, 5.2.1, 6.1.1

CO5	1.2.2, 1.3.1, 2.2.1, 2.2.2, 2.3.2, 3.2.1, 3.2.3, 6.2.1

Assessment Criterion of the Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria: The Learner can:**	**Evaluated under ISA/MSE/ESE/LAB**
LO 1.1: Analyze and resolve different types of coplanar force systems. (P.I.- 1.1.1) (CO1)	• Identify types of coplanar force systems (concurrent, parallel, general). • Resolve force systems graphically and analytically. • Calculate resultants using vector methods. • Interpret real-life situations using coplanar force systems.	ISA, MSE
LO 1.4: Navigate CAD software interface, menu systems, and toolbars. (P.I.- 1.4.2) (CO1)	• Open CAD software and locate interface components. • Use menu and toolbar options to initiate a new drawing. • Demonstrate a simple CAD sketch with basic tools. • Save, modify, and print a simple CAD file.	LAB, ISA
LO 2.1: Compute the centroid of regular and composite laminas. (P.I.- 1.1.1) (CO3)	• Define the concept of centroid and first moment of area. • Use standard formulas to calculate centroid of composite shapes. • Apply symmetry to reduce calculations. • Explain practical applications in structural design.	MSE, ESE
LO 3.1: Draw free-body diagrams for support conditions. (P.I.- 2.1.3) (CO1, CO2)	• Identify all forces acting on a structure. • Use standard symbols for supports and loads. • Label all dimensions and directions of forces correctly. • Construct free-body diagrams for different beams.	ISA, MSE
LO 4.1: Understand and differentiate between static and dynamic friction. (P.I.- 1.1.1) (CO5)	• Define and compare static vs. dynamic friction. • Identify situations involving both types of friction. • Explain real-world examples of friction in design. • Interpret effects of friction on motion.	ISA, MSE, LAB
LO 5.1: Analyze rectilinear motion with uniform and non-	• Define acceleration and types of motion. • Solve numerical problems on	ISA, MSE, ESE

uniform acceleration. (P.I.- 1.2.2) (CO4)	uniformly accelerated motion. • Sketch motion graphs for given scenarios. • Apply concepts to objects falling under gravity.	
LO 6.1: Locate the Instantaneous Centre of Rotation (ICR). (P.I.- 2.2.3) (CO4)	• Define ICR and its role in velocity analysis. • Identify ICR in link mechanisms. • Use ICR to relate angular and linear velocities. • Solve practical problems using ICR method.	ISA, MSE, LAB

Tools / Technologies / Software Learnt:

• Simulation Tools: Autodesk ForceEffect, Algodoo, SimScale, PTC Creo Mechanism, PhET Interactive Simulations

• Engineering Analysis Tools: MATLAB (for solving equilibrium and kinematics), GeoGebra (for graphical solutions)

• Diagramming Tools: Microsoft Visio, Lucidchart, AutoCAD (for drawing Free Body Diagrams and force systems)

• Measurement & Lab Simulation Tools: Virtual Labs (by MHRD), Online Inclined Plane Simulators, Projectile Motion Simulators

• Learning Platforms for Mechanics: NPTEL, MIT OCW, LearnEngineering YouTube Channel

• Assessment & Practice Tools: Edmodo, Google Forms with Auto-Grading, Labster Physics Simulations

• Kinematics Visualization Tools: Tracker Video Analysis Software, Physlets, Interactive Physics

Textbooks:

1. R.S. Khurmi, *"Engineering Mechanics"*, 23rd Edition, S. Chand Publishing, 2021
2. S.S. Bhavikatti, *"Engineering Mechanics"*, 5th Edition, New Age International, 2020

Reference Books:

1. F.L. Singer and K. Manicka Selvam, *"Engineering Mechanics"*, 3rd Edition, Harper Collins, 2017
2. Timoshenko and Young, *"Engineering Mechanics"*, 5th Edition, McGraw Hill Education, 2013
3. A.K. Tayal, *"Engineering Mechanics (Statics and Dynamics)"*, 14th Edition, Umesh Publications, 2019

Related / Equivalent MOOC and Associated Certification:

1. Engineering Mechanics – Statics and Dynamics – Core Certification Course
   • Platform: NPTEL (National Programme on Technology Enhanced Learning)
   • Link: https://nptel.ac.in/courses/112103109
2. Engineering Mechanics – Equivalent Introductory Course
   • Platform: Coursera (offered by Georgia Institute of Technology)
   • Link: https://www.coursera.org/learn/engineering-mechanics-statics
3. Engineering Statics – Foundational Course
   • Platform: edX (offered by Georgia Tech)
   • Link: https://www.edx.org/course/engineering-statics
4. Mechanics / Dynamics – Advanced Visual Learning Series
   • Platform: MIT OpenCourseWare
   • Link: https://ocw.mit.edu/courses/mechanical-engineering/2-003sc-engineering-dynamics-fall-2011/

Course Name: Basic Electrical & Electronics Engineering

Course Code: ES08T & ES08P

Vertical/ Sub-Vertical: ESC

K-S-A Mapping: Knowledge and Skill

Pre-requisite required: Nill

Pre-requisite for:

Recommended Semester:

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
ES08T	2	-	2	-
ES08P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (ES08T)	15(~20%)	20(~30%)	40(~50%)	75(100%)
Practical (ES08P)	25(50%)		25(50%)	50(100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

This course introduces learners to basic techniques for electrical circuit analysis.

Course Objectives:

- To enable learners to gain understanding of the D.C circuit analysis and different network theorem.
- To facilitate learners in developing the skills analysing single and three phase AC circuits.
- To create awareness of single-phase transformer working.
- To introduce basic Electronics Devices applications.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level

CO1	Evaluate DC circuits using different network theorems.	Evaluating
CO2	Evaluate 1-Φ circuit and 3-Φ AC circuits.	Evaluating
CO3	Illustrate the constructional features and operation of 1-Φ transformer.	Illustration
CO4	Understand different types of electronic circuits.	Analysing

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	DC Circuits (Only Independent Sources)	***Learning Objective:*** *Introduce the concept of electrical engineering and DC circuits. (CO1).* ***Contents:*** Kirchhoff's Laws, Ideal and practical voltage and current Sources, Source Transformation, Star-Delta / Delta-Star Transformations, Mesh and Nodal Analysis, Superposition Theorem, Thevenin's Theorem, Norton's Theorem and Maximum Power Transfer Theorem. ***Learning Outcomes:*** *A learner will be able to:* *1.1 Recall the basic definitions of electrical and electronics engineering. (P.I.-1.1.1 and 1.2.1) (CO1)* *1.2 Explain principles of electrical and electronics engineering with examples. (P.I -1.2.3 and 1.3.2) (CO1, CO2)*	10
2	AC Circuits	***Learning Objective:*** *Understand the functionality, implementation, and applications of Single phase Series and Parallel circuits (CO2, CO3)* ***Contents:*** *AC Circuits: Generation of alternating voltage, basic definitions, average and R.M.S. values, phasor and phase difference, sums on phasors. Single-phase ac series and parallel circuits consisting of R, L, C, RL, RC, RLC combinations, definitions - real, reactive and apparent power, admittance (Y), Series and parallel resonance, Q factor* ***Learning Outcomes:*** *A learner will be able to:* *2.1* ***Explain*** *the* ***generation of alternating voltage*** *and define key terms such as frequency, period, amplitude, and phase angle. (P.I.- 1.3.2 and 1.3.6) (CO2)* *2.2* ***Solve*** *numerical problems involving* ***phasor algebra*** *and the use of complex numbers in AC analysis. (P.I.-1.2.4 and 1.2.5) (CO2, CO4)*	8

		2.3 ***Analyze*** *single-phase* ***AC circuits*** *(series and parallel) composed of* ***R, L, C, RL, RC, and RLC*** *combinations using phasor and impedance methods. (P.I.-1.4.4) (CO2)*	
3	Three Phase AC circuits	***Learning Objective:*** *Understand* ***the fundamental concepts*** *of three-phase AC systems, including phase sequence, line and phase voltages, and current relationships. (CO2)* ***Contents:*** *Generation of Three-Phase Voltages, voltage & current relationships in Star and Delta Connections, Power Measurement* ***Learning Outcomes:*** *A learner will be able to:* *3.1 Interpret the waveform and phasor representations of generated three-phase voltages. (P.I.-1.2.3, 1.4.1) (CO2)* *3.2 Derive and apply the relationships between line and phase voltages and currents for Star and Delta configurations. (P.I.- 2.1.1, 2.3.1) (CO2 and CO4)* *3.3 Analyze how power measurements differ between balanced and unbalanced loads (P.I.-2.4.2, 3.1.1) (CO2)*	3
4	Single Phase Transformer	***Learning Objective: To understand the construction, working principle, and performance of a single-phase transformer, and to analyze its voltage, current, and power relationships under various operating conditions. (CO3)*** ***Contents:*** *Working principle, EMF equation, Transformer losses, Comparison between Actual (practical) and ideal transformer, Performance parameters, Phasor diagram* ***Learning Outcomes:*** *A learner will be able to:* *4.1* ***Analyze transformer operation under no-load and load conditions****, and interpret phasor diagrams accordingly. (P.I.-1.2.4, 2.2.3) (CO3)* *4.2* ***Perform calculations*** *for voltage, current, and power in the primary and secondary windings of ideal and practical transformers. (P.I.-2.1.1, 2.1.4) (CO3)*	5
5	Applications of Basic Electronics Devices	***Learning Objective: To understand, d****efine and explain the basic characteristics of electronic devices such as diodes, transistors, and operational amplifiers.*	4

		Diagnose faults in simple electronic circuits using multimeters and oscilloscopes. (CO4) ***Contents:*** *Rectifier circuits using diodes, filter circuits using inductor and capacitor, voltage regulator using diode, Transistor as a switch.* ***Learning Outcomes:*** *A learner will be able to:* *5.1 Describe the working principles of half-wave, full-wave, and bridge rectifiers. (P.I.-2.1.1, 2.1.2) (CO4)* *5.2 Design and implement simple capacitor, inductor, and LC filter circuits. (P.I.-2.2.6) (CO4)* *5.3 Analyze the output waveform of filtered rectifier circuits using measurement tools. (P.I.- 1.3.4, 2.4.4) (CO4)*	
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Implement output voltage across load resistor using mesh and nodal analysis ***Learning Outcomes:*** *A learner will be able to:* *1.1 Apply Mesh and Nodal analysis techniques to determine the theoretical values of voltage across and current through a load resistor in a given electrical circuit. (P.I.-1.1.1, 1.2.2, 1.2.3) (CO1)*
2.	Implementation of Superposition Theorem. ***Learning Outcomes:*** *A learner will be able to:* ***1.1 Analyze*** *a given electrical circuit by considering the effect of each independent source acting alone, while replacing others with their internal resistances. (P.I.-1.1.4) (CO1)*
3.	Implementation of Thevenin's Theorem. ***Learning Outcomes:*** *A learner will be able to:* *1.3 Apply Thevenin's Theorem to reduce a linear two-terminal circuit to its equivalent form. (P.I.-1.3.2, 1.3.3) (CO1)*
4.	Implementation of Norton's Theorem ***Learning Outcomes:*** *A learner will be able to:* *2.1 Convert a complex circuit into its Norton equivalent using systematic steps. (P.I.-2.1.1, 2.1.5)(CO1)*
5.	Implementation of Maximum Power Transfer Theorem ***Learning Outcomes:***

	A learner will be able to: *2.3 Verify the theoretical predictions of maximum power transfer through practical measurement or circuit simulation. (P.I-.2.3.1, 2.3.3) (CO1)*
6.	Implement resonance conditions in a R-L-C series resonance circuit ***Learning Outcomes:*** *A learner will be able to:* *2.3 Interpret frequency response curves to observe resonance effects. (P.I.-2.3.2) (CO 2)*
7.	Implementation of three phase system (Star & Delta) ***Learning Outcomes:*** *A learner will be able to:* *2.3 Explain Phase vs. line voltage and current relationships in both Y and Δ systems. (P.I.-2.3.1) (CO2)*
8.	Implementation of Power and phase in three phase system by two wattmeter method. ***Learning Outcomes:*** *A learner will be able to:* *2.4 Interpret data and draw conclusions about system behaviour, power consumption, and efficiency. (P.I-2.4.1, 2.4.5) (CO3)*
9.	Implementation of OC and SC test on single phase transformer ***Learning Outcomes:*** *A learner will be able to:* *2.3 Determine **voltage regulation**, which indicates the change in secondary voltage from no-load to full-load conditions. (P.I.- 2.3.1, 2.3.4) (CO4)*

Performance Indicators:

PI 1.1.1 Remembering: Recall key mathematical formulas and concepts relevant to engineering problems.
PI 1.1.2 Understanding: Explain how mathematical models are used to represent engineering systems or processes.
PI 1.1.3 Applying: Solve engineering problems by applying appropriate mathematical models and methods.
PI 1.1.4 Analyzing: Break down a complex engineering problem into mathematical components to evaluate relationships
PI 1.2.1 Remembering: Identify core principles of physics and chemistry relevant to engineering.
PI 1.2.2 Understanding: Describe how basic science concepts apply to material behavior and engineering
PI 1.2.3 Applying: Use scientific laws (e.g., Newton's laws, conservation laws) to solve basic engineering
PI 1.2.4 Analyzing: Examine the interaction between scientific principles in multi-disciplinary engineering systems
PI 1.3.2 Understanding: Explain the relevance of basic engineering principles to real-world problems.
PI 1.3.3 Applying: Perform calculations and simulations to solve simple engineering tasks.
PI 1.3.4 Analyzing: Deconstruct engineering scenarios to identify fundamental principles at work.
PI 2.1.1 Remembering: Recall relevant engineering principles, theories, and concepts to identify a problem.
PI 2.1.2 Understanding: Explain the key features and scope of a complex engineering problem.
PI 2.1.4 Analyzing: Decompose a complex engineering problem into its constituent parts to identify critical aspects.
PI 2.1.5 Evaluating: Assess the relevance and significance of various problem aspects using evidence-based reasoning.
PI 2.2.3 Applying: Develop a basic solution plan using a systematic approach to solve an identified problem.
PI 2.2.6 Creating: Design a comprehensive and innovative solution plan, integrating multidisciplinary methods if necessary.
PI 2.3.1 Remembering: Identify the types of models (e.g., mathematical, physical, computational) used in engineering problem-solving.
PI 2.3.2 Understanding: Explain the purpose and assumptions of a model in the context of a specific engineering problem.
PI 2.3.3 Applying: Construct a basic model to represent a complex engineering system or process.
PI 2.3.4 Analyzing: Evaluate the model's validity by interpreting results and assessing assumptions.

PI 2.4.1 Remembering: Recall procedures and tools required for executing an engineering solution process.
PI 2.4.4 Analyzing: Examine the results of the solution process to determine trends, patterns, and inconsistencies.
PI 2.4.5 Evaluating: Critically assess the solution's accuracy and efficiency, and propose improvements if necessary.

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1, 1.2
CO2	1.2, 2.1, 2.2, 2.3, 3.1, 3.2, 3.3
CO3	4.1, 4.2
CO4	2.2, 3.2, 5.1, 5.2, 5.3

Mapping of Course Outcomes with Programme Outcomes:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO7**	**PO8**	**PO9**	**P010**	**PO11**	**PO12**
CO1	2/24	-	-	-	-	-	-	-	-	-	-
CO2	9/24	3/24	-	-	-	-	-	-	-	-	-
CO3	1/24	3/24	-	-	-	-	-	-	-	-	-
CO4	1/24	4/24	-	-	-	-	-	-	-	-	-

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria: The Learner can:**	**Evaluated under ISA/MSE/ESE/LAB**
LO1.1: *Recall the basic definitions of electrical and electronics engineering. (P.I.-1.1.1 and 1.2.1) (CO1)*	• The student can define what are electrical and electronics circuit parameters • The student is able to list different electrical and electronics parameters • The student can able to understand the roles and applications of electrical and electronics engineering in real-world technology and infrastructure.	MSE ISA ESE
LO1.2: *Explain principles of electrical and electronics engineering with examples. (P.I -1.2.3 and 1.3.2) (CO1, CO2)*	• The student can describe the electrical and electronics principles. • The student provides relevant examples of kirchoff's current and voltage law	MSE ISA ESE

	• The student can explain AC v/s DC principle.	
LO2.1: *Explain the generation of alternating voltage and define key terms such as frequency, period, amplitude, and phase angle. (P.I.- 1.3.2 and 1.3.6) (CO2)*	• The student can Identifies and defines key terms: frequency, period, amplitude, and phase angle. • The student can clearly explains the working principle of AC voltage generation using electromagnetic induction. • The student can demonstrates understanding by relating waveform features to definitions (e.g., sine wave graph)	ISA MSE ESE
LO2.2: *Solve numerical problems involving phasor algebra and the use of complex numbers in AC analysis. (P.I.- 1.2.4 and 1.2.5) (CO2, CO4)*	• The student can correctly converts sinusoidal quantities to phasor (polar or rectangular) form. • The student can accurately performs phasor operations (addition, subtraction, multiplication, division) • The student can correctly solves numerical problems involving AC quantities (impedance, voltage, current, power)	MSE LAB ESE
LO2.3: *Analyze single-phase AC circuits (series and parallel) composed of R, L, C, RL, RC, and RLC combinations using phasor and impedance methods. (P.I.- 1.4.4) (CO2)*	• The student is able to identify circuit components and configurations (series or parallel) • The student can calculate total impedance of R, L, C, RL, RC, or RLC combinations using complex numbers • The student is able to apply phasor algebra correctly to analyze voltages and currents in the circuit • Determines and interprets power quantities (active, reactive, apparent power and power factor)	LAB MSE ESE
LO 3.1: *Interpret the waveform and phasor representations of generated three-phase voltages. (P.I.-1.2.3, 1.4.1) (CO2)*	• The student can define Identify the characteristics of a balanced three-phase voltage waveform (magnitude, frequency, phase shift • The student is able to accurately sketches or interprets sinusoidal waveforms for three-phase voltages (R, Y, B) • The student explains the relationship between time-	MSE ISA ESE

	domain waveforms and phasor-domain representation	
LO 3.2: *Derive and apply the relationships between line and phase voltages and currents for Star and Delta configurations. (P.I.- 2.1.1, 2.3.1) (CO2 and CO4)*	• The student is able to derives voltage and current relationships for Star (Y) and Delta (Δ) configuration • The student can Correctly applies relationships to solve numerical problems involving line and phase quantities in Y and Δ systems • The student can illustrates understanding with clear phasor diagrams or configuration schematics for Star and Delta connections	ISA MSE,LAB ESE
LO 3.3 *Analyze how power measurements differ between balanced and unbalanced loads (P.I.-2.4.2, 3.1.1) (CO2)*	• The student is able to clearly explains the characteristics of balanced and unbalanced three-phase loads • The student can Describes how power is calculated in balanced loads using appropriate formulas • The student can analyzes power measurement techniques for unbalanced loads (e.g., three-wattmeter vs two-wattmeter method)	MSE ISA ESE
LO 4.1: *Analyze transformer operation under no-load and load conditions, and interpret phasor diagrams accordingly. (P.I.-1.2.4, 2.2.3) (CO3)*	• The student is able to accurately explains transformer working principle and distinguishes between no-load and load conditions • The student can Analyzes behavior of primary and secondary voltages, currents, and flux under no-load and load conditions • The student can Draws or interprets accurate phasor diagrams for both no-load and loaded transformer conditions • The student can demonstrates correct application of transformer equivalent circuit concepts	ESE ISA,LAB MSE, LAB MSE
LO 4.2: *Perform calculations for voltage, current, and power in the primary and secondary windings of ideal and practical transformers. (P.I.-2.1.1, 2.1.4) (CO3)*	• The student can correctly applies transformer voltage and current transformation equations for ideal transformers • The student can performs power calculations for primary and	ISA LAB,ISA

	secondary windings considering ideal transformer conditions • The student is able to incorporates losses and efficiency factors to analyze practical transformer performance • The student can solve numerical problems involving voltage regulation and efficiency of transformers	MSE,ESE
LO 5.1: *Describe the working principles of half-wave, full-wave, and bridge rectifiers. (P.I.-2.1.1, 2.1.2) (CO4)*	• The student can clearly explains the basic operation of a half-wave rectifier, including input-output waveforms • The student can describes the working principle of full-wave rectifier (center-tapped and bridge types) with relevant diagrams • The student is able to identify and explain the advantages and disadvantages of each rectifier type	ISA,MSE MSE MSE,ESE
LO 5.2: *Design and implement simple capacitor, inductor, and LC filter circuits. (P.I.-2.2.6) (CO4)*	• The student is able select appropriate components (capacitor, inductor values) based on filter type and design requirements • The student can design basic filter circuits (capacitor-only, inductor-only, and LC combinations: low-pass, high-pass) • The student can Correctly implements the designed filter circuit on simulation software or breadboard • The student is able test and analyze circuit behaviour, including cut-off frequency and signal attenuation	LAB LAB LAB LAB
LO 5.3: *Analyze the output waveform of filtered rectifier circuits using measurement tools. (P.I.- 1.3.4, 2.4.4) (CO4)*	• The student is able Analyzes waveform shape (with and without filter) and explains the effect of filtering components • The student can able to compare filtered vs unfiltered waveforms and explains differences in ripple and DC output	ESE ISA,MSE

Textbooks:

1. V. N. Mittal and Arvind Mittal "Basic Electrical Engineering" Tata McGraw Hill, (Revised Edition) S. S. Dara, "Engineering Chemistry", Chand & Co, New Delhi (2006)
2. Vincent Del Toro "Electrical Engineering Fundamentals", PHI Second edition, 2011
3. Edward Hughes "Hughes Electrical and Electronic Technology", Pearson Education (Tenth edition)
4. D P Kothari and I J Nagrath "Theory and Problems of Basic Electrical Engineering", PHI 13th edition 2011.
5. M. Naidu,S. Kamakshaiah "Introduction to Electrical Engineering" McGraw-Hill Education, 2004
6. B.R Patil "Basic Electrical Engineering" Oxford Higher Education, Revised Second Edition, 2018

Reference Books:

1**.** B.L.Theraja "Electrical Engineering " Vol-I and II.
2. S.N.Singh, "Basic Electrical Engineering" PHI , 2011Book

Course Name: Physics for Biomedical Engineering

Course Code: PCBM01T&P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge

Pre-requisite required: Vector Calculus, Differential Equations, Linear Algebra and Basic 12th standard Physics

Pre-requisite for: -

Recommended Semester: 1

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
PCBM01T	2	--	2	-
PCBM01P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

Most of the engineering branches are being offspring of basic sciences where physics plays a pivotal role in concept and understanding the foundation of core engineering branches. Physics prepares students to apply physics to tackle 21st century engineering challenges, and to apply engineering to address 21st century questions in physics.

Course Objectives:

• The course will develop the student awareness in semiconductor devices and quantum Physics
•The student will develop an informed appreciation of the paradigm shift already in evidence in technologies behind modern services and products.
•He will possess basic physics knowledge to pursue simulation and modelling of semiconductor systems.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level

CO1	Understand the concept of thin film technology using interference and diffraction	Remember
CO2	Understand the band theory of solids and the carrier concentration in solids	Understand
CO3	Analyse the charge distribution and charge transport processes in semiconductors	Apply
CO4	Apply the knowledge of Fermi level in semiconductors and applications of semiconductors in electronic devices	Analyze
CO5	Understand different methods to generate ultrasonic waves	Evaluate
CO6	Illustrate the working principle of various lasers and quantum processes	Create

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Fundamentals of Optics	***Learning Objective:*** *Understand the principles of optical interference and diffraction, and apply them to analyze phenomena such as thin film patterns, Newton's rings, and diffraction through slits and gratings.. (C01).* **Contents:** Interference by division of amplitude, Interference in thin film of constant thickness due to reflected and transmitted light; Wedge shaped film; Newton's rings. Diffraction: Fraunhofer diffraction at single slit, Diffraction Grating, resolving power of a grating; Determination of wavelength of light using plane transmission grating ***Self-Learning Topics***: Explore fringe formation in wedge films and Newton's rings, phase shift on reflection, intensity patterns in single-slit diffraction, grating equation, and resolving power of optical instruments. ***Learning Outcomes:*** *1.1 – Recall the fundamental principles of interference and diffraction to identify experimental conditions that produce observable patterns. (CO1, PI 1.2.1)1.2 – Explain the formation of interference patterns in wedge films and*	5

		Newton's rings, and the role of diffraction gratings in wavelength measurement. (CO2, PI 1.2.1) *1.3 – Apply theoretical formulas and optical instrument techniques to compute fringe spacing, wavelength, and grating resolution. (CO3, PI 2.4.1)*	
2	Semiconductor Physics	***Learning Objective:*** *Explain the classification of semiconductors, band theory, and the role of Fermi energy in determining carrier concentration(CO2)* **Contents:** Band theory of solids, Classification of semiconductors. Fermi-Dirac statistics, carrier concentrationin semiconductors. Concept of Fermi energy level, its position and variation with temperature and impurity concentration.. ***Self-Learning Topics****: Study intrinsic vs extrinsic semiconductor energy diagrams and temperature dependence of carrier concentration.* ***Learning Outcomes:*** *A learner will be able to:* 1. *2.1: Describe the band theory of solids and energy band diagrams. (P.I. – 1.2.2 and 1.3.1) (CO2)* 2. *2.2: Explain Fermi-Dirac distribution and calculate carrier concentration. (P.I. – 1.4.2 and 2.1.2) (CO2)* 3. *2.3: Classify semiconductors using band structure. (P.I. – 1.2.2 and 2.1.4) (CO2)*	5
3	Semiconductor Conductivity	***Learning Objective:*** *Apply principles of drift, diffusion, and the Hall effect to analyze charge transport and conductivity in semiconductors.(CO3)* **Contents:** Intrinsic carrier density, mobility, and conductivity. Carrier diffusion, drift, and resistance. Electrical conduction in extrinsic semiconductor. Diffusion length and mean lifetime. Hall Effect. ***Learning Outcomes:*** *A learner will be able to:*	5

		1. *3.1: Calculate current density from drift and diffusion mechanisms. (P.I. – 2.3.1 and 2.4.1) (CO3)3.2: Explain and apply the Hall effect to determine carrier concentration and type. (P.I. – 1.3.1 and 1.2.2) (CO3)3.3: Analyze the influence of mobility and lifetime on conductivity. (P.I. – 2.1.4 and 2.2.3) (CO3)*	
4	Semiconductor Devices	***Learning Objective:*** *Analyze the operation of p-n junctions and associated devices using band bending and Fermi level concepts.(CO4)* **Content:** Physics of p-n junctions. Fermi level - in equilibrium, in forward and in reverse bias. Band bending in forward and reverse bias junction Introduction to two terminal devices – Rectifier diode, LED, Zener diode, PIN diode, Solar Cell, Schottky diode etc. ***Learning Outcomes:*** *A learner will be able to:* *4.1: Explain Fermi level shift and band bending under bias conditions. (P.I. – 2.1.2 and 2.2.1) (CO4)4.2: Describe the working of diodes like LED, Zener, and PIN diode. (P.I. – 1.4.2 and 2.1.2) (CO4)4.3: Analyze the current-voltage characteristics of different p-n junction devices. (P.I. – 3.1.1 and 3.2.1) (CO4)*	5
5	Physics of Sound	***Learning Objective*** *Understand the principles of ultrasonic wave generation and explore their applications in industrial, medical, and sensing technologies..(CO2)* **Content:** Ultrasonic Wave generation; Magnetostriction Oscillator; Piezoelectric Oscillator. Applications of ultrasonic: Eco sounding; NDT; ultrasonic cleaning(cavitation); ultrasonic sensors; Industrial applications of ultrasonic (soldering, welding, cutting, drilling) ***Learning Outcomes:***	4

		1.1 – Recall the working principles of magnetostriction and piezoelectric oscillators for ultrasonic wave generation. (CO1, PI 1.2.1) *1.2 – Explain the applications of ultrasonic waves in industrial, medical, and sensing domains. (CO2, PI 1.2.1)* *1.3 – Apply the concepts of ultrasonic wave propagation to analyze techniques like eco-sounding, NDT, and ultrasonic cleaning. (CO3, PI 2.4.1)*	
6	Lasers	***Learning Objective:*** *Illustrate laser working principles and compare the structure and applications of various laser systems. (CO6)* **Contents:** Radiation Matter Interactions, Einstein's coefficients. Basics of Laser- Population inversion, Pumping, Optical Resonator, Metastable state etc. Laser Beam Characteristics. Laser Systems - Ruby laser, He-Ne Laser, Semiconductor Laser, Nd-YAG Laser. Engineering applications of Laser. ***Learning Outcomes:*** *A learner will be able to:* *6.1: Explain the concept of stimulated emission and population inversion. (P.I. – 1.2.2 and 2.1.2) (CO6)6.2: Describe the working of different laser systems. (P.I. – 3.1.1 and 4.3.2) (CO6)6.3: Identify engineering applications of lasers. (P.I. – 3.2.1 and 3.3.2) (CO6)*	4
7	Introduction to Quantum Physics	***Learning Objective:*** *Explain the fundamental concepts of quantum mechanics including matter waves and Schrödinger's equation. (CO6)* **Contents:** De Broglie hypothesis of matter waves; properties of matter waves. Physical interpretation of wave function	

		Introduction to Schrodinger's equations ***Learning Outcomes:*** *A learner will be able to:* *7.1: State the de Broglie hypothesis and derive the expression for matter waves. (P.I. – 1.2.1 and 2.1.2) (CO2)7.2: Explain the significance of wave function and probability density. (P.I. – 2.1.2 and 2.3.1) (CO2)7.3: Apply Schrödinger's equation to basic quantum systems. (P.I. – 2.4.1 and 2.2.3) (CO2)*	
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Determination of diameter of wire/hair or thickness of paper using Wedge shape film method. ***Learning Outcome:*** *A learner will be able to:* *Apply interference concept to determine small thickness of a wedge film.CO2* *P.I-1.2.1, 2.4.1*
2.	Determination of refractive index of water using Newton's Ring. ***Learning Outcome:*** *A learner will be able to:* *Analyze Newton's rings to calculate refractive index of a liquid. CO2* *P.I.-4.1.2, 4.6.4*
3.	Study of Hall Effect. ***Learning Outcome:*** *A learner will be able to:* *Apply Hall effect principles to determine carrier type and mobility. CO1* *P.I-1.2.1, 2.4.2*
4.	Determination of energy band gap of semiconductor. ***Learning Outcome:*** *A learner will be able to:* *Calculate the band gap of a semiconductor using temperature vs current graph.CO1* *P.I-2.4.1, 2.4.4*
5.	Study of I/V characteristics of LED. ***Learning Outcome:*** *A learner will be able to:* *Analyze the electrical behavior of an LED to identify threshold voltage.CO1, CO3* *P.I.-1.3.1, 2.4.2*

6.	Determination of 'h' using Photocell. ***Learning Outcome:*** *A learner will be able to:* *Determine Planck's constant using photoelectric effect and graphical analysis.CO5* *P.I-2.4.1, 2.4.2*
7.	Study of I/ V characteristics of semiconductor diode ***Learning Outcome:*** *A learner will be able to:* *Analyze the behavior of a semiconductor diode under forward/reverse bias. CO1* *P.I-1.3.1, 2.4.2*
8.	Determination of wavelength using Diffraction grating. (Hg/Na source) ***Learning Outcome:*** *A learner will be able to:* *Calculate the wavelength of light using diffraction grating and known light sources. CO2* *P.I-1.2.1, 4.1.2*
9.	Determination of number of lines on the grating surface using LASER Source. ***Learning Outcome:*** *A learner will be able to:* *Calculate number of lines on a grating using LASER diffraction.CO3* *P.I-5.2.2*
10.	Determination of Numerical Aperture of an optical fibre. ***Learning Outcome:*** *A learner will be able to:* *Measure numerical aperture and acceptance angle of a fibre.CO4* *P.I- 1.2.1, 2.4.1*
11.	Determination of wavelength using Diffraction grating. (Laser source) ***Learning Outcome:*** *A learner will be able to:* *Determine wavelength of LASER using diffraction method. CO3* *P.I-5.2.2*
12.	Study of divergence of laser beam. ***Learning Outcome:*** *A learner will be able to:* *Analyze divergence angle of a LASER beam through experimental setup.CO3* *P.I-5.2.2*
13.	Determination of refractive index of water using Laser source. ***Learning Outcome:*** *A learner will be able to:* *Evaluate refractive index of water using angle of incidence/refraction with LASER.CO2* *P.I-4.6.2, 4.6.4*

Performance Indicators:

P.I. – 1.1.1: **Remembering** – Recall key mathematical formulas and concepts relevant to engineering problems.
P.I. – 1.2.1: **Applying** – Apply laws of natural science to an engineering problem.
P.I. – 1.2.2: **Understanding** – Describe how basic science concepts apply to material behavior and engineering systems.

