Vidyalankar Institute of Technology

An Autonomous Institute affiliated to University of Mumbai

Bachelor of Technology

in

Information Technology

Detailed Syllabus
Sem 1 (R-2026)

(As per NEP 2020, with effect from the Academic Year 2026-27)

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 Professional 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 professional 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 Information Technology
Vidyalankar Institute of Technology

Chairman, Academic Council
Vidyalankar Institute of Technology

Abbreviations used in this document

Basic Science and Engineering Science Courses (BSES)
Basic Science and Engineering Science Courses>Basic Science Courses (BSES_BSC)
Basic and Engineering Science Courses>Engineering Science Courses (BSES_ESC)
Programme Courses (PC)
Programme Courses>Programme Core Courses (PC_PCC)
Programme Courses> Programme Elective Course (PC_PEC)
Multidisciplinary Courses (MDC)
Multidisciplinary Courses>Multidisciplinary Minor (MDC_MDM)
Multidisciplinary Courses>Open Elective (MDC_OE)
Skill Courses (SC)
Skill Courses>Vocational and Skill Enhancement Course (SC_VSEC)
Humanities Social Science and Management (HSSM)
Humanities Social Science and Management>Ability Enhancement Course (HSSM_AEC)
Humanities Social Science and Management>Entrepreneurship/ Economics/ Management Course (HSSM_EEMC)
Humanities Social Science and Management>Indian Knowledge System (HSSM_IKS)
Humanities Social Science and Management>Value Education Course (HSSM_VEC)
Experiential Learning Courses (ELC)
Experiential Learning Courses>Research Methodology (ELC_RM)
Experiential Learning Courses>Comm. Engagement Project / Field Project (ELC_CEPFP)
Experiential Learning Courses>Project (ELC_PRJ)
Experiential Learning Courses>Internship/ OJT (ELC_IOJT)
Liberal Learning Courses (LLC)
Liberal Learning Courses>Co-Curricular Courses (LLC_CC)

First Year B. Tech. Information Technology **Preferred Semester: I**

Course Structure and Assessment Guidelines

Vertical Sub-Vertical	Course Code	Course Name	Required Prerequisite	Prerequisite for	KSA Mapping	Hours Per Week			Credits	Assessment Guidelines (Marks)				Preparedness for Industry-Level Certification$
						Theory	Practical	Tutorial		Total ISA	Total MSE	Total ESE	Total Marks (Passing @40%)	
BSES_ESC	BSC12	Engineering Mathematics-I	NIL	BSC03	K	3	-	-	3	20	30	50	100	
	BSC09T	Physics	NIL	NIL	K	2	-	-	2	15	20	40	075	
	BSC09P	Physics Lab	NIL	NIL	S	-	2	-	1	25	-	25	050	
	ESC11T	Fundamentals of Microprocessor and Assembly Language	NIL	ESC08	K	2	-	-	2	15	20	40	075	
	ESC11P	Fundamentals of Microprocessor and Assembly Language	NIL	ESC08	S	-	2	-	1	25	-	25	050	
	ESC13T	Digital Logic Circuits	NIL	ESC08	K	2	-	-	2	15	20	40	075	
	ESC13P	Digital Logic Circuits Lab	NIL	ESC08	S	-	2	-	1	25	-	25	050	
SC_VSEC	VSEC01T	Structured Programming	NIL	VSEC02T PCIT01T	K	2	-	-	2	15	20	40	075	
SC_VSEC	VSEC01P	Structured Programming Lab	NIL	VSEC02T PCIT01T	S	-	2	-	1	25	-	25	050	
HSSM_AEC	AEC01T	Effective Communication	NIL	NIL	A	2	-	-	2	15	20	40	075	
HSSM_AEC	AEC01P	Effective Communication Lab	NIL	NIL	A	-	2	-	1	25	-	25	050	
LLC_CC	CCXX*	Any LLC_CC course offered	NIL	NIL	K	2	-	-	2	25	-	50	075	
Total									**20**	**245**	**130**	**425**	**800**	

*Selection based on the subset of courses made available by the Institute for the semester.

$Details regarding Industry-Level Certification(s) can be obtained from syllabus of respective course.

ISA=In Semester Assessment: This will involve evaluation based on thought provoking assignments/ experiments/ class tests/ take home tests/ open book tests/ quizzes/ certification course etc… activities which will be assigned on weekly basis during the semester.

MSE= Mid Semester Examination: This will be a proctored examination conducted in the semester. Syllabus will be based on the percentage of syllabus completed till the exam.

ESE= End Semester Examination: This examination will be conducted after the end of academic session covering 100% syllabus of the course.

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 Liberal Learning_ Cocurricular Courses

Vertical Sub-Vertical	Course Code	Course Name	Required Prerequisite	Prerequisite for	KSA Mapping	Hours Per Week			Credits	Assessment Guidelines (Marks)				Preparedness for Industry-Level Certification$
						Theory	Practical	Tutorial		Total ISA	Total MSE	Total ESE	Total Marks (Passing @40%)	
LLC_CC	CC01	Various Dance Forms	NIL	NIL		2	-	-	2	25	-	50	075	
LLC_CC	CC02	Corporate and Social Etiquettes	NIL	NIL		2	-	-	2	25	-	50	075	
LLC_CC	CC03	Global Citizenship Education	NIL	NIL		2	-	-	2	25	-	50	075	
LLC_CC	CC04	Wellness – Body, Mind & Spirit	NIL	NIL		2	-	-	2	25	-	25	050	
LLC_CC	CC05	IQ vs EQ	NIL	NIL		2	-	-	2	25	-	50	075	
LLC_CC	CC06	Nutrition and Physical Wellness	NIL	NIL		2	-	-	2	25	-	25	050	
LLC_CC	CC07	Facets of Astronomy	NIL	NIL		2	-	-	2	25	-	50	075	
LLC_CC	CC08	Railways - Wonders of Infrastructure	NIL	NIL		2	-	-	2	25	-	50	075	
LLC_CC	CC09	Financial Literacy for Engineers	NIL	NIL		2	-	-	2	25	-	50	075	
LLC_CC	CC10	Mastering Advanced Excel	NIL	NIL		2	-	-	2	25	-	50	075	
LLC_CC	CC11	Personal Grooming Essentials	NIL	NIL		2	-	-	2	25	-	50	075	
LLC_CC	CC12	Various Music Forms	NIL	NIL		2	-	-	2	25	-	50	075	
LLC_CC	CC13	Wellness: Introduction to MOJO and Yoga												
LLC_CC	CC14	Wellness: Joy of Giving												
LLC_CC	CC15	Wellness: Sports and Hobbies												
LLC_CC	CC16	Wellness: Nutrition and Healthy Eating												
Total									**24**	**300**	**-**	**600**	**850**	

First Year B. Tech. Information Technology **Preferred Semester: II**

Course Structure and Assessment Guidelines

Vertical_Sub-Vertical	Course Code	Course Name	Required Prerequisite	Prerequisite for	KSA Mapping	Hours Per Week			Credits	Assessment Guidelines (Marks)				Preparedness for Industry-Level Certification$
						Theory	Practical	Tutorial		Total ISA	Total MSE	Total ESE	Total Marks (Passing @40%)	
BSES_BSC	BSC03	Engineering Mathematics-II	BS01	BSC05	K	3	-	-	3	20	30	50	100	
BSES_BSC	ESC01T	Engineering Graphics	NIL	PCIT03	K	2	-	-	2	15	20	40	075	
BSES_BSC	ESC01P	Engineering Graphics Lab	NIL	PCIT03	S	-	2	-	1	25	-	25	050	
BSES_ESC	ESC08	Computer Organization and Architecture	ESC04 ESC05	PCIT17	K	3	-	-	3	20	30	50	100	
SC_VSEC	VSEC02T	Object-Oriented Programming	VSEC01	PCIT01	K	2	-	-	2	15	20	40	075	
SC_VSEC	VSEC02P	Object-Oriented Programming Lab	VSEC01	PCIT01	S	-	2	-	1	25	-	25	050	
HSSM_VEC	VEC01T	Professional Skills	NIL	NIL	A	2	-	-	2	15	20	40	075	
HSSM_VEC	VEC01P	Professional Skills Lab	NIL	NIL	A	-	2	-	1	25	-	25	050	
HSSM_IKS	IKSXX*	Any HSSM_IKS course	NIL	NIL	A	2	-	-	2	25	-	50	075	
LLC_CC	CCXX*	Any LLC_CC course offered	As per list below			2	-	-	2	25	-	50	075	
Total									**19**	**210**	**120**	**395**	**675**	

*Selection based on the subset of courses made available by the Institute for the semester.

$Details regarding Industry-Level Certification(s) can be obtained from syllabus of respective course.

ISA=In Semester Assessment: This will involve evaluation based on thought provoking assignments/ experiments/ class tests/ take home tests/ open book tests/ quizzes/ certification course etc… activities which will be assigned on weekly basis during the semester.

MSE= Mid Semester Examination: This will be a proctored examination conducted in the semester. Syllabus will be based on the percentage of syllabus completed till the exam.

ESE= End Semester Examination: This examination will be conducted after the end of academic session covering 100% syllabus of the course.