P.I. – 1.3.1: **Remembering** – List fundamental engineering principles (e.g., Ohm's law, Bernoulli's equation) and their applications.
P.I. – 1.3.2: **Understanding** – Explain the relevance of basic engineering principles to real-world problems.
P.I. – 1.4.2: **Understanding** – Explain the functions of specialized engineering systems in the computer engineering domain.
P.I. – 2.1.2: **Understanding** – Explain the key features and scope of a complex engineering problem.
P.I. – 2.1.4: **Analyzing** – Decompose a complex engineering problem into its constituent parts to identify critical aspects.
P.I. – 2.2.1: **Analyzing** – Identify functionalities and computing resources for the system.
P.I. – 2.2.3: **Analyzing** – Identify existing solutions or methods to solve the problem.
P.I. – 2.3.1: **Applying** – Apply engineering principles to formulate modules of a system.
P.I. – 2.4.1: **Applying** – Apply engineering mathematics to implement the solution.
P.I. – 3.1.1: **Defining / Applying** – Define a precise problem statement with objectives and scope.
P.I. – 3.2.1: **Creating / Evaluating** – Explore design alternatives and analyze solutions.
P.I. – 3.2.2: **Creating / Evaluating** – Produce a variety of potential design solutions.
P.I. – 3.3.1: **Evaluating** – Perform systematic evaluation of design concepts.
P.I. – 3.3.2: **Evaluating / Creating** – Consult experts to select the candidate engineering design.
P.I. – 4.3.2: **Analyzing** – Analyze and interpret data for trends and correlations.
P.I. – 5.1.1: **Applying** – Use modern tools, techniques, and resources to solve engineering problems.
P.I. – 5.2.1: **Applying / Evaluating** – Select appropriate software tools for solving computational tasks.

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1, 1.3
CO2	1.2, 2.1, 2.2, 2.3, 7.1, 7.2, 7.3
CO3	3.1, 3.2, 3.3
CO4	4.1, 4.2, 4.3
CO5	5.1, 5.2, 5.3

Mapping of Course Outcomes with Programme Outcomes:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO7**	**PO8**	**PO9**	**P010**	**PO11**	**PO12**
CO1	4/48	-	-	-	-	-	-	-	-	-	-
CO2	5/48	-	-	-	-	-	-	-	-	-	-
CO3	6/48	-	-	-	-	-	-	-	-	-	-
CO4	5/48	-	-	-	-	-	-	-	-	-	-
CO5	6/48	-	-	-	-	-	-	-	-	-	-
CO6	5/48	-	-	-	-	-	-	-	-	-	-

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria: The Learner can:**	**Evaluated under ISA/MSE/ESE/LAB**

LO1: The learner will be able to explain Fermi level behavior, analyze semiconductor properties, and describe the operation of devices like LEDs and solar cells.	1.1 Define and explain Fermi level and band structure..	ISA, LAB, MSE, ESE
	1.2 Analyze doping effects and carrier mobility.	ISA,LAB
	1.3 Demonstrate Hall effect setup and data analysis.	ISA,LAB
	1.4 Explain LED/solar cell operation with diagrams..	ISA,MSE
	1.5 Perform lab experiments on diode characteristics.	LAB
LO2: The learner will interpret lattice geometry and crystal defects, and apply Miller indices in structure identification.	2.1 Identify Bravais lattices and unit cells.	ISA,LAB,MSE,ESE
	2.2 Interpret Miller indices and lattice planes.	ISA,LAB
	2.3 Classify and explain the impact of crystal defects.	ISA,LAB
	2.4 Apply interplanar spacing formula using Miller indices.	ISA,MSE
	2.5 Perform crystallography experiments using simulations.	LAB
LO3: The learner will understand wave-particle duality, quantum equations, and apply them to atomic-scale systems.	3.1 Explain de Broglie hypothesis and matter waves.	ISA,LAB,MSE
	3.2 Apply Schrödinger's equation to potential well problems.	ISA,LAB,MSE
	3.3 Interpret wave function and probability distributions.	ISA,MSE,ESE
	3.4 Analyze energy quantization and uncertainty principles.	ISA,MSE,LAB
	3.5 Perform quantum experiments like Planck's constant.	LAB
LO4: The learner will learn the physics of LASER action, types of LASERs, and their practical applications in optics and imaging.	4.1 Explain spontaneous and stimulated emission principles.	ISA,LAB,MSE,ESE
	4.2 Compare types of lasers: He-Ne, Nd:YAG, semiconductor.	ISA,LAB,MSE,ESE
	4.3 Explain population inversion and pumping methods.	ISA,LAB
	4.4 Apply laser principles in holography and imaging.	ISA,LAB
	4.5 Perform laser-based experiments (divergence, grating).	LAB
LO5: The learner will understand the principles of light propagation	5.1 Calculate numerical aperture, V-number, and acceptance angle.	ISA,LAB,MSE,ESE

in optical fibres and their use in communication systems.		
	5.2 Explain light propagation and supported modes.	ISA,LAB,MSE,ESE
	5.3 Classify step-index vs graded-index fibres.	ISA,LAB
	5.4 Describe fibre optic communication system block diagram.	ISA,LAB
	5.5 Perform numerical aperture and fibre demo.	LAB
LO6: The learner will learn the working principles of resistive, piezoelectric, and optical sensors and their calibration techniques.	6.1 Explain working of PT100, piezoelectric, and photodiode sensors.	
	6.2 Demonstrate calibration and operation principles.	
	6.3 Analyze sensor outputs and measurement accuracy.	
	6.4 Discuss application suitability of various sensors.	
	6.5 Perform experiments on PT100, piezo, and optical sensors.	

Tools/ Technologies/ Programming Languages learnt:

- Wedge film setup
- Newton's Rings apparatus
- Diffraction grating (Hg/Na/Laser)
- Optical fiber kit
- Photocell setup
- Semiconductor devices (Diode, LED, Zener, PIN, Schottky, Solar cell)
- Laser systems (Ruby, He-Ne, Semiconductor, Nd-YAG)
- Liquid crystals and LCDs
- Multiferroics and magnetoresistive materials (GMR, CMR)
- Spintronics
- Band theory and Fermi-Dirac tools
- Hall effect setup
- Quantum models and Schrödinger equation
- Python, MATLAB, COMSOL (implied for simulation)

Textbooks:

1. John Wiley ,S.M. Sze Physics of Semiconductor Devices,
2. Prentice Hall India, B. Streetman, and S. Banerjee, Solid State Electronics,
3. Narosa 2008 R.P. Feynman, "The Feynman Lectures on Physics (Vol. 1-3)",
4. Pearson Education 2013-I.S. Tyagi, "Principles of Quantum Mechanics",

5. D.J. Griffiths," Introduction to Quantum Mechanics"
6. R Shankar, second edition Principles of Quantum Mechanics

Reference Books:

1. Lasers- Fundamentals and Applications, Ajoy Ghatak K.Thyagarajan, S-Chand, 2016
2. Solid State Physics, Neil Ashcroft (Author), N. Mermin (Author), Dan Wei (Author), Cengage Learning Asia, 2016
3. Concepts of Modern Physics, Arther Beiser, Tata McGraw Hill, 2024
4. Principles of Quantum Mechanics, R. Shankar, Springer, 2011
5. Physics of Semiconductor Devices, S M Sze, Wiley, 2024

Related/ Equivalent MOOC and Associated Certification:

1. Fundamentals of Engineering Physics
   Platform: SWAYAM
   Link: https://onlinecourses.swayam2.ac.in/nou24_ph01/preview
2. Experimental Physics I
   Platform: NPTEL
   Link: https://onlinecourses.nptel.ac.in/noc20_ph16/preview
3. Computational Physics
   Platform: NPTEL
   Link: https://onlinecourses.nptel.ac.in/noc19_ph16/preview
4. Semiconductor Physics
   Platform: Coursera (University of Colorado Boulder)
   Link: https://www.coursera.org/learn/semiconductor-physics
5. Semiconductor Device Modeling and Simulation
   Platform: NPTEL
   Link: https://onlinecourses.nptel.ac.in/noc24_ee27/preview

Course Name: Effective Communication

Course Code: AEC01T, AEC01P

Vertical/ Sub-Vertical: HSSM/AEC

K-S-A Mapping: Knowledge, Skill & Attitude

Pre-requisite required: Nil

Pre-requisite for: Nil

Recommended Semester: I

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
AEC01T	2	-	2	-
AEC01P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (AEC01T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (AEC01P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:
This course introduces learners to the basics of Effective Communication which will equip them with the requisite soft skillset required for higher studies and placements. With focus on LSRW skills, the course considers the important foundational aspects of communication skills and English proficiency required for the workplace. It acquaints the students with modern communication tools and the basics of public speaking before an audience.

Course Objectives:

- To enable learners to gain understanding of the cyclic process, methods, channels, and barriers of communication.
- To facilitate learners in developing the skills of active listening, impactful public speaking, reading strategies, and effective writing.
- To create awareness of strengthening English proficiency for competitive exam preparation and the art of comprehension and summarization.
- To introduce strategies for creating effective presentations using modern ICT enabled tools.
- To enhance learners' summarization and comprehension skills using graphic organizers to identify key ideas, structure information, and improve retention and clarity of understanding across diverse texts.
- To equip learners with skills in digital content creation using ICT tools, infographics, and social and popular media to communicate ideas effectively and engage diverse audiences.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Use verbal/non-verbal cues at social and workplace situations by learning the basics of communication skills.	Affective Responding
CO2	Employ listening strategies to become effective listeners and powerful speakers for speaking at social, academic and business situations.	Psychomotor Perception
CO3	Improved verbal aptitude to be equipped for competitive examinations and placements.	Cognitive Application
CO4	Make effective presentations and present before an audience with confidence.	Affective Organizing
CO5	Use reading strategies for faster comprehension, summarization and evaluation of texts.	Cognitive Comprehension
CO6	Develop awareness of contemporary digital tools of communication.	Cognitive Application

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Fundamentals of Communication	***Learning Objective:*** *To enhance students' proficiency in verbal and non-verbal communication relevant to academic and professional settings. (CO1)* **Contents:** Concept, Elements and Cycle of Communication, Methods of Communication (Verbal and Nonverbal), Objectives and Channels of Communication (Formal and Informal), Barriers to Communication: Physical, Mechanical, Psychological, Semantic, Socio-cultural, Cross-cultural ***Learning Outcomes:*** *1.1 Learners will be able to identify and explain the key concepts, elements, and stages of the communication cycle, and apply them to analyse and improve real-life communication scenarios. (CO1) (P.I. 10.1.2, 10.2.1, 12.1.1, 12.1.2)* *1.2 Learners will be able to differentiate between verbal and non-verbal methods and channels of communication, align them with specific communication objectives, and choose the most effective approach for diverse contexts. (CO1) (P.I.10.1.1, 10.2.2, 12.1.1, 12.1.2)* *1.3 Learners will be able to identify and analyse physical, mechanical, psychological, semantic, socio-cultural, and cross-cultural barriers to communication, and propose strategies to overcome them effectively. (CO1) (P.I.10.1.1, 12.1.2)*	10

2	Listening & speaking	***Learning Objective:*** *To cultivate active listening, and appropriate response strategies in both academic and professional interactions. (CO2)* **Contents:** Techniques to improve Listening, Listening-exercises, Speech writing and delivery, Different types of Speeches & Tips on Public Speaking ***Learning Outcomes:*** *2.1 Learners will be able to apply effective listening techniques to enhance understanding, retention, and response in various communication contexts. (CO2) (P.I. 10.2.1, 10.2.2, 12.1.1, 12.1.2, 12.2.2)* *2.2 Learners will be able to craft clear, organized speeches and deliver them confidently using effective verbal and non-verbal communication techniques. (CO2) (P.I. 10.3.2, 10.2.1, 8.1.1, 8.4.2, 12.1.1, 12.1.2)* *2.3 Learners will be able to distinguish different types of speeches and apply key public speaking tips to deliver engaging and effective presentations. (CO2) (P.I. 10.1.3, 10.2.2, 10.3.2, 9.2.1, 9.2.2, 9.2.3, 12.1.1,12.1.2, 12.2.2)*	6
3	English Usage	***Learning Objective:*** *To equip students with strategies to perform well in verbal aptitude sections of standardized tests and engineering placement assessments. (CO3)* **Contents:** Vocabulary Building (Etymology, Synonyms, Antonyms, One Word Substitutes) useful for TOEFL, GRE, Grammar Proficiency Tests (Articles, Prepositions, Tenses, Punctuation), Identifying Common Errors in Writing, Grammar Checkers and Sentence Correction Tools ***Learning Outcomes:*** *3.1 Learners will be able to enhance their vocabulary through etymology, synonyms, antonyms, and one-word substitutes, while strengthening grammar proficiency in articles, prepositions, tenses, and punctuation to excel in TOEFL, GRE, and other proficiency tests. (CO3) (P.I.10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.3.1, 12.3.2)* *3.2 Learners will be able to identify common writing errors and effectively use grammar checkers and sentence correction tools to improve the accuracy and clarity of their written work. (CO3) (P.I. 10.1.2, 12.1.1, 12.1.2, 12.2.2)* *3.3 Learners will be able to apply grammar knowledge and utilize digital correction tools to produce clear, professional written communication essential for career success. (CO3) (P.I.10.1.2, 12.1.1, 12.1.2, 12.2.2)*	4

4	Presentation Skills	***Learning Objective:*** *To build confidence and effectiveness in delivering oral presentations, including the use of visual aids and proper body language. (CO1, CO4)* **Contents:** Introduction to Presentation Skills, Creating Presentations-Content, Delivering Presentations before an audience, Using Presentation Software-Modern Presentation Tools ***Learning Outcomes:*** *4.1 Learners will be able to design well-structured presentations by effectively organizing content and applying fundamental presentation skills. (CO4) (P.I. 10.1.3, 10.3.1, 10.3.2, 5.1.1, 5.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1)* *4.2 Learners will be able to confidently deliver presentations to an audience using effective verbal and non-verbal communication techniques to engage and inform listeners. (CO4) (P.I.9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.3, 10.2.2, 10.3.2)* *4.3 Learners will be able to proficiently use modern presentation software and tools to create visually engaging and impactful presentations. (CO4) (P.I.10.1.3, 10.2.2, 10.3.1, 10.3.2, 5.1.1, 5.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1)*	4
5	Comprehension And Summarization	***Learning Objective:*** *To improve the ability to quickly read, interpret, and respond to complex texts such as manuals, technical articles, and instructions. (CO5)* **Contents:** Comprehension & Reading Strategies, Graphic Organizers (Mind Maps, Flow Charts, Tree Diagrams etc.), Summarization of technical passages within specified word limit ***Learning Outcomes:*** *5.1 Learners will be able to apply effective comprehension and reading strategies to analyse, interpret, and critically evaluate various types of texts. (CO5) (P.I.10.1.1, 12.1.1, 12.1.2)* *5.2 Learners will be able to use graphic organizers like mind maps, flow charts, and tree diagrams to visually organize information and enhance understanding and retention. (CO5) (P.I.10.3.1, 12.1.1)* *5.3 Learners will be able to accurately summarize technical passages within a specified word limit,*	2

		capturing key points clearly and concisely. (CO5) (P.I.10.1.1, 10.1.2, 12.1.1, 12.3.1)	
6	Communication Strategies for Virtual Age	***Learning Objective**: To raise awareness of secure digital communication practices, develop online content, and master the use of ICT tools in accordance with professional and ethical standards. (CO6)* **Contents:** Digital Content Creation, Infographics, ICT Tools, Social and Popular Media Self-learning topics: List of self-learning topics on communication strategies for the virtual age are: Virtual communication etiquette by watching relevant videos, writing clear digital messages by using various social media platforms ***Learning Outcomes:*** *6.1 Learners will be able to create engaging digital content and infographics using various ICT tools to effectively communicate information. (CO6) (P.I.10.3.2, 10.3.1, 12.1.1, 12.1.2, 12.2.2, 5.1.1,5.2.1, 5.2.2, 5.3.1, 5.3.2)* *6.2 Learners will be able to critically analyse and effectively use social and popular media platforms to engage audiences and communicate messages responsibly. (CO6) (P.I. 10.1.2, 10.1.3, 5.2.2, 5.3.2, 8.1.1, 8.4.2, 12.1.1, 12.1.2, 12.2.2)*	4
Total			**30**

Suggested List of Practical:

Sr No.	Suggested Topic(s)
1.	Practice and Delivery of Public Speech. Document a speech, free of plagiarism. ***Learning Outcomes:*** *A learner will be able to:* *2.2 Learners will be able to craft clear, organized speeches and deliver them confidently using effective verbal and non-verbal communication techniques. (CO2) (P.I. 10.3.2, 10.2.1, 10.2.1, 8.1.1, 8.4.2, 12.1.1, 12.1.2)* *2.3 Learners will be able to distinguish different types of speeches and apply key public speaking tips to deliver engaging and effective presentations. (CO2) (P.I. 10.1.3, 10.2.2, 10.3.2, 9.2.1, 9.2.2, 9.2.3, 12.1.1,12.1.2, 12.2.2)* *3.2 Learners will be able to identify common writing errors and effectively use grammar checkers and sentence correction tools to improve the accuracy and clarity of their written work. (CO3) (P.I. 10.1.2, 12.1.1, 12.1.2, 12.2.2)*

	3.3 Learners will be able to apply grammar knowledge and utilize digital correction tools to produce clear, professional written communication essential for career success. (CO3) (P.I.10.1.2, 12.1.1, 12.1.2, 12.2.2)
2.	MOOC TCSion Course ***Learning Outcomes:*** *A learner will be able to:* *1.1 Learners will be able to identify and explain the key concepts, elements, and stages of the communication cycle, and apply them to analyse and improve real-life communication scenarios. (CO1) (P.I. 10.1.2, 10.2.1, 12.1.1, 12.1.2)* *1.2 Learners will be able to differentiate between verbal and non-verbal methods and channels of communication, align them with specific communication objectives, and choose the most effective approach for diverse contexts. (CO1) (P.I.10.1.1, 10.2.2, 12.1.1, 12.1.2)* *1.3 Learners will be able to identify and analyse physical, mechanical, psychological, semantic, socio-cultural, and cross-cultural barriers to communication, and propose strategies to overcome them effectively. (CO1) (P.I.10.1.1, 12.1.2)* *2.1 Learners will be able to apply effective listening techniques to enhance understanding, retention, and response in various communication contexts. (CO2) (P.I. 10.2.1, 10.2.2, 12.1.1, 12.1.2, 12.2.2)* *2.2 Learners will be able to craft clear, organized speeches and deliver them confidently using effective verbal and non-verbal communication techniques. (CO2) (P.I. 10.3.2, 10.2.1, 10.2.1, 8.1.1, 8.4.2, 12.1.1, 12.1.2)* *3.3 Learners will be able to apply grammar knowledge and utilize digital correction tools to produce clear, professional written communication essential for career success. (CO3) (P.I.10.1.2, 12.1.1, 12.1.2, 12.2.2)* *4.2 Learners will be able to confidently deliver presentations to an audience using effective verbal and non-verbal communication techniques to engage and inform listeners. (CO4) (P.I.9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.3, 10.2.2, 10.3.2)* *5.4 Learners will be able to apply effective comprehension and reading strategies to analyse, interpret, and critically evaluate various types of texts. (CO5) (P.I.10.1.1, 12.1.1, 12.1.2)*
3.	Poster Making and Presentation ***Learning Outcomes:*** *A learner will be able to:* *2.3 Learners will be able to distinguish different types of speeches and apply key public speaking tips to deliver engaging and effective presentations. (CO2) (P.I. 10.1.3, 10.2.2, 10.3.2, 9.2.1, 9.2.2, 9.2.3, 12.1.1,12.1.2, 12.2.2)* *4.1 Learners will be able to design well-structured presentations by effectively organizing content and applying fundamental presentation skills. (CO4) (P.I. 10.1.3, 10.3.1, 10.3.2, 5.1.1, 5.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1)*

	4.2 Learners will be able to confidently deliver presentations to an audience using effective verbal and non-verbal communication techniques to engage and inform listeners. (CO4) (P.I.9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.3, 10.2.2, 10.3.2) *4.3 Learners will be able to proficiently use modern presentation software and tools to create visually engaging and impactful presentations. (CO4) (P.I.10.1.3, 10.2.2, 10.3.1, 10.3.2, 5.1.1, 5.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1)*
4.	Listening Exercises ***Learning Outcomes:*** *A learner will be able to:* *2.1 Learners will be able to apply effective listening techniques to enhance understanding, retention, and response in various communication contexts. (CO2) (P.I. 10.2.1, 10.2.2, 12.1.1, 12.1.2, 12.2.2)* *2.2 Learners will be able to craft clear, organized speeches and deliver them confidently using effective verbal and non-verbal communication techniques. (CO2) (P.I. 10.3.2, 10.2.1, 10.2.1, 8.1.1, 8.4.2, 12.1.1, 12.1.2)* *2.3 Learners will be able to distinguish different types of speeches and apply key public speaking tips to deliver engaging and effective presentations. (CO2) (P.I. 10.1.3, 10.2.2, 10.3.2, 9.2.1, 9.2.2, 9.2.3, 12.1.1,12.1.2, 12.2.2)*
5.	Comprehension (Reading research paper) and Summarization ***Learning Outcomes:*** *A learner will be able to:* *5.1 Learners will be able to apply effective comprehension and reading strategies to analyse, interpret, and critically evaluate various types of texts. (CO5) (P.I.10.1.1, 12.1.1, 12.1.2)* *5.2 Learners will be able to use graphic organizers like mind maps, flow charts, and tree diagrams to visually organize information and enhance understanding and retention. (CO5) (P.I.10.3.1, 12.1.1)* *5.3 Learners will be able to accurately summarize technical passages within a specified word limit, capturing key points clearly and concisely. (CO5) (P.I.10.1.1, 10.1.2, 12.1.1, 12.3.1)*
6.	Reel/ Video/ Tabloid Making or Blog Writing or Travelogues ***Learning Outcomes:*** *A learner will be able to:* *6.1 Learners will be able to create engaging digital content and infographics using various ICT tools to effectively communicate information. (CO6) (P.I.10.3.2, 10.3.1, 12.1.1, 12.1.2, 12.2.2, 5.1.1,5.2.1, 5.2.2, 5.3.1, 5.3.2)* *6.2 Learners will be able to critically analyse and effectively use social and popular media platforms to engage audiences and communicate messages responsibly.* (*CO6) (P.I. 10.1.2, 10.1.3, 5.2.2, 5.3.2, 8.1.1, 8.4.2, 12.1.1, 12.1.2, 12.2.2)*
7.	Extempore Speech Delivery ***Learning Outcomes:*** *A learner will be able to:* *2.2 Learners will be able to craft clear, organized speeches and deliver them confidently using effective verbal and non-verbal communication techniques. (CO2) (P.I. 10.3.2, 10.2.1, 10.2.1, 8.1.1, 8.4.2, 12.1.1, 12.1.2)*

	2.3 Learners will be able to distinguish different types of speeches and apply key public speaking tips to deliver engaging and effective presentations. (CO2) (P.I. 10.1.3, 10.2.2, 10.3.2, 9.2.1, 9.2.2, 9.2.3, 12.1.1,12.1.2, 12.2.2)
8.	Group Presentation on "Innovative Technologies related to the domains/ ICT tools" along with 2-3 Page Report ***Learning Outcomes:*** *6.1 Learners will be able to create engaging digital content and infographics using various ICT tools to effectively communicate information. (CO6) (P.I.10.3.2, 10.3.1, 12.1.1, 12.1.2, 12.2.2, 5.1.1,5.2.1, 5.2.2, 5.3.1, 5.3.2)* *6.2 Learners will be able to critically analyse and effectively use social and popular media platforms to engage audiences and communicate messages responsibly. (CO6) (P.I. 10.1.2, 10.1.3, 5.2.2, 5.3.2, 8.1.1, 8.4.2, 12.1.1, 12.1.2, 12.2.2)*

Performance Indicators –

P.I. 5.1.1: Understanding: Identify modern engineering tools, techniques and resources for engineering activities

P.I. 5.2.2: Applying: Create/adapt/modify/extend tools and techniques to solve engineering problems

P.I. 5.2.1: Understanding: Identify the strengths and limitations of tools for (i) acquiring information, (ii) modeling and simulating, (iii) monitoring system performance, and (iv) creating engineering designs.

P.I. 5.3.1: Analysing: Discuss limitations and validate tools, techniques and resources

P.I. 5.3.2: Analysing: Verify the credibility of results from tool use with reference to the accuracy and limitations, and the assumptions inherent in their use

P.I. 8.1.1: Understanding: Identify situations of unethical professional conduct and propose ethical alternatives

P.I. 8.4.2: Applying: Examine and apply moral & ethical principles to known case studies

P.I. 9.1.1: Remembering: Recognize a variety of working and learning preferences; appreciate the value of diversity on a team

P.I. 9.1.2: Applying: Implement the norms of practice (e.g. rules, roles, charters, agendas, etc.) of effective teamwork, to accomplish a goal

P.I.9.2.4: Understanding: Maintain composure in difficult situations

P.I. 9.3.1: Applying: Present results as a team, with smooth integration of contributions from all individual efforts

P.I. 9.2.1: Applying: Demonstrate effective communication, problem-solving, conflict resolution and leadership skills

P.I. 9.2.2: Applying: Treat other team members respectfully

P.I. 9.2.3: Applying: Listen to other members

P.I. 10.1.1: Understanding: Read, understand and interpret technical and non-technical information

P.I. 10.1.2: Applying: Produce clear, well-constructed, and well-supported written engineering documents

P.I. 10.1.3: Applying: Create flow in a document or presentation - a logical progression of ideas so that the main point is clear

P.I. 10.2.1: Understanding: Listen to and comprehend information, instructions, and viewpoints of others

P.I. 10.2.2: Applying: Deliver effective oral presentations to technical and non-technical audiences

P.I. 10.3.1: Applying: Create engineering-standard figures, reports and drawings to complement writing and presentations

P.I. 10.3.2: Applying: Use a variety of media effectively to convey a message in a document or a presentation

P.I. 12.1.1: Understanding: Describe the rationale for the requirement for continuing professional development

P.I. 12.1.2: Understanding: Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
P.I. 12.2.2: Understanding: Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
P.I. 12.3.1: **Understanding: Source and comprehend** technical literature and other credible sources of information
P.I. 12.3.2: Analysing: Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1, 1.2, 1.3, 4.2, 3.3
CO2	2.1, 2.2, 2.3, 3.1, 3.3
CO3	3.1, 3.2, 3.3, 2.1, 2.2
CO4	4.1, 4.2, 4.3, 3.3, 6.1
CO5	5.1, 5.2, 5.3
CO6	6.1, 6.2, 4.3, 3.3

Mapping of Course Outcomes with Programme Outcomes:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO7**	**PO8**	**PO9**	**P010**	**PO11**	**PO12**
CO1								7/95	6/95		3/95
CO2							2/95	3/95	6/95		5/95
CO3							2/95		6/95		5/95
CO4					5/95			7/95	5/95		4/95
CO5									3/95		3/95
CO6					5/95		2/95	7/95	5/95		4/95

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	Assessment Criteria: The Learner can:	Evaluated under ISA/MSE/ESE/LAB
LO 1.1: Learners will be able to identify and explain the key concepts, elements, and stages of the communication cycle, and apply them to analyse and improve real-life communication scenarios. (CO1) (P.I. 10.1.2, 10.2.1, 12.1.1, 12.1.2)	1.1 *Learners will practice public speaking through Speech delivery to enhance both verbal and non-verbal communication*	ISA LAB
LO 1.2: *Learners will be able to differentiate between verbal and non-verbal methods and channels of communication, align them with*	1.2 *Learners will document the speech, free of plagiarism, using various plagiarism checkers.*	ISA TH

specific communication objectives, and choose the most effective approach for diverse contexts. (CO1) (P.I.10.1.1, 10.2.2, 12.1.1, 12.1.2)		
LO 1.3: Learners will be able to identify and analyse physical, mechanical, psychological, semantic, socio-cultural, and cross-cultural barriers to communication, and propose strategies to overcome them effectively. (CO1) (P.I.10.1.1, 12.1.2)	1.3 *Learners will perform role plays to identify and analyse physical, mechanical, psychological, semantic, socio-cultural, and cross-cultural barriers to communication, and propose strategies to overcome them effectively. (Activity)*	ISA LAB
LO 2.1 Learners will be able to apply effective listening techniques to enhance understanding, retention, and response in various communication contexts. (CO2) (P.I. 10.2.1, 10.2.2, 12.1.1, 12.1.2, 12.2.2)	2.1 *Learners will be able to apply effective listening techniques through various listening exercises*	ISA LAB
LO 2.2 Learners will be able to craft clear, organized speeches and deliver them confidently using effective verbal and non-verbal communication techniques. (CO2) (P.I. 10.3.2, 10.2.1, 8.1.1, 8.4.2, 12.1.1, 12.1.2)	2.2 *Learners will complete MOOC on TCSion for effective verbal and non-verbal communication techniques.*	MSE
LO 2.3 Learners will be able to distinguish different types of speeches and apply key public speaking tips to deliver engaging and effective presentations. (CO2) (P.I. 10.1.3, 10.2.2, 10.3.2, 9.2.1, 9.2.2, 9.2.3, 12.1.1,12.1.2, 12.2.2)	2.3 *Learners will deliver extempore public speeches by applying key public speaking tips.*	ISA LAB
LO 3.1: Learners will be able to enhance their vocabulary through etymology, synonyms, antonyms, and one-word substitutes, while strengthening grammar proficiency in articles, prepositions, tenses, and punctuation to excel in TOEFL, GRE, and other proficiency tests. (CO3) (P.I.10.1.1, 10.1.2, 10.1.3, 12.1.1, 12.1.2, 12.3.1, 12.3.2)	3.1 *Learners will attempt various grammar tests, in the form of comprehension exercises, thereby, strengthening grammar proficiency in articles, prepositions, tenses, and punctuation to excel in TOEFL, GRE, and other proficiency tests.*	ISA TH
3.2 Learners will be able to identify common writing errors and effectively use grammar checkers and sentence correction tools to improve the accuracy and clarity of their written work. (CO3) (P.I. 10.1.2, 12.1.1, 12.1.2, 12.2.2)	3.2 *Learners will read research papers and summarise them to improve the accuracy and clarity of their written work.*	ESE LAB