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

Vertical_Sub-Vertical	Course Code	Course Name	Required Prerequisite	Prerequisite for	KSA Mapping	Hours Per Week			Credits	Assessment Guidelines (Marks)				Preparedness for Industry-Level Certification$
						Theory	Practical	Tutorial		Total ISA	Total MSE	Total ESE	Total Marks (Passing @40%)	
IKS	IKS01	Indian Traditional Knowledge System	NIL	NIL	A	2	-	-	2	25	-	50	075	
IKS	IKS02	Indian Constitution	NIL	NIL	A	2	-	-	2	25	-	50	075	
IKS	IKS03	Exploring Indian Art	NIL	NIL	A	2	-	-	2	25	-	50	075	
Total									**06**	**75**	**130**	**150**	**225**	

List of Liberal Learning_ Cocurricular Courses

Vertical_Sub-Vertical	Course Code	Course Name	Required Prerequisite	Prerequisite for	KSA Mapping	Hours Per Week			Credits	Assessment Guidelines (Marks)				Preparedness for Industry-Level Certification$
						Theory	Practical	Tutorial		Total ISA	Total MSE	Total ESE	Total Marks (Passing @40%)	
LLC_CC	CC01	Various Dance Forms	NIL	NIL	S	2	-	-	2	25	-	50	075	
LLC_CC	CC02	Corporate and Social Etiquettes	NIL	NIL	A	2	-	-	2	25	-	50	075	
LLC_CC	CC03	Global Citizenship Education	NIL	NIL	A	2	-	-	2	25	-	50	075	
LLC_CC	CC04	Wellness – Body, Mind & Spirit	NIL	NIL	K S A	2	-	-	2	25	-	25	050	
LLC_CC	CC05	IQ vs EQ	NIL	NIL	A	2	-	-	2	25	-	50	075	
LLC_CC	CC06	Nutrition and Physical Wellness	NIL	NIL	K A	2	-	-	2	25	-	25	050	
LLC_CC	CC07	Facets of Astronomy	NIL	NIL	K	2	-	-	2	25	-	50	075	
LLC_CC	CC08	Railways - Wonders of Infrastructure	NIL	NIL	K	2	-	-	2	25	-	50	075	
LLC_CC	CC09	Financial Literacy for Engineers	NIL	NIL	K	2	-	-	2	25	-	50	075	
LLC_CC	CC10	Mastering Advanced Excel	NIL	NIL	S	2	-	-	2	25	-	50	075	
LLC_CC	CC11	Personal Grooming Essentials	NIL	NIL	A	2	-	-	2	25	-	50	075	
LLC_CC	CC12	Various Music Forms	NIL	NIL	S	2	-	-	2	25	-	50	075	
Total									**24**	**300**	**-**	**600**	**850**	

Detailed Syllabus of First Year Semester-I

Course Name: Engineering Mathematics-I

Course Code: BSC12

Vertical/ Sub-Vertical: BSES_BSC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required:

Pre-requisite for: BSC03 & BSC04 (Engineering Mathematics-II), and higher-level mathematical courses.

Recommended Semester: I

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
BSC12	3	-	3	-

Assessment guidelines:

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

Engineering Mathematics-I provides a strong mathematical foundation for first-year engineering students by introducing essential concepts in complex analysis, discrete-time systems, multivariable calculus, and linear algebra. The course covers complex numbers, hyperbolic and logarithmic functions, Z-transforms, partial differentiation, matrix theory, and computational methods for solving linear systems. Emphasis is placed on developing analytical thinking, problem-solving skills, and the application of mathematical techniques to engineering and technological problems encountered across various disciplines.

Course Objectives:

- To recall and understand the fundamental concepts of complex numbers, hyperbolic functions, logarithmic functions, Z-transforms, partial differentiation, matrices, and linear systems.
- To develop proficiency in mathematical techniques used for solving engineering problems involving complex variables, discrete-time systems, and multivariable functions.
- To apply matrix methods and computational techniques for analyzing and solving systems of linear equations.
- To develop analytical skills for interpreting mathematical models and evaluating engineering systems using appropriate mathematical tools.
- To prepare learners for advanced engineering mathematics courses and their applications in various engineering domains.

Course Outcomes:

Learner will be able to:

Course Outcomes	Course Outcome Statement	Bloom's Level
CO1	Recall the definitions, properties, formulas, and theorems related to complex numbers, hyperbolic functions, logarithmic functions, Z-transforms, partial differentiation, matrices, and systems of linear equations.	Remember
CO2	Explain the concepts and underlying principles of complex numbers, hyperbolic and logarithmic functions, Z-transforms, partial differentiation, matrix operations, and linear systems.	Understand
CO3	Apply techniques of complex numbers, Z-transforms, partial differentiation, matrix methods, and computational methods to solve mathematical and engineering problems.	Apply
CO4	Analyze multivariable functions, discrete-time systems, matrix structures, and systems of linear equations using appropriate mathematical and computational techniques.	Analyze

Detailed Syllabus:

Module No.	Module Name	Content	No of Hours	CO's Mapped
1	Complex Numbers	**Contents:** De Moivre's Theorem, expansion of sinnθ and cosnθ, powers and roots of complex numbers. **Learning Objective:** Understand the use of De Moivre's Theorem and the operations on complex numbers. (CO1 to CO4) **Learning Outcomes:** A learner will be able to: 1.1 Recall De Moivres Theorem and related expansions. (CO1) 1.2 Explain power and roots of complex numbers. (CO2) 1.3 Apply De Moivres theorem to trigonometric identities. (CO3) **Self-Learning Topics**: Geometric representation of complex numbers	8	
2	Hyperbolic & Logarithmic Functions	**Contents:** Circular and hyperbolic functions, inverse functions, separation of real and imaginary parts, logarithmic functions. **Learning Objective:** Understand circular, hyperbolic and logarithmic functions for real and complex inputs. (CO1 to	7	

		CO4) **Learning Outcomes:** A learner will be able to: 2.1 Recall definition of circular and hyperbolic functions. (CO1) 2.2 Explain inverse and logarithmic functions. (CO2) 2.3 Apply separation of real/imaginary parts in problems. (CO3) 2.4 Analyze logarithm of complex numbers. (CO4) **Self-Learning Topics**: Applications of Hyperbolic Functions in Signal Processing and Communication Systems.		
3	Z Transforms	**Contents:** Z-Transform of a sequence, Properties of Z-Transform, Examples based on properties of Z-Transform, Inverse Z- Transform, Inverse Z-Transform using Binomial method and convolution theorem. **Learning Objective:** To understand the Z-transform and its properties and apply methods to compute inverse Z-transforms using binomial expansion and convolution theorem for solving discrete systems. (CO1 to CO4) **Learning Outcomes:** A learner will be able to: 3.1 Recall definition of Z-transform and its basic properties. (CO1) 3.2 Understand the significance of properties of Z-transform in discrete-time systems. (CO2) 3.3 Apply Z-transform techniques to compute inverse Z-transforms using binomial method and convolution theorem. (CO3) 3.4 Analyze inverse Z-transform computations by comparing different methods such as binomial expansion and convolution theorem. (CO4) **Self-Learning Topics**: Expansions of functions using Taylor's series.	7	
4	Partial Differentiation and Applications	**Content:** Partial derivatives (first and higher order), composite functions, maxima and minima of two-variable functions.	8	

		Learning Objective: Apply partial derivatives and Euler's theorem to understand functions of several variables. (CO1 to CO4) **Learning Outcomes:** A learner will be able to: 4.1 Recall formulae for partial derivatives. (CO1) 4.2 Understand conditions for maxima and minima of functions in two variables. (CO2) 4.3 Apply partial derivatives in multi-variable problems. (CO3) 4.4 Analyze extreme points using conditions of maxima & minima. (CO4) **Self-Learning Topics**: Euler's Theorem in two and three variables and its applications.		
5	Linear Algebra (Matrices)	**Contents:** Rank of matrix, evaluation of rank using echelon forms, reduction to normal form, PAQ forms. **Learning Objective:** To introduce the concept of rank of a matrix and various methods to compute it, and to compare these methods based on their application and interpretation. (CO1 to CO4) **Learning Outcomes:** A learner will be able to: 5.1 Recall Definition of rank of matrix. (CO1) 5.2 Understand normal and echelon form of rank of matrix. (CO2) 5.3 Compute the rank using echelon form, normal form and PAQ normal form (CO3) 5.4 Analyze inverse of a matrix using its rank (CO4) **Self-Learning Topics**: Applications of Matrix Rank in Image Processing and Network Analysis.	8	
6	Linear Systems and Computational Methods	**Contents:** System of homogeneous and non-homogeneous equations their consistency and solution. Linear Independence and Dependence of Vectors. Computational Method - LU Decomposition Method. **Learning Objective:** To develop an understanding of how matrix rank is applied to analyze and solve systems of linear	7	

		equations and understand various computational methods. (CO1 to CO4) **Learning Outcomes:** A learner will be able to: 6.1 Recall definition of solution of system of homogenous and non-homogeneous equations. (CO1) 6.2 Understand linear dependence and independence of vectors. (CO2) 6.3 Apply matrix methods to solve non-homogeneous and homogeneous linear systems. (CO3) 6.4 Analyze numerical stability & efficiency of a system using LU decomposition method. (CO4) **Self-Learning Topics**: Computational Implementation of LU Decomposition using MATLAB/Python.		
Total			45	

Textbooks:

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Reference Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44th ed. New Delhi, India: Khanna Publishers, 2017.
2. H. K. Dass and Er. Rajnish Verma, Higher Engineering Mathematics, 3rd ed. New Delhi, India: S. Chand Publishing, 2014.
3. N. P. Bali and M. Goyal, A Textbook of Engineering Mathematics, 9th ed. New Delhi, India: Laxmi Publications, 2015.
4. K. A. Stroud, Engineering Mathematics, 7th ed. London, UK: Palgrave Macmillan, 2013.
5. S. Lipschutz and M. Lipson, Schaum's Outline of Linear Algebra, 5th ed. New York, NY, USA: McGraw-Hill, 2018.
6. E. Kreyszig, Advanced Engineering Mathematics, 10th ed. Hoboken, NJ, USA: John Wiley & Sons, 2011.

Online Reference Material:

1. P. Dawkins, Complex Numbers (Algebra & Trigonometric Form, De Moivre's Theorem). Lamar University, TX, USA, 2018. [Online].
   Available: https://tutorial.math.lamar.edu/Classes/Alg/ComplexNumbers.aspx
2. P. Dawkins, Hyperbolic Functions and Logarithms. Lamar University, TX, USA, 2018. [Online]. Available: https://tutorial.math.lamar.edu/Classes/CalcII/HyperbolicFunctions.aspx
3. MIT OpenCourseWare, Multivariable Calculus (Partial Derivatives and Applications). Cambridge, MA, USA: Massachusetts Institute of Technology, 2010. [Online].
   Available: https://ocw.mit.edu/courses/18-02sc-multivariable-calculus-fall-2010/

4. MIT OpenCourseWare, Linear Algebra (Matrix Methods and Rank, Systems of Equations and LU Decomposition). Cambridge, MA, USA: Massachusetts Institute of Technology, 2005. [Online].
   Available: https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/
5. MIT OpenCourseWare, Signals and Systems (Z-Transform Concepts). Cambridge, MA, USA: Massachusetts Institute of Technology, 2011. [Online].
   Available: https://ocw.mit.edu/courses/res-6-007-signals-and-systems-spring-2011/

Course Name: Physics

Course Code: BSC09T and BSC09P

Vertical/ Sub-Vertical: BSES_BSC

K-S-A Mapping: Knowledge

Pre-requisite required: Vector calculus, differential equations, and linear algebra., Basic 12th standard Physics.