3.3 Learners will be able to apply grammar knowledge and utilize digital correction tools to produce clear, professional written communication essential for career success. (CO3) (P.I.10.1.2, 12.1.1, 12.1.2, 12.2.2)	3.3 *Learners will write Blogs/ Travelogues, etc. to apply grammar knowledge and utilize digital correction tools to produce clear, professional written communication essential for career success.*	ESE LAB
LO 4.1: Learners will be able to design well-structured presentations by effectively organizing content and applying fundamental presentation skills. (CO4) (P.I. 10.1.3, 10.3.1, 10.3.2, 5.1.1, 5.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1)	4.1 *Learners will confidently deliver group presentations to an audience using effective verbal and non-verbal communication techniques to engage and inform listeners.*	ISA LAB
LO 4.2: Learners will be able to confidently deliver presentations to an audience using effective verbal and non-verbal communication techniques to engage and inform listeners. (CO4) (P.I.9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1, 10.1.3, 10.2.2, 10.3.2)	4.2 *Learners will be able to proficiently use modern presentation software and tools to create visually engaging and impactful presentations. Various ICT tools may also be used for enhanced content delivery.*	MSE
LO 4.3: Learners will be able to proficiently use modern presentation software and tools to create visually engaging and impactful presentations. (CO4) (P.I.10.1.3, 10.2.2, 10.3.1, 10.3.2, 5.1.1, 5.2.2, 9.1.1, 9.1.2, 9.2.1, 9.2.2, 9.2.3, 9.2.4, 9.3.1)	4.3 *Learners will be able to proficiently use modern presentation software and tools to create visually engaging and impactful presentations. Various ICT tools may also be used for enhanced content delivery.*	ISA LAB
LO 5.1: Learners will be able to apply effective comprehension and reading strategies to analyse, interpret, and critically evaluate various types of texts. (CO5) (P.I.10.1.1, 12.1.1, 12.1.2)	5.1 *Learners will make reports of the Presentations to improve their writing prowess.*	ISA TH
LO 5.2: Learners will be able to use graphic organizers like mind maps, flow charts, and tree diagrams to visually organize information and enhance understanding and retention. (CO5) (P.I.10.3.1, 12.1.1)	2. *Learners will use graphic organizers like mind maps, flow charts, and tree diagrams to visually organize information from research papers.*	ISA LAB
LO 5.3: Learners will be able to accurately summarize technical passages within a specified word limit, capturing key points clearly and concisely. (CO5) (P.I.10.1.1, 10.1.2, 12.1.1, 12.3.1)	3. *Learners will be able to accurately summarize technical passages within a specified word limit, capturing key points clearly and concisely.*	ISA LAB

LO 6.1: Learners will be able to create engaging digital content and infographics using various ICT tools to effectively communicate information. (CO6) (P.I.10.3.2, 10.3.1, 12.1.1, 12.1.2, 12.2.2, 5.1.1,5.2.1, 5.2.2, 5.3.1, 5.3.2)	6.1 *Learners will make Posters using different ICT tools and give presentations.*	ISA LAB
LO 6.2: Learners will be able to critically analyse and effectively use social and popular media platforms to engage audiences and communicate messages responsibly. (CO6) (P.I. 10.1.2, 10.1.3, 5.2.2, 5.3.2, 8.1.1, 8.4.2, 12.1.1, 12.1.2, 12.2.2)	*6.2 Learners will design and share a media post or campaign (e.g., image, video, reel, or story) that communicates a clear message to a target audience. They will justify their content choices based on message clarity, platform suitability, and responsible communication practices.*	ISA LAB

Textbooks:

Sr. No	Text Book Titles	Author/s	Publisher	Edition	Module Nos.
1	Communication Skills with CD	Sanjay Kumar & Pushp Lata	OUP		All
2	Business communication with writing improvement exercises	P.D. Hemphill; D.W. McCormick; R.D. Hemphill	NJ Prentice Hall		3
3	Effective Business Communication	A.Kaul	Prentice Hall of India		1
4	Business Communication- Building Critical Skills	Kitty O. Locker	ManjulPublications	18th	4
5	Effective Business Communication	Herta Murphy	Mc Graw Hill	7th	4

Reference Books:

Sr. No	Reference Book Titles	Author/s	Publisher	Edition	Module Nos.
1	Mastering Communication	Nicky Stanton	Palgrave Master Series	3rd	1
2	BCOM	Lehman, Dufrene, Sinha	Cengage Learning	2nd	1,4
3	Soft Skills	K. Alex	S. Chand and Company	3rd	1,4
4	Business Communication Strategies	Monippally	Tata McGraw Hill	12th	1

6	Non Verbal Communication: The Unspoken Dialogue	J.K Burgoon, D.B Buller and W.G Woodall	McGraw Hill	3rd	1
7	Body Language	Alan Pease	Tata McGraw Hill	1st	1
8	Business Communication – Concepts, Cases and Applications	Chaturvedi and Chaturdevi	Pearson	2nd	1
9	How to Speak Fluently (Handbook)	Jones	Indian Publishing House	1st	1
10	50 ways to improve your Business English	Ken Taylor	Orient Blackswan	1st	3
11	Objective English	Thorpe and Thorpe	Pearson	2nd	2
12	Technical Writing & Professional Communication for non-native speakers of English	Thomas N. Huckin & Leslie A. Olsen	McGraw – Hill	2nd	5
14	English Vocabulary in Use	Micahel McCarthy and Felicity O'Dell	Cambridge University Press	7th	2
15	Communication in Organizations	Dalmar Fisher	Jaico Publishing House	2nd	1,6
16	Communication Skills	Meenakshi Raman & Sangeeta Sharma	Oxford University Press	1st	1
17	Business Correspondence & Report-writing	R.C. Sharma & Krishna Mohan	Tata McGraw Hill	2nd	2
18	Effective Technical Communication	Ashraf Rizvi	Tata McGraw-Hill	1st	5

Related / Equivalent MOOC and Associated Certification:

Sr. No.	MOOC Course Link	Course conducted by – Person / University / Institute / Industry	Course Duration	Certificate (Y / N)
1	https://learning.tcsionhub.in/courses/tcs-ion/introduction-to-soft-skills/ (Introduction to Soft Skills)	TCS ion	1 Week	Y
2	https://www.tcsion.com/courses/nsdc/effective_communication/ (Effective Communication) by NSDC	TCS ion	1 Week	Y

Course Name: Structured Programming

Course Code: ES04

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required:

Pre-requisite for: VSEC02T (Object Oriented Programming), PCCE01T (Data Structure)

Recommended Semester: 1

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
ES04T	2	-	2	-
ES04P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

Structured Programming is a foundational course designed to introduce the principles of programming and problem-solving using the C language. As one of the most widely used and efficient programming languages, C provides a strong base for understanding core concepts such as data types, control flow, functions, arrays, pointers, and file handling.

This course emphasizes a structured approach to programming—focusing on clarity, modularity, and maintainability. It equips students with the ability to write efficient, error-free, and logically organized code, which is essential for developing software in engineering and real-world applications.

It lays the groundwork for future studies in data structures, algorithms, operating systems, embedded systems, and other technical domains that rely on C or its derivatives.

Course Objectives:

- To familiarize students with the syntax, semantics, and foundation concepts of the C programming language.

- To develop structured programming and logical problem-solving abilities.
- To introduce modular programming using functions and various data types like arrays, strings and structures.
- To Equip students with skills to handle pointer manipulation, dynamic memory allocation and file operations.
- Prepare students to write efficient and reusable code for solving real world engineering problems.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	**Explain** the syntax and semantics of C programming constructs such as identifiers, variables, data types, operators, input/output functions and control structures.	Understand
CO2	**Develop** logic using conditional and iterative control structures.	Apply
CO3	**Decompose** the problem and solve it using modular programming approach.	Analyse
CO4	**Implement** algorithms using arrays, strings, pointers, and structures in C.	Analyse
CO5	**Perform** file operations and dynamic memory allocation to handle data processing and storage requirements in software applications.	Evaluate
CO6	**Integrate** debugging and testing methodologies using standard development tools to ensure degree of correctness.	Evaluate

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Fundamentals of C	***Learning Objective:*** *Introduce the concept of data types, type conversion, operators, in-built mathematical functions and the generic C program structure. (C01).* **Contents:** Character Set, Identifiers and Keywords, Data Types, Constants and Variables Operators, Math Library Functions, Expressions, Pre-processor Directives. ***Self-Learning Topics***: *Frequently used mathematical library functions* ***Learning Outcomes:*** *A learner will be able to:* *1.9 Describe syntax, keywords, data types and variables. (P.I. – 1.3.1) (CO1)* *1.10 Use appropriate operators in expressions to perform various calculations and operations. (P.I. 1.3.2) (CO1)* *1.11 Use math library functions to perform mathematical computations within C programs. (P.I. 1.3.3) (CO1)*	4

		1.12 Explain the purpose of preprocessor directives. (P.I. 1.3.2) (CO1)	
2	Input and Output	***Learning Objective:*** *Understand the format specifiers and their utility in input/output functions (CO1, CO6)* **Contents:** Unformatted and formatted I/O, scanf(), printf() functions, concept of field width, precision and flags and basic programs on computation. ***Self-Learning Topics****: Format specifiers, flags and their effect* ***Learning Outcomes:*** *A learner will be able to:* *2.5 Use appropriate format specifiers for various data types in both input and output operations. (P.I. – 1.3.2 (CO1)* *2.6 Collaborate with peers to debug and improve computational programs, applying learned concepts effectively. (P.I. – 2.1.3, 9.2.1) (CO1, CO6)*	2
3	Control Structures	***Learning Objective:*** *To design and implement control flow in C programs using conditional statements (if-else, nested if-else, switch-case), looping constructs (for, while, do-while), and control statements (break, continue). They will also be able to apply nested loops to solve complex programming problems efficiently. (CO1, CO2, CO6)* **Contents:** Conditional Branching – if else statement, nested if else statement, Switch case statement, Looping – for loop, while loop and do while loop, Nesting of loops, use of unconditional branching using break and continue statement ***Self-Learning Topics****: Mathematical concepts like natural numbers , sum of first n natural numbers, Armstrong, Magic, Strong Numbers, Fibonacci series.* ***Learning Outcomes:*** *A learner will be able to:* *3.6 Analyse the flow of control in programs using selection statements to make decisions based on specific conditions. (P.I. – 2.1.2) (CO1, CO2)* *3.7 Implement multi-choice logic using switch statements to manage multiple options conditions effectively. (P.I. 2.1.2) (CO1, CO2)* *3.8 Illustrate the syntax and use cases for each type of loop, explaining when to use one over the others. (P.I. – 2.1.2) (CO1, CO2)*	6

		3.9 Analyse loop control mechanisms (break, continue) and their effect on loop execution. (P.I. - 2.1.2) (CO2, CO6) *3.10 Integrate selection and looping statements in C programs to solve more complex problems. (P.I. – 2.2.3) (CO2, CO6).*	
4	Functions	***Learning Objective:*** *To create and use functions in C, including passing arguments and managing return values, understand the scope of variables (local and global), utilize different storage classes (auto, extern, static, register), and implement recursive functions to solve problems involving repeated computation. (CO1, CO3, CO6)* **Content:** Introduction to functions Declaration and definition of functions, calling a function and passing argument to a function, concept of global and local variables, Storage classes – auto, extern, static and register, recursive Functions ***Self-Learning Topics****: Decomposition of problems in to sub tasks.* ***Learning Outcomes:*** *A learner will be able to:* *4.1 Write function declarations and definitions to modularize C programs effectively. (P.I. – 1.3.3, 2.2.3) (CO1, CO3)* *4.2 Demonstrate how to divide the problem into subproblems and propose a function to address a subproblem (P.I. –2.1.4) (CO3, CO6)* *4.3 Identify and apply appropriate storage classes (auto, extern, static, register) to control variable lifetime and linkage. (P.I. - 2.1.2) CO3)* *4.4 Compare recursive and iterative approaches to problem-solving and justify the selection of one over the other based on context. (P.I. – 2.2.3) (CO1, CO3, CO6)*	6
5	Arrays, Strings and Structures	***Learning Objective:*** *To declare, initialize, and manipulate one-dimensional and multi-dimensional arrays, perform operations on strings using built-in and user-defined functions, and design and implement structures—including nested structures and arrays of structures—to manage grouped data efficiently in C programs.* *(CO2, CO3, CO4, CO6).* **Content:**	6

		Array-Concepts, Declaration, Definition, Accessing array element, One-dimensional and Multidimensional array. String- Basic of String, Array of String, Functions in string.h Structure- Declaration, Initialization, Nested structure, Operation on structures, Array of Structure. ***Self-Learning Topics**: Functions for string and character processing, Concepts of Matrix multiplication, Matrix transform, Symmetric Matrix , Upper and Lower triangular matrix.* ***Learning Outcomes:*** *A learner will be able to:* *5.6 Declare, initialize, and manipulate one-dimensional and multidimensional arrays to store and process data efficiently. (P.I. – 1.3.1, 2.1.2) (CO2, CO4)* *5.7 Implement string operations using standard library functions from <string.h> and construct programs that manipulate arrays of strings. ((P.I. – 2.2.3) (CO2, CO4)* *5.8 Define and use structures, including nested structures, to represent complex data types in C. (P.I. – 1.3.2) (CO2, CO4)* *5.9 Create and manage arrays of structures to handle grouped data, and perform operations such as sorting, searching, and updating structure members. (P.I.-2.2.3) (CO2, CO3, CO4, CO6)*	
6	Pointers and Files	***Learning Objective: T**o demonstrate the use of pointers in C for referencing, dereferencing, pointer arithmetic, and dynamic memory allocation, apply pointer concepts to arrays, functions, and perform file operations, including creating, opening, reading, writing, and processing files using standard I/O functions. (CO1, CO4, CO5, CO6).* **Contents:** Pointer introduction, pointer variable, reference and dereference, operators and void pointer, Pointer call by reference, pointer arithmetic, pointer to pointer, pointer and array, passing arrays to function, array of pointers and dynamic memory allocation, Types of files, file operations – opening, closing, creating, reading and processing file ***Self-Learning Topics**: File Operations.* ***Learning Outcomes:*** *A learner will be able to:* *6.6 Explain the concept of pointers, including referencing, dereferencing, and the use of pointer operators. (P.I. – 1.3.2) (CO1, CO4)*	6

		6.7 Apply pointers for call-by-reference, and pointer arithmetic in solving programming problems. (P.I. – 2.2.3) (CO1, CO4) *6.8 Use pointers effectively with arrays, including passing arrays to functions and working with arrays of pointers. (P.I. – 1.3.4) (CO4, CO6)* *6.9 Implement dynamic memory allocation using functions like malloc(), calloc(), realloc(), and free() to manage memory during runtime. (P.I. – 2.4.5) (CO5)* *6.10 Perform file operations such as creating, opening, reading, writing, updating and closing files using C standard library functions. (P.I. – 2.3.3) (CO5, CO6)*	
Total			**30**

Suggested List of Practical:

Sr No.	Suggested Topic(s)
1.	Perform arithmetic operations using math library functions. ***Learning Outcome:*** LO1.2 Use operators and math library functions in expressions (P.I. – 1.3.3) (CO1)
2.	Use printf() and scanf() with format specifiers and field widths. ***Learning Outcome:*** LO2.1 Write program using correct format specifiers in input/output functions to perform basic computations (P.I. – 1.3.2) (CO1) *2.3*
3.	Display various patterns using nested loops. ***Learning Outcome:*** LO3.4 Develop a logic to display various patterns by using nested loops (P.I. – 2.2.3) (CO2, CO6)
4.	Implement control structures to solve problems like Armstrong number, Fibonacci series, etc. ***Learning Outcome:*** LO3.3 Develop a logic and implement it for the problems which demands usage of Iterative Constructs (P.I. – 2.1.2) (CO2)
5.	Write recursive functions to compute factorial, GCD, etc. ***Learning Outcome:*** LO4.2 Analyse the problem statement to identify the scope of using recursion and accordingly implement it (P.I. – 2.2.3) (CO3, CO6)
6.	Perform sorting, searching on 1D array and matrix multiplication using 2D array.

	Learning Outcome: LO5.2 Perform operations like Matrix Multiplication, Addition, Transform, Magic Square generation etc. *4.3* (P.I. – 1.3.1) (CO4)
7.	Develop string functions: reverse, length, concat, and substring search. ***Learning Outcome:*** LO5.3 Propose user defined functions for: string length, string copy, string reverse, string concatenation, searching for substring *5.2* (P.I. – 2.2.3) (CO4)
8.	Create and manage student records using structures and arrays of structures. ***Learning Outcome:*** LO5.4 Declare a structure for representing the data about the entity, perform operations like, data population, updating, searching and displaying the records (P.I. – 2.2.3) (CO4, CO6)
9.	Use pointers to access and manipulate elements of 1D and 2D arrays. ***Learning Outcome:*** LO6.2 Write a program to process elements of 1 D array and 2 D array with the help of pointers (P.I. – 1.3.4) (CO4)
10.	Copy contents from one file to another using file handling. ***Learning Outcome:*** LO6.4 Develop an application to insert records into text file, delete and update them as per the need (P.I. – 2.3.3) (CO5)

Performance Indicators:

P.I.- 1.3.1: **Remembering**: List fundamental engineering principles and their applications.
P.I.- 1.3.2: **Understanding**: Explain the relevance of basic engineering principles to real-world problems.
P.I.- 1.3.3: **Applying**: Perform calculations and simulations to solve simple engineering tasks.
P.I.- 1.3.4: **Analysing**: Deconstruct engineering scenarios to identify fundamental principles at work.
P.I.- 2.1.2: **Understanding**: Explain the key features and scope of a complex engineering problem.

P.I.- 2.1.3: **Applying**: Use standard problem-identification techniques to define an engineering challenge.

P.I.- 2.1.4: **Analysing**: Decompose a complex engineering problem into its constituent parts to identify critical aspects.

P.I.- 2.2.3: **Applying**: Develop a basic solution plan using a systematic approach to solve an identified problem.

P.I.- 2.3.3: **Applying**: Construct a basic model to represent a complex engineering system or process..

P.I.- 2.4.5: **Evaluating**: Critically assess the solution's accuracy and efficiency and propose of improvements if necessary.

P.I.- 9.2.1: **Understanding**: Describe the importance of effective communication and conflict resolution within a team..

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	LO1.1, LO1.2, LO1.3, LO1.4, LO2.1 (5)
CO2	LO3.1, LO3.2, LO3.3, LO3.4, LO3.5 (5)
CO3	LO4.1, LO4.2, LO4.3 (3)
CO4	LO5.1, LO5.2, LO5.3, LO5.4, LO6.1, LO6.2 (6)
CO5	LO6.4, LO6.5 (2)
CO6	LO2.2, LO3.4, LO4.2, LO4.4, LO5.4, LO6.3, LO6.5 (7)

Mapping of Course Outcomes with Programme Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	4/28	1/28	-	-	-	-	-	-	-	-	-	-
CO2	-	-	5/28	-	-	-	-	-	-	-	-	-
CO3	-	-	-	3/28	-	-	-	-	-	-	-	-
CO4	-	-	-	-	4/28	2/28	-	-	-	-	-	-
CO5	-	-	-	-	-	2/28	-	-	-	-	-	-
CO6		1/28	1/28	2/28	1/28	1/28	-	-	-	-	-	-

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	Assessment Criteria: The Learner can:	Evaluated under ISA/MSE/ESE/LAB
Describe syntax, keywords, data types and variables. (P.I. – 1.3.1) (CO1)	• Define the syntax rules of the C programming language. • List and explain commonly used C keywords. • Describe the basic data types in C (int, float, char, double, etc.) and their usage. • Demonstrate the declaration and initialization of variables with correct syntax.	ISA, LAB
Use appropriate operators in expressions to perform various calculations and operations. (P.I. 1.3.2) (CO1)	• Identify different types of operators in C (arithmetic, relational, logical, assignment, increment/decrement, etc.). • Write expressions using appropriate operators based on the problem statement. • Evaluate complex expressions involving multiple operators with correct precedence and associativity.	ISA, MSE, LAB

	• Debug and correct operator-related errors in given C code snippets.	
Use math library functions to perform mathematical computations within C programs. (P.I. 1.3.3) (CO1)	• Identify commonly used functions from the <math.h> library (e.g., sqrt(), pow(), abs(), ceil(), floor()). • Apply appropriate math functions to solve computation-based problems in C. • Write C programs that include math functions to perform real-world calculations. • Interpret the output of math function-based expressions and validate their correctness.	ISA, MSE, LAB
1.4 Explain the purpose of preprocessor directives. (P.I. 1.3.2) (CO1)	• Define what preprocessor directives are in the C language. • Describe common directives such as #include, #define, and #ifdef. • Explain how preprocessor directives affect the compilation process. • Illustrate the use of preprocessor directives with relevant code examples.	ISA
2.1 Use appropriate format specifiers for various data types in both input and output operations. (P.I. – 1.3.2 (CO1)	• dentify the correct format specifiers for data types like int, float, char, and double in C. • Write programs using scanf() and printf() with proper format specifiers. • Apply field width, precision, and flags to format the output appropriately. • • Debug and correct input/output statements with incorrect specifiers.	ISA, MSE, LAB
2.2 Collaborate with peers to debug and improve computational programs, applying learned concepts effectively. (P.I. – 2.1.3, 9.2.1) (CO1, CO6)	• Work effectively in a team to identify logical and syntax errors in C programs. • Apply debugging techniques (like dry run, printf-debugging, or using IDE tools) to locate and fix errors. • Suggest and implement improvements in peer-written code to enhance efficiency or readability. • • Demonstrate teamwork and communication skills during collaborative problem-solving sessions.	LAB
3.1 Analyse the flow of control in programs using selection statements to make decisions based on specific conditions. (P.I. – 2.1.2) (CO1, CO2)	• Identify and use appropriate selection statements (if, if-else, nested if-else, switch) based on the problem requirements. • Analyse conditions and logical expressions to determine program flow. • Trace and predict the execution path of programs using selection constructs. • • Debug control flow errors in decision-making code blocks.	LAB, MSE

3.2 Implement multi-choice logic using switch statements to manage multiple options conditions effectively. (P.I. 2.1.2) (CO1, CO2)	• Write programs using switch statements to handle multiple decision paths. • Appropriately use case, break, and default clauses to structure multi-choice logic. • Select switch over if-else where it enhances code clarity and performance. • Test and debug switch constructs to ensure correct branching and output.	ISA, LAB, MSE
3.3 Illustrate the syntax and use cases for each type of loop, explaining when to use one over the others. (P.I. – 2.1.2) (CO1, CO2)	• Describe the syntax of for, while, and do-while loops with examples. • Explain the differences in behavior and typical use cases of each loop type. • Choose the most appropriate loop construct based on the problem requirements. • Implement programs using different loop types and justify the selection.	ISA, MSE, ESE
3.4 Analyse loop control mechanisms (break, continue) and their effect on loop execution. (P.I. - 2.1.2) (CO2, CO6)	• Describe the purpose and syntax of break and continue statements in loops. • Implement programs demonstrating the use of break and continue in various loop constructs. • Trace the execution of loops with control statements to observe their impact on flow. • Analyse scenarios to determine when and why to use break or continue for optimal logic.	ISA, ESE, LAB
3.5 Integrate selection and looping statements in C programs to solve more complex problems. (P.I. – 2.2.3) (CO2, CO6).	• Combine conditional (if, switch) and iterative (for, while, do-while) constructs to implement problem-solving logic. • Design solutions for real-world or mathematical problems that require nested or sequential control flow. • Implement modular code using combined control structures for clarity and reusability. • Test and debug integrated logic to ensure correctness and efficiency.	LAB
4.1 Write function declarations and definitions to modularize C programs effectively. (P.I. – 1.3.3, 2.2.3) (CO1, CO3)	• Declare and define functions correctly with appropriate return types and parameters. • Break down problems into smaller tasks and implement each using separate functions. • Use function prototypes to enhance code structure and readability. • Develop modular programs by reusing functions and maintaining logical separation of concerns.	LAB

4.2 Demonstrate how to divide the problem into subproblems and propose a function to address a subproblem (P.I. –2.1.4) (CO3, CO6)	• Analyse a given problem and identify logical sub-tasks that can be solved independently. • Design function signatures and logic specific to each subproblem. • Implement multiple functions to handle individual components of the main problem. • Justify the modular breakdown and demonstrate how it improves readability, reusability, and testing.	ISA, LAB, ESE
4.3 Identify and apply appropriate storage classes (auto, extern, static, register) to control variable lifetime and linkage. (P.I. - 2.1.2) CO3)	• Define the purpose and behavior of each storage class in C. • Demonstrate the use of auto, static, extern, and register in suitable programming scenarios. • Explain the effect of storage classes on variable scope, lifetime, and visibility across files or functions. • Write C programs that utilize different storage classes and validate their behavior through outputs.	MSE, LAB, ESE
4.4 Compare recursive and iterative approaches to problem-solving and justify the selection of one over the other based on context. (P.I. – 2.2.3) (CO1, CO3, CO6)	• Explain the concepts of recursion and iteration with examples. • Implement equivalent programs using both recursive and iterative techniques (e.g., factorial, Fibonacci). • Compare performance, readability, and memory usage of recursive vs. iterative solutions. • Justify the choice of approach based on problem complexity, constraints, and clarity.	ISA, LAB, ESE
5.1 Declare, initialize, and manipulate one-dimensional and multidimensional arrays to store and process data efficiently. (P.I. – 1.3.1, 2.1.2) (CO2, CO4)	• Declare and initialize one-dimensional and multidimensional arrays using correct syntax. • Access and modify array elements through indexing in real-world problem contexts. • Perform operations such as insertion, deletion, traversal, and updates on arrays. • Write programs using arrays for computational tasks like summation, average, matrix operations, etc.	ISA, LAB, MSE, ESE
5.2 Implement string operations using standard library functions from <string.h> and construct programs that manipulate arrays of strings. ((P.I. – 2.2.3) (CO2, CO4)	• Identify and use standard string functions such as strlen(), strcpy(), strcat(), strcmp(), and strrev(). • Write programs to perform string manipulation tasks using these library functions. • Declare and work with arrays of strings (2D character arrays) effectively.	ISA, LAB

	• Solve real-world problems involving string processing, like sorting names or validating input.	
5.3 Define and use structures, including nested structures, to represent complex data types in C. (P.I. – 1.3.2) (CO2, CO4)	• Declare and define user-defined structures with appropriate data members. • Create and access structure variables using dot operator and pointers. • Implement nested structures to represent hierarchical or grouped data logically. • Write programs that utilize structures for storing and processing related data entities.	ISA, LAB
5.4 Create and manage arrays of structures to handle grouped data, and perform operations such as sorting, searching, and updating structure members. (P.I.-2.2.3) (CO2, CO3, CO4, CO6)	• Declare arrays of structures to manage collections of related records (e.g., student, employee). • Write functions to perform operations like insertion, deletion, search, and update on structure members. • Implement sorting algorithms (e.g., bubble sort, selection sort) on structure data based on specific fields. • Test and debug code for correctness, maintainability, and scalability when handling grouped data.	LAB, ESE
6.1 Explain the concept of pointers, including referencing, dereferencing, and the use of pointer operators. (P.I. – 1.3.2) (CO1, CO4)	• Define what pointers are and explain their significance in C programming. • Demonstrate referencing (&) and dereferencing (*) operations through simple examples. • Use pointer variables to store and manipulate memory addresses. • Explain and apply the correct usage of pointer operators in different programming contexts.	LAB, ESE
6.2 Apply pointers for call-by-reference, and pointer arithmetic in solving programming problems. (P.I. – 2.2.3) (CO1, CO4)	• Implement functions using pointers to achieve call-by-reference and modify actual parameters. • Demonstrate pointer arithmetic (e.g., incrementing/decrementing pointers, accessing array elements) with appropriate examples. • Solve problems that require manipulation of data using pointer expressions. • Debug and validate programs involving pointer-based logic for correctness and efficiency.	ISA, LAB
6.3 Use pointers effectively with arrays, including passing arrays to functions and working with arrays of pointers. (P.I. – 1.3.4) (CO4, CO6)	• Demonstrate how to pass one-dimensional and two-dimensional arrays to functions using pointers. • Use pointer notation to access and manipulate array elements.	ISA, LAB

	• Implement and utilize arrays of pointers (e.g., array of strings) in C programs. • Solve problems involving dynamic data structures and memory access using pointer-array combinations.	
6.4 Implement dynamic memory allocation using functions like malloc(), calloc(), realloc(), and free() to manage memory during runtime. (P.I. – 2.4.5) (CO5)	• Explain the need for dynamic memory allocation in C programming. • Use malloc(), calloc(), and realloc() to allocate memory for variables, arrays, and structures. • Apply free() to release dynamically allocated memory and prevent memory leaks. • Develop programs that demonstrate efficient memory usage and reallocation based on runtime requirements.	ISA, LAB
6.5 Perform file operations such as creating, opening, reading, writing, updating and closing files using C standard library functions. (P.I. – 2.3.3) (CO5, CO6)	• Explain different file modes (r, w, a, r+, etc.) used in C file handling. • Use file handling functions such as fopen(), fprintf(), fscanf(), fgets(), fputs(), and fclose(). • Write programs that perform tasks like reading from and writing to text files. • Implement file operations for creating, updating, and managing data in real-world applications (e.g., student records, logs).	LAB

Tools/ Technologies/ Programming Languages learnt:

Programming Languages: C
Integrated Development Environments (IDEs): Visual Studio Code

Textbooks:

1. E. Balagurusamy, “Programming in ANSI C”, 8th Edition, McGraw Hill Education, 2019.
2. Yashavant Kanetkar, “Let Us C”, 17th Edition, BPB Publications, 2023.
3. Byron Gottfried, “Programming with C”, 3rd Edition, McGraw Hill Education, 2017.
4. Brian W. Kernighan, Dennis M. Ritchie, “The C Programming Language”, 2nd Edition, Prentice Hall, 1988.
5. Ashok N. Kamthane, “Programming in C”, 3rd Edition, Pearson Education, 2015.
6. P.B. Mahapatra, “Thinking in C”, 1st Edition, PHI Learning, 2010.

Reference Books:

1. Brian W. Kernighan, Dennis M. Ritchie,
“The C Programming Language”, 2nd Edition, Prentice Hall, 1988.

2. E. Balagurusamy, “Programming in ANSI C”, 8th Edition, McGraw Hill Education, 2019.

Related/ Equivalent MOOC and Associated Certification:

1. Introduction to C Programming

Platform: NPTEL (National Programme on Technology Enhanced Learning)
Instructor: Prof. Anupam Basu, IIT Kharagpur
Link: https://nptel.ac.in/courses/106105085
🚀 Equivalent Certification Course

2. Programming in C
Platform: SWAYAM-NPTEL
Instructor: Prof. Shriram K. Vasudevan, IIT Madras
Link: https://nptel.ac.in/courses/106105171
🚀 Beginner-friendly, with weekly assignments and proctored exam

3. C Programming: Getting Started
Platform: edX (offered by Dartmouth College & IMT)
Link: https://www.edx.org/course/c-programming-getting-started
🚀 Part of "C Programming with Linux" Professional Certificate

4. Introduction to Programming in C
Platform: Coursera (Duke University)
Link: https://www.coursera.org/learn/c-programming
🚀 Hands-on certification course with beginner to intermediate content

Detailed Syllabus of First Year Semester-II

Course Name: Engineering Mathematics-II

Course Code: BESE_BSC_04

Vertical/ Sub-Vertical: BS_BSC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Nil

Pre-requisite for: BESE_BSC_06 and BESE_BSC_33 (Engineering Mathematics-III), and higher-level mathematical courses.

Recommended Semester: 2

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
BESE_BSC_04	3	-	3	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (BESE_BSC_04)	20 (~20%)	30 (~30%)	50 (~50%)	100 (100%)

The assessment guidelines are standardized across credit-based courses. However, faculty members may propose a revised methodology subject to approval from an institute-level panel. The approved method will be shared with learners at the start of the semester.

Preamble

The objective of the course is to develop the basic Mathematical skills of engineering learners that are imperative for effective understanding of engineering subjects. The topics introduced will serve as basic tools for specialized studies in many fields of engineering and technology, impart fundamental knowledge of Differential Equations of First Order, Higher Order, Special functions like Beta and Gamma Function, Double and Triple Integration, DUIS, Rectification, Numerical solutions of Differential Equations and Numerical Integration.

Course Objectives

- To recall and remember basics of differential equations, integral Calculus.
- To apply methods to solve engineering problems.
- To solve and evaluate the problems using Multiple Integration, Numerical Integration.
- To analyze problems based on Numerical Methods for solving differential Equations.

Course Outcomes

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Recall fundamental concepts and standard forms of first-order and higher-order differential equations, Beta and Gamma functions, and multiple integrals.	Remembering

CO2	Explain methods to solve linear and non-linear differential equations and describe the role of integrating factors, variation of parameters, and special functions in solving them.	Understanding
CO3	Apply analytical techniques to solve ordinary differential equations and evaluate integrals in Cartesian, polar, cylindrical, and spherical coordinates.	Applying

Mapping of Course Outcomes with Learning Outcomes

Module No.	Module Name	Content	No of Hours
1	Differential Equations of First Order and First Degree	**Learning Objective:** Recall facts, formulas, definitions, and basic concepts. Define types of first-order differential equations and their standard forms. Understand the method of integrating factors, Use procedures and techniques to solve problems first-order and higher-order linear differential equations analytically. (CO1 to CO3) **Contents:** Exact differential Equations, Equations reducible to exact form by using integrating factors. Linear differential equations (Review), equation reducible to linear form, Bernoulli's equation **Self-Learning Topics**: • Applications of first-order differential equations in population models and mixing problems • Clairaut's differential equation and singular solutions • Orthogonal trajectories (Cartesian and polar) • Riccati's and Lagrange's differential equations (introductory concepts) **Learning Outcomes:** A learner will be able to: 1.13 Recall Exact differential Equations (P.I.- 1.1.1) (CO1) 1.14 Explain Reducible to Exact differential Equations and Linear Differential Equation (P.I.- 1.1.1) (CO2) 1.15 Explain Reducible to Linear differential Equations and Bernoulli's Differential Equation (P.I.- 2.4.1) (CO3)	7
2	Linear Differential Equations with Constant Coefficients and Variable Coefficients of Higher Order	**Learning Objective:** Recall facts, formulas, definitions, and basic concepts Identify standard forms of linear differential equations with constant coefficients. Explain concepts and apply methods of variation of parameters in solving higher-order linear ODEs. (CO1 to CO3) **Contents:** Linear Differential Equation with constant coefficient- complementary function, particular integrals of differential equation of the type f(D)y = X where X is eax, $\sin(ax+b)$, $\cos(ax+b)$, xm, $m\ is\ positive\ integer$, $e\ axV$, $x.V\ or\ X$. Method of variation of parameters.	7

		Self-Learning Topics: • Cauchy-Euler (Equidimensional) equations • Solution of systems of linear differential equations (2 variables) • Use of Laplace transforms in solving linear ODEs (brief exposure) • Operator D method and shortcut techniques for finding P.I. **Learning Outcomes:** A learner will be able to: 2.4 Recall definition of Linear Differential Equation with constant coefficient (P.I.- 1.1.1) (CO1) 2.5 Explain complementary function, particular integrals of differential equation of various types (P.I.- 1.1.1) (CO2) 2.6 Apply Method of variation of parameters (P.I.- 2.4.1) (CO3)	
3	Special Functions	**Learning Objective:** Understand Beta and Gamma functions and learn DUIS for solving integrals. (CO1 to CO3) **Self-Learning Topics**: • Connection between Beta and Gamma functions • Evaluation of improper integrals using Gamma functions • Applications in probability and statistics (e.g., Gamma distribution) • Dirichlet's integral and its applications **Contents:** Beta and Gamma function with properties, differentiation under integral sign with constant limits. **Learning Outcomes:** A learner will be able to: 4.4 Recall properties of Beta and Gamma functions. (P.I.- 1.1.1) (CO1) 4.5 Explain DUIS Technique. (P.I.- 2.4.1) (CO2) 4.6 Apply Beta and Gamma to solve improper integrals. (P.I.- 2.4.1) (CO3)	7
4	Multiple Integrals-I	**Learning Objective:** Learn to solve double integrals in Cartesian and polar form and apply to real-world regions. (CO1 to CO3) **Content:** Double integrals in Cartesian and polar forms, evaluation over specified regions. **Self-Learning Topics**: • Applications of double integrals in physics and engineering (mass, center of gravity) • Numerical evaluation of double integrals • Line integrals and their relationship to double integrals (Green's Theorem as an overview)	8

		• Volume of solids by double integration **Learning Outcomes:** A learner will be able to: 4.1 Recall Double integration concepts. (P.I.- 1.1.1) (CO1) 4.2 Explain the conversion between cartesian and polar coordinates. (P.I.- 1.1.1) (CO2) 4.3 Apply Double Integration to change the order of integration. (P.I.- 2.4.1) (CO3)	
5	Multiple Integrals-II	**Learning Objective:** Learn to solve double integrals by ching to polar form compute area evaluate Triple Integration using Cartesian cylindrical and spherical polar coordinates and applying to real-world regions. (CO2 to CO3) **Content:** Evaluation of double integrals by changing to polar form, Application of double integrals to compute Area, Triple integration by changing to polar coordinates. **Self-Learning Topics**: 6.3 Surface area and mass using triple integrals 6.4 Change of variables in multiple integrals (Jacobian method – brief idea) 6.5 Use of spherical and cylindrical coordinates in heat transfer problems 6.6 Brief intro to vector calculus (gradient, divergence, curl) **Learning Outcomes:** A learner will be able to: 5.2 Understand about an Integral about when to change to polar form. (P.I.- 1.1.1) (CO2) 5.3 Evaluate the double integral to compute area and triple integral using polar form (P.I.- 2.4.1) (CO3)	8
6	Numerical solutions of ordinary differential equations of first order and first degree, and Numerical Integration	**Learning Objective:** Recall formulas of Euler's method and Runge-Kutta fourth order, Use Euler's and Runge-Kutta methods to compute approximate solutions to differential equations. Differentiate between different numerical integration techniques based on their accuracy and complexity. (CO1 to CO3) **Content:** Numerical solution of ordinary differential equation using Euler's method and Runge-Kutta fourth order method Numerical integration-by Trapezoidal, Simpson's 1/3rd and Simpson's 3/8th rule. **Self-Learning Topics**: • Error analysis in numerical methods • Adaptive step size in Runge-Kutta methods • Introduction to MATLAB/Python for implementing numerical methods • Stability and convergence of numerical solutions **Learning Outcomes:** A learner will be able to:	

		6.1 Recall formulae of Euler's method and Runge-Kutta fourth order method. (P.I.- 1.1.1) (CO1) 6.2 Explain Euler's method and Runge-Kutta fourth order method. (P.I.- 2.1.1) (CO2) 6.3 Apply Numerical solution of ordinary differential equation methods (P.I.- 2.4.1) (CO3)	
Total			**45**

Performance Indicators:

P.I.–1.1.1: Applying, Understanding: Apply knowledge of discrete structures, linear algebra, statistics, and numerical techniques.
P.I.–1.1.2: Applying, Understanding: Apply concepts of probability, statistics, and queuing theory in modeling.
P.I.–1.2.1: Applying: Apply laws of natural science to an engineering problem.
P.I.–1.3.1: Applying: Apply engineering fundamentals to solve engineering problems.
P.I.–1.4.1: Applying: Apply theory and principles of computer science and engineering to solve engineering problems.
P.I.–2.1.1: Analyzing: Evaluate problem statements and identify objectives.
P.I.–2.1.2: Analyzing: Identify processes, modules, and algorithms of a system and parameters to solve the problem.
P.I.–2.2.1: Analyzing, Applying: Reframe the computer-based system into interconnected subsystems.
P.I.–2.2.2: Analyzing: Identify functionalities and computing resources for the system.
P.I.–2.2.3: Analyzing: Identify existing solutions or methods to solve the problem, including justified approximations.
P.I.–2.3.1: Applying: Apply engineering principles to formulate modules of a system.
P.I.–2.4.1: Applying: Apply engineering mathematics to implement the solution.
P.I.–3.1.1: Defining, Applying: Define a precise problem statement with objectives and scope.
P.I.–3.1.2: Defining: Identify and document system requirements from stakeholders.
P.I.–3.1.3: Evaluating: Review state-of-the-art literature to synthesize system requirements.
P.I.–3.1.4: Evaluating: Choose appropriate quality attributes as defined by ISO/IEC/IEEE standards.
P.I.–3.1.5: Analyzing, Evaluating: Synthesize requirements from larger social and professional concerns.
P.I.–3.2.1: Creating, Evaluating: Explore design alternatives and analyze solutions.
P.I.–3.2.2: Creating, Evaluating: Produce a variety of potential design solutions to meet functional requirements.
P.I.–3.3.1: Evaluating: Perform systematic evaluation of design concepts based on criteria.
P.I.–3.3.2: Evaluating, Creating: Consult with domain experts to select the candidate engineering design for further development.
P.I.–3.4.1: Applying, Evaluating: Refine architecture design into a detailed design within the existing constraints.
P.I.–3.4.2: Applying, Creating: Implement and integrate modules into the design.
P.I.–3.4.3: Evaluating, Applying: Verify functionalities and validate the design.

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1, 2.1, 3.1, 4.1, and 5.1
CO2	1.2, 2.2, 3.2, 4.2, 5.2 and 6.2

CO3	1.3, 2.3, 3.3, 4.3, 5.3, and 6.3

Mapping of Course Outcomes with Programme Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO7	PO8	PO9	P010	PO11	PO12
CO1	5/17	-	-	-	-	-	-	-	-	-	-
CO2	4/17	2/17	-	-	-	-	-	-	-	-	-
CO3	-	6/17	-	-	-	-	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	-	-	-

Mapping of Course Outcomes with Programme Specific Outcomes:

Course Outcome	PSO1	PSO2	PSO3
CO1	SAME AS PO mapping (As per Performance Indicators of PSOs)		
CO2			
CO3			

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	Assessment Criteria: The Learner can:	Evaluated under ISA/MSE/ESE/LAB
Solve exact, linear, and Bernoulli's equations. Apply integrating factors to reduce equations.	Quiz, Written Test, Assignments, Exam, Project	ISA/MSE/ESE
Solve linear ODEs with constant coefficients. Use undetermined coefficients and variation of parameters. Model systems using higher-order ODEs.	Quiz, Written Test, Assignments, Exam, Project	ISA/MSE/ESE
Evaluate integrals using Beta and Gamma functions. Apply Leibnitz's rule for differentiation under the integral sign.	Quiz, Written Test, Assignments, Exam, Project	ISA/MSE/ESE
Evaluate double integrals in Cartesian and polar forms. Change the order of integration and interpret regions.	Quiz, Written Test, Assignments, Exam, Project	ISA/MSE/ESE
Compute volumes and areas using double/triple integrals.	Quiz, Written Test, Assignments, Exam, Project	ISA/MSE/ESE

Use coordinate transformations in triple integration.		
Solve ODEs using Euler and Runge-Kutta methods. Perform numerical integration using Trapezoidal and Simpson's rules. Analyze and compare method accuracy.	Quiz, Written Test, Assignments, Exam, Project	ISA/MSE/ESE

Course Name: Engineering Chemistry

Course Code: BS16 (T) & BS16 (P)

Vertical/ Sub-Vertical: Basic Science (BS)

K-S-A Mapping: Knowledge

Pre-requisite required: Nil

Pre-requisite for: Nanotechnology, Electronics Manufacturing

Recommended Semester: 1 or 2

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
BS16 T	2	-	2	-
BS16 P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (CE01T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (CE01P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

This course imparts students sound knowledge on the fundamentals of chemistry which can be applied in various courses and projects taken in Electronics and Computer Science, Electronics and Telecommunication and Biomedical Engineering.

Course Objectives:

1. The contents of this course will aid in quantification and understand the applications of several concepts in Chemistry.
2. To appreciate the need for and importance of engineering chemistry for industrial and domestic use.
3. To gain the knowledge on existing and future upcoming materials used in device fabrication.
4. To impart knowledge of green chemical technology and its applications.
5. To enhance the thinking capabilities in line with the modern trends in engineering and technology.

Course Outcome:

Student will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level

CO1	Interpret properties, synthesis, and uses of important materials in various engineering applications.	Understand
CO2	Apply the fundamentals of electrochemistry in prevention & control measures related to corrosion of structures and devices.	Apply
CO3	Rationalise different types of batteries and their real-life engineering applications.	Analyse
CO4	Analyse different spectroscopic techniques and study fundamentals of electromagnetic spectrum.	Analyse
CO5	Associate Green Chemistry principles in product development knowledge.	Apply

Detailed Syllabus:

Module no	Module name	Content	No of Hours
1	Polymer Chemistry	***Learning Objective:*** *To understand the types, properties, and synthesis methods of polymers used in various engineering applications. (CO1).* **Contents:** Introduction to Polymer, Properties of Polymers- Molecular weight, numerical problems on molecular weight, Glass transition temperature Methods of polymerization, Synthesis, Properties and Uses of commercially important polymers, Study of Speciality polymers like Conducting polymers, Liquid Crystal Polymer etc., Applications of Polymers ***Learning Outcomes:*** *A learner will be able to:* 1. *Describe types and properties of polymers. (PI 1.1.1) (CO1)* 2. *Illustrate synthesis processes and correlate structure with properties. (PI 1.2.1) (CO1)*	6
2	Electrochemistry and Corrosion	***Learning Objective:*** *To explore electrochemical principles and their application in understanding and preventing corrosion. (CO2).* **Contents:** Electrochemistry- Basics, Types of electrochemical cells, Electrochemical series and Galvanic series, Nernst equation, Numerical problems, Construction & Application of various electrodes Corrosion- Chemical and Electrochemical corrosion, Mechanism, Types- Differential aeration, Galvanic, Stress, Intergranular, Microbial, Soil corrosion etc., Prevention and control Measures, Case studies like- Corrosion in human body implants & Corrosion in electronic gadgets ***Learning Outcomes:*** *A learner will be able to:*	6

		1. *Apply Nernst equation and electrochemical cell concepts in real-life scenarios. (PI 2.1.2) (CO2)* 2. *Analyse corrosion mechanisms and suggest appropriate prevention techniques. (PI 2.2.3) (CO2)*	
3	Energy Storage systems	***Learning Objective:*** *To investigate the working, classification, and applications of modern batteries and fuel cells in sustainable engineering. (CO3).* **Contents:** Fundamentals of Energy storage, primary cells and secondary cells, Types of Batteries, Construction and application of Li-Ion battery Fuel cells- principle, components of fuel cell, types of fuel cell, applications, advantages and disadvantages, hydrogen production and hydrogen storage system Numerical problems ***Learning Outcomes:*** *A learner will be able to:* 1. *Classify batteries based on chemistry and structure. (PI 1.3.1) (CO3)* 2. *Evaluate suitability of energy storage devices for different applications. (PI 2.2.2) (CO3)*	4
4	Chemistry of Semiconductors	***Learning Objective:*** *To understand the properties and chemistry of semiconductor elements and compounds and their relevance in electronic applications. (CO1).* **Contents:** Silicon & Germanium - Physical and chemical properties, Isotopes, Chemistry of compounds like GaAs, GaP, InP. InGaAs, ZrO, HfO and applications in industry ***Learning Outcomes:*** *A learner will be able to:* 1. *Compare physical and chemical properties of Silicon and Germanium. (PI 1.1.1) (CO1)* 2. *Describe isotopes and analyze semiconductor compounds such as GaAs, GaP, InP, InGaAs, ZrO, and HfO with industrial applications. (PI 1.2.1, PI 2.2.2) (CO1)*	3
5	Engineering Materials	***Learning Objective:*** *To explore the structure, properties, and applications of advanced materials including nanomaterials, composites, shape memory alloys, and smart materials. (CO1)* **Contents:** **Nanomaterials:** Introduction, Graphene, Fullerenes, Carbon nanotubes, Electronic and Mechanical properties, Synthesis of CNT, Role of nano materials in electronics, Photonics, MEMS, Energy Nano-bio application **Composite Materials:** Types, properties, and industrial applications	5

		Shape Memory alloys: Principle, properties, super elasticity- One way and two-way shape memory effect, Austenite and martensite transformations, applications **Smart Materials:** Self-Assembled Nanostructures - Energy Harvesting Materials, Intelligent Materials – Magneto strictive Materials ***Learning Outcomes:*** *A learner will be able to:* 1. *Explain structure, synthesis, and applications of nanomaterials such as graphene, fullerenes, and carbon nanotubes. (PI 1.1.1, PI 1.2.1) (CO1)* 2. *Describe the types, properties, and uses of composite materials. (PI 2.2.2) (CO1)* 3. *Illustrate the working and characteristics of shape memory alloys and their transformations. (PI 1.3.1, PI 2.1.2) (CO1)* 4. *Evaluate functionalities and applications of smart materials like self-assembled nanostructures and magnetostrictive materials. (PI 7.2.1, PI 1.4.2) (CO1)*	
6	Spectroscopic techniques	***Learning Objective:*** *To understand the basic principles and applications of spectroscopic techniques in structural elucidation and analysis. (CO4)* **Contents:** Fundamentals of Spectroscopy, Electromagnetic spectrum, Different Forms of Spectroscopy, Beer-Lambert's law- Numerical problems, Techniques, Instrumentation and applications in Medicines and electronics ***Learning Outcomes:*** *A learner will be able to:* 1. *Explain principles of UV-Vis, IR, and NMR spectroscopy. (PI 1.1.1) (CO4)* 2. *Analyse spectra and infer structural information. (PI 1.4.2) (CO4)*	4
7	Green Chemistry	***Learning Objective:*** *To apply the principles of Green Chemistry in developing environmentally benign processes and materials. (CO5).* **Contents:** 12 Principles of Green Chemistry & application in green computing & Green Electronics, Numerical problems ***Learning Outcomes:*** *A learner will be able to:* 1. *Identify and explain 12 principles of Green Chemistry. (PI 7.1.1) (CO5)* 2. *Propose eco-friendly alternatives to conventional processes. (PI 7.2.1) (CO5)*	2

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	To determine free acid pH of different solutions using pH meter ***Learning Outcomes:*** *A learner will be able to:* *Determine and interpret pH values of various solutions using instrumentation. (P.I. – 1.3.1, 1.4.2)*
2.	To determine the Wavelength of Maximum Absorbance using colorimeter. ***Learning Outcomes:*** *A learner will be able to:* *Identify λ and analyze the electronic transitions in solutions. (P.I. – 1.1.1, 1.4.2)*
3.	To determine metal ion concentration using colorimeter. ***Learning Outcomes:*** *A learner will be able to:* *Apply Beer-Lambert's law to quantify unknown metal ions. (P.I. – 2.2.2, 1.4.2)*
4.	To determine Molecular weight of polymers by Oswald Viscometer. ***Learning Outcomes:*** *A learner will be able to:* *Calculate intrinsic viscosity and determine polymer molecular weight. (P.I. 1.2.1, 1.3.1)*
5.	To synthesize UF, PF, Nylon 66. ***Learning Outcomes:*** *A learner will be able to:* *Perform polymer synthesis and understand polymerization mechanisms. (P.I. – 1.1.1, 1.2.1)*
6.	To synthesize biodegradable polymer. ***Learning Outcomes:*** *A learner will be able to:* *Understand green polymer alternatives and eco-friendly chemistry. (P.I. - 7.1.1, 7.2.1)*
7.	To determine Viscosity of oil by Redwood Viscometer ***Learning Outcomes:*** *A learner will be able to:* *Measure and interpret the viscosity of lubricants for industrial applications. (P.I. – 1.3.1, 1.2.1)*
8.	To separate pigments using paper chromatography. ***Learning Outcomes:*** *A learner will be able to:* *Apply separation techniques for analyzing mixtures and identifying compounds. (P.I. – 1.4.2, 2.1.2)*
9.	To determine total, temporary, and permanent hardness of water sample by EDTA method. ***Learning Outcomes:*** *A learner will be able to:* *Analyze water samples using complexometric titration and distinguish types of hardness. (P.I. – 2.2.3, 2.1.2)*
10.	To construct the battery and measure potential difference across two terminals ***Learning Outcomes:*** *A learner will be able to:* *Construct electrochemical cells and evaluate voltage output. (P.I. – 2.1.2, 2.2.2)*
11.	To identify the materials and learn their properties ***Learning Outcomes:*** *A learner will be able to:* *Observe and analyze structure-property relationships of engineering materials. (P.I. – 1.1.1, 1.2.1)*
12.	To set up a galvanic cell ***Learning Outcomes:*** *A learner will be able to:*

	Explain the principles of redox reactions and voltage generation in galvanic cells. (P.I. – 2.1.2, 1.3.1)
13.	To set up an electrolytic cell and carry out electroplating ***Learning Outcomes:*** *A learner will be able to:* *Understand electrolysis and apply it for electroplating techniques. (P.I. – 1.4.2, 2.2.2)*
14.	To carry out etching of the Printed Circuit Board (PCB) ***Learning Outcomes:*** *A learner will be able to:* *Apply chemical etching processes in electronics fabrication. (P.I. – 1.3.1, 2.2.3)*
15.	To synthesize a nanomaterial and study its characterization ***Learning Outcomes:*** *A learner will be able to:* *Synthesize nanomaterials and interpret results using characterization tools. (P.I. – 1.2.1, 1.4.2)*
16.	To detect the adulteration in given milk sample ***Learning Outcomes:*** *A learner will be able to:* *Detect contaminants in food samples using chemical tests. (P.I. – 1.3.1, 2.2.2)*

Performance Indicators:

P.I.- 1.1.1: **Remembering**: Recall key mathematical formulas and concepts relevant to engineering problems.
P.I.- 1.2.1: **Understanding:** Explain how mathematical models are used to represent engineering systems or processes.
P.I.- 1.3.1: **Remembering**: List fundamental engineering principles (e.g., Ohm's law, Bernoulli's equation) and their applications.
P.I.- 1.4.2: **Understanding:** Explain the functions of specialized engineering systems in the computer engineering domain.
P.I.- 2.1.2: **Understanding:** Explain the key features and scope of a complex engineering problem.
P.I.- 2.2.2: **Understanding:** Describe the steps involved in formulating a solution plan for an engineering problem.
P.I.- 2.2.3: **Applying:** Develop a basic solution plan using a systematic approach to solve an identified problem.
P.I.- 7.1.1: **Understanding:** Explain how engineering activities and industrial practices affect the environment, society, and economy.
P.I.- 7.2.1: **Creating:** Propose sustainable solutions based on environmental criteria.

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1, 1.2, 4.1, 4.2, 5.1, 5.2, 5.3 and 5.4
CO2	2.2 & 2.2
CO3	3.1 & 3.2
CO4	6.1 & 6.2
CO5	7.1 & 7.2

Mapping of Course Outcomes with Programme Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO7	PO8	PO9	P010	PO11	PO12
CO1	4/9	--	--	--	--	--	--	--	--	--	--
CO2	--	3/9	--	--	--	--	--	--	--	--	--
CO3	1/9	2/9	--	--	--	--	--	--	--	--	--
CO4	2/9	--	--	--	--	--	--	--	--	--	--
CO5	--	--	1/9	--	--	1/9	--	--	--	--	--

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria:** The Learner can:	**Evaluated under ISA/MSE/ESE/LAB**
LO 1.1: *Describe types and properties of polymers. (PI 1.1.1) (CO1)*	• Correctly identifies various polymer types with examples • Describes key physical and chemical properties of polymers • Analyzes how different types exhibit unique properties based on structure	ISA MSE ESE
LO 1.2: *Illustrate synthesis processes and correlate structure with properties. (PI 1.2.1) (CO1)*	• Explains common synthesis processes with correct steps and conditions • Explains how structure influences physical properties (e.g., crystallinity, Tg) • Illustrates synthesis processes accurately with key reactants and catalysts.	MSE ISA ESE
LO 2.1: *Apply Nernst equation and electrochemical cell concepts in real-life scenarios. (PI 2.1.2) (CO2)*	• Correctly writes and interprets the Nernst equation with standard notations and units. • Explains the function of an electrochemical cell with examples (e.g., Daniell cell) • Performs correct calculations of Ecell for given concentrations/conditions.	MSE ISA ESE
LO 2.2: *Analyse corrosion mechanisms and suggest appropriate prevention techniques. (PI 2.2.3) (CO2)*	• Identifies various corrosion types with relevant examples • Explains mechanisms using relevant concepts (oxidation/reduction, electrochemical cells) • Suggests appropriate techniques based on identified corrosion type • Selects techniques appropriate to corrosion type and environment.	MSE ISA ESE ESE
LO 3.1: *Classify batteries based on chemistry and structure. (PI 1.3.1) (CO3)*	• Classifies batteries by chemistry (e.g., alkaline, lead-acid, Li-ion, NiMH) • Relates battery types to appropriate applications (e.g., EVs, UPS, wearables) • Differentiates batteries based on structure	MSE ISA LAB
LO 3.2: *Evaluate suitability of energy storage devices for different applications. (PI 2.2.2) (CO3)*	• Categorizes various devices with basic characteristics (type, energy density, etc.)	MSE ESE

	• Explains parameters like energy/power density, lifecycle, and efficiency	
LO 4.1: *Compare physical and chemical properties of Silicon and Germanium. (PI 1.1.1) (CO1)*	• Describes basic characteristics (group, period, type of element) • Lists and compares major physical properties (e.g., band gap, conductivity) • Describes chemical properties and typical reactions.	ISA ISA MSE
LO 4.2: *Describe isotopes and analyze semiconductor compounds such as GaAs, GaP, InP, InGaAs, ZrO, and HfO with industrial applications. (PI 1.2.1, PI 2.2.2) (CO1)*	• Describes isotopes with correct examples and basic applications (e.g., nuclear, medical) • Describes key properties like band gap, electrical behavior, and usage in devices.	ISA ISA
LO 5.1: *Explain structure, synthesis, and applications of nanomaterials such as graphene, fullerenes, and carbon nanotubes. (PI 1.1.1, PI 1.2.1) (CO1)*	• Explains synthesis methods with reactants, processes, and equipment • Explains how structure determines key properties (e.g., conductivity, strength) • Describes atomic/molecular structures of graphene, fullerenes, CNTs clearly.	ISA ISA ISA
LO 5.2: *Describe the types, properties, and uses of composite materials. (PI 2.2.2) (CO1)*	• Describes key mechanical, thermal, and chemical properties with some reasoning • Describes specific applications with context (e.g., "carbon fiber in aerospace panels")	ISA ISA
LO 5.3: *Illustrate the working and characteristics of shape memory alloys and their transformations. (PI 1.3.1, PI 2.1.2) (CO1)*	• Lists and explains key characteristics like superelasticity, pseudoelasticity • Uses appropriate terms like martensite, austenite, transformation temperature • Explains how SMA is used in engineering contexts (e.g., stents, actuators)	ISA ISA
LO 5.4: *Evaluate functionalities and applications of smart materials like self-assembled nanostructures and magnetostrictive materials. (PI 7.2.1, PI 1.4.2) (CO1)*	• Explains how these materials function under specific stimuli (e.g., magnetic field, pH, temperature) • Describes real-world engineering applications in detail (e.g., vibration control, nano-drug delivery)	ISA MSE
LO 6.1: *Explain principles of UV-Vis, IR, and NMR spectroscopy. (PI 1.1.1) (CO4)*	• Explains basic principle (electronic transitions, λmax) • Explains each spectroscopy type clearly	ISA MSE ESE

	• Uses basic correct terms (e.g., λmax, functional group region, chemical shift)	
LO 6.2: *Analyse spectra and infer structural information. (PI 1.4.2) (CO4)*	• Uses correct principles (e.g., Beer–Lambert law, chemical shift rules) in analysis	ESE
LO 7.1: *Identify and explain 12 principles of Green Chemistry. (PI 7.1.1) (CO5)*	• Identifies most of the 12 principles with correct titles • Explains principles clearly with basic examples • Uses appropriate green chemistry terms in explanations	MSE ESE LAB
LO 7.2: *Propose eco-friendly alternatives to conventional processes. (PI 7.2.1) (CO5)*	• Clearly explains a conventional process, including its environmental impact • Applies basic green chemistry principles to suggest improvements.	MSE ESE

Textbooks:

1. Shashi Chawla, "A Textbook of Engineering Chemistry", Dhanpat Rai & Co. (PVT.) LTD., New Delhi (2004).
2. S. S. Dara, "Engineering Chemistry", Chand & Co, New Delhi (2006)
3. Jain and Jain, "Engineering Chemistry", Dhanpat Rai & Co (PVT.) LTD, New Delhi (2006).

Reference Books:

1. B.R. Puri and L.R. Sharma, "Principles of Physical Chemistry", 45th Edition, Vishal Publishing Co. 2012.
2. Peter Atkins, "Physical Chemistry", XI th ed, Oxford, United Kingdom, Oxford University Press, 2017
3. V. K. Ahluwalia, "Green Chemistry: A textbook", Alpha Science International
4. J. D. Lee, "Concise Inorganic Chemistry"
5. V.R.Gowariker, "Polymer Science", New Age International Publication
6. S.K.Kulkarni, "Introduction to Nanotechnology"
7. C. N. Banwell, Elaine M. McCash, "Fundamentals of Molecular Spectroscopy", (4th edition), Tata McGraw Hill.
8. Y.R. Sharma, "Elementary Organic Spectroscopy", S. Chand and Co.
9. William D. Callister, "Materials Science and Engineering: An Introduction", Wiley
10. Mel Schwartz, "Smart Materials", CRC Press New York, 2009
11. Dimitris C. Lagoudas, "Shape Memory Alloys", Springer, New York, 2008
12. Micky Rakotondrabe, "Smart Materials- Based Actuators at Micro/Nano-Scale", Springer Science + Business Media, New York, 2013

Related/ Equivalent MOOC and Associated Certification:

1. Nanotechnology: A Maker's course offered by Duke University, North Carolina State University The University of North Carolina at Chapel Hill
https://www.coursera.org/learn/nanotechnology
2. Fundamentals of Material Science offered by Shanghai Jiao Tong University
https://www.coursera.org/learn/fundamentals-of-materials-science
3. Smart materials: Microscale and macroscale approaches offered by Peter the Great St. Petersburg Polytechnic University and Kazan National Research Technological University
https://www.coursera.org/learn/smart-materials-microscale-and-macroscale-approaches

Course Name: Engineering Graphics
Course Code: ESC01T & ESC01P

Vertical/ Sub-Vertical: BESC_ESE

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Basic Geometry

Pre-requisite for: Computer Graphics, Electrical Circuit Analysis, Probabilistic Graphical Model, Biological Modelling and Simulation, Robotics in Medicine, Installation & Maintenance of Medical devices

Recommended Semester: 1 & 2

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
ES01T	2	-	2	-
ES01P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (ES01T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (ES01P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

To improve the visualization skills of the learners, with imparting the learner's ability to read a drawing. This course also imparts and inculcates learners to understand the theory of projection.

Course Objectives:

- To understand the concepts of the Engineering Graphics.
- To know how to use drawing instruments for drafting and dimensioning.
- To understand visualisation technic and skills of Engineering Graphics.
- To know the Construction of 3D object.
- To introduce the tools of Computer Aided drafting (CAD).