Pre-requisite for: Memory devices, Digital Circuit, Magnetism, Semiconductor devices-LED, Photocells, solar cells, Diodes and Transistors**.**

Recommended Semester: 1 and 2

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
BSC09T	2	-	2	-
BSC09P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (BSC09T)	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical (BSC09P)	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 students to the understanding of fundamental principles of Semiconductor Physics, Optics Laser, Optical Fibre, Fundamentals of Quantum Physics and their engineering applications. It also provides problem solving experience in semiconductor physics, in both the classroom and the laboratory learning environment. It will motivate the students through practical examples that demonstrates the role of physics in progress of engineering disciplines, so as to inculcate the interdisciplinary academic environment.

Course Objectives:

To impart fundamental and applied knowledge of modern physics concepts including semiconductors, wave optics, lasers, fibre optics, quantum mechanics, and sensor physics, focusing on their practical applications in engineering and technology.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Definitions: Fermi level, mobility, Hall effect, numerical aperture, de Broglie wavelength, PT100, piezoelectricity, photodiode, spontaneous emission, etc. - Equations: Schrödinger's equation, interference formulas, laser coefficients, etc.	Remembering
CO2	Working of semiconductors and optoelectronic devices - Interference and diffraction phenomena - Population inversion and LASER types - Total internal reflection, optical fibre principles - Quantum principles and wave-particle duality	Understanding
CO3	Calculate: ▸ Hall voltage, carrier mobility ▸ Fringe width, wavelength via Newton's rings/grating ▸ NA, V-number, number of fibre modes ▸ Energy levels in quantum wells ▸ Light intensity, temperature with sensors	Applying
CO4	Compare forward/reverse-biased junctions using Fermi diagrams - Interpret interference patterns for different film shapes - Differentiate LASERs based on construction and applications - Analyse phase and group velocity effects - Classify optical fibres based on mode and NA	Analysing
CO5	Assess sensor performance (accuracy, sensitivity) - Evaluate optical system (e.g., fibre link, grating resolution) - Choose appropriate LASER or optical method for given tasks - Judge experimental setup efficiency (e.g., surface flatness testing)	Evaluating

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
01	Semiconductors Physics	***Learning Objective:*** *To understand the fundamental properties of semiconductors, carrier dynamics, and working principles of optoelectronic devices. (CO1, CO2, CO3)* **Content**: Fermi level, Fermi dirac distribution, Fermi energy level in intrinsic & extrinsic semiconductors, effect of impurity concentration and temperature on fermi level, mobility, current density, Hall Effect, Fermi Level diagram for p-n junction (unbiased, forward bias, reverse bias), Semiconducting devices: LED, Solar Cell, Photo diode ***Learning Outcomes:***	6

		1.1 ***Remember****: Define and explain Fermi level and band structure. (CO1) PI 1.2.1* *1.2* ***Understand****: Explain the behavior of semiconductors under doping and temperature effects. (CO2 PI 1.2.1* *1.3* ***Apply****: Demonstrate Hall Effect and compute carrier concentration and mobility. (CO3) PI 2.4.1, 2.4.2* *1.4* ***Analyze****: Analyze the I–V characteristics of LED, solar cell, and photodiode. (CO3) PI 2.4.2* *1.5* ***Evaluate****: Evaluate the performance of semiconductor devices under varying conditions. (CO3) PI 2.4.4*	
02	Interference and Diffraction	***Learning Objective*****:** *To comprehend wave interference and diffraction principles and apply them in optical measurements and surface analysis. (CO1, CO2, CO3, CO4)* **Content**: Interference by division of amplitude, Interference in thin film of constant thickness due to reflected and transmitted light, Wedge shaped film, Newton's rings, Applications of interference – Determination of thickness of very thin wire or foil, refractive index of liquid, wavelength of incident light, testing of surface flatness, Anti-reflecting films and highly reflecting film. Diffraction: Fraunhofer diffraction at single slit, Diffraction Grating, resolving power of a grating, Determination of wavelength of light using plane transmission grating. ***Learning Outcomes:*** *2.1* ***Remember****: Explain interference by thin films and diffraction grating theory. (CO1) PI 1.2.1* *2.2* ***Understand****: Interpret Newton's rings and wedge film patterns. (CO2) PI- 4.1.2 |* *2.3* ***Apply****: Perform calculations for wavelength, refractive index, and surface flatness. (CO3) PI-4.1.2, 4.6.4* *2.4* ***Analyze****: Compare and analyze different interference and diffraction configurations. (CO4) PI-4.6.4* *2.5* ***Evaluate****: Evaluate the accuracy of experimental optical techniques. (CO4) PI-4.6.2, 4.6.4*	6

03	LASER	***Learning Objective*:** *To learn the physics of LASER action, types of LASERs, and their practical applications in optics and imaging. (CO1, CO2, CO3, CO4)* **Content**: Spontaneous emission and stimulated emission, metastable state, Population inversion, types of pumping, resonant cavity, Einstein's equations, Helium Neon LASER, Nd-YAG LASER, Semiconductor LASER, Applications of LASER- Holography ***Learning Outcomes:*** 1. ***Remember**: Explain spontaneous and stimulated emission. (CO1) PI- 1.3.1* 2. ***Understand**: Describe population inversion, pumping types, and resonant cavities. (CO2) PI-1.3.1* 3. ***Apply**: Perform LASER-based experiments and explain holography applications. (CO3) PI-5.2.2* 4. ***Analysis**: Compare construction and applications of different LASER types. (CO4)-PI-5.2.2.* 5. ***Evaluation**: Evaluate the effectiveness of LASERs for specific applications. (CO4) PI- 5.2.2*	4
04	Fibre Optics	***Learning Objective:** To understand the principles of light propagation in optical fibres and their use in communication systems. (CO1, CO2, CO3)* **Content**: Numerical Aperture for step index fiber; critical angle; angle of acceptance; V number; number of modes of propagation; types of optical fibres. Application: Fiber optic communication system. ***Learning Outcomes:*** *4.1 **Remember**: Define numerical aperture, critical angle, and V-number. (CO1) PI-1.2.1* *4.2 **Understand**: Describe propagation of light and fibre modes. (CO2) PI-1.2.1* *4.3 **Apply**: Calculate NA, V-number, and number of propagation modes. (CO3) PI- 2.4.1* *4.4 **Analyze**: Differentiate types of optical fibres and their communication roles. (CO4) PI-2.4.2* *4.5 **Evaluate**: Assess suitability of fibre optics in various systems. (CO4) PI-2.4.4*	4

05	Quantum Physics	***Learning Objective*:** *To grasp the core concepts of quantum mechanics, including matter waves, uncertainty, and quantum confinement. (CO1, CO2, CO3, CO5)* **Content**: De Broglie hypothesis of matter waves; properties of matter waves; wave packet, phase velocity and group velocity; Wave function; Physical interpretation of wave function; Heisenberg uncertainty principle; nonexistence of electron in nucleus; Schrodinger's time dependent wave equation; time independent wave equation; Particle trapped in one dimensional infinite potential well. ***Learning Outcomes:*** *5.1* ***Remember****: Recall de Broglie hypothesis and Heisenberg's uncertainty principle. (CO1) PI- 1.2.1* *5.2* ***Understand****: Explain wave-particle duality and Schrödinger's wave equations. (CO2) PI- 1.2.1* *5.3* ***Apply****: Solve Schrödinger's equation for a 1D potential well. (CO3) PI- 2.4.1* *5.4* ***Analyze****: Interpret wave functions and energy level diagrams. (CO4) PI- 2.4.2* *5.5* ***Evaluate****: Evaluate the quantum mechanical models for their physical relevance. (CO5) PI- 2.4.4*	6

06	Physics of Sensors	***Learning Objective*:** *To learn the working principles of resistive, piezoelectric, and optical sensors and their calibration techniques. (CO1, CO2, CO4)* **Content**: Resistive sensors: Temperature measurement: PT100 construction, calibration, Piezoelectric transducers: Concept of piezoelectricity, use of piezoelectric transducer as ultrasonic generator and application of ultrasonic transducer for distance measurement. Optical sensor: Photodiode, construction and use of photodiode as ambient light measurement and flux. ***Learning Outcomes:*** *6.1* ***Remember****: Identify types and working principles of PT100, piezoelectric, and photodiode sensors. (CO1) PI- 1.4.1* *6.2* ***Understand****: Explain sensor calibration and configuration techniques. (CO2) PI- 1.4.1* *6.3* ***Apply****: Operate and test sensors in practical settings. (CO3) PI-5.2.2* *6.4* ***Analyze****: Analyze sensor outputs and identify limitations. (CO4) PI-5.2.2*	4

		6.5 ***Evaluate****: Evaluate sensors for specific applications based on sensitivity and accuracy. (CO4) PI- 5.3.2*	
Total			**30**

Suggested List of Practical:

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:* *Analyse 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:* *Analyse the electrical behaviour 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:* *Analyse the behaviour 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-1.2.1: Apply laws of natural science

P.I-1.3.1: Apply engineering fundamentals

P.I-2.4.1 – 2.4.4: Apply mathematics, analyze results, conclude

P.I-4.1.2, 4.6.2, 4.6.4: Design and analyze experiments

P.I-5.2.2: Use discipline-specific tools

Mapping of Course Outcomes with Learning Outcomes:

	Mapped to Learning Outcomes
CO1	1.1, 2.1 ,3.1, 4.1, 5.1, 6.1
CO2	1.2, 2.2, 3.2, 4.2, 5.2, 6.2
CO3	1.3, 1.4, 1.5, 2.3, 3.3, 4.3, 5.3, 6.3
CO4	2.4, 2.5, 3.4, 3.5, 4.4, 4.5, 5.4, 6.4, 6.5
CO5	5.5

Mapping of Course Outcomes with Programme Outcomes:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO7**	**PO8**	**PO9**	**P010**	**PO11**	**PO12**
CO1	4/48	-	-	-	-	-	-	-	-	-	-
CO2	3/48	-	-	-	-	-	-	-	-	-	-
CO3	2/48	-	-	-	-	-	-	-	-	-	-
CO4	2/48	-	-	-	-	-	-	-	-	-	-
CO5	1/48	-	-	-	-	-	-	-	-	-	-

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 explain Fermi level behavior, analyze semiconductor properties, and describe the operation of devices like LEDs, solar cells, and photodiodes	1.1-Define and explain Fermi level and band structure.	,MSE
	1.2 Analyze doping effects and carrier mobility.	ISA
	1.3 Demonstrate Hall effect setup and data analysis.	MS
	1.4 Explain LED/solar cell operation with diagrams.	ESE
	1.5 Perform lab experiments on diode characteristics	LAB
LO2: ***Learning Objective:*** *To comprehend wave interference and diffraction principles and apply them in optical measurements and surface analysis.*	2.1-Explain interference by thin films.	ESE
	2.2- Analyze Newton's rings and wedge film results.	ISA
	2.3- Describe diffraction grating theory.	MSE
	2.4- Calculate wavelength, thickness, or refractive index.	MSE
	2.5 - Perform Newton's ring and grating experiments.	LAB
LO3: ***Learning Objective:*** *To learn the physics of LASER action, types of LASERs, and their practical applications in optics and imaging.*	3.1- Explain spontaneous/stimulated emission.	MSE
	3.2- Compare types of lasers: HeNe, Nd:YAG, semiconductor.	ISA
	3.3 - Explain population inversion and pumping methods.	MSE
	3.4- Apply LASER principles in holography discussion.	ESE
	3.5 - Perform LASER-based experiments (divergence, grating).	LAB
LO4 ***Learning Objective:*** *To understand the principles of light propagation in optical fibres and their use in communication systems*	4.1- Calculate numerical aperture, V-number, acceptance angle.	MSE
	4.2- Explain light propagation and modes in fibres.	ESE
	4.3- Classify step-index vs graded-index fibres.	MSE
	4.4- Describe fibre communication block diagram.	ISA
	4.5- Perform NA and fibre optic demo.	LAB
LO5: ***Learning Objective:*** *To grasp the core concepts of quantum mechanics, including matter waves, uncertainty, and quantum confinement.*	5.1- Explain de Broglie hypothesis and wave-particle duality.	MSE
	5.2- Apply Schrödinger's equation to particle in a box.	ESE
	5.3- Use Heisenberg's principle in atomic models.	ISA

	5.4- Plot and interpret wave functions and energy levels.	MSE
	5.5- Conduct lab on Planck's constant or photoelectric effect.	LAB
LO6: ***Learning Objective:*** *To learn the working principles of resistive, piezoelectric, and optical sensors and their calibration techniques*	6.1- Explain PT100, piezoelectric and photodiode sensors.	ESE
	6.2- Demonstrate calibration and operation principles.	LAB
	6.3- Analyse output and measurement accuracy.	ISA
	6.4- Discuss sensor suitability for different applications.	MSE
	6.5- Perform lab on PT100, photodiode, piezo sensors	LAB

Tools/ Technologies/ Programming Languages learnt:

1. Semiconductor Physics: Semiconductor Kits
2. Interference and Diffraction: Optical Bench Setup (Newton's Rings, Wedge Film), Diffraction Grating Setup + Spectrometer
3. LASER: He-Ne Laser
4. Fibre Optics: Fibre Optic Trainer Kit, NA Measurement Setup
5. Quantum Physics: Mathematica / MATLAB / Python (NumPy)
6. Physics of Sensors: Ultrasonic Distance Sensors, Photodiode Circuits + Lux Meters, Arduino

Textbooks:

1. Engineering Physics, Kshirsagar and Avdhanulu, S-Chand Publications.
2. Engineering Physics, Gaur and Gupta, Dhanpat Rai Publications.
3. Engineering Physics, Rajendra Kumar, Tata McGraw Hill.
4. A Textbook of Engineering Physics, S. O. Pillai, New Age International Publishers.

Reference Books:

1. Solid State Electronic Devices- B. G. Streetman, Prentice Hall Publisher, B. G. Streetman, Prenticee Hall.
2. Modern Engineering Physics, Vasudeva, S. Chand.
3. Optics by Brij Lal and Subramaniam-S. Chand.
4. Concepts of Modern Physics, Arther Beiser, Tata McGraw Hill.
5. A Textbook of Engineering Physics, S. O. Pillai, New Age International Publishers.
6. Principles of Quantum Mechanics, R Shankar, John Wiley & Sons.

Related/ Equivalent MOOC and Associated Certification:

5. Semiconductor Devices by Columbia University
    - Platform: Coursera
    - Link: https://www.ee.columbia.edu/content/semiconductor-device-physics

6. Applied Optics By Prof. Akhilesh Kumar Mishra | IIT Roorkee

- Platform: SWAYAM
- Link: https://onlinecourses.nptel.ac.in/noc23_ph41/preview
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7. Laser and Photonics by University of Colorado Boulder
    - Platform: Coursera
    - Link: https://www.colorado.edu/ecee/academics/online-programs/ms-ee-coursera/curriculum/photonics-and-optics

8. Fiber-Optic Communication Systems and Techniques, IIT Kanpur by Dr. Pradeep Kumar K
    - Platform: NPTEL (National Programme on Technology Enhanced Learning)
    - Link: https://nptel.ac.in/courses/108104113

9. Quantum Mechanics by University
    - Platform: Coursera
    - Link: https://www.coursera.org/learn/quantum-mechanics

10. Introduction to Sensors by University of Colorado Boulder
    - Platform: Coursera
    - Link: https://www.coursera.org/learn/sensors-circuit-interface

Course Name: Fundamentals of Microprocessor and Assembly Language

Course Code: ESC11T and ESC11P

Vertical/ Sub-Vertical: PC_PCC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: NIL

Pre-requisite for: Microcontrollers and Applications, Computer Networks

Recommended Semester: 1

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
ESC11T	2	-	2	-
ESC11P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (ESC11T)	15	20	40	75
Practical (ESC11P)	25	-	25	50

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 students to the basic concepts of computer organization, memory systems, and microprocessor architecture, along with an understanding of input/output devices, buses, and peripheral interfacing. It focuses on the architecture and operation of the Intel 8086 microprocessor, including segmentation and pipelining concepts, its addressing modes, instruction set, assembler directives, and interrupt structure. The accompanying laboratory course provides hands-on experience in 8086 assembly language programming, enabling learners to understand low-level operations such as arithmetic processing, data conversion, memory manipulation, and string operations using simulation tools. Together, the theory and laboratory components build a strong foundation for advanced studies in embedded systems and computer architecture.

Course Objectives:

1. To understand the basic organisation of computer systems, including functional units, memory hierarchy, input/output devices, buses, and peripheral devices.

2. To trace the evolution of Intel microprocessors and compare the features of different processor architectures, including the internal architecture of the 8086 (Bus Interface Unit, Execution Unit, segmentation and pipelined operation).

3. To apply knowledge of 8086 addressing modes, instruction sets, and assembler directives to interpret and construct assembly-level instructions.

4. To analyse the interrupt structure of the 8086 microprocessor, including types of interrupts, the interrupt vector table, and interrupt service routines.

5. To develop, execute and debug 8086 assembly language programs - using simulation/assembler tools - for arithmetic, logical, data-conversion, memory-manipulation and string-processing tasks.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Identify and explain the functional components of a computer system, memory organization, I/O devices, buses, and peripheral devices.	Understanding
CO2	Discuss the historical development of microprocessors and differentiate between major processor architectures based on their features.	Analysing
CO3	Illustrate the 8086 architecture and interpret the roles of its major units, address formation, and segmentation scheme.	Applying
CO4	Use 8086 addressing modes, instruction sets, and assembler directives correctly in assembly language problem-solving.	Applying
CO5	Examine and implement interrupt handling concepts in 8086, including interrupt vector table usage and interrupt service routine design.	Applying
CO6	Write and debug basic 8086 assembly language programs involving data transfer, arithmetic, logical operations, branching, and looping.	Evaluating

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours

01	Basics of Computer System	***Learning Objective:*** *To understand the basic organisation of a computer system, its memory hierarchy, I/O devices, buses, and peripheral devices. (CO1)* **Content:** Basic organization of computers, Functional block diagram of computer system, Memory hierarchy, Classification of primary and secondary memory, Common I/O device types and characteristics, Introduction to buses, Introduction to peripheral devices of computer systems. ***Learning Outcomes:*** **1.1** ***Understand:*** Identify and list the functional units of a computer system (CPU, memory, I/O, buses). (CO1) PI 1.1.1 **1.2** ***Analyze:*** Explain memory hierarchy, I/O device types and peripheral organisation. (CO1) PI 1.2.1	4
02	Evolution of Microprocessors	***Learning Objective:*** *To trace the evolution of Intel microprocessors and compare the features of different processor architectures. (CO2)* **Content:** Evolution of INTEL microprocessors, Features of various processor architectures. Self-Learning Topics: Registers as binary storage elements and their different uses in microprocessor organization. ***Learning Outcomes:*** **2.1** ***Understand:*** Recall the historical evolution of Intel microprocessors. (CO2) PI 2.1.1 **2.2** ***Analyze:*** Explain the use of registers as binary storage elements in microprocessor organisation. (CO2) PI 2.2.1 **2.3** ***Apply:*** Apply comparison criteria to evaluate features of different processor architectures. (CO2) PI 2.3.1 **2.4** ***Analyze:*** Differentiate between major processor architectures based on their features. (CO2) PI 2.2.2	4
03	8086 Architecture	***Learning Objective:*** *To describe the internal architecture of the 8086 microprocessor and its address formation scheme. (CO3)* **Content:** Bus Interface Unit, Execution unit, Pipelined Architecture, Concept of Segmentation, Physical Address, Logical Address. ***Learning Outcomes:*** **3.1** ***Understand:*** Identify the Bus Interface	6