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Understand conventional method and usage of CAD software.	Understanding

CO2	Apply the basic principles of projections and visualization to communicate ideas graphically.	Applying
CO3	Construct the drawing of curves, points, straight lines, and planes using concept of projections.	Analysing
CO4	Interpret the three-dimensional pictorial objects and represent in two-dimensional views.	Evaluating
CO5	Construct three dimensional shapes from two dimensional views using the concept of projections.	Evaluating

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Engineering Graphics and CAD	***Learning Objective:*** Introduce the fundamentals of engineering graphics and CAD tools essential for technical drawing and visualization. (CO1) **Contents:** Introduction and importance of engineering graphics. Introduction of different types of the quadrants, method of projection, lines and dimensioning. Drawing instruments and their usage. Introduction Computer Aided Design and Drafting (CADD or CAD) software and operations, menu system and toolbars. ***Self-Learning Topics***: *Basic Geometry and Constructions of lines and shapes.* ***Learning Outcomes:*** *A learner will be able to:* 1. *Identify the importance of engineering graphics in technical communication. (PI-1.1.2**)** (CO1)* 2. *Explain the types of quadrants and methods of projection used in engineering drawings. (PI-1.2.2**)** (CO1)* 3. *Demonstrate the use of drawing instruments and perform basic dimensioning and line work. (PI-1.3.1) (CO1)* 4. *Navigate CAD software interface, menu systems, and toolbars to create basic drawings. (PI-1.4.2**)** (CO1)*	3
2	Engineering Curve	***Learning Objective:*** Develop the ability to construct engineering curves like cycloids, involutes, and helices using standard geometric methods. *(CO3)* **Contents:** Basic construction of cycloid, involutes, and helix of cylinder. ***Self-Learning Topics****: NIL* ***Learning Outcomes:*** *A learner will be able to:* 1. Construct the path of a cycloid using basic geometric techniques. (*PI-3.1.1*) *(CO3)*	4

		2. Draw the involute of a circle and apply it in mechanical contexts such as gear tooth profiles. (*PI-3.1.2*) *(CO3)* 3. Generate the helix of a cylinder and interpret its application in threaded components. (*PI-3.1.3*)*(CO3)*	
3	Projection of Points & lines	***Learning Objective:*** Apply projection techniques to represent lines inclined to both horizontal and vertical planes using the first angle projection method. *(CO2, CO3)* **Contents:** Projections of lines, inclined to both the reference planes HP and VP as per the first angle projection method. ***Learning Outcomes:*** *A learner will be able to:* 1. Interpret the concept of reference planes and first angle projection system. (*PI-2.1.2*) *(CO2)* 2. Construct projections of lines inclined to both HP and VP using graphical methods. (*PI-3.1.4*) *(CO3)* 3. Analyse the true length and true inclinations of lines from given projections. (*PI-3.1.5*) *(CO3)*	4
4	Projection of Planes	***Learning Objective:*** Construct and interpret the projections of various geometric planes inclined to both HP and VP using the first angle projection method. *(CO2, CO3).* **Content:** Projection of rectangular, triangular, square, pentagonal, hexagonal, and circular planes, inclined to both the reference planes HP and VP as per the first angle projection method. ***Learning Outcomes:*** *A learner will be able to:* 4. Identify different types of planes (rectangular, triangular, polygonal, and circular) and their positions with respect to reference planes. (*PI-2.2.3*)*(CO2)* 5. Construct accurate projections of inclined planes using the first angle projection method. (*PI-3.1.6*)*(CO3)* 6. Analyze the orientation and true shape of inclined planes through graphical representation. (*PI-3.1.7*)*(CO3)*	4
5	Orthographic Projections	***Learning Objective:*** Develop skills to create orthographic and sectional views of machine parts using manual and CAD methods with appropriate dimensions and annotations. *(CO1, CO4).*	8

		Content: Drawing orthographic views from pictorial projections. Sectional orthographic Projections of a simple machine part as per the first angle projection method. - By drafting in the sketchbook as well as on CAD software. CAD Drawing: Applying dimensions to objects, applying annotations to drawings, setting up and use of layers, changing of the line properties, Printing setup and procedure. Different CAD Tools and usage- Draw tools, modify tools, properties, copy selection, dimensioning and editing (text height and arrow size). ***Learning Outcomes:*** *A learner will be able to:* 1. Interpret pictorial views and convert them into accurate orthographic projections using the first angle method. (*PI-4.1.1*)*(CO4)* 2. Generate sectional orthographic views of simple machine components using sketchbook and CAD software. (*PI-4.1.2*)*(CO4)* 3. Use CAD tools to apply dimensions, annotations, layers, and line properties effectively. (*PI-1.5.1*)*(CO1)* 4. Demonstrate CAD operations such as drawing, modifying, copying, dimensioning, and printing a technical drawing. (*PI-1.6.1*)*(CO1)*	
6	Isometric Views	***Learning Objective:*** Construct isometric views of blocks with planar and cylindrical features using manual and CAD drafting techniques. *(CO1, CO5).* **Contents:** Drawing Isometric views from given views of simple blocks with plane, cylindrical surfaces, and circular holes. - By drafting in the sketchbook as well as on CAD software CAD Drawing: Switching to isometric drafting mode, switch /change to different ISO planes, ISO circles on different ISO planes, Different CAD Tools and usage- Draw tools, Modify tools, Properties of line. ***Learning Outcomes:*** *A learner will be able to:* 1. Convert orthographic views into isometric drawings of objects with planar, cylindrical surfaces, and circular holes. (*PI-5.1.1*)*(CO5)* 2. Create isometric drawings manually and by using CAD tools, including switching ISO planes and drawing ISO circles. (*PI-5.1.2*)*(CO5)* 3. Apply CAD features like draw tools, modify tools, and line properties to complete accurate isometric projections. (*PI-1.7.1*) *(CO1)*	7

Total	30

Suggested List of Practical:

Sr No.	Suggested Topic(s)
1.	Introduction and practice of AutoCAD software ***Learning Outcomes:*** *A learner will be able to:* 1. *Navigate CAD software interface, menu systems, and toolbars to create basic drawings. (P.I. – 1.4.2) (CO1)*
2.	Drawing of Water Tap ***Learning Outcomes:*** *A learner will be able to:* 1. *Use CAD tools to apply dimensions, annotations, layers, and line properties effectively. (P.I. – 1.5.1) (CO1).*
3.	Orthographic Projection ***Learning Outcomes:*** *A learner will be able to:* 1. *Interpret pictorial views and convert them into accurate orthographic projections using the first angle method. (P.I. – 4.1.1) (CO4).*
4.	Isometric Projection ***Learning Outcomes:*** *A learner will be able to:* 1. *Convert orthographic views into isometric drawings of objects with planar, cylindrical surfaces, and circular holes. (P.I. - 5.1.1) (CO5)*
5.	Floor Plan ***Learning Outcomes:*** *A learner will be able to:* 1. *Demonstrate CAD operations such as drawing, modifying, copying, dimensioning, and printing a technical drawing. (P.I. – 1.6.1) (CO1)*
6.	2D Views of Car/Vehicle ***Learning Outcomes:*** *A learner will be able to:* 1. *Interpret pictorial views and convert them into accurate orthographic projections using the first angle method. (P.I. - 4.1.1) (CO4)*

Performance Indicators:

P.I.- 1.1.2: **Remembering**: Identify the importance of engineering graphics in technical communication.
P.I.- 1.2.2: **Understanding**: Explain the types of quadrants and methods of projection used in engineering drawings.
P.I.- 1.3.1: **Applying**: Demonstrate the use of drawing instruments and perform basic dimensioning and line work.
P.I.- 1.4.2: **Applying**: Navigate CAD software interface, menu systems, and toolbars to create basic drawings.
P.I.- 1.5.1: **Applying**: Use CAD tools to apply dimensions, annotations, layers, and line properties effectively.
P.I.- 1.6.1: **Applying**: Demonstrate CAD operations such as drawing, modifying, copying, dimensioning, and printing a technical drawing.
P.I.- 1.7.1: **Applying**: Apply CAD features like draw tools, modify tools, and line properties to complete accurate isometric projections.
P.I.- 2.1.2: **Understanding**: Interpret the concept of reference planes and first angle projection system.

P.I.- 2.2.3: **Understanding**: Identify different types of planes (rectangular, triangular, polygonal, and circular) and their positions with respect to reference planes.
P.I.- 3.1.1: **Applying**: Construct the path of a cycloid using basic geometric techniques.
P.I.- 3.1.2: **Applying**: Draw the involute of a circle and apply it in mechanical contexts such as gear tooth profiles.
P.I.- 3.1.3: **Applying**: Generate the helix of a cylinder and interpret its application in threaded components.
P.I.- 3.1.4: **Applying**: Construct projections of lines inclined to both HP and VP using graphical methods.
P.I.- 3.1.5: **Analyzing**: Analyze the true length and true inclinations of lines from given projections.
P.I.- 3.1.6: **Applying**: Construct accurate projections of inclined planes using the first angle projection method.
P.I.- 3.1.7: **Analyzing**: Analyze the orientation and true shape of inclined planes through graphical representation.
P.I.- 4.1.1: **Applying**: Interpret pictorial views and convert them into accurate orthographic projections using the first angle method.
P.I.- 4.1.2: **Applying**: Generate sectional orthographic views of simple machine components using sketchbook and CAD software.
P.I.- 5.1.1: **Applying**: Convert orthographic views into isometric drawings of objects with planar, cylindrical surfaces, and circular holes.
P.I.- 5.1.2: **Applying**: Create isometric drawings manually and by using CAD tools, including switching ISO planes and drawing ISO circles.

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1, 1.2, 1.3, 1.4, 5.3, 5.4, 6.3
CO2	3.1, 4.1
CO3	2.1, 2.2, 2.3, 3.2, 3.3, 4.2, 4.3
CO4	5.1, 5.2
CO5	6.1, 6.2

Mapping of Course Outcomes with Programme Outcomes:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO7**	**PO8**	**PO9**	**P010**	**PO11**	**PO12**
CO1	7/21	-	-	-	-	-	-	-	-	-	-
CO2	2/21	-	-	-	-	-	-	-	-	-	-
CO3	-	7/21	-	-	-	-	-	-	-	-	-
CO4	-	-	2/21	-	-	-	-	-	-	-	-
CO5	-	-	-	-	3/21	-	-	-	-	-	-

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria:** The Learner can:	**Evaluated under ISA/MSE/ESE/LAB**
LO 1.1: Identify the importance of engineering graphics in technical communication. (P.I.- 1.1.2) (CO1)	• Define engineering graphics and its purpose in communication. • Explain real-world applications of engineering drawings. • List the industries where engineering graphics is used.	ISA, MSE
LO 1.4: Navigate CAD software interface, menu	• Open and operate basic CAD interface elements. • Locate and use standard menu tools.	ISA, LAB

systems, and toolbars. (P.I.-1.4.2) (CO1)	• Demonstrate drawing a simple figure using toolbar.	
LO 2.2: Draw the involute of a circle and apply it in mechanical contexts. (P.I.-3.1.2) (CO3)	• Sketch an accurate involute of a circle. • Label tangent development method correctly. • Explain real-life application of involute in gears.	ISA, MSE
LO3.2: Construct projections of lines inclined to both HP and VP. (P.I.- 3.1.4) (CO3)	• Identify correct projection reference planes. • Draw projections of a line using correct angles. • Demonstrate true length and inclination.	MSE, ESE
LO 4.1: Identify types of planes and their positions w.r.t. reference planes. (P.I.-2.2.3) (CO2)	• Classify plane surfaces by shape. • Distinguish between different plane positions. • Draw examples with proper quadrant placement.	ISA, MSE
LO 5.1: Convert pictorial views into orthographic projections. (P.I.- 4.1.1) (CO4)	• Visualize and draw 3 main views (top, front, side). • Maintain scale and proportion. • Label views correctly.	LAB, ESE
LO 6.1: Convert orthographic views into isometric drawings. (P.I.- 5.1.1) (CO5)	• Identify object orientation from 2D views. • Draw an isometric view with correct dimensions. • Use CAD software or sketching tools appropriately.	LAB, ISA, ESE

Tools / Technologies / Software Learnt:

- **CAD Software:** AutoCAD, DraftSight, LibreCAD
- **2D & 3D Drawing Tools:** AutoCAD Isometric Drafting, Orthographic Projection Tools
- **Annotation & Dimensioning Tools:** Dimensioning Toolbars, Text & Leader Tools, Hatch & Section tools
- **Layer and Property Management:** Layer Manager, Lineweight, Linetype Control, Object Properties
- **CAD File Operations:** Plotting & Printing Tools, DWG File Handling, Template Usage
- **Visualization Tools:** Isometric Grid, UCS (User Coordinate System), View Controls
- **Simulation & Practice Platforms (if applicable):** TinkerCAD, Fusion 360 (for extended practice)
- **Learning Platforms:** Autodesk Education Community, LinkedIn Learning – AutoCAD tutorials, NPTEL CAD Video Lectures

Textbooks:

1. N.D. Bhatt, *"Engineering Drawing"*, 53rd Edition, Charotar Publishing House, 2016.
2. P.S. Gill, *"Engineering Drawing"*, 17th Edition, S.K. Kataria & Sons, 2019.

Reference Books:

1. K. Venugopal, V. Prabhu Raja, *"Engineering Drawing + AutoCAD"*, 5th Edition, New Age International Publishers, 2020.
2. Dhananjay A. Jolhe, *"Engineering Drawing with an Introduction to AutoCAD"*, 3rd Edition, Tata McGraw-Hill Education, 2017.
3. M.B. Shah & B.C. Rana, *"Engineering Drawing"*, 2nd Edition, Pearson Education, 2009.

Related / Equivalent MOOC and Associated Certification:

1. **Engineering Drawing and Computer Graphics** – Equivalent Certification Course
   - **Platform:** NPTEL (National Programme on Technology Enhanced Learning)
   - **Link:** https://nptel.ac.in/courses/112103019

2. **Engineering Graphics Essentials with AutoCAD** – Skill-based Certification Course
   - **Platform:** Udemy
   - **Link:** https://www.udemy.com/course/autocad-engineering-graphics/
3. **Technical Drawing and Engineering Design** – Related Course
   - **Platform:** Coursera (offered by Moscow Institute of Physics and Technology)
   - **Link:** https://www.coursera.org/learn/technical-drawing
4. **AutoCAD for Design and Drafting** – Autodesk Certified Path
   - **Platform:** Autodesk Learning Hub
   - **Link:** https://academy.autodesk.com/course/115297/introduction-autocad

Course Name: Professional Skills

Course Code: VEC01T

Vertical/ Sub-Vertical: HSSM_VEC

K-S-A Mapping: Knowledge, Skill & Attitude

Pre-requisite required: NIL

Pre-requisite for: NIL

Recommended Semester: 2

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
VEC01T	2	-	2	-
VEC01P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (VEC01T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (VEC01P)	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

The course, Professional Skills, will groom students in the areas of developing professional etiquettes, building digital profiles, imbibing workplace ethics, and organizational behaviour. This course will also be an essential guide in building business communication and soft skills concepts.

Course Objectives:

- Recognize and apply the do's and don'ts of participation in group discussions, resume writing and interviews. (K)
- To develop professional etiquettes and build an effective digital profile for positive communication and workplace presence. (A)
- Learn and demonstrate the dynamics of various types of interpersonal skills through team presentations and role play sessions. (S)
- Comprehend various ethical and unethical practices and ethical decision-making and concepts like intellectual property rights, and plagiarism checks. (K)
- Learn about various personality traits, learning styles, productivity tools and understand SWOT. (A)
- To foster critical thinking, creativity, collaboration, and communication skills essential for success in the 21st-century workplace and society. (K)

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Observe and participate in Group Discussions and Mock Interviews on the lines of campus placement training.	Cognitive Application
CO2	Build a digital profile by demonstrating awareness of a professional persona	Cognitive Application
CO3	Identify various interpersonal skills through participation in presentations and role play.	Affective Responding
CO4	Differentiate between ethical and non-ethical behaviour through analysis of case studies.	Affective Valuing
CO5	Identify their personality traits and learning styles through activities like SWOT analysis	Affective Responding
CO6	Demonstrate awareness of 4 C's relevant to 21st Century Skills.	Affective Responding

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Employment Skills:	***Learning Objective:*** Students will be able to demonstrate essential employment skills by effectively participating in group discussions, preparing professional resumes, and performing confidently in job interviews. *(C01).* **Contents:** Job Application & Resume Writing Group Discussion Interview Skills ***Self-Learning Topics***: Nil ***Learning Outcomes:*** *A learner will be able to:* 1.1 *Demonstrate effective participation and articulation of viewpoints in group discussions. (P.I.- 9.1.1, 9.1.2, 9.2.2, 9.2.3, 9.3.1, 10.2.1 (CO1)* 1.2 *Prepare for and perform confidently in various interview formats. (P.I. –9.2.3, 9.2.4, 10.2.1, 10.2.2 (CO1)* 1.3 *Create a professional and tailored resume, and portfolios highlighting skills and achievements. (P.I. 10.1.2, 10.1.3 (CO1)*	10
2	Professional Etiquettes	***Learning Objective:*** Students will be able to demonstrate appropriate professional etiquette in academic and workplace environments by practicing respectful communication, maintaining decorum in formal interactions, and following accepted norms of behavior during meetings, emails, and networking events. (*CO2)*	4

		Contents: Techniques Corporate Grooming and Workplace Etiquette Telephone Etiquette Netiquettes, Telephone Etiquette Digital Footprints, Social Media, Personal Profile Privacy Digital Profile Building (ePortfolio, LinkedIn) ***Self-Learning Topics**: Nil* ***Learning Outcomes:*** *A learner will be able to:* *2.7 Apply appropriate grooming and etiquette to project a professional image at the workplace. (P.I. –9.2.3, 9.2.4) (CO2)* *2.8 Practice responsible and respectful behavior in telephone and all forms of digital communications. (P.I. –9.2.2, 9.2.3, 10.1.1) (CO2)* *2.9 Manage digital footprints and ensure privacy across social media platforms and maintain a professional digital profile using ePortfolio and LinkedIn. (P.I. – 9.2.1, 10.1.1, 10.3.2) (CO2)*	
3	Interpersonal Skills:	***Learning Objective:*** Students will be able to **develop effective interpersonal communication skills** by engaging in active listening, expressing ideas clearly, providing constructive feedback, and collaborating productively in diverse teams and professional environments. *(CO3)* **Contents:** Assertiveness, Negotiation Leadership, Team Building Problem Solving, Decision Making Cultural and Emotional Intelligence ***Self-Learning Topics:** Nil* ***Learning Outcomes:*** *A learner will be able to:* *3.11 Demonstrate assertive communication, effective negotiation skills, and leadership qualities to influence and guide individuals and teams toward common goals. (P.I. –9.1.1, 9.2.1, 10.2.1) (CO3)* *3.12 Collaborate effectively within teams to solve problems and make informed decisions in dynamic professional environments. (P.I. –9.1.1, 9.2.1, 9.3.1, and 12.1.2) (CO3)*	6

		3.13 Apply cultural awareness and emotional intelligence to foster inclusive, empathetic, and productive interpersonal interactions. (P.I. –9.1.1, 9.1.2, 9.2.1) (CO3)	
4	Ethics	***Learning Objective:*** Students will be able to analyze and apply ethical principles in engineering practices by recognizing moral dilemmas, evaluating consequences, and making decisions that reflect integrity, responsibility, and social accountability. *(CO4).* **Content:** Introduction to Ethics Plagiarism and Online Plagiarism Checker Patents Trademark and Copyrights and GI – Geographical Indicators Professional Ethics Corporate Social Responsibility (CSR) –Information Confidentiality ***Self-Learning Topics:*** *Nil* ***Learning Outcomes:*** *A learner will be able to:* *4.6 Recognize and apply ethical principles in professional decision-making. (P.I. – 8.1.1 and 8.2.2) (CO4)* *4.7 Identify plagiarism, understand IPR and utilize tools to ensure academic and professional integrity. (P.I. – 8.1.1 and 8.2.1) (CO4)* *4.8 Demonstrate understanding of CSR principles and the importance of maintaining information confidentiality. (P.I. -8.2.2) (CO4)*	4
5	Personality Enrichment:	***Learning Objective:*** *Students will be able to enhance their personal and professional identity by developing self-awareness, confidence, emotional intelligence, and a positive mindset that supports personal growth, stress management, and career readiness. (CO5)* **Content:** SWOT Analysis and JOHARI window Developing Positive Attitude Personality Types and Learning Styles Vision and Goal Setting Stress Management and Time Management ***Self-Learning Topics:*** *Nil* ***Learning Outcomes:*** *A learner will be able to:*	2

		5.10 Apply SWOT analysis, JOHARI Window to enhance self-awareness and personal development and also set personal and professional goals aligned with a clear vision. (P.I. 9.1.1, 10.2.1) (CO5) *5.11 Identify different personality types and adapt learning strategies accordingly. (P.I.-9.1.1) (CO5)* *5.12 Employ strategies to effectively manage stress and optimize time. (P.I. – 9.2.4, 10.2.1) (CO5)*	
6	21st Century Skills	***Learning Objective:*** *Enable students to apply creative and critical thinking, analyze and solve problems collaboratively, and communicate ideas effectively in diverse professional and social contexts.(CO5).* **Contents:** Creative Thinking Critical Thinking Collaboration and Communication ***Self-Learning Topics: All*** ***Learning Outcomes:*** *A learner will be able to:* *6.11 Generate original ideas and innovative solutions to problems. (P.I. – 10.1.2, 10.2.2 and 12.2.1, 12.2.2) (CO6)* *6.12 Analyze information logically to make informed decisions and solve complex problems. (P.I.-12.1.2) (CO6)* *6.13 Collaborate effectively and communicate ideas clearly in diverse team environments. (P.I. –9.3.1, 10.1.1, 10.2.1) (CO6)*	4
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Group Discussion ***Learning Outcomes:*** *A learner will be able to:* *1.1 Demonstrate effective participation and articulation of viewpoints in group discussions. (P.I.- 9.1.1, 9.1.2, 9.2.2, 9.2.3, 9.3.1, 10.2.1 (CO1)*
2.	Mock Interviews (Participate in Peer Interviews and learn the skills required to ace the Interviews) ***Learning Outcomes:*** *A learner will be able to:* 1.2 *Prepare for and perform confidently in various interview formats. (P.I. –9.2.3, 9.2.4, 10.2.1, 10.2.2 (CO1)*
3.	Case Study on Ethics ***Learning Outcomes:*** *A learner will be able to:*

	4.9 Recognize and apply ethical principles in professional decision-making. (P.I. – 8.1.1 and 8.2.2) (CO4)
4.	E-Portfolio ***Learning Outcomes:*** *A learner will be able to:* 1.3 *Create a professional and tailored resume, and portfolios highlighting skills and achievements. (P.I. 10.1.2, 10.1.3 (CO1)*
5.	Video Resume ***Learning Outcomes:*** *A learner will be able to:* 1.3 *Create a professional and tailored resume, and portfolios highlighting skills and achievements. (P.I. 10.1.2, 10.1.3 (CO1)*
6.	Mini Project ***Learning Outcomes:*** *A learner will be able to:* *6.1 Generate original ideas and innovative solutions to problems. (P.I. – 10.1.2, 10.2.2 and 12.2.1, 12.2.2) (CO6)*
7.	Interpersonal Skills Presentation ***Learning Outcomes:*** *A learner will be able to:* *A learner will be able to:* *3.1 Demonstrate assertive communication, effective negotiation skills, and leadership qualities to influence and guide individuals and teams toward common goals. (P.I. –9.1.1, 9.2.1, 10.2.1) (CO3)*

Performance Indicators:

P.I. 8.1.1 - **Analyzing** :Analyze ethical issues in engineering practice and societal expectations.

P.I. 8.2.1- **Evaluating :** Evaluate the responsibility of engineers towards public safety and welfare.

P. I. 8.2.2 **Applying**: Examine and apply moral & ethical principles to known case studies.

P.I. 9.1.1 **Understanding**: Recognize a variety of working and learning preferences; appreciate the value of diversity on a team.

P.I. 9.2.1 **Remembering**: Demonstrate effective communication, problem-solving, conflict resolution and leadership skills

P.I. 9.2.2 **Understanding**: Treat other team members respectfully

P.I. 9.2.3 **Understanding**: Listen to other members

P.I. 9.2.4 **Understanding**: Maintain composure in difficult situations

P.I. 9.3.1 **Applying**: Present results as a team, with smooth integration of contributions from all individual efforts

P.I. 10.1.1 **Understanding**: Read, understand and interpret technical and non-technical information

P.I. 10.1.2- **Applying**: Produce clear, well-constructed, and well-supported written engineering documents.

P.I. 10.2.1- **Applying**: Listen to and comprehend information, instructions, and viewpoints of others

P.I. 10.2.2- **Understanding** Deliver effective oral presentations to technical and non-technical audiences

P.I. 12.1.2- **Analyzing;** Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap

P.I. 12.2.1- **Remembering** Actively pursue self-learning, professional development, and staying updated with emerging technologies.

P.I. 12.2.2- **Remembering** Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field

P.I.- 1.1.1: **Remembering**: Students will gain knowledge to develop the traits of a suitable candidate with respect to resume writing, participating in group discussions, and facing interviews

P.I.- 1.2.2: **Understanding**: Students will understand the techniques to analyse problem statements and formulate solutions of problems using surveys and project work

P.I.- 1.3.1: **Remembering**: Students can demonstrate the key skills required to face GDs, interviews, and resume writing as an individual or a team member

P.I.- 1.3.2: **Understanding**: Students can exhibit professional presentation skills both individually or in a team

P.I.- 1.4.2: **Understanding**: Students can prepare themselves as an individual or as a part of a team for various corporate ethics and etiquettes

P.I.- 2.1.2: **Understanding**: Student will inculcate professional ethics to build stronger relationships in professional practices

P.I.- 2.1.3: **Applying**: Students will apply the skills of communicating effectively to deliver the right employment skills

P.I.- 2.1.4: **Analyzing**: Students will critically analyse the insights about communicating effectively during campus placements and competitive examinations

P.I.- 2.2.3: **Applying**: Students will develop effective communication strategies to build their inter-personal skills.

P.I.- 3.2.1: **Remembering**: Students will inculcate knowledge by communicating about contemporary issues and demonstrate the ethical code of conduct.

P.I.- 3.2.2: **Understanding**: Students will learn to communicate effectively to deliver the right employment skills

P.I.- 3.2.3: **Applying**: Students can apply their skills to prepare themselves as an individual or as a part of a team for various corporate ethics and etiquettes

P.I.- 3.3.1: **Remembering**: Students will gain fundamental knowledge of various inter-personal skills like team building, motivation, assertiveness, conflict resolution etc., to progress professionally

P.I.- 3.3.2: **Understanding**: Students will explain and demonstrate the formal presentations using modern ICT tools for a successful career that meets the global corporate world virtual requirements.

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes

CO1	1.1, 1.2, 1.3
CO2	2.1, 2.2, 2.3, 2.4
CO3	3.1, 3.2, 3.3
CO4	4.1, 4.2
CO5	5.1, 5.2, 5.3
CO6	6.1, 6.2, 6.3

Mapping of Course Outcomes with Programme Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO7	PO8	PO9	P010	PO11	PO12
CO1		-	-	-	-	-	-	08/48	05/48	-	-
CO2				-	-	-	-	05/48	03/48	-	-
CO3				-	-	-	-	08/48	01/48	-	01/48
CO4				-	-	-	05/48	-	-	-	-
CO5				-	-	-	-	02/48	02/48	-	-
								01/48	04/48		03/48

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria:** The Learner can:	**Evaluated under ISA/MSE/ESE/LAB**
LO1: Students will be able to demonstrate essential employment skills by effectively participating in group discussions, preparing professional resumes, and performing confidently in job interviews.	1.1 Participate in Group Discussions and evaluate cases of group discussions	ISA LAB, MSE, ESE
	1.2 Group Discussion Do's and Don'ts, Selection Criteria	ISA TH
	1.2 Draft a professional beginner level resume	ESE LAB
	1.3 Participate in Mock interviews and write appropriate responses to HR and Technical Interview Questions	ISA LAB
	1.4 Prepare professional e-Portfolios	ESE LAB
	1.5 Prepare video resumes	ESE LAB
LO2: Students will be able to demonstrate appropriate professional etiquette in academic and workplace environments by practicing respectful communication, maintaining decorum in formal interactions, and following accepted norms of behavior during meetings, emails, and networking events.	2.1 Perform role play on different scenarios pertaining to professional etiquettes	ISA LAB
	2.2 Identify 4 Etiquettes which you feel matter a lot in the professional world. Write down tips to develop those etiquettes	ISA TH
LO3: Students will be able to develop effective interpersonal communication skills by engaging	3.1 Design presentations on Interpersonal Skills and present in the class as a flipped activity	ISA

in active listening, expressing ideas clearly, providing constructive feedback, and collaborating productively in diverse teams and professional environments.	3.2 Mini Project Report and Presentation	ESE (P)
LO4: Students will be able to analyze and apply ethical principles in engineering practices by recognizing moral dilemmas, evaluating consequences, and making decisions that reflect integrity, responsibility, and social accountability.	4.1 Analyze case studies based on Ethics	ISA LAB
	4.2 A. Select any one research paper from the AAP, read it and paraphrase the same. B. Submit a plagiarism check report of your paraphrase.	ISA TH
LO5: Students will be able to enhance their personal and professional identity by developing self-awareness, confidence, emotional intelligence, and a positive mindset that supports personal growth, stress management, and career readiness.	5.1 Personality MBTI Test and Psychometric Test. Submit screenshot of results.	ISA LAB
	2. Identify the major stressors in your life. Make a mind map on Stress Management.	ISA TH
	4. Prepare a comprehensive Time Management Matrix and design a productive schedule for yourself.	ISA TH
	5. What is SWOT analysis and what is its use? Prepare your SWOT Analysis	ISA TH
	6. What is Johari Window and how is it useful? Prepare your Johari Window.	ISA TH
	5.6 Complete MOOC course and get certified	ISA LAB
	5.7 Prepare a visual representation of your Vision Chart and Short-Term Goals and Long Term Goals.	ISA TH
LO6: Enable students to apply creative and critical thinking, analyze and solve problems collaboratively, and communicate ideas effectively in diverse professional and social contexts.(	6.1 Design a Poster and write-up on any one of the following 21st century skills	ISA TH

Reference Books:

1. Personal Development for Life and Work, Wallace and Masters, Thomson Learning
2. Soft Skills, Dr. K.Alex, S. Chand and company
3. Organizational Behaviour, Robbins Stephens, Pearson Education
4. What Are Soft Skills? Dorch, Patricia, NewYork: Execu Dress Publisher, 2013
5. Soft Skills and Professional Communication, Francis Peter, Tata McGraw Hill
6. Business Communication- "Building Critical Skills," Kitty O Locker, McGraw Hill
7. "Business Communication - Concepts Cases and Applications," Chaturvedi and Chaturdevi, Pearson
8. How to Speak Fluently, Jones, Indian Publishing House

Related/ Equivalent MOOC and Associated Certification:

1. LinkedIn Mastery: Creating an awesome profile - https://www.udemy.com/course/linkedinmastery-creating-an-awesome-profile/
2. Soft Skills: The 11 Essential Career Soft Skills - https://www.udemy.com/course/soft-skills-the11-essential-career-soft-skills/
3. Understanding Personality Types at Work - https://www.udemy.com/course/understandingpersonality-types-at-work/
4. Speak English Professionally: In Person, Online & On the Phone -

https://www.coursera.org/learn/speak-english-professionally

5. How to Write a Resume (Project Centered Course) https://www.coursera.org/learn/how-to-write-aresume
6. Interviewing and Resume Writing in English Specialization

https://www.coursera.org/specializations/english-interview-resume

7. Build Your Professional ePortfolio in English - https://www.coursera.org/learn/eportfolio-english

Course Name: Object Oriented Programming

Course Code: VSEC02T & VSEC02P

Vertical/ Sub-Vertical: SC_VSEC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: VSEC01T & VSEC01P (Structured Programming)

Pre-requisite for: VSEC03 (Python Programming), PCCE13T (Machine Learning), PRJCE01 (Project)

Recommended Semester: 2

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
VSEC02T	2	-	2	-
VSEC02P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical	25 (50%)	-	25 (50%)	50 (100%)

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:

The course aims to advance learner's knowledge in problem solving and programming principles for real world applications through object-oriented programming using Java language. The course emphasizes data abstraction and object-oriented programming design through the implementation of classes, objects and related concept like Inheritance, Polymorphism, Exception Handling, Multithreading and Applets.

Course Objectives:

1. To introduce students to the foundational concepts of Java programming, including its features, platform independence for developing basic programs.
2. To enable learners to implement object-oriented programming principles such as classes, objects, constructors, method overloading, and object passing, fostering modular and reusable Java code.
3. To apply advanced OOP concepts like inheritance, interfaces, polymorphism, and wrapper classes (String, StringBuffer, Vector) to develop extensible and maintainable Java applications.
4. To develop the ability to handle runtime errors gracefully by applying exception handling mechanisms for building robust applications.
5. To introduce students to concurrent programming and application modularization for building interactive and scalable Java programs.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Explain the features of Java and its platform-independent nature using bytecode, JVM, and JRE.	Understand
CO2	Develop basic Java programs using data types, operators, control structures, static members, and arrays (1D and 2D).	Apply
CO3	Construct modular programs using object-oriented programming concepts such as classes, constructors, object passing, and method overloading.	Apply
CO4	Implement inheritance, interfaces, polymorphism, and use of wrapper classes to enhance code reusability and flexibility.	Analyse
CO5	Apply exception handling techniques such as try-catch, throw, throws, and user-defined exceptions for developing error-resilient applications	Evaluate
CO6	Design multithreaded Java applications and modular programs using packages and interactive applets.	Create

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Introduction to Java	***Learning Objective:*** *To enable students to understand and apply the foundational concepts of Java programming such as platform independence, data types, control structures, static members, and arrays to develop simple and structured programs.(CO1, CO2)* **Contents:** Features of Java, Platform Independence – Byte Code, JVM, JRE. Data Types, Operators, Control Structures, Static Data, Static Function, 1D Array and 2D Array ***Self-Learning Topics***: *Array Data Structure* **Learning Outcomes:** LO1.1: Describe the features of Java and explain how bytecode, JVM, and JRE contribute to its platform independence.(PI1.4.1 & PI 2.1.2)(CO1) **LO1.2**: Use data types, operators, and control structures to write basic Java programs. (PI1.3.3 & PI1.4.3) (CO2) **LO1.3**: Implement static variables and static functions to demonstrate shared functionality in Java. (PI2.4.3)(CO2) **LO1.4**: Construct Java programs using one-dimensional and two-dimensional arrays to manipulate tabular data. (PI2.2.3 & PI1.3.3) (CO2)	4
2	Object Oriented Programming	***Learning Objective:*** *To enable students to construct modular and reusable programs by applying core object-oriented programming concepts such as class design, constructors, method overloading, object passing, and array of objects in Java.(CO3)* **Contents:** Classes and Objects, Instance Variables, Constructors,	4

		Object Passing Methods, Method Overloading, Array of Objects ***Learning Outcomes:*** *A learner will be able to:* ***LO2.1****: Define and use classes, objects, and instance variables to model real-world entities in Java programs. (PI1.4.1 & PI1.3.2)(CO3)* ***LO2.2****: Implement constructors (default and parameterized) to initialize Java objects (PI1.3.3 & PI2.4.3) (CO3)* ***LO2.3****: Demonstrate method overloading and object passing techniques to achieve functional flexibility. (PI1.4.3 & PI2.2.3)(CO3)* ***LO2.4****: Create and manipulate arrays of objects to organize and manage grouped object data. (PI1.3.6 & PI1.4.6)(CO3)*	
3	Inheritance	***Learning Objective:*** *To equip students with the ability to develop flexible and reusable Java programs by applying advanced object-oriented concepts such as inheritance, interfaces, method overriding, and wrapper classes.(CO4)* **Contents:** Concept and Types, Constructors in Inheritance, Method Overriding and Dynamic Method Dispatch, abstract and final keyword, Interfaces – Concept and Significance, Wrapper Classes – String, StringBuffer, Vector ***Learning Outcomes:*** *A learner will be able to:* ***LO3.1****: Explain the concept and types of inheritance and the use of constructors in inheritance(PI2.1.2 & PI1.3.2)(CO4)* ***LO3.2****: Apply method overriding and dynamic method dispatch to implement runtime polymorphism.(PI1.4.3 & PI2.4.3)(CO4)* ***LO3.3****: Use abstract classes, final keywords, and interfaces to build structured and extendable programs.(PI1.4.4 & PI2.2.4)(CO4)*	4
4	Exception Handling	***Learning Objective:*** *To enable students to develop robust Java applications by applying exception handling mechanisms such as try-catch blocks, throws/throw keywords, and custom exception classes to manage runtime errors effectively.(CO5)* **Content:** To enable students to develop robust Java applications by applying exception handling mechanisms such as try-catch blocks, throws/throw keywords, and custom exception classes to manage runtime errors effectively. ***Learning Outcomes:*** *A learner will be able to:* ***LO4.1****: Explain the need for exception handling and distinguish between checked and unchecked exceptions (PI2.1. & PI2.4.2) (CO5)* ***LO4.2****: Analyze the flow of control in nested or multiple catch blocks to ensure error handling effectiveness. (PI2.4.4) (CO5)* ***LO4.3****: Create and use user-defined exceptions to handle domain-specific errors in Java applications.(PI2.4.5 & PI1.4.6) (CO5)*	7
5	Multithreaded Programming	***Learning Objective:*** *To enable students to design and manage concurrent programs by applying thread creation techniques, thread lifecycle methods, synchronization mechanisms, and exception handling in Java.(CO6)*	5

		Content: Creating Thread – Different Methods, Using Thread Methods, Thread Exceptions, Priorities, Life Cycle of Thread Synchronization ***Learning Outcomes:*** *A learner will be able to:* ***LO5.1****: Explain the thread lifecycle and different ways of creating and managing threads in Java. (PI2.1.2 & PI3.2.2)(CO6)* ***LO5.2****: Implement multithreading using Thread class and Runnable interface with appropriate thread methods and priorities.(PI1.4.3 & PI2.4.3)(CO6)* ***LO5.3****: Handle thread-related exceptions and apply synchronization to avoid race conditions in concurrent programs.(PI2.4.4 & PI3.1.4)(CO6)* ***LO5.4****: Design efficient multithreaded applications incorporating synchronization, priorities, and exception handling.(PI1.4.6 & PI2.2.6)(CO6)*	
6	Packages and Applets	***Learning Objective*** *To enable students to design modular and interactive Java applications by organizing code using packages and developing applets using life cycle methods and graphical capabilities.(CO6)* **Contents:** Inbuilt Package, Importing Packages, User Defined Packages, Naming Packages, Advantages of Packages, Applet Basics, Applet Life Cycle, Applet Drawing Methods. ***Learning Outcomes:*** *A learner will be able to:* ***LO6.1****: Explain the concept, purpose, and benefits of using inbuilt and user-defined packages in Java. terms of efficiency and reliability. (PI2.1.2 & PI3.2.3) (CO6)* ***LO6.2****: Implement modular Java applications using package creation, importing, and naming conventions.(PI2.4.3 & PI1.4.3)(CO6)* ***LO6.3****: Develop interactive Java applets using applet life cycle methods and override paint() to draw on the screen.(PI1.4.6 & PI2.2.6)(CO6)* ***LO6.4****: Analyze the structure of modular Java programs using packages and applets to ensure maintainability and scalability.(PI2.4.4 & PI3.1.4)(CO6)*	5
Total			**30**

Performance Indicators:

PI 1.1.1 Remembering: Recall key mathematical formulas and concepts relevant to engineering problems.

PI 1.3.1 Remembering: List fundamental engineering principles (e.g., Ohm's law, Bernoulli's equation) and their applications.

PI 1.3.2 Understanding: Explain the relevance of basic engineering principles to real-world problems.

PI 1.3.3 Applying: Perform calculations and simulations to solve simple engineering tasks.
PI 1.3.6 Creating: Design a system or solution integrating basic engineering fundamentals to meet specific requirements
PI 1.4.1 Remembering: Identify key concepts and tools in specialized areas such as computer architecture, AI, programming
PI 1.4.3 Applying: Implement domain-specific tools and technologies
PI 1.4.4 Analyzing: Compare and contrast different specialized engineering approaches for solving a given problem
PI 1.4.6 Creating: Propose innovative solutions using advanced computer engineering knowledge and tools.
PI 2.1.1 Remembering: Recall relevant engineering principles, theories, and concepts to identify a problem.
PI 2.1.2 Understanding: Explain the key features and scope of a complex engineering problem.
PI 2.1.3 Applying: Use standard problem-identification techniques (e.g., root cause analysis) to define an engineering challenge
PI 2.1.4 Analyzing: Decompose a complex engineering problem into its constituent parts to identify critical aspects
PI 2.1.5 Evaluating: Assess the relevance and significance of various problem aspects using evidence-based reasoning
PI 2.2.1 Remembering: List standard methodologies and tools applicable to solving engineering problems.
PI 2.2.2 Understanding: Describe the steps involved in formulating a solution plan for an engineering problem
PI 2.2.3 Applying: Develop a basic solution plan using a systematic approach to solve an identified problem.
PI 2.2.4 Analyzing: Evaluate various solution methodologies to determine the most effective approach for a given problem
PI 2.2.6 Creating: Design a comprehensive and innovative solution plan, integrating multidisciplinary methods if necessary
PI 2.4.1 Remembering: Recall procedures and tools required for executing an engineering solution process.
PI 2.4.2 Understanding: Explain the solution process and its relevance to the identified engineering problem.
PI 2.4.3 Applying: Implement the solution process using appropriate tools, software, or experimental setups.
PI 2.4.4 Analyzing: Examine the results of the solution process to determine trends, patterns, and inconsistencies
PI 2.4.5 Evaluating: Critically assess the solution's accuracy and efficiency, and propose improvements if necessary
PI3.1.3 Applying: Translate real-world challenges into structured engineering problem statements.
PI 3.1.4 Analyzing: Break down the problem into sub-problems and evaluate its complexity in engineering terms
PI 3.2.1 Remembering: List potential design approaches and tools relevant to solving the problem.
PI 3.2.2 Understanding: Describe the principles and methodologies used to generate alternative design solutions
PI 3.2.3 Applying: Propose multiple design concepts addressing the problem's constraints and requirements.
PI 4.1.4 Analyzing: Break down the problem into components and critically assess the relationships between them

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1 (01)
CO2	1.2, 1.3, 1.4 (03)
CO3	2.1, 2.2, 2.3, 2.4 (04)
CO4	3.1, 3.2, 3.3 (03)
CO5	4.1, 4.2, 4.3 (03)
CO6	5.1, 5.2, 5.3, 5.4, 6.1, 6.2, 6.3, 6.4 (08)

Mapping of Course Outcomes with Programme Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO7	PO8	PO9	P010	PO11	PO12
CO1	1/22	-	-	-	-	-	-	-	-	-	-
CO2	-	3/22	-	-	-	-	-	-	-	-	-
CO3	-	4/22	-	-	-	-	-	-	-	-	-
CO4	-	-	3/22	-	-	-	-	-	-	-	-
CO5	-	-	-	3/22	-	-	-	-	-	-	-
CO6	-	-	8/22	-	-	-	-	-	-	-	-

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	Assessment Criteria: The Learner can:	Evaluated under ISA/MSE/ESE/LAB
Describe the features of Java and explain how bytecode, JVM, and JRE contribute to its platform independence.(PI1.4.1 & PI 2.1.2)(CO1)	• **Identify key features of Java** (e.g., Object-oriented, Simple, Secure, Robust, Architecture Neutral, etc.) • Describe the compilation and execution process in Java • Define and differentiate between Bytecode, JVM, and JRE • Explain how Java achieves platform independence	ISA, LAB
Use data types, operators, and control structures to write basic Java programs. (PI1.3.3 & PI1.4.3) (CO2)	• Identify different types of operators in Java (arithmetic, relational, logical, assignment, increment/decrement, etc.). • Write expressions using appropriate operators based on the problem statement. • Evaluate complex expressions involving multiple operators with correct precedence and associativity. • Debug and correct operator-related errors in given C code snippets.	ISA, MSE, LAB
Implement static variables and static functions to demonstrate shared functionality in Java. (PI2.4.3)(CO2)	• Declare and initialize static variables • Define and use static functions • Demonstrate the sharing of static variables across multiple objects • Differentiate static and non-static context	ISA, MSE, ESE, LAB
Construct Java programs using one-dimensional and two-dimensional arrays to manipulate tabular	• Declare and initialize one-dimensional and two-dimensional arrays • Access and manipulate array elements • Display array contents in a tabular format	ISA, MSE, ESE, LAB

data. (PI2.2.3 & PI1.3.3) (CO2)	• Implement input/output operations for arrays	
Define and use classes, objects, and instance variables to model real-world entities in Java programs. (PI1.4.1 & PI1.3.2)(CO3)	• Define a Java class representing a real-world entity • Use instance variables to store and access individual object data • Demonstrate encapsulation by using methods to operate on object data • Implement a Java program that interacts with multiple objects	ESE, LAB
Implement constructors (default and parameterized) to initialize Java objects (PI1.3.3 & PI2.4.3) (CO3)	• Define a default constructor • Define a parameterized constructor • Create and initialize objects using both types of constructors	ISA, MSE, LAB
Demonstrate method overloading and object passing techniques to achieve functional flexibility. (PI1.4.3 & PI2.2.3) (CO3)	• Implement method overloading • Demonstrate correct selection of overloaded methods • Define a method that accepts an object as a parameter • Demonstrate functional flexibility using overloading and object passing	ISA, MSE, ESE, LAB
Create and manipulate arrays of objects to organize and manage grouped object data. (PI1.3.6 & PI1.4.6) (CO3)	• Declare and initialize an array of object references • Use loops to populate object arrays with user or predefined data • Traverse the object array to access or update attributes	ISA, ESE, LAB
Explain the concept and types of inheritance and the use of constructors in inheritance (PI2.1.2 & PI1.3.2) (CO4)	• Define and explain the concept of inheritance • Identify and describe different types of inheritance supported by Java • Demonstrate inheritance using a Java program • Explain constructor calling mechanism in inheritance	ISA, MSE, ESE, LAB
Apply method overriding and dynamic method dispatch to implement runtime polymorphism. (PI1.4.3 & PI2.4.3) (CO4)	• Override a method in a subclass • Execute overridden method at runtime using dynamic dispatch • Demonstrate polymorphic behavior through multiple subclass types	ISA, ESE, LAB
Use abstract classes, final keywords, and interfaces to build structured and extendable programs. (PI1.4.4 & PI2.2.4) (CO4)	• Define and use an abstract class and method • Define and implement interfaces • Use the final keyword appropriately • Demonstrate polymorphism using abstract class or interface	ISA, MSE, ESE, LAB
Explain the need for exception handling and distinguish between checked and unchecked exceptions (PI2.1. & PI2.4.2) (CO5)	• Explain the need for exception handling in Java • Define what exceptions are and where they occur • Classify exceptions as checked and unchecked • Describe the role of try-catch-finally and throws/throw • Provide relevant examples for both checked and unchecked exceptions	ISA, MSE, ESE, LAB

Analyze the flow of control in nested or multiple catch blocks to ensure error handling effectiveness. (PI2.4.4) (CO5)	• Implement nested try-catch blocks and track control flow • Compare multiple catch vs. nested try-catch	ESE, LAB
Create and use user-defined exceptions to handle domain-specific errors in Java applications. (PI2.4.5 & PI1.4.6) (CO5)	• Define a custom exception class • Throw user-defined exceptions in appropriate conditions • Catch and handle user-defined exceptions	ESE, LAB
Explain the thread lifecycle and different ways of creating and managing threads in Java. (PI2.1.2 & PI3.2.2)(CO6)	• Describe the complete thread lifecycle • Explain thread creation using the Thread class • Explain thread creation using the Runnable interface • Describe thread management methods • Differentiate between Thread and Runnable approaches	ESE, LAB
Implement multithreading using Thread class and Runnable interface with appropriate thread methods and priorities. (PI1.4.3 & PI2.4.3)(CO6)	• Apply appropriate thread methods • Set and utilize thread priorities effectively	ESE, LAB
Handle thread-related exceptions and apply synchronization to avoid race conditions in concurrent programs. (PI2.4.4 & PI3.1.4)(CO6)	• Apply synchronization using synchronized methods or blocks	LAB
Design efficient multithreaded applications incorporating synchronization, priorities, and exception handling. (PI1.4.6 & PI2.2.6)(CO6)	• Create a multithreaded application using Thread/Runnable • Use thread priorities to influence execution order	LAB
Explain the concept, purpose, and benefits of using inbuilt and user-defined packages in Java. terms of efficiency and reliability. (PI2.1.2 & PI3.2.3) (CO6)	• Define packages and differentiate between inbuilt and user-defined packages • Explain the purpose of using packages in Java • Describe efficiency and reliability benefits of using packages	ISA, LAB
Implement modular Java applications using package creation, importing, and naming conventions. (PI2.4.3 & PI1.4.3)(CO6)	• Import and use inbuilt and custom packages correctly • Demonstrate modular application design using packages	LAB
Develop interactive Java applets using applet life cycle methods and override paint() to draw on the screen. (PI1.4.6 & PI2.2.6)(CO6)	• implement applet life cycle methods (init(), start(), stop(), destroy()) correctly • Compile and run the applet successfully in a browser or applet viewer	ISA, ESE, LAB
Analyze the structure of modular Java programs using packages and applets to	• Evaluate how applet components are integrated within the program	LAB

ensure maintainability and scalability. (PI2.4.4 & PI3.1.4)(CO6)		

Tools/ Technologies/ Programming Languages learnt:

- Programming Languages: Java.
- Integrated Development Environments (IDEs): Eclipse.
- Code Practice Platforms: LeetCode, HackerRank, CodeSignal.
- Data Structure Visualization Tools: Algorithm Visualizer.
- Version Control Systems: Git and GitHub.
- Online Learning Platforms with Interactive Coding Environments: Codeblock, Eclipse.

Textbooks:

1. Herbert Schildt, "JAVA: The Complete Reference", Oracle Press
2. Sachin Malhotra and Saurabh Chaudhary, "Programming in JAVA", Oxford University Press

Reference Books:

1. Ivor Horton, "Beginning JAVA", Wiley, India
2. Dietal and Dietal, "Java: How to program", Prentice Hall
3. Stevan Jolzner, "JAVA Programming- Black Book", Dreamtech Press
4. ScriptDemics, "Learn to Master Java Programming", Staredu Solutions.

Related/ Equivalent MOOC and Associated Certification:

1. Programming in Java (NPTEL) –

- SWAYM-NPTEL
- Link: https://nptel.ac.in/courses/106105191

Detailed Syllabus of Indian Knowledge System Courses

Course Name: Indian Traditional Knowledge System

Course Code: IKS01

Vertical/ Sub-Vertical: HSSM_IKS

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: Introduction to Indian History and Culture, Sanskrit Basics (Optional but beneficial), Introduction to Agricultural Science, Animal Science and Veterinary Basics, Fundamentals of Astronomy

Recommended Semester: 2

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
IKS01	2	-	2	-
	-		-	

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (IKS01)	25 (~25%)	-	50 (~50%)	75 (100%)
	-	-	-	-

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assesment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Preamble:
This course explores its interdisciplinary nature—spanning philosophy, science, technology, art, and ecology—while highlighting its relevance to contemporary education and innovation. Through critical study of ancient texts and practices, students will engage with indigenous perspectives that foster holistic thinking and sustainable solutions.

Course Objectives:

- To understand the concepts of Indian Traditional Knowledge.
- To understand the importance of the roots of the knowledge system.
- To reflect on the thought process, reasoning, and inference.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Understand the rich history of the Indian Traditional Knowledge System	Understanding
CO2	Understand the different areas of contributions from India	Applying
CO3	Analyse the different principles of traditional knowledge in modern systems	Analysing

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	Review of Scientific Literature in Sanskrit:	***Learning Objective:*** *To critically analyze and evaluate classical Sanskrit texts for their contributions to traditional scientific knowledge systems, such as Ayurveda, astronomy, mathematics, and linguistics, and to develop the ability to contextualize these contributions within both historical and contemporary frameworks. (CO1, CO2)* **Contents:** References of sciences /scientific knowledge through different textual sources. ***Self-Learning Topics***: *Nil* ***Learning Outcomes:*** *A learner will be able to:* 1. *Gain an overview of the vast repository of scientific knowledge preserved in Sanskrit texts (P.I. 10.1.1) CO1* 2. *Familiarize with specific works like Aryabhatiya (astronomy), Charaka Samhita (medicine), and Sulbasutras (geometry) (P.I.12.1.1) CO2* 3. *Learn how ancient principles from Sanskrit texts can be applied to modern sciences like astronomy, medicine, and environmental studies (P.I.12.1.2) CO2*	6
2	Chemistry and Mathematics:	***Learning Objective:*** *To explore and interpret key concepts, techniques, and contributions of ancient Indian scholars in the fields of chemistry (Rasashastra) and mathematics (Ganitashastra), and to understand their relevance and application in the evolution of scientific thought and practices (CO2, CO3).* **Contents:** Various treatises on Chemistry, Use of Chemistry in Medicines, Metallurgy, Use of Chemistry for occult practices, Mathematical concepts through Shulbasutras, Development of different types of mathematical branches and treatises based on that, Development of Astronomy etc. ***Learning Outcomes:*** *A learner will be able to:* *2.1 Learn about the use of alchemy in Ayurveda and traditional medicine, including processes like purification and transformation of metals (P.I. 12.2.1)CO2* *2.2 Learn about ancient Indian metallurgical techniques, including the extraction, alloying, and casting of metals as described in texts like Krishi-Parashara and Brihatsamhita (P.I. 12.2.2) CO2* *2.3 Understand the contributions of mathematicians like Aryabhata, Bhaskara, and Brahmagupta to global mathematical advancements (P.I. 12.2.1) CO2* *2.4 Learn about the Indian contributions to astronomy, including planetary motion, eclipses, and time calculation, as described in Surya Siddhanta and Aryabhatiya (P.I. 12.3.1) CO3*	6
3	Dietetics:	***Learning Objective:*** *To examine the principles of ancient Indian dietetics as outlined in classical texts such as Ayurveda, focusing on the relationship between food, health, and seasonal/regional variations, and to assess their applicability in promoting holistic well-being today. (CO1, CO2, CO3).*	7

		Content: Study of different texts based on culinary art Nalapakadarpana, Bhojanakuthuhalam, Supashastra, Modes of preservation of food, Dietary guidelines through branches of Ayurveda, Food and Diseases, etc. ***Learning Outcomes:*** *A learner will be able to:* *3.1 Learn traditional methods of food preservation such as fermentation, pickling, drying, and smoking (P.I2.2.1) CO1* *3.2 Study the dietary principles and guidelines described in Ayurvedic texts, emphasizing balance (Tridosha), seasonal eating, and personalized nutrition (P.I. 12.3.1) CO1* *3.3 Explore the role of food as medicine in Ayurveda, focusing on how specific dietary practices can prevent and manage diseases (P.I. 12.1.2) CO2* *3.4 Study ancient practices of food presentation, garnishing, and plating as described in culinary texts (P.I. 12.2.1. 12.2.2) CO3* *3.5 Study ancient practices of food presentation, garnishing, and plating as described in culinary texts (P.I. 12.3.1) CO2*	
4	Agriculture, Astronomy, and Zoology	***Learning Objective:*** *To investigate the foundational knowledge and practices in agriculture, astronomy, and zoology as reflected in ancient Indian texts, and to appreciate their scientific insights, innovations, and environmental harmony in the context of traditional knowledge systems.(CO2, CO3).* **Content:** Study of Krishisuktas, Krishiparashara, Brihatsamhita, Types of crops, Manures, Types of land- Devamatruka, Nadimatruka, Indian Astronomy, Use of animals in warfare, Animal husbandry, Animals for medicine. ***Learning Outcomes:*** *A learner will be able to:* 1. *Learn about the types of crops, their cultivation cycles, and their significance in ancient Indian agronomy (P.I0. 2.1) CO2* 2. *Understand the classification of land types like Devamatruka and Nadimatruka based on fertility, water retention, and suitability for specific crops (P.I2.1.2) CO2* 3. *Explore the role of Indian astronomy in agricultural practices, including the timing of sowing, harvesting, and irrigation (P.I2.2.1) CO3* 4. *Learn about the historical use of animals like horses, elephants, and others in warfare strategies and their impact(P.I.12.3.1) CO3* 5. *Study ancient practices of animal husbandry, focusing on their role in supporting agriculture and society(P.I. 12.3.2) CO3* 6. *Understand the medicinal uses of animals and animal-derived products as described in ancient texts (P.I.12.3.1) CO2*	6
Total			**30**

Suggested List of Practicals:

Sr No.	Suggested Topic(s)
1.	Poster Presentation ***Learning Outcomes:*** *A learner will be able to:*

	1.1 Gain an overview of the vast repository of scientific knowledge preserved in Sanskrit texts (P.I. 10.1.1) (CO1)
2.	Blog Writing ***Learning Outcomes:*** *A learner will be able to:* *2.4 Learn about the Indian contributions to astronomy, including planetary motion, eclipses, and time calculation, as described in Surya Siddhanta and Aryabhatiya (P.I. 12.3.1) CO2*
3.	Book Review ***Learning Outcomes:*** *A learner will be able to:* *3.4 Study ancient practices of food presentation, garnishing, and plating as described in culinary texts . (P.I. – 12..2.1) (CO3).*
4.	Question and Answers ***Learning Outcomes:*** *A learner will be able to:* *3.1 Learn traditional methods of food preservation such as fermentation, pickling, drying, and smoking* *(P.I2.2.1) (CO2)*
5.	Essay Writing ***Learning Outcomes:*** *A learner will be able to:* 1. *Learn about the types of crops, their cultivation cycles, and their significance in ancient Indian agronomy (P.I. I0. 2.1) (CO3)*
6.	Infographics ***Learning Outcomes:*** *A learner will be able to:* *5.3Explore the role of Indian astronomy in agricultural practices, including the timing of sowing, harvesting, and irrigation (P.I2.2.1, 12.3.2 (CO3)*

Performance Indicators:

P.I.- 10.1.1 **Remembering:** Read, understand and interpret technical and non-technical information

P.I.- 10.2.1 **Understanding**: Listen to and comprehend information, instructions, and viewpoints of others

P.I.- 12.2.1 Remembering: Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current

P.I.- 12.3.1 **Understanding**: Source and comprehend technical literature and other credible sources of information

P.I.-12.3.2 **Analyzing**: Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

P.I.-12.2.2 **Understanding:** Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1. 3.1, 3.2
CO2	1.2, 1.3, 2.1, 2.2, 2.3, 3.3, 3.5, 5.1,5.2, 5.6
CO3	2.4, 3.4, 5.3, 5.4, 5.5
CO4	
CO5	

Mapping of Course Outcomes with Programme Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO7	PO8	PO9	P010	PO11	PO12
CO1									1/13		4/13
CO2									1/13		5/13
CO3											2/13
CO4											
CO5											

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria:** The Learner can:	**Evaluated under ISA/MSE/ESE/LAB**
LO1 : *Students will be able to critically analyze and evaluate classical Sanskrit texts for their contributions to traditional scientific knowledge systems, such as Ayurveda, astronomy, mathematics, and linguistics, and to develop the ability to contextualize these contributions within both historical and contemporary frameworks. (CO1, CO2)*	• The student can analyze classical Sanskrit texts • The student is able to contextualize contributions to traditional scientific knowledge systems within historical and contemporary frameworks .	ISA ISA, MSE
LO2: *Students will be able to explore and interpret key concepts, techniques, and contributions of ancient Indian scholars in the fields of chemistry (Rasashastra) and mathematics (Ganitashastra), and to understand their relevance and application in the evolution of scientific thought and practices (CO2, CO3).*	• The student can describe interpret key concepts, techniques, and contributions of ancient Indian scholars in the fields of chemistry (Rasashastra) and mathematics (Ganitashastra), • The student provides relevant examples of contributions of ancient Indian scholars in the fields of chemistry (Rasashastra) and mathematics (Ganitashastra), • The student can explain their relevance and application in the evolution of scientific thought and practices	ese ISA ESE ISA
LO3: *Students will be able to examine the principles of ancient Indian dietetics as outlined in classical texts such as Ayurveda, focusing on the relationship between food, health, and seasonal/regional variations, and to assess their applicability in promoting holistic well-being today. (CO1, CO2, CO3).*	• The student is able to examine the principles of ancient Indian dietetics as outlined in classical texts such as Ayurveda • The student can justify their applicability in promoting holistic well-being today.	ESE ISA
LO4: *Students will be able to investigate the foundational knowledge and practices in agriculture, astronomy, and zoology as reflected in ancient*	• The student can investigate the foundational knowledge and practices in agriculture, astronomy, and zoology • The student is able to appreciate their scientific insights, innovations, and	ISA ISA

Indian texts, and to appreciate their scientific insights, innovations, and environmental harmony in the context of traditional knowledge systems.(CO2)	environmental harmony in the context of traditional knowledge systems.	

Reference Books:

1. Nirmal Trikha, "Scientific Knowledge in Sanskrit Literature"
2. S. Balachandra Rao, "Indian Astronomy: An Introduction"
3. B. Seal, "Ancient Indian Sciences"
4. Melissa Stewert, "Science in Ancient India (Science of the Past)"
5. Sudheer Birodkar, "India's Contribution to World Culture"
6. R. C. Majumdar, "Ancient India"
7. Swami ChidatmanJee Maharaj, "Ancient Indian Sciences"
8. Stella Kramrisch, "The Art of India through the Ages"
9. K.Krishna Murthy, "Early Indian Secular Architecture"

Related/ Equivalent MOOC and Associated Certification:

1. Introduction to Indian Knowledge System – IGNOU (SWAYAM) Offered by: IGNOU | Language: English | Duration: 12 weeks, Starts: 15 Jul 2025 | Enroll by: 15 Sep 2025

Enroll here: https://onlinecourses.swayam2.ac.in/nou25_ge95/preview

2. . Indian Knowledge System (IKS): Concepts & Applications in Science – IIM Bangalore & Chanakya University (SWAYAM) Offered by: IIMB & Chanakya Univ. Duration: 10 weeks

Enroll here: https://onlinecourses.swayam2.ac.in/imb23_mg54/preview

3. Indian Knowledge System (IKS): Humanities & Social Sciences – IIM Bangalore & Chanakya University (SWAYAM) Offered by: IIMB & Chanakya Univ. Duration: 10 weeks

Enroll here: https://onlinecourses.swayam2.ac.in/imb23_mg55/preview

4. Indian Knowledge System – Dr Roli Pradhan (NITTTR, Bhopal) (SWAYAM) Offered by: NITTTR Bhopal Duration: 8 weeks

Enroll here: https://onlinecourses.swayam2.ac.in/ntr24_ed78/preview

Press.