		Unit and Execution Unit of the 8086. (CO3) PI 3.1.1 **3.2** ***Analyze:*** Explain the concept of segmentation and pipelined architecture of the 8086. (CO3) PI 3.2.1 **3.3** ***Apply:*** Compute the physical address from a given segment and offset (logical address). (CO3) PI 3.3.1	
04	8086 Addressing Modes & Instruction Set	***Learning Objective:*** *To apply knowledge of 8086 addressing modes, instruction sets, and assembler directives to interpret and construct assembly-level instructions. (CO4)* **Content:** Addressing Modes, Instruction Set, Assembler Directives. ***Learning Outcomes:*** **4.1** ***Understand:*** List the addressing modes and assembler directives of the 8086. (CO4) PI 4.1.1 **4.2** ***Analyze:*** Explain the purpose of various 8086 instructions and assembler directives. (CO4) PI 4.2.1 **4.3** ***Apply:*** Apply appropriate addressing modes and instructions to interpret and construct assembly-level statements. (CO4) PI 4.4.1	6
05	8086 Interrupt Structure	***Learning Objective:*** *To analyse the interrupt structure of the 8086 microprocessor, including interrupt types, the interrupt vector table, and interrupt service routines. (CO5)* **Content:** Types of Interrupts, Interrupt Structure, Interrupt Vector Table, Interrupt Service Routine. ***Learning Outcomes:*** **5.1** ***Understand:*** List the types of interrupts supported by the 8086. (CO5) PI 5.1.1 **5.2** ***Analyze:*** Explain the organisation of the Interrupt Vector Table. (CO5) PI 5.2.1 **5.3** ***Apply:*** Design an interrupt service routine for a given interrupt. (CO5) PI 5.5.1	4
06	Assembly Language Programming	***Learning Objective:*** *To develop assembly language programs using the 8086 microprocessor by employing proper program structure, data handling, instructions, flags, and control flow mechanisms. (CO6)* **Content:** Assembly Language Programming with 8086, Program Structure and data, Core Instructions and Flags, Control Flow.	6

		Learning Outcomes: **6.1** ***Understand:*** Recall the basic structure of an 8086 assembly language program. (CO6) PI 6.1.1 **6.2** ***Analyze:*** Explain the role of flags and control-flow instructions in an ALP. (CO6) PI 6.2.1 **6.3** ***Apply:*** Write 8086 ALPs using data transfer, arithmetic and logical instructions. (CO6) PI 6.4.1 **6.4** ***Apply:*** Analyse and trace the logic of branching/looping constructs in an ALP. (CO6) PI 6.5.1 **6.5** ***Evaluate:*** Debug and validate an 8086 assembly program for correctness. (CO6) PI 6.6.1	
		Total	**30**

Suggested List of Practical:

Sr No.	Suggested Topic(s)
1.	Study of tools used for programming of microprocessors (assembler/simulator set-up). **Learning Outcome:** A learner will be able to: 1.3 Understand: Identify and set up the simulation/assembler tools used for 8086 programming. CO1 PI-1.1.2
2.	Develop Assembly Language Program using 8086 microprocessor for addition and subtraction of 16/32-bit numbers. **Learning Outcome:** A learner will be able to: 6.6 Apply: Develop and execute an ALP for addition/subtraction of 16/32-bit numbers. CO6 PI-6.3.1
3.	Develop Assembly Language Program using 8086 microprocessor for 16-bit multiplication and 16-bit division. **Learning Outcome:** A learner will be able to: 6.7 Apply: Develop and execute an ALP for 16-bit multiplication and division. CO6 PI-6.3.2
4.	Implementation of ALP to find the smallest and largest element in a given array. Learning Outcome: A learner will be able to: 6.8 Apply: Implement an ALP to find the smallest and largest element in an array. CO6 PI-6.3.3

5.	Develop an 8086 Assembly Language Program for conversions - (a) Packed to Unpacked BCD (b) Unpacked to Packed BCD (c) Packed BCD to ASCII. Learning Outcome: A learner will be able to: 4.4 Apply: Implement an ALP for BCD/ASCII data conversions. CO4 PI-4.3.1
6.	Implementation of memory block transfer with and without use of string instruction. Learning Outcome: A learner will be able to: 4.5 Apply: Implement memory block transfer with and without string instructions. CO4 PI-4.6.1
7.	Implementation of memory block exchange with and without use of string instruction. Learning Outcome: A learner will be able to: 4.6 Apply: Implement memory block exchange with and without string instructions. CO4 PI-4.6.2
8.	8086 Assembly Language Program to count odd and even numbers from the given block of numbers. Learning Outcome: A learner will be able to: 6.9 Apply: Implement an ALP to count odd and even numbers in a given block of numbers. CO6 PI-6.3.4
9.	Implementation of ALP to sort an array in ascending and descending order. Learning Outcome: A learner will be able to: 6.10 Analyze: Implement and analyse an ALP to sort an array in ascending/descending order. CO6 PI-6.4.2
10.	Implementation of ALP to reverse the user-entered string. Learning Outcome: A learner will be able to: 6.11 Apply: Implement an ALP to reverse a user-entered string. CO6 PI-6.3.5
11.	Implementation of ALP to check if the user-entered string is a palindrome. Learning Outcome: A learner will be able to: 6.12 Analyze: Implement and analyse an ALP to check whether a string is a palindrome. CO6 PI-6.2.2
12.	Implementation of ALP to calculate the area of a circle. Learning Outcome: A learner will be able to: 4.7 Apply: Implement an ALP to calculate the area of a circle. CO4 PI-4.3.2

Performance Indicators:

PI 1.1.1: Identify and list the functional units of a computer system (CPU, memory, I/O, buses). (Remember)

PI 1.2.1: Explain memory hierarchy, I/O device types and peripheral organisation. (Understand)

PI 2.1.1: Recall the historical evolution of Intel microprocessors. (Remember)

PI 2.2.1: Explain the use of registers as binary storage elements in microprocessor organisation. (Understand)

PI 2.3.1: Apply comparison criteria to evaluate features of different processor architectures. (Apply)

PI 2.2.2: Differentiate between major processor architectures based on their features. (Analyze)

PI 3.1.1: Identify the Bus Interface Unit and Execution Unit of the 8086. (Remember)

PI 3.2.1: Explain the concept of segmentation and pipelined architecture of the 8086. (Understand)

PI 3.3.1: Compute the physical address from a given segment and offset. (Apply)

PI 4.1.1: List the addressing modes and assembler directives of the 8086. (Remember)

PI 4.2.1: Explain the purpose of various 8086 instructions and assembler directives. (Understand)

PI 4.4.1: Apply appropriate addressing modes and instructions to interpret and construct assembly-level statements. (Apply)

PI 5.1.1: List the types of interrupts supported by the 8086. (Remember)

PI 5.2.1: Explain the organisation of the Interrupt Vector Table. (Understand)

PI 5.5.1: Design an interrupt service routine for a given interrupt. (Apply)

PI 6.1.1: Recall the basic structure of an 8086 assembly language program. (Remember)

PI 6.2.1: Explain the role of flags and control-flow instructions in an ALP. (Understand)

PI 6.4.1: Write 8086 ALPs using data transfer, arithmetic and logical instructions. (Apply)

PI 6.5.1: Analyse and trace the logic of branching/looping constructs in an ALP. (Analyze)

PI 6.6.1: Debug and validate an 8086 assembly program for correctness. (Evaluate)

PI 1.1.2: Identify and set up the simulation/assembler tools used for 8086 programming. (Remember)

PI 6.3.1: Develop and execute an ALP for addition/subtraction of 16/32-bit numbers. (Apply)

PI 6.3.2: Develop and execute an ALP for 16-bit multiplication and division. (Apply)

PI 6.3.3: Implement an ALP to find the smallest and largest element in an array. (Apply)

PI 4.3.1: Implement an ALP for BCD/ASCII data conversions. (Apply)

PI 4.6.1: Implement memory block transfer with and without string instructions. (Apply)

PI 4.6.2: Implement memory block exchange with and without string instructions. (Apply)

PI 6.3.4: Implement an ALP to count odd and even numbers in a given block of numbers. (Apply)

PI 6.4.2: Implement and analyse an ALP to sort an array in ascending/descending order. (Analyze)

PI 6.3.5: Implement an ALP to reverse a user-entered string. (Apply)

PI 6.2.2: Implement and analyse an ALP to check whether a string is a palindrome. (Analyze)

PI 4.3.2: Implement an ALP to calculate the area of a circle. (Apply)

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, 4.3, 4.4, 4.5, 4.6, 4.7
CO5	5.1, 5.2, 5.3
CO6	6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.10, 6.11, 6.12

Mapping of Course Outcomes with Programme Outcomes:

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO7**	**PO8**	**PO9**	**P010**	**PO11**	**PO12**
CO1	2/32	-	-	-	1/32	-	-	-	-	-	-
CO2	2/32	2/32	-	-	-	-	-	-	-	-	-
CO3	2/32	1/32	-	-	-	-	-	-	-	-	-
CO4	2/32	-	2/32	1/32	-	-	-	-	-	-	-
CO5	2/32	-	1/32	-	-	-	-	-	-	-	-
CO6	2/32	3/32	3/32	4/32	-	-	-	-	-	-	-

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria:** The Learner can:	**Evaluated under ISA/MSE/ESE/LAB**
LO1: Learning Objective: To understand the basic organisation of a computer system, its memory hierarchy, I/O devices, buses, and peripheral devices.	1.1 - Identify and list the functional units of a computer system (CPU, memory, I/O, buses).	ISA
	1.2 - Explain memory hierarchy, I/O device types and peripheral organisation.	MSE
	1.3 - Identify and set up the simulation/assembler tools used for 8086 programming.	LAB
LO2: Learning Objective: To trace the evolution of Intel microprocessors and compare the features of different processor architectures.	2.1 - Recall the historical evolution of Intel microprocessors.	ISA
	2.2 - Explain the use of registers as binary storage elements in microprocessor organisation.	MSE
	2.3 - Apply comparison criteria to evaluate features of different processor architectures.	MSE
	2.4 - Differentiate between major processor architectures based on their features.	ESE
LO3: Learning Objective: To describe the internal architecture of the 8086 microprocessor and its address formation scheme.	3.1 - Identify the Bus Interface Unit and Execution Unit of the 8086.	ISA
	3.2 - Explain the concept of segmentation and pipelined architecture of the 8086.	MSE
	3.3 - Compute the physical address from a given segment and offset.	ESE
LO4: Learning Objective: To apply knowledge of 8086 addressing modes, instruction sets, and assembler directives to interpret and construct assembly-level instructions.	4.1 - List the addressing modes and assembler directives of the 8086.	ISA
	4.2 - Explain the purpose of various 8086 instructions and assembler directives.	MSE
	4.3 - Apply appropriate addressing modes and instructions to interpret/construct assembly statements.	ESE
	4.4 - Implement an ALP for BCD/ASCII data conversions.	LAB
	4.5 - Implement memory block transfer with and without string instructions.	LAB
	4.6 - Implement memory block exchange with and without string instructions.	LAB