Course Name: Indian Constitution

Course Code: IKS02

NEP Vertical _Basket: HSSM_IKS

Preamble:

This course introduces learners to the framework that demarcates fundamental political code, structure, procedures, powers, and duties of government institutions and sets out fundamental rights, directive principles, and the duties of citizens.

Pre-requisites:

NIL

Course Objective:

- To Understand what a constitution is and why it is necessary
- To Understand how constitution embodies certain ideals
- To understand the importance of fundamental rights as well as fundamental duties.
- To understand functioning of parliament

Course Outcomes:

Learner will be able to:
CO1: learner will be able to understand constitution principles
CO2: learner will be able to co-relate with political system
CO3: learner will be able to pursue the values of civic life
CO4: learner will be able to exercise their rights and duties

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction to Indian Constitution	***Learning Objective:*** *To understand the Historical and Philosophical background of the Indian Constitution (CO1, CO3)* **Contents:** Historical Background to the Constitution, Philosophy of the Constitution ***Learning Outcomes:*** *A learner will be able to:* 1. Trace the historical events and ideas that led to the drafting of the Constitution (e.g., Magna Carta, English Bill of Rights, Enlightenment thinkers). 2. Study the conditions under which the framers of the Constitution worked, including economic hardships, the challenges of creating a unified nation, and the experiences under the Articles of Confederation. 3. Grasp the philosophical underpinnings of key concepts such as **natural rights**, **separation of powers**, **checks and balances**, **popular sovereignty**, **limited government**, and **rule of law**. 4. Examine the evolving interpretation of the Constitution over time, and the idea that its principles are not static but can be reinterpreted as society changes. Be able to apply constitutional principles to current events and issues, exploring how the Constitution remains relevant or needs to adapt to new situations.	3
2	Citizenship:	***Learning Objective:*** *To explore the basic idea of Citizenship, Fundamental Rights, and Duties. (CO1, CO3, CO4).* **Contents:** Citizenship at the commencement of the Constitution, Rights of citizenship of certain persons of Indian origin residing outside India, Persons voluntarily acquiring citizenship of a foreign State not to be citizens, Continuance of the rights of citizenship, Fundamental Duties ***Learning Outcomes:*** *A learner will be able to:* 1. Learn about the legal status and conditions under which individuals became citizens of India at the time of independence (e.g., through domicile, registration,	4

		naturalization). 2. Understand the political and legal implications of the **constitutional provision for citizenship** (Part II of the Indian Constitution). 3. Understand the concept of **Overseas Citizenship of India (OCI)** and **Persons of Indian Origin (PIO)**. 4. Explore how Fundamental Rights (Part III of the Constitution) and Fundamental Duties are interrelated and how they serve to balance individual freedoms with the collective good. Develop an understanding of the legal and constitutional aspects of Indian citizenship, including how it has evolved and continues to be defined by Indian law.	
3	Fundamental Rights	***Learning Objective:*** To enable students to understand the scope, significance, and enforceability of Fundamental Rights, and to critically analyse their role in upholding individual freedoms and promoting social justice in a constitutional democracy. *(CO1, CO3, CO4).* **Contents:** Definition, Laws inconsistent with or in derogation of the fundamental rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Core issues (Uniform Civil Code, Article 370, Reservation) ***Learning Outcomes:*** *A learner will be able to:* 1. Have a clear understanding of the **Fundamental Rights** and their role in ensuring individual freedoms in India. 2. Be able to **interpret the relationship between rights** and the restrictions that may apply to them in the interest of public order and justice. 3. Understand the **core social and political issues** like **Uniform Civil Code**, **Article 370**, and **Reservation**, and their relevance in the modern Indian context. 4. Appreciate the **dynamic nature** of the Indian Constitution and the judicial mechanisms that protect and enforce these rights. Develop a critical perspective on the balance between **rights, duties, and responsibilities** in a democratic society.	4
4	Directive Principles of State Policy	***Learning Objective:*** *To develop an understanding of the Directive Principles as guiding values for governance, and to critically assess their role in shaping social and economic policies aimed at achieving a just and equitable society. (CO1, CO3, CO4).* **Contents:**	4

		Definition, Certain principles of policy to be followed by the State, Equal justice and free legal aid, Organisation of village panchayat, Right to work, to education and 10 public assistance in certain cases, Provision for just and humane conditions of work and maternity relief, Living wage, etc., for workers, Participation of worker; in management of industries, Uniform civil code for the citizens, Provision for free and compulsory education for children, Promotion of educational and economic interests of Scheduled Castes, Scheduled Tribes and other weaker sections, Protection and improvement of environment and safeguarding of forests and wild life, Protection of monuments and places and objects of national importance, Separation of judiciary from executive, Promotion of international peace and security ***Learning Outcomes:*** *A learner will be able to:* 1. Understand the Directive Principles of State Policy and their role in guiding the State's actions towards building a welfare state. 2. Grasp the State's responsibility to ensure right to work, right to education, and public assistance in certain situations. 3. Analyze the provisions for humane working conditions and maternity relief for women workers 4. Understand the importance of judicial independence and the separation of powers between the judiciary and the executive. Debate the Uniform Civil Code and its relevance in a multi-cultural, multi-religious society like India	
5	The Parliament	***Learning Objective****:* To enable students to understand the structure, powers, and functions of the Indian Parliament, and to evaluate its role in law-making, oversight, and representation within a democratic framework. (CO2 & CO3) **Contents:** Constitution of Parliament, Composition of the Council of States, Composition of the House of the People, Duration of Houses of Parliament, Rights of Ministers and Attorney-General as respects Houses, Law making procedure, Amendment process and language ***Learning Outcomes:*** *A learner will be able to:* **1.** Grasp the structure of Parliament and how the Lok Sabha and Rajya Sabha differ in composition and function. **2.** Understand the tenure and functioning of both Houses, including the distinction between permanent and dissolvable bodies. **3.** Learn the rights and privileges of ministers and the Attorney-General in relation to the Houses of Parliament.	4

		4. Examine the detailed process of law-making, from the introduction of a Bill to its passage and Presidential assent. **5.** Comprehend the procedure for amending the Constitution and the role of Parliament in making constitutional changes.	
6	Judiciary	***Learning Objective:*** *To understand the basic principles and applications of spectroscopic techniques in structural elucidation and analysis. (CO3)* **Contents:** Establishment and Constitution of Supreme Court, High Courts for States, Subordinate Courts, Working of quasi – judicial bodies ***Learning Outcomes:*** *A learner will be able to:* 1. Understand the constitution and establishment of the Supreme Court of India, and its jurisdiction and powers. 2. Grasp the role and jurisdiction of the High Courts in the administration of justice at the state level. 3. Learn the process of appointment of judges to both the Supreme Court and High Courts. 4. Examine the structure and functions of subordinate courts, and their role in the judicial system. 5. Comprehend the hierarchical structure and relationship between the Supreme Court, High Courts, and subordinate courts.	4
7	Elections	***Learning Objective:*** To understand the constitutional framework and principles governing elections in India, and to critically examine the role of free and fair elections in sustaining democratic governance and political accountability. (CO3) **Contents:** Superintendence, direction and control of elections to be vested in an Election Commission, Power of Parliament to make provision with respect to elections to Legislatures, Power of Legislature of a State to make provision with respect to elections to such Legislature Bar to interference by Couns in electoral matters ***Learning Outcomes:*** *A learner will be able to:* 1. Understand the Election Commission's powers and role in overseeing elections in India. 2. Examine the composition and functions of the Election Commission. 3. Analyse the Election Commission's role in ensuring the fairness and integrity of elections through monitoring and reforms.	4

		4. Examine the power of the Election Commission to issue rules and regulations regarding the conduct of elections. 5. Understand the reforms that the Election Commission has introduced to improve the transparency and credibility of elections.	
8	Landmark cases	**Learning Objective:** To analyze key landmark judicial decisions that have shaped constitutional interpretation in India, and to understand their impact on fundamental rights, federalism, and the balance of power within the democratic framework. (CO3) **Contents:** Nanavati case, Shah Bano, Keshvanand Bharti case, Vishakha Case etc ***Learning Outcomes:*** **1.** Examine the role of the judiciary in upholding gender equality and addressing women's rights through landmark judgments. **2.** Study the power of judicial review, as demonstrated in the Kesavananda Bharati case, and its role in interpreting constitutional limits. **3.** Learn about the conflict between personal and civil laws, as seen in the Shah Bano case, and its effect on the legal system. **4.** Explore the role of judicial activism in influencing public policy, legal reforms, and the protection of fundamental rights. **5.** Understand the impact of these landmark cases in shaping India's legal landscape and reinforcing constitutional rights and gender equality.	3
Total			**30**

Suggested Online Courses:

1. Constitutional Studies
   https://onlinecourses.nptel.ac.in/noc20_lw03/preview
2. Constitution of India
   https://www.udemy.com/course/constitution-of-india/

Reference Books:

1. Basu, D. D. (2018). *Introduction to the Constitution of India* (24th ed.). LexisNexis.
2. Jain, M. P. (2019). *Indian Constitutional Law* (8th ed.). LexisNexis.
3. Shukla, V. N. (2020). *Constitution of India* (Revised by M. P. Singh). Eastern Book Company.
4. Austin, G. (1966). *The Indian Constitution: Cornerstone of a Nation*. Oxford University Press.
5. Austin, G. (1999). *Working a Democratic Constitution: The Indian Experience*. Oxford University Press.
6. Kashyap, S. C. (2009). *Our Constitution*. National Book Trust, India.
7. Kashyap, S. C. (2003). *Our Political System*. National Book Trust, India.
8. Bhargava, R. (Ed.). (2008). *Politics and Ethics of the Indian Constitution*. Oxford University Press.
9. B., Mukherjee, M., Mukherjee, A., Panikkar, K. N., & Mahajan, S. (2008). *India Since Independence* (Revised ed.). Penguin Books.
10. Noorani, A. G. (2000). *Constitutional Questions in India: The President, Parliament and the States*. Oxford University Press

11. Bose, S. (2003). *Kashmir: Roots of Conflict, Paths to Peace*. Harvard University Press.
12. Noorani, A. G. (2011). *Article 370: A Constitutional History of Jammu and Kashmir*. Oxford University Press.
13. Zutshi, C. (2014). *Kashmir's Contested Pasts: Narratives, Sacred Geographies, and the Historical Imagination*. Oxford University Press.
14. Chowdhary, R. (2016). *India's Path to Abrogation of Article 370: Policy Shift and Its Impact*. *India Quarterly, 72*(4), 348–361. https://doi.org/10.1177/0974928416669984
15. Agnes, F. (2011). *Law and Gender Inequality: The Politics of Women's Rights in India* (2nd ed.). Oxford University Press.
16. Derrett, J. D. M. (1970). *Religion, Law and the State in India*. Oxford University Press.
17. Menski, W. (2003). *Hindu Law: Beyond Tradition and Modernity*. Oxford University Press
18. Thorat, S., & Newman, K. S. (Eds.). (2010). *Blocked by Caste: Economic Discrimination in Modern India*. Oxford University Press.
19. Deshpande, S. (2013). *The Problem of Caste*. Orient BlackSwan.
20. Jaffrelot, C. (2003). *India's Silent Revolution: The Rise of the Lower Castes in North India*. Columbia University Press.

Course Name: Exploring Indian Arts

Course Code: GEA03

Vertical/ Sub-Vertical: HSSM/AEC

K-S-A Mapping: Knowledge, Skill & Attitude

Pre-requisite required: NIL

Pre-requisite for: NIL

Recommended Semester: 2

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	075

Preamble:

This course offers a vibrant journey into the rich and diverse artistic traditions of India. Through an exploration of classical and folk forms across music, dance, visual arts, and crafts, students will gain an appreciation of India's cultural heritage and the ways in which art reflects social, historical, and spiritual contexts. Emphasizing experiential learning, the course encourages creative engagement and critical understanding of India's artistic expressions.

Course Objectives:

- To develop the intellectual skills and competencies necessary to participate effectively in society and the world
- To develop broad knowledge of living and non-living world
- To develop ability to appreciate and acknowledge creativity.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Understand how they can contribute towards each type of art.	Understand
CO2	Work towards developing holistic personality through critical and creative thinking.	Apply
CO3	Complement technical knowledge by developing diversified perspectives on various aspects of learning.	Understand

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours
1	**Introduction to Indian Art**	***Learning Objective:*** *To understand the diversity, forms, and geographical scope of Indian art in both traditional and modern contexts. (CO1)* ***Contents:*** Indian art consists of a variety of art forms, including painting, sculpture, pottery, and textile arts such as woven silk. Geographically, it spans the entire Indian Subcontinent, including what is now India, Pakistan, Bangladesh, Sri Lanka, Nepal, and at times Eastern Afghanistan. A strong sense of design is characteristic of Indian Art and can be observed in its modern and traditional forms. Discussing different types and forms in Indian Art, like Drawing, Painting, Handicraft performing art, and the performing arts. ***Learning Outcomes:*** *A learner will be able to:* 1. *Learners will be able to describe the cultural, religious, and socio-political contexts that shaped various art traditions in India. (CO1) (P.I.* 10.1.1, 10.1.2, 12.1.2, 12.3.1) 2. *Learners will be able to differentiate between classical, folk, tribal, and modern Indian art forms. (CO1) (P.I.* 10.1.1, 10.1.2, 12.1.2, 12.3.1) 3. *Learners will be able to analyze visual and performing arts using appropriate terminology and critical frameworks. (CO1) (P.I.* 10.1.3, 10.3.1, 12.3.2, 12.1.2) 4. *Learners will be able to appreciate the diversity and symbolism in Indian sculpture, painting, architecture, music, dance, and crafts. (CO1) (P.I.* 10.2.1, 10.2.2, 12.3.2) 5. *Learners will be able to trace the regional variations and continuity of artistic practices across India. (CO1) (P.I.* 10.1.1, 10.1.3, 12.2.1, 12.3.1)	2
2	**Indian Architecture**	***Learning Objective:*** *To identify and analyze the distinctive features, historical development, and cultural significance of major architectural styles in India—from ancient to contemporary periods—while understanding their influence on society, religion, and regional identity.* (CO2) **Contents:** Photos and Videos of Indian structure will be shown. Students will share their views on the same. The session starts with students will get one topic, which they must discuss with their teammates and present in front of the class. Assignments will	7

		be on architectural sites. They will choose their own topic and will present in limited time span. ***Learning Outcomes:*** *A learner will be able to:* 1. *The Learners will be able to identify key architectural styles and monuments across different periods of Indian history (e.g., Buddhist, Hindu, Jain, Islamic, Colonial, and Modern). (CO 2) (P.I.* 10.1.1, 10.1.2, 12.3.1) 2. *The Learners will be able to describe the historical, religious, and cultural contexts that shaped the evolution of Indian architecture. (CO2) (P.I.* 10.1.1, 10.1.2, 12.1.2, 12.3.1) 3. *The Learners will be able to differentiate between regional architectural features and materials used across various parts of India. (CO2) (P.I.* 10.1.1, 10.1.2, 12.3.1) 4. *The Learners will be able to analyze the structural elements, aesthetics, and symbolism in prominent Indian architectural works. (CO2) (P.I.* 10.1.3, 10.3.1, 12.3.2, 12.1.2) 5. *The Learners will be able to trace the development of temple, stupa, mosque, palace, and fort architecture in India. (CO2) (P.I.* 10.1.1, 10.1.3, 12.2.1, 12.3.1)	
3	**Indian music and Performing Arts**	***Learning Objective:*** *To enable students to understand and appreciate the fundamental concepts, historical evolution, and cultural significance of Indian music and performing arts, while developing the ability to critically engage with various classical, folk, and contemporary forms. (CO1)* **Contents:** What is Performing Arts? 4 major streams of dance music, theatre and film. Languages, Rulers and Kings as depicted in the paintings. Students will share their native experiences and will perform for their class. ***Learning Outcomes:*** *A learner will be able to:* 1. *The Learners will be able to identify the major forms of Indian music (classical, folk, devotional) and performing arts (dance, theatre, puppetry). (CO1) (P.I.* 10.1.1, 10.1.2) 2. *The Learners will be able to understand the theoretical foundations of Indian classical music and dance, including ragas, talas, and natya shastra principles. (CO1) (P.I.* 10.1.1, 10.1.2, 12.1.2)	7

		3. *The Learners will be able to differentiate between Hindustani and Carnatic music traditions and their regional and stylistic variations. (CO1) (P.I.* 10.1.1, 10.1.2) 4. *The Learners will be able to describe the key elements, techniques, and expressions used in major Indian classical dance forms (e.g., Bharatanatyam, Kathak, Odissi, Kathakali). (CO1) (P.I.* 10.1.3, 10.2.2, 12.3.2) 5. *The Learners will be able to trace the historical development and cultural significance of Indian performing arts across periods. (CO1) (P.I.* 10.1.1, 10.1.3, 12.2.1)	
4	**Painting Styles and Handicrafts**	***Learning Objective:*** *To develop an understanding of the Directive Principles as guiding values for governance, and to critically assess their role in shaping social and economic policies aimed at achieving a just and equitable society. (CO3)* **Contents:** Warli Painting is a Tribal Art mostly created by the tribal people from the North Sahyadri Range in Maharashtra, India. This range encompasses cities such as Dahanu, Talasari, Jawahar, Palghar, Mokhada, and Vikramgad of Palghar district. This tribal art originated in Maharashtra, where it is still practiced today. ***Learning Outcomes:*** *A learner will be able to:* 1. *The Learners will be able to identify major traditional and regional painting styles of India, such as Madhubani, Warli, Pattachitra, Kalamkari, Tanjore, and Miniature painting. (CO3) (P.I.* 10.1.1, 10.1.2, 12.3.1) 2. *The Learners will be able to recognize key Indian handicraft traditions, including textiles, pottery, woodwork, metalwork, and jewelry-making. (CO3) (P.I.* 10.1.1, 10.1.2, 12.3.1) 3. *The Learners will be able to Describe the historical and cultural context in which various painting styles and handicrafts developed. (CO3) (P.I.* 10.1.1, 10.1.2, 12.1.2, 12.3.1) 4. *The Learners will be able to Differentiate between folk, tribal, and classical painting forms and their thematic and stylistic features. (CO3) (P.I.* 10.1.1, 10.1.2, 12.3.1) 5. *The Learners will be able to Analyze the materials, techniques, and symbolism used in traditional Indian*	7

		art and craft practices. (CO3) (P.I. 10.1.3, 10.3.1, 12.3.2, 12.1.2)	
5	**Madhubani Painting**	***Learning Objective**: To enable students to understand the origin, techniques, themes, and cultural significance of Madhubani painting, and to develop basic skills in creating artworks using its traditional motifs and styles. (CO2)* **Contents:** Madhubani Painting is a style of painting practiced in the Mithila region of India and Nepal. It is named after the Madhubani district of Bihar, India (the place of its origin). Artists create this painting by using a variety of mediums, including their own fingers, twigs, brushes, nib-pens, and matchsticks. The paint is created using natural dyes and pigments. The paintings are characterized by their eye-catching geometrical patterns. There is a ritual content for particular occasions, such as birth or marriage, and festivals such as Holi, Surya Shasti, Kali Puja, Upanayana, and Durga Puja. ***Learning Outcomes:*** *A learner will be able to:* 1. *The Learners will be able to understand the historical and cultural origins of Madhubani painting and its connection to the Mithila region of Bihar. (CO2) (P.I.* 10.1.1, 10.1.2, 12.1.2, 12.3.1) 2. *The Learners will be able to identify key themes and symbols traditionally used in Madhubani art, such as mythology, nature, and rituals. (CO2) (P.I.* 10.1.1, 10.1.2, 12.3.1) 3. *The Learners will be able to recognize different styles within Madhubani painting (e.g., Bharni, Kachni, Tantrik, Godna, and Kohbar). (CO2) (P.I.* 10.1.1, 10.1.2, 12.3.1) 4. *The Learners will be able to describe the traditional tools and materials used, including natural dyes, handmade paper, and bamboo pens.(CO2) (P.I.* 10.1.1, 10.1.2, 12.3.1) 5. *The Learners will be able to demonstrate basic techniques of line drawing, border making, and motif repetition typical of Madhubani. (CO2) (P.I.* 10.3.1, 10.3.2, 12.3.2)	5
Total			**30**

Suggested List of Practical:

Sr No.	Suggested Topic(s)
1.	Various Quizzes (as mentioned in the syllabus copy) ***Learning Outcomes:*** *A learner will be able to:*

	1.5Learners will be able to trace the regional variations and continuity of artistic practices across India. (CO1) (P.I. 10.1.1, 10.1.3, 12.2.1, 12.3.1) *2.5The Learners will be able to trace the development of temple, stupa, mosque, palace, and fort architecture in India. (CO2) (P.I.* 10.1.1, 10.1.3, 12.2.1, 12.3.1) *3.5The Learners will be able to trace the historical development and cultural significance of Indian performing arts across periods. (CO1) (P.I.* 10.1.1, 10.1.3, 12.2.1, 12.3.1) *4.5The Learners will be able to analyze the materials, techniques, and symbolism used in traditional Indian art and craft practices. (CO3) (P.I.* 10.1.3, 10.3.1, 12.3.2, 12.1.2) *5.5The Learners will be able to demonstrate basic techniques of line drawing, border making, and motif repetition typical of Madhubani. (CO2) (P.I.* 10.3.1, 10.3.2, 12.3.2)

Performance Indicators:

P.I. 10.1.1 Understanding: Read, understand and interpret technical and non-technical information
P.I. 10.1.2 Create: Produce clear, well-constructed, and well-supported written engineering
P.I. 10.1.3 Create/Analyze: Create flow in a document or presentation - a logical progression of ideas so that the main point is clear
P.I. 10.2.1 Understand: Listen to and comprehend information, instructions, and viewpoints of others
P.I. 10.2.2 Apply/Create: Deliver effective oral presentations to technical and non-technical audiences
P.I. 10.3.1 Create: Create engineering-standard figures, reports and drawings to complement writing and presentations
P.I. 10.3.2 Apply/Create: Use a variety of media effectively to convey a message in a document or a presentation
P.I. 12.1.1 Understand: Describe the rationale for the requirement for continuing professional development
P.I. 12.1.2 Analyse: Identify deficiencies or gaps in knowledge and demonstrate an ability to source information to close this gap
P.I. 12.2.1 Remember: Identify historic points of technological advance in engineering that required practitioners to seek education in order to stay current
P.I. 12.2.2 Understand: Recognize the need and be able to clearly explain why it is vitally important to keep current regarding new developments in your field
P.I. 12.3.1 Understand: Source and comprehend technical literature and other credible sources of information
P.I. 12.3.2 Analyze: Analyze sourced technical and popular information for feasibility, viability, sustainability, etc.

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1, 1.2,1.3,1.4, 1.5, 3.1,3.2,3.3,3.4,3.5
CO2	2.1,2.2,2.3,2.4,2.5, 5.1,5.2,5.3,5.4,5.5
CO3	4.1,4.2,4.3,4.4,4.5

Mapping of Course Outcomes with Programme Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO7	PO8	PO9	P010	PO11	PO12
CO1	-	-	-	-	-	-	-	-	6/25	-	4/25
CO2	-	-	-	-	-	-	-	-	5/25	-	4/25
CO3	-	-	-	-	-	-	-	-	4/25	-	2/25

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria:** The Learner can:	**Evaluated under** **ISA/MSE/ESE/LAB**
LO 1.1: Learners will be able to describe the cultural, religious, and socio-political contexts that shaped various art traditions in India. (CO1) (P.I. 10.1.1, 10.1.2, 12.1.2, 12.3.1)	Learners will identify and explain key regional art forms across India, highlighting their unique features, cultural contexts, and historical roots through a painting/ a song/ a folkdance. Learners will attempt a quiz on an artwork inspired by a regional Indian art form, demonstrating understanding of its visual style and traditional techniques.	ESE ISA QUIZ
LO 1.2: Learners will be able to differentiate between classical, folk, tribal, and modern Indian art forms. (CO1) (P.I. 10.1.1, 10.1.2, 12.1.2, 12.3.1)		
LO 1.3: Learners will be able to analyze visual and performing arts using appropriate terminology and critical frameworks. (CO1) (P.I. 10.1.3, 10.3.1, 12.3.2, 12.1.2)		
LO 1.4: Learners will be able to appreciate the diversity and symbolism in Indian sculpture, painting, architecture, music, dance, and crafts. (CO1) (P.I. 10.2.1, 10.2.2, 12.3.2)		
LO 1.5: Learners will be able to trace the regional variations and continuity of artistic practices across India. (CO1) (P.I. 10.1.1, 10.1.3, 12.2.1, 12.3.1)		
LO 2.1: The Learners will be able to identify key architectural styles and monuments across different periods of Indian history (e.g., Buddhist, Hindu, Jain, Islamic, Colonial, and Modern). (CO 2) (P.I. 10.1.1, 10.1.2, 12.3.1)	Learners will describe the historical development, key features, and regional styles of temple, stupa, mosque, palace, and fort architecture in India. They will analyze how these structures reflect cultural, religious, and political influences over time through paintings. Learners will attempt a quiz on one architectural form (e.g.,	ESE ISA QUIZ
LO 2.2: The Learners will be able to describe the historical, religious, and cultural contexts that shaped the evolution of Indian architecture. (CO2) (P.I. 10.1.1, 10.1.2, 12.1.2, 12.3.1)		
LO 2.3: The Learners will be able to differentiate between		

regional architectural features and materials used across various parts of India. (CO2) (P.I. 10.1.1, 10.1.2, 12.3.1)	stupa, temple, mosque, fort, or palace), showcasing its key structural and decorative elements.	
LO2.4: The Learners will be able to analyze the structural elements, aesthetics, and symbolism in prominent Indian architectural works. (CO2) (P.I. 10.1.3, 10.3.1, 12.3.2, 12.1.2)		
LO 2.5: The Learners will be able to trace the development of temple, stupa, mosque, palace, and fort architecture in India. (CO2) (P.I. 10.1.1, 10.1.3, 12.2.1, 12.3.1)		
LO 3.1: The Learners will be able to identify the major forms of Indian music (classical, folk, devotional) and performing arts (dance, theatre, puppetry). (CO1) (P.I. 10.1.1, 10.1.2)	Learners will explain the evolution of key Indian performing arts (such as classical dance, music, and theater) across different historical periods through dance.	ESE
LO 3.2: The Learners will be able to understand the theoretical foundations of Indian classical music and dance, including ragas, talas, and natya shastra principles. (CO1) (P.I. 10.1.1, 10.1.2, 12.1.2)	Learners will attempt a quiz on an element of a traditional Indian performing art, reflecting its style and historical context.	ISA QUIZ
LO 3.3: The Learners will be able to differentiate between Hindustani and Carnatic music traditions and their regional and stylistic variations. (CO1) (P.I. 10.1.1, 10.1.2)		
LO 3.4: The Learners will be able to describe the key elements, techniques, and expressions used in major Indian classical dance forms (e.g., Bharatanatyam, Kathak, Odissi, Kathakali). (CO1) (P.I. 10.1.3, 10.2.2, 12.3.2)		

LO 3.5: The Learners will be able to trace the historical development and cultural significance of Indian performing arts across periods. (CO1) (P.I. 10.1.1, 10.1.3, 12.2.1)		
LO 4.1: The Learners will be able to identify major traditional and regional painting styles of India, such as Madhubani, Warli, Pattachitra, Kalamkari, Tanjore, and Miniature painting. (CO3) (P.I. 10.1.1, 10.1.2, 12.3.1)	Learners will identify and explain various materials and techniques used in traditional Indian art and craft, along with the symbolic meanings behind common motifs and designs through singing/ painting. Learners will attempt a quiz on a craft or artwork based on traditional materials and techniques, demonstrating their understanding of the symbolic elements involved.	ESE ISA QUIZ
LO 4.2: The Learners will be able to recognize key Indian handicraft traditions, including textiles, pottery, woodwork, metalwork, and jewelry-making. (CO3) (P.I. 10.1.1, 10.1.2, 12.3.1)		
LO 4.3: The Learners will be able to Describe the historical and cultural context in which various painting styles and handicrafts developed. (CO3) (P.I. 10.1.1, 10.1.2, 12.1.2, 12.3.1)		
LO 4.4: The Learners will be able to Differentiate between folk, tribal, and classical painting forms and their thematic and stylistic features. (CO3) (P.I. 10.1.1, 10.1.2, 12.3.1)		
LO 4.5: The Learners will be able to Analyze the materials, techniques, and symbolism used in traditional Indian art and craft practices. (CO3) (P.I. 10.1.3, 10.3.1, 12.3.2, 12.1.2		
LO 5.1: The Learners will be able to understand the historical and cultural origins of Madhubani painting and its connection to	Learners will describe the fundamental techniques used in Madhubani art, including line drawing, border design,	ESE

the Mithila region of Bihar. (CO2) (P.I. 10.1.1, 10.1.2, 12.1.2, 12.3.1)	and motif repetition through Madhubani paintings. Learners will attempt a quiz on Madhubani-style artwork that includes skillful use of line drawing, border making, and repeated motifs.	ISA QUIZ
LO 5.2: The Learners will be able to identify key themes and symbols traditionally used in Madhubani art, such as mythology, nature, and rituals. (CO2) (P.I. 10.1.1, 10.1.2, 12.3.1)		
LO 5.3: The Learners will be able to recognize different styles within Madhubani painting (e.g., Bharni, Kachni, Tantrik, Godna, and Kohbar). (CO2) (P.I. 10.1.1, 10.1.2, 12.3.1)		
LO 5.4: The Learners will be able to describe the traditional tools and materials used, including natural dyes, handmade paper, and bamboo pens. (CO2) (P.I. 10.1.1, 10.1.2, 12.3.1)		
LO 5.5: The Learners will be able to demonstrate basic techniques of line drawing, border making, and motif repetition typical of Madhubani. (CO2) (P.I. 10.3.1, 10.3.2, 12.3.2)		

Reference Books:

1. Coomaraswamy, A. K. (1956). *The dance of Śiva: Fourteen Indian essays*. Dover Publications.
2. Michell, G. (1990). *The Penguin guide to the monuments of India: Volume 1: Buddhist, Jain, Hindu*. Penguin Books.
3. Ebeling, K. (1973). *The art of India: Traditions of Indian sculpture, painting and architecture*. Crown Publishers.
4. Chandra, P. (1983). *Indian art*. Thames & Hudson.
5. Varadpande, M. L. (1987). *History of Indian theatre: Volume 1*. Abhinav Publications.
6. Mitter, P. (2001). *Indian art*. Oxford University Press.
7. Kapila, V. (2002). *Textiles and weavers in South India*. Marg Publications.
8. Saraswati, H. (1975). *The sacred arts of India*. Rizzoli International Publications.
9. Vatsyayan, K. (1977). *Classical Indian dance in literature and the arts*. Sangeet Natak Akademi.
10. Khokar, M. (2001). *Traditions of Indian classical dance*. Clarion Books.
11. Jain, J. (1999). *Kalātattvakośa: A dictionary of fundamental concepts of the Indian arts (Vols. 1–6)*. Indira Gandhi National Centre for the Arts.

12. Rowell, M. (1999). *Music and musical thought in early India*. University of Chicago Press.
13. Ghosh, M. (1951). *Natyashastra (2 vols.)*. Asiatic Society of Bengal.
14. Devi, R. (1990). *Mudras in Bharata Natyam*. D. K. Printworld.
15. Singh, K. (1994). *Himalayan art*. Roli Books.
16. Craven, R. C. (1976). *Indian art: A concise history*. Thames and Hudson.
17. Das, S. K. (2005). *A history of Indian literature: 500–1399 AD*. Sahitya Akademi.
18. Goswamy, B. N. (2010). *Indian paintings in the Punjab hills*. Niyogi Books.
19. Michell, G. (2005). *Hindu art and architecture*. Thames & Hudson.
20. Lal, A. (2004). *The Oxford companion to Indian theatre*. Oxford University Press.

Related/ Equivalent MOOC and Associated Certification:

1. *Art Appreciation: An Introduction to Indian Art*

Platform: SWAYAM – CEC
Instructor: Dr. Kakoli Gogoi (Dibrugarh University)
Link: https://onlinecourses.swayam2.ac.in/cec24_as04/preview

2. *Introduction to Indian Art – An Appreciation*

Platform: NPTEL via SWAYAM

Instructor: Prof. Soumik Nandy Majumdar (Visva Bharati)

Link: https://onlinecourses.nptel.ac.in/noc25_hs200/preview

3. *Indian Art: Materials, Techniques and Artistic Practices*

Platform: NPTEL via SWAYAM

Instructor: Faculty from IIT Kanpur

Link: https://onlinecourses.nptel.ac.in/noc25_hs180/preview

4. *Folk and Minor Art in India*

Platform: NPTEL via SWAYAM
Instructor: Prof. Shatarupa Thakurta Roy (IIT Kanpur)
Link: https://onlinecourses.nptel.ac.in/noc25_hs201/preview

5. *Modern & Contemporary Indian Art*

Platform: MAP Academy (Art & Photography Foundation)
Instructor: Dr. Beth Citron & team
Link: https://courses.mapacademy.io/courses/modern-contemporary-indian-art

Detailed Syllabus of Liberal Learning-Co-curricular Courses

Course Name: Various Dance Forms

Course Code: CC01

NEP Vertical _Basket: LLC_CC

Preamble:

Wide platter of General Education courses are offered to First Year Engineering students with an aim to focus on holistic personality development These courses will also help to create balance in brain hemispheres and thereby improve learners' clarity in thoughts and responses.

Pre-requisites:

NIL

Course Objectives:

- To develop the intellectual skills and competencies necessary to participate effectively in society and the world
- To develop broad knowledge of living and non-living world
- To develop ability to integrate knowledge, make informed ethical decisions and accept civic responsibilities

Course Outcomes:

Learner will be able to:
CO1: Differentiate between various dance forms
CO2: Work towards developing holistic personality through critical and creative thinking
CO3: Complement technical knowledge by developing diversified perspectives on various aspects of learning.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Various Dance Forms	Dance, Definition, History, music, rhythm. Basic understanding of the term ABHINAYA and definition of its four aspects. Technical terminology of dance. Acquaintance with the traditional costumes. Dance forms: Indian Classical dance, folk dance, Bollywood, Jazz and performances	15 15
Total			**30**

Recommended Online Courses:

Nil

Reference Books:

As suggested by resource person in session

Course Name: Corporate and Social Etiquettes

Course Code: CC02

NEP Vertical _Basket: LLC_CC

Preamble:
In today's dynamic and multicultural workplace, technical expertise alone is not enough. Success in the professional world hinges on one's ability to communicate effectively, behave appropriately, and uphold ethical standards. The Corporate and Social Etiquettes course equips individuals with essential soft skills that foster professionalism, enhance personal branding, and build confidence in both corporate and social settings. This course bridges the gap between academic knowledge and real-world workplace behavior, preparing participants to thrive in diverse professional environments with poise, clarity, and integrity.

Pre-requisites:
NIL
Course Objectives:

- To develop essential corporate communication and interpersonal etiquette for professional settings.
- To build competence in public speaking, business interactions, and ethical decision-making.
- To enhance learners' ability to apply professionalism in diverse workplace and social scenarios.

Course Outcomes:

Learners will be able to:
CO1: Demonstrate willingness to adopt professional etiquette in communication, dress, and interpersonal conduct. (Receiving → Responding)
CO2: Participate actively in professional interactions, showing respect for workplace diversity and social norms. (Responding → Valuing)
CO3: Value ethical behavior and integrity as essential components of professional identity and decision-making. (Valuing)
CO4: Integrate appropriate etiquette into routine professional practices, including interviews, meetings, and networking. (Organizing)
CO5: Exemplify professionalism and responsible conduct consistently across diverse business and social situations. (Characterizing)

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	075

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Foundations of Corporate Etiquette & Professional Image	• Importance of corporate etiquette in modern workplaces • First impressions and body language • Dressing for success: grooming and attire • Professional conduct: punctuality, workspace manners • Cross-cultural and global etiquette basics	5
2	Business Communication & Digital Etiquette	• Verbal and non-verbal communication • Active listening and empathetic speaking • Email writing and etiquette • Telephone, messaging, and video conferencing protocols • Social media and digital footprint management	5
3	Public Speaking & Presentation Skills	• Overcoming stage fright • Structure of effective speeches and presentations • Visual aids and storytelling techniques • Q&A handling and engagement strategies • Persuasive speaking for business settings	5
4	Business Meetings, Networking & Social Etiquette	• Preparing for and participating in meetings • Formal introductions and small talk • Networking at events, conferences, and dinners • Exchanging business cards appropriately • Business dining and RSVP etiquette	5
5	Interview Skills & Professional Advancement	• Resume walkthroughs and professional storytelling • STAR method for answering questions • Mock interviews: HR and panel types • Follow-up etiquette (emails, thank-yous) • Career etiquette: internships, promotions, resignations	5
6	Corporate Ethics, Integrity & Capstone Project	• Defining corporate ethics and code of conduct • Conflict of interest and workplace compliance • Handling ethical dilemmas and reporting concerns • Diversity, equity, and inclusion in behavior • Course wrap-up, capstone presentations, and reflection	5
Total			**30**

Reference Books / Resources:

1. "Business Communication Today" by Courtland L. Bovee and John V. Thill.
2. "The Etiquette Advantage in Business: Personal Skills for Professional Success" by Peter Post, Anna Post, and Lizzie Post.
3. "Speak with Confidence: How to Prepare, Learn, and Perform Effective Public Speaking" by Jack Valenti.
4. "Cracking the Code to a Successful Interview: 15 Insider Secrets from a Top-Level Recruiter" by Evan Pellett.
5. "Ethics and the Conduct of Business" by John R. Boatright.

Course Name: Global Citizenship Education

Course Code: CC03

NEP Vertical _Basket: LLC_CC

Preamble:

Global Citizenship Education (GCE) equips students with the understanding, skills, and values they need to cooperate in resolving interconnected global challenges and to become responsible citizens of the world. This course introduces learners to the concepts of identity, diversity, sustainability, and human rights, while enhancing cross-cultural competence and promoting social responsibility in engineering practice.

Pre-requisites:

NIL

Course Objectives:

- To understand core concepts related to identity, culture, sustainability, and global interdependence.
- To nurture empathy, critical thinking, and collaborative problem-solving.
- To empower students to take informed, reflective action in both local and global contexts.

Course Outcomes:

Learners will be able to:
CO1: Describe key global issues and cultural differences and appreciate the diversity of perspectives.
CO2: Analyze how engineering solutions can promote sustainable development and equity.
CO3: Demonstrate intercultural competence, ethical reasoning, and civic responsibility in personal and professional settings.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	075

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Understanding Global Citizenship	• Identity and belonging, Global vs. Local Citizenship, Rights and Responsibilities • India: Fundamental Duties, Gandhian universal values	6

Module No.	Module Name	Content	No. of Hours
		• Activities: Identity web, Reflective essay • Case Study: Teach for India Fellows	
2	Diversity and Intercultural Understanding	• Cultural sensitivity, Stereotypes and bias, Inclusion and equity • India: Festivals and linguistic diversity • Activities: Role-play, Bias quiz • Case Study: Infosys/Tata global team management	6
3	Sustainability and Global Interdependence	• Environmental responsibility, SDGs, Global systems (economic, political, technological) • India: Ganga Project, SDGs 6 & 13 • Activities: Carbon calculator, Development debate • Case Study: Reliance renewable initiatives	6
4	Peace, Conflict, and Human Rights	• Human rights frameworks, Non-violent communication, Case studies • India: RTI, RTE, Peace in Northeast • Activities: Landmark legal discussion, Peace circles • Case Study: Narmada Bachao Andolan	6
5	Taking Action and Civic Engagement	• Ethical decision making, Civic responsibility, social entrepreneurship, Youth action • India: Goonj, SELCO, I Change My City • Activities: Civic campaign design, Volunteering simulation • Case Study: Zomato Feeding India	6
Total			**30**

Reference Books:

As suggested by the resource person in session

Course Name: Wellness- Body, Mind and Spirit

Course Code: CC04

NEP Vertical _Basket: LLC_CC

Preamble:

Wide platter of Liberal Learning courses are offered to First Year Engineering students with an aim to focus on holistic personality development These courses will also help to create balance in brain hemispheres and thereby improve learners' clarity in thoughts and responses.

Pre-requisites:

NIL

Course Objectives:

- To develop the intellectual skills and competencies necessary to participate effectively in society and the world.
- To develop broad knowledge of living and non-living world
- The course aims to provide students with a comprehensive understanding of wellness, with a focus on mental, emotional, social, and spiritual dimensions.

Course Outcomes:

Learner will be able to:
CO1: Holistic Understanding of Wellness
CO2: Proficiency in Yogic Practices
CO3: Application of Wellness Principles

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	075

Detailed Syllabus:

Module No.	Module Name	Content
1	Introduction to Wellness	1.1 Understanding Wellness

Module No.	Module Name	Content
		Definition and dimensions of wellness: mental, emotional, social, spiritual Importance of achieving a balanced and holistic lifestyle 1.2 Wellness Models Exploring different models of wellness (e.g., The Wheel of Wellness) Identifying factors that contribute to overall well-being 1.3 Assessing Personal Wellness Self-assessment tools for mental, emotional, and social well-being Goal-setting for wellness improvement
2	Yoga for Mind and Spirit	2.1 Introduction to Yoga History, philosophy, and different forms of yoga Yoga as a holistic approach to well-being 2.2 Yogic Asanas (Postures) Practicing basic yoga poses for mental and spiritual benefits Alignment, breathing, and mindfulness in yoga practice 2.3 Meditation and Mindfulness in Yoga Incorporating meditation and mindfulness techniques into yoga Developing mental clarity and focus through yogic practices
3	Mental and Emotional Wellness	3.1 Stress Management Recognizing sources of stress Yogic techniques for stress reduction 3.2 Emotional Intelligence Applying yogic principles to enhance emotional intelligence Cultivating compassion and self-awareness through yoga 3.3 Mindfulness and Relaxation Techniques Yoga nidra and other relaxation practices Using breathwork for emotional well-being
4	Spiritual Wellness	5.1 Exploring Spirituality through Yoga Connecting with one's inner self and values through yoga Understanding the spiritual dimensions of yoga 5.2 Practices for Spiritual Wellness Meditation, chanting, and other spiritual practices in yoga Integrating spirituality into daily life
5	Integrating Yoga into Daily Life	6.1 Creating a Personal Yoga and Wellness Plan Synthesizing knowledge from previous modules Developing a comprehensive and realistic yoga and wellness plan 6.2 Overcoming Challenges Strategies for overcoming obstacles to regular yoga practice Building resilience and maintaining a positive mindset through yoga

Module No.	Module Name	Content
		6.3 Lifelong Yoga and Wellness Habits Establishing habits for sustained well-being through ongoing yoga practice Continuing personal growth and development with yoga
		Total Hours=30

Recommended Online Courses:

Nil

Reference Books:

As suggested by resource person in session

Course Name: IQ vs EQ

Course Code: CC05

NEP Vertical _Basket: LLC_CC

Preamble:

Wide platter of General Education courses are offered to First Year Engineering students with an aim to focus on holistic personality development These courses will also help to create balance in brain hemispheres and thereby improve learners' clarity in thoughts and responses.

Pre-requisites:

NIL

Course Objectives:

- To develop the intellectual skills and competencies necessary to participate effectively in society and the world
- To develop broad knowledge of living and non-living world
- To develop ability to integrate knowledge, make informed ethical decisions and accept civic responsibilities

Course Outcomes:

Learner will be able to:
CO1: Understand strategies to enhance EQ as it is important in their personal as well as professional success.
CO2: Work towards developing holistic personality through critical and creative thinking
CO3: Complement technical knowledge by developing diversified perspectives on various aspects of learning.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	IQ vs EQ	Introduction to Emotional Intelligence, the ability to understand, use, and manage your own emotions in positive ways to relieve stress, communicate effectively, empathize with others, overcome challenges and defuse conflict. Applications of EQ skills for mental health and wellbeing, self-awareness, self-motivation, active listening. The EQ view and Neuroscience of emotional intelligence, Intrinsic motivation and goal setting	15 15
Total			**30**

Recommended Online Courses:

Nil

Reference Books:

As suggested by resource person in session

Course Name: Nutrition and Physical Wellness

Course Code: CC06

NEP Vertical _Basket: LLC_CC

Preamble:

Wide platter of General Education courses are offered to First Year Engineering students with an aim to focus on holistic personality development These courses will also help to create balance in brain hemispheres and thereby improve learners' clarity in thoughts and responses.

Pre-requisites:

NIL

Course Objectives:

- To develop the intellectual skills and competencies necessary to participate effectively in society and the world
- To develop broad knowledge of living and non-living world
- To develop ability to integrate knowledge, make informed ethical decisions and accept civic responsibilities

Course Outcomes:

Learner will be able to:
CO1: Adapt healthy lifestyle and focus on overall wellbeing
CO2: Work towards developing holistic personality through critical and creative thinking
CO3: Complement technical knowledge by developing diversified perspectives on various aspects of learning

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Nutrition and Physical Wellness	Nutrition, Types of nutrition, Human need, Carbohydrates, proteins, vitamins, water, fats, minerals Well-balanced diet and its advantages Physical activities, daily exercises, need of stretching in working hours, best time and duration for physical activities, risk of taking supplements, dangers of following harmful fads. Physical wellness, finding time to move your body, warning sign by body, maintaining regular sleep schedule, maintaining ideal weight.	15 15
Total			**30**

Recommended Online Courses:

Nil

Reference Books:

As suggested by resource person in session

Course Name: Facets of Astronomy

Course Code: CC07

NEP Vertical _Basket: LLC_CC

Preamble:

Wide platter of General Education courses are offered to First Year Engineering students with an aim to focus on holistic personality development These courses will also help to create balance in brain hemispheres and thereby improve learners' clarity in thoughts and responses.

Pre-requisites:

NIL

Course Objectives:

- To develop the intellectual skills and competencies necessary to participate effectively in society and the world
- To develop broad knowledge of living and non-living world
- To develop ability to integrate knowledge, make informed ethical decisions and accept civic responsibilities

Course Outcomes:

Learner will be able to:
CO1: Develop an urge to research things that occur naturally on earth and in the universe.
CO2: Work towards developing holistic personality through critical and creative thinking
CO3: Complement technical knowledge by developing diversified perspectives on various aspects of learning.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Facets of Astronomy	Astrophysics: applying the laws of physics in space. Astrometry: mapping celestial bodies. Astrogeology: examining rocks, terrain, and material in space. Astrobiology: Searching for life outside Earth. Use of physics, mathematics, chemistry in astronomy Types of telescopes, Refractor Telescopes. Reflector Telescopes. Dobsonian Telescopes. Maksutov-Cassegrain Telescopes. The scientific study of celestial objects visible at night, Various celestial objects to observe.	15 15
Total			**30**

Recommended Online Courses:

Nil

Reference Books:

As suggested by resource person in session

Course Name: Railways – Wonders of Infrastructure

Course Code: CC08

NEP Vertical _Basket: LLC_CC

Preamble:

Wide platter of General Education courses are offered to First Year Engineering students with an aim to focus on holistic personality development These courses will also help to create balance in brain hemispheres and thereby improve learners' clarity in thoughts and responses.

Pre-requisites:

NIL

Course Objectives:

- To develop the intellectual skills and competencies necessary to participate effectively in society and the world
- To develop broad knowledge of living and non-living world
- To develop ability to integrate knowledge, make informed ethical decisions and accept civic responsibilities

Course Outcomes:

Learner will be able to:
CO1: Understand reach of Indian Railways and how can engineers contribute towards it
CO2: Work towards developing holistic personality through critical and creative thinking
CO3: Complement technical knowledge by developing diversified perspectives on various aspects of learning.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content
1	Railways – Wonders of Infrastructure	History of civilization, Industrial revolution, early-stage steam engine, steam powered locomotives Liverpool to Manchester railways, Economic changes brought by railways. Indian Railways, Land and bridges, electrification, telecommunication, public sector undertakings, Reforms in railway sector.
		Total Hours=30

Recommended Online Courses:

Nil

Reference Books:

As suggested by resource person in session

Course Name: Financial Literacy for Engineers

Course Code: CC09

NEP Vertical _Basket: LLC_CC

Preamble:
Financial literacy is a crucial skill for engineers to understand and manage their personal finances efficiently and make informed decisions in their professional roles. This course aims to equip engineering students with the knowledge and skills necessary to navigate financial matters effectively.
Prerequisite: NIL

Course Objective:

1. Introduce students to fundamental financial concepts, including budgeting, saving, and investing, tailored for engineering professionals.
2. Equip students with tools to analyze costs, returns, and economic feasibility in engineering projects.
3. Teach students effective strategies for managing personal finances, including debt management and tax planning.
4. Familiarize students with investment options, portfolio diversification, and strategies for long-term wealth generation.
5. Train students to make informed financial decisions by analyzing risks, benefits, and ethical considerations.
6. Prepare students to incorporate financial insights into project planning, resource allocation, and entrepreneurial ventures.

Course Outcomes: Learner will be able to:
CO1: Understand and apply basic financial concepts in both personal and professional contexts.
CO2: Evaluate the economic viability of engineering projects using cost-benefit and break-even analyses.
CO3: Create budgets, manage debts, and plan for taxes efficiently.
CO4: Assess various investment vehicles and design diversified portfolios to achieve financial goals.
CO5: Integrate financial considerations into engineering decision-making processes.
CO6: Solve real-world financial problems using analytical tools and ethical practices.

Course Scheme

Contact hours		Credits assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	75

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.
Detailed Syllabus:

Module No.	Module Name	Content	No of hrs
1	Introduction to Financial Literacy	• Importance of financial literacy for engineers, Core financial concepts: income, expenses, savings, and budgeting, Introduction to financial statements: balance sheets and income statements • Understanding the time value of money.	5
2	Engineering Economics and Project Evaluation	• Basics of Engineering Economics: cost estimation and feasibility studies • Techniques for project evaluation: Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period, Break-even analysis and decision-making under uncertainty • Case studies on financial analysis in engineering projects.	5
3	Personal Finance Management	• Budgeting methods and tools for engineers, Debt management: understanding loans, credit cards, and interest rates • Basics of tax planning for salaried and entrepreneurial engineers, Insurance: life, health, and asset protection.	5
4	Investment and Wealth Management	• Overview of investment options: stocks, bonds, mutual funds, and real estate • Principles of portfolio diversification and risk management, Retirement planning and compounding benefits • Basics of cryptocurrency and its implications for engineers.	5
5	Ethical and Sustainable Financial Practices	• Ethical considerations in financial decision-making, financial fraud prevention and awareness, Sustainable financial planning: balancing profit with social responsibility • Corporate financial ethics and accountability.	5
6	Practical Applications and Case Studies	• Real-world case studies of engineering startups and financial challenges • Hands-on workshops: budgeting, financial analysis, and investment planning • Group project: evaluating the financial viability of an engineering project • Final assessment: creating a comprehensive personal financial plan.	5
Total			**30**

Reference Books:

1. The Richest Engineer: A Story of Wealth Building Strategies for Engineers by Raj Surya
2. Financial Freedom for Engineers: A Practical Guide to Wealth Creation by Neeraj Negi
3. The Intelligent Investor by Benjamin Graham
4. Rich Dad Poor Dad by Robert Kiyosaki

Course Name: Mastering Advanced Excel

Course Code: CC10

NEP Vertical _Basket: LLC_CC

Preamble:

Microsoft Excel has become a vital tool for data analysis, financial modelling, and decision-making across industries. This course is designed to equip learners with advanced Excel skills, enabling them to solve complex problems, streamline workflows, and create impactful visualizations. It emphasizes hands-on learning through real-world applications, fostering confidence and expertise in advanced spreadsheet techniques.

Prerequisite:

Basic knowledge of Excel, including familiarity with basic formulas, formatting, and chart creation.

Course Objective:

1. Enable students to effectively use advanced Excel functions and formulas, including logical, statistical, and lookup functions, for complex data manipulation and problem-solving.
2. Teach students to organize, filter, and analyze large datasets using tools like PivotTables, Power Query, and advanced sorting techniques.
3. Equip students with the ability to create dynamic and visually impactful charts, dashboards, and reports for data-driven decision-making.
4. Introduce students to Excel automation using Macros and VBA (Visual Basic for Applications) to improve productivity and efficiency.
5. Familiarize students with tools such as Solver, Data Tables, Scenario Manager, and advanced conditional formatting to solve real-world business problems.
6. Provide practical exposure by solving real-world business challenges and projects using advanced Excel features, fostering hands-on learning and application.

Course Outcomes: Learner will be able to:
CO1: Apply advanced formulas and functions for complex data manipulation.
CO2: Perform data analysis using tools like PivotTables, Power Query, and Power Pivot.
CO3: Automate repetitive tasks using macros and Visual Basic for Applications (VBA).
CO4: Create interactive dashboards and dynamic visualizations.
CO5: Use advanced tools to solve real-world business problems.
CO6: Optimize Excel workflows and enhance productivity.

Course Scheme

Contact hours		Credits assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	75

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of hrs
1	Advanced Functions and Formulas	• Logical Functions: IF, AND, OR, IFERROR • Lookup Functions: VLOOKUP, HLOOKUP, XLOOKUP, INDEX-MATCH • Text Functions: CONCATENATE, TEXT, LEFT, RIGHT, MID, TRIM • Date and Time Functions: TODAY, NOW, DATEDIF, NETWORKDAYS • Array Formulas and Dynamic Arrays: FILTER, SORT, UNIQUE, SEQUENCE	5
2	Data Analysis and Management	• Working with Large Data Sets • Sorting, Filtering, and Subtotals • Data Validation Techniques • Advanced Data Analysis Tools • PivotTables and PivotCharts • Grouping and Ungrouping Data • Power Query for Data Transformation • Scenario Analysis and Forecasting • What-If Analysis: Goal Seek, Data Tables, Scenario Manager • Using Solver for Optimization	5
3	Advanced Charting and Data Visualization	• Creating Dynamic Charts • Combo Charts, Waterfall Charts, Histogram, Sparklines • Interactive Dashboards • Using Slicers and Timelines • Conditional Formatting for Visual Impact • Design Principles for Effective Visualizations	5
4	Automation with Macros and VBA	• Introduction to Macros • Recording, Editing, and Running Macros • Basics of VBA Programming • VBA Editor and Debugging • Writing VBA Code: Loops, Conditional Statements, and Functions • Automating Tasks: Sending Emails, Generating Reports • Customizing Excel with VBA • User Forms and Advanced Interactivity	5
5	Advanced Excel Tools and Techniques	• Power Pivot for Data Modeling • Relationships and DAX (Data Analysis Expressions) • Protecting and Sharing Workbooks • Workbook and Worksheet Protection • Sharing and Collaboration in Excel • Time-Saving Tips • Keyboard Shortcuts	5

Module No.	Module Name	Content	No of hrs
		• Custom Ribbon and Quick Access Toolbar	
6	Applications and Real-World Case Studies	• Solving Business Problems: • Financial Modelling • Budgeting and Forecasting • Inventory Management • Data Cleaning and Preparation for Analysis • Case Studies: • Sales Analysis Dashboard • Employee Productivity Tracker • Project Management Templates	5
Total			**30**

Reference Books:

1. Microsoft Excel 365 Bible by Michael Alexander, Dick Kusleika, and John Walkenbach.
2. Excel 2019 Power Programming with VBA by Michael Alexander and Richard Kusleika.
3. Data Analysis with Microsoft Excel by Kenneth N. Berk and Patrick Carey.
4. Online Resources: Microsoft Learn, ExcelJet, Chandoo.org

Course Name: Personal Grooming Essentials

Course Code: CC11

NEP Vertical _Basket: LLC_CC

Preamble:
The Personal Grooming Essentials course aims to equip students with foundational skills and knowledge to enhance their personal appearance, confidence, and social etiquette. Through a blend of theoretical concepts and practical demonstrations, students will learn the importance of personal grooming in professional and social settings. The course aligns with the National Board of Accreditation (NBA) standards as per All India Council for Technical Education (AICTE) norms, focusing on holistic development and industry relevance.

Prerequisite: NIL

Course Objective:
1. Introduce the importance of personal grooming and its impact on self-confidence and professional image.
2. Teach effective personal hygiene practices and skincare routines tailored to different skin types and needs.
3. Provide basic knowledge and techniques for maintaining hair and applying makeup for various occasions.
4. Educate students on choosing appropriate attire for professional, casual, and formal settings.
5. Train students to project confidence through effective verbal and non-verbal communication.
6. Equip students with strategies to manage their daily grooming routine efficiently without compromising quality.

Course Outcomes: Learner will be able to:
CO1: Apply consistent grooming habits to maintain a polished and presentable appearance.
CO2: Design skincare routines suited to their individual skin types and concerns.
CO3: Demonstrate basic hairstyling and makeup application techniques for professional and social occasions.
CO4: Select clothing and accessories that align with professional, casual, and formal etiquette.
CO5: Display poise and professionalism using refined communication and body language skills.
CO6: Integrate grooming into their daily schedule effectively, balancing personal and professional commitments.

Course Scheme

Contact hours		Credits assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	75

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course.

However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of hrs
1	Foundations of Personal Grooming	• Importance of grooming for personal and professional growth • Assessing individual grooming needs and goals, Grooming and first impressions: psychological and social impacts.	5
2	Hygiene and Skincare Essentials	• Fundamentals of personal hygiene: habits and tools • Skin types and common concerns (e.g., acne, dryness, sensitivity) • Daily skincare routines: cleansing, moisturizing, and protection • Seasonal skincare adjustments and home remedies.	5
3	Hair Care and Makeup Basics	• Hair care routines: washing, conditioning, and styling tips • Identifying hair types and selecting suitable products • Basic makeup application: foundation, eyeliner, and lipstick, Day vs. evening makeup: subtle and bold looks.	5
4	Dressing and Styling Etiquette	• Understanding dress codes: formal, semi-formal, business casual, and casual • Choosing clothing based on body type and occasion • Accessorizing effectively: jewelry, watches, and belts, Color coordination and fabric selection.	5
5	Communication and Body Language	• Basics of verbal communication: tone, clarity, and courtesy • Non-verbal communication: eye contact, posture, and gestures • Building confidence through body language and self-awareness, Handling criticism and feedback gracefully.	5
6	Grooming Time Management and Application	• Creating a time-efficient grooming schedule, Adapting grooming routines for travel and emergencies • Real-life practice: grooming for interviews, meetings, and events, Final project: presenting a well-groomed, confident persona.	5
Total			**30**

Reference Books:

1. The Beauty Book by Ritu Kalra.
2. The Grooming Guide by Malini Singh.
3. The Essential Guide to Grooming by Kate Smith.
4. The Science of Personal Grooming by John Taylor.

Course Name: Various Music Forms
Course Code: CC12

NEP Vertical _Basket: LLC_CC

Preamble:

Music, often referred to as the universal language of humanity, is an art form that transcends boundaries of culture, geography, and time. The study of Various Music Forms provides learners with a deep appreciation of the diverse styles and traditions that have shaped human expression. From classical compositions and folk traditions to contemporary genres, music forms are reflection of societal evolution, emotional depth, and artistic creativity. This course offers a structured exploration of music as a cultural phenomenon, an emotional outlet, and a technical discipline. Students will engage with theoretical underpinnings, historical contexts, and practical demonstrations of distinct music forms, fostering a holistic understanding of:

- Classical Music: The disciplined and structured traditions of Western and Eastern classical genres.
- Folk Music: The rich and diverse expressions of communities and their oral traditions.
- Contemporary Genres: The dynamic and evolving sounds of modern music, including pop, rock, jazz, and electronic styles.
- Global Perspectives: The cross-cultural influences and fusion trends that redefine music in the globalized world.

By connecting theory with practice, the course aims to nurture a well-rounded appreciation for the role of music in individual lives and societal frameworks. Additionally, it encourages creativity and interdisciplinary thinking, equipping students with the skills to analyze, perform, and innovate across music forms. Whether approached as a performer, composer, listener, or critic, the study of Various Music Forms is a journey through the heart of human expression and artistic legacy.

Prerequisite: NIL

Course Objective:

1. Explore the historical and cultural development of various music forms across the globe.
2. Familiarize students with the key features, instruments, and structures of various music genres.
3. Enhance students' understanding of diverse musical traditions and their cultural significance.
4. Train students to identify and interpret rhythm, melody, harmony, and texture in different music forms.
5. Inspire students to explore their musical preferences and express themselves creatively.
6. Provide students with opportunities to perform, compose, and appriciate music in different styles.

Course Outcomes

Learner will be able to:
CO1: Demonstrate an understanding of fundamental music forms, including their origins, evolution, and the key characteristics that define classical, folk, popular, sacred, and contemporary music traditions.
CO2: Analyze the structures, styles, and cultural significance of classical music traditions, including their influence on modern musical compositions and performances.
CO3: Explore and interpret the cultural roots, storytelling elements, and regional diversity of folk and traditional music forms across various societies.
CO4: Examine the development of popular music genres, identifying their socio-cultural impact, influential artists, and technological advancements that shaped their evolution.

CO5: Investigate the role of sacred and spiritual music in different traditions, recognizing its significance in rituals, worship, and community bonding.
CO6: Evaluate the influence of globalization on contemporary music, exploring how cross-cultural exchanges shape modern music forms and trends worldwide.

Course Scheme

Contact hours		Credits assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment Guidelines

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	50	75

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No of hrs
1	Introduction to Music Forms	• Definition and purpose of music • Overview of global music forms and their evolution, • Elements of music: rhythm, melody, harmony, and texture • Introduction to Western and non-Western music traditions.	5
2	Classical Music Traditions	• Western classical music: Baroque, Classical, Romantic, and Modern eras • Indian classical music: Hindustani and Carnatic traditions, Comparison of scales, rhythms, and instruments across traditions • Case studies: iconic composers and performances.	5
3	Folk and Traditional Music	• Characteristics of folk music: oral traditions, storytelling, and communal significance • Examination of regional folk music from India, Africa, Europe, and the Americas • Role of folk music in cultural identity and preservation • Hands-on: listening and interpreting folk songs.	5
4	Popular Music Genres	• Development of popular music genres: jazz, blues, rock, pop, and hip-hop • Evolution of modern music forms like electronic, EDM, and fusion • Analysis of instrumentation, lyrics, and cultural impact, Case studies: iconic artists and albums.	5

Module No.	Module Name	Content	No of hrs
5	Sacred and Spiritual Music	• Role of music in religion and spirituality, Chanting, hymns, and devotional music across traditions • Sacred music in Christianity, Hinduism, Islam, Buddhism, and Indigenous cultures • Exploration of the therapeutic and meditative aspects of sacred music.	5
6	Contemporary Music and Global Influences	• Influence of technology and globalization on music production and distribution • Fusion music: blending of traditional and modern styles • Cross-cultural collaborations and their impact on music innovation • Final project: creating a presentation or performance blending multiple music forms.	5
Total			**30**

Reference Books:

1. My Music, My Life by Ravi Shankar
2. The Music of India by Raghunath Panigrahi
3. Indian Classical Music and Gharana Tradition by Shubha Mudgal
4. The Oxford Encyclopaedia of the Music of India by Ashok Ranade