	4.7 - Implement an ALP to calculate the area of a circle.	LAB
LO5: Learning Objective: To analyse the interrupt structure of the 8086 microprocessor, including interrupt types, the interrupt vector table, and interrupt service routines.	5.1 - List the types of interrupts supported by the 8086.	ISA
	5.2 - Explain the organisation of the Interrupt Vector Table.	MSE
	5.3 - Design an interrupt service routine for a given interrupt.	ESE
LO6: Learning Objective: To develop assembly language programs using the 8086 microprocessor by employing proper program structure, data handling, instructions, flags, and control flow mechanisms.	6.1 - Recall the basic structure of an 8086 assembly language program.	ISA
	6.2 - Explain the role of flags and control-flow instructions in an ALP.	MSE
	6.3 - Write 8086 ALPs using data transfer, arithmetic and logical instructions.	MSE
	6.4 - Analyse and trace the logic of branching/looping constructs in an ALP.	ESE
	6.5 - Debug and validate an 8086 assembly program for correctness.	ESE
	6.6 - Develop and execute an ALP for addition/subtraction of 16/32-bit numbers.	LAB
	6.7 - Develop and execute an ALP for 16-bit multiplication and division.	LAB
	6.8 - Implement an ALP to find the smallest and largest element in an array.	LAB
	6.9 - Implement an ALP to count odd and even numbers in a given block of numbers.	LAB
	6.10 - Implement and analyse an ALP to sort an array in ascending/descending order.	LAB
	6.11 - Implement an ALP to reverse a user-entered string.	LAB
	6.12 - Implement and analyse an ALP to check whether a string is a palindrome.	LAB

Tools/ Technologies/ Programming Languages learnt:

1. 8086 Assembly Language (ALP) programming
2. 8086/8085 Simulator/Emulator (e.g., EMU8086, MASM/TASM Assembler)
3. DOS/BIOS interrupt utilities and command-line debugger (DEBUG.exe)
4. Microprocessor trainer kit / 8086 development kit

5. Basic computer organisation and memory-interfacing hardware demonstration setups

Textbooks:

1. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram International Publishing.

2. A.K. Ray & K.M. Bhurchandi, Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing, Tata McGraw-Hill Education.

3. Douglas V. Hall, Microprocessors and Interfacing: Programming and Hardware, Tata McGraw-Hill Education.

Reference Books:

1. Barry B. Brey, The Intel Microprocessors: Architecture, Programming and Interfacing, Pearson Education.

2. Walter A. Triebel & Avtar Singh, The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware and Applications, Pearson Education.

3. Yu-Cheng Liu & Glenn A. Gibson, Microcomputer Systems: The 8086/8088 Family - Architecture, Programming and Design, Prentice Hall.

Related/ Equivalent MOOC and Associated Certification:

1. Microprocessors and Microcontrollers by Prof. Santanu Chattopadhyay, IIT Kharagpur
- Platform: NPTEL / SWAYAM
- Link: https://nptel.ac.in/courses/108105102

2. Microprocessors and Interfacing by Prof. Shaik Rafi Ahamed, IIT Guwahati
- Platform: NPTEL / SWAYAM
- Link: https://nptel.ac.in/courses/108103157

3. Microprocessors and Microcontrollers/Interfacing with 8086 by Prof. M. Krishna Kumar, IISc Bangalore
- Platform: NPTEL / SWAYAM
- Link: https://nptel.ac.in/courses/106108100

4. Tutorials on 8085/8086, memory and I/O interfacing
- Platform: GeeksforGeeks
- Link: https://www.geeksforgeeks.org/computer-organization-architecture/physical-memory-organisation-of-8086/

Course Name: Digital Logic Circuits

Course Code: ESC13T and ESC13P

Vertical/ Sub-Vertical: BSES_ESC

K-S-A Mapping: Knowledge

Pre-requisite required: Nil

Pre-requisite for: COA,Sem 2

Recommended Semester: 1

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Practical	Theory	Practical
ESC13T	2	-	2	-
ESC13P	-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory ESC13T	15 (~20%)	20 (~30%)	40 (~50%)	75 (100%)
Practical ESC13P	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 the fundamentals of digital electronics, including number systems, logic gates, Boolean algebra, and logic simplification techniques. It enables learners to design combinational circuits and understand the operation of memory elements, counters, and registers, providing a foundation for digital system analysis and implementation

Course Objectives:

- To understand number systems and codes.
- To understand Boolean algebra and logic simplification techniques.
- To understand logic gates and digital circuits.
- To implement combinational logic circuits.
- To understand memory elements and flip-flops.
- To analyze sequential logic circuits using counters and registers.

Course Outcomes:

Learner will be able to:

Course Outcome	Course Outcome Statement	Bloom's Level
CO1	Describe number systems, codes, and digital logic fundamentals.	Understanding
CO2	Apply Boolean algebra and K-Map techniques for logic simplification.	Applying
CO3	Design combinational logic circuits using logic gates.	Creating
CO4	Design combinational circuits using multiplexers, decoders, and encoders.	Creating
CO5	Analyze the operation of flip-flops and memory elements.	Analysing
CO6	Compare synchronous and asynchronous sequential circuits	Analysing

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
01	Number Systems and Codes	***Learning Objective:*** *To understand number systems, codes, and digital mathematical operations (CO1)* **Content**: Review of Binary, Octal and Hexadecimal Number Systems, their inter-conversion, Binary code, Gray code and BCD code., Binary Arithmetic, Addition, Subtraction using 1's and 2'sComplement, ***Learning Outcomes:*** *A learner will be able to:* *1.1 Recall of Binary, Octal and Hexadecimal Number Systems, their inter-conversion (P.I.- 1.3.1) (CO1)* *1.2 Convert numbers between decimal, binary, octal, and hexadecimal number systems. (P.I. – 1.3.3 and 1.4.2) (CO1)* *1.3 Explain the concept of Binary code, Gray code and BCD code (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO1)* *1.4 Solve the numerical for Binary Arithmetic, Addition, Subtraction using 1's and 2'sComplement (P.I.- 2.1.3,2.2.3) (CO1)*	4
02	Logic Gates and Boolean Algebra	***Learning Objective*****:** *To understand the operations of logic gates, apply Boolean algebra principles to realize digital logic circuits using basic and universal gates and to develop ability to reduce the given expression using K-Maps. (CO2)*	6

		Content: Analog and Digital signals, Digital logic gates, Universal gates, Realization using NAND and NOR gates, Boolean Algebra, De Morgan's Theorem SOP and POS representation, K-Map up to four variables ***Learning Outcomes:*** *A learner will be able to:* *2.1 Define Analog and Digital signals, Logic levels and Difference between both the signals (P.I. 1.3.1) (CO2)* *2.2 Discuss operations of Digital logic gates, Universal gates, De Morgan's Theorem (P.I. 1.3.2) (CO2)* *2.3 Apply concepts of Boolean algebra to reduce the given expression. (P.I. - 2.1.3,2.2.3 ,3.2.2, 5.1.3,5.2.3) (CO2)* *2.4 Understand the concept of SOP and POS Expression (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO2)* *2.5 Apply K-Map up to four variables for minimization of logic expressions (P.I. - 2.1.3,2.2.3 ,3.2.2, 5.1.3,5.2.3) (CO2)*	
03	Combinational Logic Design using Gates	***Learning Objective:*** *To develop the ability to design and analyze fundamental combinational circuits such as adders, subtractors and comparators (CO3)* **Content**: Arithmetic Circuits: Half adder, Full adder, Carry Look ahead adder, Half Subtractor, Full Subtractor, and Comparator. ***Learning Outcomes:*** *A learner will be able to:* *3.1 Understand the operation of Half and Full Adders, Half and full Subtractors, Comparators (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO3)* *3.2 Design Arithmetic Circuits such as Half adder, Full adder, Half Subtractor, Full Subtractor and Magnitude comparators using logic gates (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO2, CO3).*	4
04	Combinational Logic Design using ICs	***Learning Objective:*** *To develop the ability to design and analyze combinational circuits using IC'S such as* Multiplexer and De-Multiplexer, encoders and decoders (CO4) **Content:** Multiplexer and De-Multiplexer, Multiplexer operations, cascading of Multiplexer, Boolean function implementation using MUX, DEMUX, Encoder and Decoder, Concept of Tri-state Logic. ***Learning Outcomes:***	6

		A learner will be able to: *4.1 Understand Multiplexer operations, cascading of Multiplexer, Encoder and Decoder (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO4)* *4.2 Apply the concepts for Boolean function implementation using MUX and DEMUX and logic gates (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO4)* *4.3 Design combinational logic using IC's using (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO4)*	
05	Basics of Memory Elements	***Learning Objective:*** *To understand the operation and characteristics of various flip-flops and conversion of Flip flops (CO5).* **Content:** Introduction to Flip flops: RS, JK, Master slave flip flops; T & D flip flops with various triggering methods, Characteristic table, Excitation table, state transition diagram, Conversion of flip flops. ***Learning Outcomes:*** *A learner will be able to:* *5.1 Understand Flip flops: RS, JK, Master slave flip flops; T & D flip flops with various triggering methods (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO5)* *5.2 Design various flip flops by applying conversions from one flip flop to the other (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO5)*	4
06	Sequential Logic Design	***Learning Objective:*** *To understand the operation and characteristics of shift registers, and counters, and to analyze and design various types of counters. (CO6).* **Content:** Asynchronous and Synchronous counters with State transition diagram, Up/Down, MOD N Counter, Registers: SISO, SIPO, PISO, PIPO, Universal Shift Register ***Learning Outcomes:*** *A learner will be able to:* *6.1 Explain Registers: SISO, SIPO, PISO, PIPO, Universal Shift Register (P.I. – 1.3.2,1.4.2 and 2.1.2) (CO6)* *6.2 Explain Asynchronous and Synchronous counters with State transition diagram, Up/Down, MOD N Counters (P.I. – 1.3.2,1.4.2 and 2.1.2) (CO6)* *6.3 Analyze and design Up/Down, MOD N Counters (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO6)*	6

Suggested List of Practical:

Sr No.	Suggested Topic(s)
1.	Verification of truth table for different logic gates. ***Learning Outcomes:*** *A learner will be able to:* *Explain the different logic gates and its implementation. (P.I. – 1.3.2,1.3.4) (CO1)*
2.	Implement all basic logic gates operation using Universal NAND and NOR Gates. ***Learning Outcomes:*** *A learner will be able to:* *Implement EX-OR operations using universal gates. (P.I. – 13.3, 1.3.4, 2.4.3) (CO1).*
3.	Design binary to gray and gray to binary code converter using logic gates. ***Learning Outcomes:*** *A learner will be able to:* *Design binary to gray and gray to binary converter using logic gates. (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO2, CO3).*
4.	Reduction of Boolean Expression using Laws and implementation using Logic gates. ***Learning Outcomes:*** *A learner will be able to:* *Simplify and implement logical expressions using Boolean algebra and logical gates. (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO2, CO3).*
5.	Design and implement Half adder and Full adder using Logic Gates. ***Learning Outcomes:*** *A learner will be able to:* *Design and Implement Half Adder and Full adder using Logic Gates. (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO2, CO3).*
6.	Design and implement Half subtractor and full subtractor using Logic Gates. ***Learning Outcomes:*** *A learner will be able to:* *Design and Implement Half adder and Full subtractor using Logic Gates. (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO2, CO3).*
7.	Design and implement 2:1 Multiplexer and Demultiplexer using Logic Gates/Multiplexer ICs. *Learning Outcomes:* *A learner will be able to:* *Design and implement 2:1 Multiplexer and Demultiplexer using Logic Gates/Multiplexer ICs. (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO4).*
8.	Verification of Truth table for Flip Flops ***Learning Outcomes:*** *A learner will be able to:* *Implement and verify truth tables of flip-flops. (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO5).*
9.	Design and simulate Mod-N counter circuit using Logic Gates and Logisim Simulator. ***Learning Outcomes:*** *A learner will be able to:* *Design and simulate Mod-N counter circuit using Logic Gates and Logisim Simulator. (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO6).*
10.	Design and implementation of various real-life applications such as washing machine, Fuel tank controller ***Learning Outcomes:*** *A learner will be able to:* *Design and implementation of various real lige applications (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO4).*

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: **Analyzing**: Deconstruct engineering scenarios to identify fundamental principles at work.

P.I.- 1.3.5: **Creating**: Design a system or solution integrating basic engineering fundamentals to meet specific requirements.

P.I.- 1.4.2: **Understanding**: Explain the functions of specialized engineering systems in the computer engineering domain.

P.I.- 1.4.3: **Applying**: Implement domain-specific tools and technologies (e.g., HDL for hardware design, Python for AI).

P.I.- 1.4.4: **Analyzing**: Compare and contrast different specialized engineering approaches for solving a given problem.

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.- 2.2.4: **Analyzing**: Evaluate various solution methodologies to determine the most effective approach for a given problem.

P.I.- 2.4.3: **Applying**: Implement the solution process using appropriate tools, software, or experimental setups.

P.I.- 3.4.2: **Understanding**: Explain how engineering principles and tools are applied during the design development process.

Mapping of Course Outcomes with Learning Outcomes:

CO	Mapped to Learning Outcomes
CO1	1.1,1.2,1.3,1.4
CO2	2.1,2.2,2.3,2.4,2.5
CO3	3.1,3.2
CO4	4.1,4.2,4.3
CO5	5.1,5.2
CO6	6.1,6.2,6.3

Mapping of Course Outcomes with Programme Outcomes:

CO	PO1	PO2	PO3	PO4	PO5	PO7	PO8	PO9	PO10	PO11	PO12
CO1	5/63	2/63	--	--	2/63	--	--	--	--	--	--
CO2	3/63	4/63	3/63	--	6/63	--	--	--	--	--	--
CO3	4/63	1/63	1/63	--	2/63	--	--	--	--	--	--
CO4	6/63	1/63	1/63	--	4/63	--	--	--	--	--	--
CO5	4/63	--	--	--	4/63	--	--	--	--	--	--
CO6	6/63	2/63	--	--	2/63	--	--	--	--	--	--

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 the definitions and characteristics of binary, octal, and hexadecimal number systems. (P.I.- 1.3.1 and 1.3.2) (CO1)*	• Define binary, Decimal, Octal, Hexadecimal number system. • Applications of number systems.	ISA MSE ESE
LO 1.2: *Convert numbers between decimal, binary, octal, and hexadecimal number systems. (P.I. – 1.3.3 and 1.4.2) (CO2)*	• Convert numbers among different number systems.	MSE ISA ESE
LO 1.3: *Explain the concept of Binary code, Gray code and BCD code (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO1)*	• Convert binary to Gray code and Gray code to binary code. conversion. • The student can identify the usage of each code in real-life applications or systems.	LAB ISA
LO 1.4: *Solve the numerical for Binary Arithmetic, Addition, Subtraction using 1's and 2'sComplement (P.I.- 2.1.3,2.2.3) (CO1)*	• The student can do binary numbers addition and subtraction. • The student can do binary numbers addition and subtraction using 1's and 2's complement methods. • The student can identify the usage of binary arithmetic real-life applications or systems.	ISA MSE ISA
LO 2.1: *Define Analog and Digital signals, Logic levels and Difference between both the signals (P.I. 1.3.1) (CO2)*	• The students can Differentiate between analog and digital signals. • The student can identify the usage/processing and applications in real-life applications or systems.	MSE ISA LAB
LO 2.2: *Discuss operations of*	• The student can Identify and verify truth	ISA

Digital logic gates, Universal gates, De Morgan's Theorem (P.I. 1.3.2) (CO2)	table of the basic and universal logic gates • The student can be able to represent basic gates using universal gates. • Students will be able to implement logical expressions using logic and universal gates.	 LAB MSE ESE
LO 2.3: *Apply concepts of Boolean algebra to reduce the given expression. (P.I. - 2.1.3,2.2.3 ,3.2.2, 5.1.3,5.2.3) (CO2)*	• student will be able simplify logical expressions using Boolean algebra and Demorgan's theorem. • Students can identify the use and applications of Boolean algebra and Demorgan's theorem in real-life applications or systems	LAB LAB ISA MSE ESE
LO 2.4: *Understand the concept of SOP and POS Expression (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO2)*	• Student will be able represent and simplify logical functions using SOP and POS forms. • Student will be able to represent SOP and POS functions using NAND-NAND and NOR- NOR realizations.	ISA MSE ESE ISA
LO 2.5: *Apply K-Map up to four variables for minimization of logic expressions (P.I. - 2.1.3,2.2.3 ,3.2.2, 5.1.3,5.2.3) (CO2)*	• Student will be able represent and simplify logical functions using SOP and POS forms. using K-Map.	ISA MSE ESE
LO 3.1 *Understand the operation of Half and Full Adders, Half and full Subtractors, Comparators (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO3)*	• Student will be able to understand operation of arithmetic circuits such as Half Adder, Full Adder, Half and full Subtractors. • Student will be able to understand operation of comparators using logic gates	ISA MSE ESE
LO 3.2: Design Arithmetic Circuits such as Half adder, Full adder, Half Subtractor, Full Subtractor and Magnitude comparators using logic gates (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO2,CO3).	• Student will be able to Design and implement arithmetic circuits such as Half Adder, Full Adder, Subtractors. • Student will be able to Design and implement comparators using logic gates	ISA MSE ESE
LO 4.1 Understand Multiplexer operations, cascading of Multiplexer, Encoder and Decoder (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO4)	• Student will be able to understand operations of multiplexers, demultiplexers, decoders, encoders, cascading of multiplexers and demultiplexers. • Student will be able to identify the use and applications of multiplexers, demultiplexers in real life systems. • Student can identify the use and applications of encoders and decoders	ISA MSE ESE

	in real life applications/systems.	
LO 4.2 Apply the concepts for Boolean function implementation using MUX and DEMUX and logic gates (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO4)	• Student will be able to apply concepts of Boolean functions implementation using multiplexers, demultiplexers,	ISA MSE ESE LAB
LO 4.3 Design combinational logic using IC's (P.I. – 1.3.3, 1.3.4, 2.4.3 and 3.4.2) (CO4)	• Student will be able to design combinational circuits implementation using IC's	ISA MSE ESE LAB
LO 5.1 Understand Flip flops: RS, JK, Master slave flip flops; T & D flip flops with various triggering methods (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO5)	• Student will be able to Describe the operation of basic flip-flops such as RS, JK, T, D, and master-slave configurations.	ISA MSE ESE
LO 5.2 Design various flip flops by applying conversions from one flip flop to the other (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO5)	• Student will be able to Compare and perform conversion between different types of flip-flops and explain and distinguish between types of triggering methods (edge-triggered, level-triggered). • Student can identify the use and applications of different types of flip-flops and their triggering types in real life applications/systems. •	ISA MSE ESE LAB
LO 6.1 Explain Registers: SISO, SIPO, PISO, PIPO, Universal Shift Register (P.I. – 1.3.2,1.4.2 and 2.1.2) (CO6)	• Student will be able to understand the operation of shift registers (SISO, SIPO, PISO, PIPO) and universal shift registers. • Student will be able to analyse and design registers (SISO, SIPO, PISO, PIPO) and universal shift registers.	ISA MSE ESE LAB
LO 6.2 Explain Asynchronous and Synchronous counters with State transition diagram, Up/Down, MOD N Counters (P.I. – 1.3.2,1.4.2 and 2.1.2) (CO6)	• Student will be able to understand and explain Asynchronous counters • Student will be able to understand and explain synchronous counters	ISA MSE ESE LAB
LO 6.3 Analyze and design Up/Down, MOD N Counters (P.I.- 1.3.2,1.4.2, 5.1.3 and 5.2.3) (CO6)	• Student will be able to design Mod-N Asynchronous counters • Student will be able to design Mod-N synchronous counters	ISA MSE ESE LAB

Tools/ Technologies/ Programming Languages learnt:

- Basic logic gates and Universal gates.
- K-Map and Boolean Logic Minimization
- Flip flops
- Multiplexer and counter ICs.
- Simulation Software Logisim

Textbooks:

1. R. P. Jain ," Modern Digital Electronics", 2nd Edition, TMcGraw, 2020.
2. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition.

Reference Books:

1. M. Morris Mano, "Digital Logic and computer Design", PHI.
2. Robert L. Boylestad, Louis Nashelsky, "Electronic devices and circuit Theory", PHI 2.
3. Donald P Leach, Albert Paul Malvino, "Digital Principals & Applications", TMH

Related/ Equivalent MOOC and Associated Certification:

1. Digital System Design, NPTEL Course by Prof. Goutam
   Link: https://archive.nptel.ac.in/courses/108/105/108105132/

2. Digital Systems: From Logic Gates to Processors course Offered by: Universitat Autònoma de Barcelona
   Link: https://www.coursera.org/learn/digital-systems

3. Digital Design course Offered by Harvey Mudd College
   Link: https://www.edx.org/learn/design/harvey-mudd-college-digital-design

4. Digital System Design By Prof. Neeraj Goel IIT Ropar
   Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ee71

Course Name: Structured Programming

Course Code: VSEC01T and VSEC01P

Vertical/ Sub-Vertical: SC_VSEC

K-S-A Mapping: Knowledge & Skill

Pre-requisite required: --

Pre-requisite for: VSEC02 (OOP)

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).*	4

		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:* *1.4 Describe syntax, keywords, data types and variables. (P.I. – 1.3.1) (CO1)* *1.5 Use appropriate operators in expressions to perform various calculations and operations. (P.I. 1.3.2) (CO1)* *1.6 Use math library functions to perform mathematical computations within C programs. (P.I. 1.3.3) (CO1)* *1.7 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

		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)	
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:* *3.5 Analyse the flow of control in programs using selection statements to make decisions based on specific conditions. (P.I. – 2.1.2) (CO1, CO2)* *3.6 Implement multi-choice logic using switch statements to manage multiple options conditions effectively. (P.I. 2.1.2) (CO1, CO2)* *3.7 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)* *3.8 Analyse loop control mechanisms (break, continue) and their effect on loop execution. (P.I. - 2.1.2) (CO2, CO6)* *3.9 Integrate selection and looping statements in C programs to solve more complex problems. (P.I. – 2.2.3) (CO2, CO6).*	6

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.*	6

		(CO2, CO3, CO4, CO6). **Content:** 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:* *5.5 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)* *5.6 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)* *5.7 Define and use structures, including nested structures, to represent complex data types in C. (P.I. – 1.3.2) (CO2, CO4)* *5.8 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:**	6

		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:* *6.5 Explain the concept of pointers, including referencing, dereferencing, and the use of pointer operators. (P.I. – 1.3.2) (CO1, CO4)* *6.6 Apply pointers for call-by-reference, and pointer arithmetic in solving programming problems. (P.I. – 2.2.3) (CO1, CO4)* *6.7 Use pointers effectively with arrays, including passing arrays to functions and working with arrays of pointers. (P.I. – 1.3.4) (CO4, CO6)* *6.8 Implement dynamic memory allocation using functions like malloc(), calloc(), realloc(), and free() to manage memory during runtime. (P.I. – 2.4.5) (CO5)* *6.9 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)
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	-	-	-	-	-	-

Mapping of Course Outcomes with Programme Specific Outcomes:

Course Outcome	**PSO1**	**PSO2**	**PSO3**
CO1	5/28	-	-
CO2	5/28	-	-
CO3	3/28	-	-
CO4	-	6/28	-
CO5	-	2/28	-
CO6	4/28	2/28	-

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria:** The Learner can:	**Evaluated under ISA/MSE/ESE/LAB**
LO1: Explain and apply fundamental elements of the C programming language, including syntax, keywords, data types, variables, operators, preprocessor directives, and math library functions, to write and evaluate basic computational expressions.	1.1 Identify and use appropriate C syntax, keywords, data types, and variables.	LAB
	1.2 Use operators and math library functions in expressions	ISA, LAB
	1.3 Explain the role of preprocessor directives.	ISA
	1.4 Write programs using mathematical functions.	ISA, MSE, LAB
	1.5 Debug and troubleshoot issues in code implementations	LAB
LO2: Apply appropriate input/output operations using format specifiers for various data types and collaborate effectively with peers to debug and enhance C programs by integrating foundational programming concepts.	2.1 Write program using correct format specifiers in input/output functions to perform basic computations	LAB
	2.2 Collaborate with peers to debug and troubleshoot issues in code implementations.	LAB
LO3: Analyse and implement control flow constructs in C programs using selection statements (if-else, switch) and iterative structures (for, while, do-while), including loop control mechanisms (break, continue), to design solutions for complex computational problems.	3.1 Frame conditional expressions to validate the required criteria.	LAB, MSE
	3.2 Solve 3 programs on Leet Code / Hacker Rank Platform	ISA, LAB, MSE
	3.3 Develop a logic and implement it for the problems which demands usage of Iterative Constructs.	ISA, MSE, ESE
	3.4 Develop a logic to display various patterns by using nested loops.	ISA, ESE, LAB
	3.5 Attempt to solve some standard methods belonging to	LAB

	computational mathematics by proposing programming solution	
LO4: Design modular C programs by defining and organizing functions to solve subproblems, apply appropriate storage classes to manage variable scope and lifetime, and evaluate recursive and iterative approaches to select the most effective solution strategy.	4.1 Propose a solution which uses divide and conquer approach to solve the challenging tasks programs on Leet Code / Hacker Rank Platform	LAB
	4.2 Analyse the problem statement to identify the scope of using recursion and accordingly implement it.	ISA, LAB, ESE
	4.3 Demonstrate the usage and effect of different storage classes.	MSE, LAB, ESE
	4.4 Use and test the library functions used for character processing	LAB
LO5: Develop C programs that utilize arrays (one-dimensional and multidimensional), strings, and structures—including nested and array-based structures—to efficiently store, process, and manipulate grouped and complex data using appropriate standard library functions and data operations.	5.1. Perform operations like sorting, insertion, deletion and searching on One dimensional array.	ISA, LAB, MSE, ESE
	5.2. Perform operations like Matrix Multiplication, Addition, Transform, Magic Square generation etc.	ISA, LAB, MSE, ESE
	5.3 Propose user defined functions for: string length, string copy, string reverse, string concatenation, searching for substring.	ISA, LAB
	5.4 Declare a structure for representing the data about the entity, perform operations like, data population, updating, searching and displaying the records	LAB, ESE
LO6: Explain and apply pointer concepts in C programming—including referencing,	6.1 Demonstrate how pointer arithmetic is different from non-pointer arithmetic.	LAB, ESE

dereferencing, pointer arithmetic, and dynamic memory allocation—and use pointers effectively with arrays and functions to solve memory and data-handling problems.	6.2 Write a program to process elements of 1 D array and 2 D array with the help of pointers	LAB, ISA
	6.3 Solve programming challenges from Leet Code / Hacker Rank platform which involves dynamic memory allocation	ISA, LAB
	6.4 Develop an application to insert records into text file, delete and update them as per the need.	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
- [1] *Equivalent Certification Course*

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2. **Programming in C**

- **Platform**: SWAYAM-NPTEL
- **Instructor**: Prof. Shriram K. Vasudevan, IIT Madras
- **Link**: https://nptel.ac.in/courses/106105171
- [1] *Beginner-friendly, with weekly assignments and proctored exam*

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3. **C Programming: Getting Started**

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

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4. **Introduction to Programming in C**

- **Platform**: Coursera (Duke University)
- **Link**: https://www.coursera.org/learn/c-programming
- [1] *Hands-on certification course with beginner to intermediate content*

Course Name: Effective Communication

Course Code: AEC01T and 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)*	10

		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	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:***	4

		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	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, capturing key points clearly and concisely. (CO5) (P.I.10.1.1, 10.1.2, 12.1.1, 12.3.1)*	2
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)*	4

		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)	
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									5/26		5/26
CO2							2/26	3/26	7/26		8/26
CO3									5/26		10/26
CO4					4/26			21/26	10/26		
CO5									4/26		5/26
CO6					7/26		2/26		4/26		6/26

Assessment Criteria of Learning Outcomes:

Learning Outcomes: The Learner will:	**Assessment Criteria:** The Learner can:	**Evaluated under ISA/MSE/ESE/LAB**
LO1: Students develop proficiency in verbal and non-verbal communication relevant to academic and professional settings.	1.1 Learners will practice public speaking through Speech delivery to enhance both verbal and non-verbal communication	ISA LAB
	1.2 Learners will document the speech, free of plagiarism, using various plagiarism checkers.	ISA TH
	1.3 Learners will perform role plays to identify and analyse physical, mechanical, psychological, semantic, socio-cultural, and	ISA LAB

	cross-cultural barriers to communication, and propose strategies to overcome them effectively. (Activity)	
LO2: Improves Listening and Speaking in both academic and professional interactions.	2.1 Learners will be able to apply effective listening techniques through various listening exercises	ISA LAB
	2.2 Learners will complete MOOC on TCSion for effective verbal and non-verbal communication techniques.	MSE
	2.3 Learners will deliver extempore public speeches by applying key public speaking tips.	ISA LAB
LO3: Equips students with strategies to perform well in verbal aptitude sections of standardized tests and engineering placement assessments.	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 read research papers and summarise them to improve the accuracy and clarity of their written work.	ESE LAB
	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
LO4: Builds confidence and effectiveness in delivering oral presentations, including the use of visual aids and proper body language.	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
	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
LO5: Improves the ability to quickly read, interpret, and respond to complex texts such as	5.1 Learners will make reports of the Presentations to improve their writing prowess.	ISA TH

manuals, technical articles, and instructions.	5.2 Learners will use graphic organizers like mind maps, flow charts, and tree diagrams to visually organize information from research papers.	ISA LAB
LO6: Students become aware of secure digital communication practices, develop online content, and master the use of ICT tools in accordance with professional and ethical standards.	6.1 Learners will make Posters using different ICT tools and give presentations.	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

Liberal Learning/ Co-curricular Courses

Course Name: Various dance forms

Course Code: CC01

NEP Vertical _Basket: LLC_CC

Preamble:

This course introduces learners with an aim to focus on holistic personality development; a wide platter of General Education courses is offered to First Year Engineering students. 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: Demonstrate effective oral communication
CO2: Demonstrate the ability to think critically and creatively
CO3: Apply quantitative reasoning concepts and skills to solve problems CO4: Illustrate the ability to self-reflect and access relevant ethical values

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/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
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

Recommended Online Courses:

Nil

Reference Books:

As suggested by resource person in session

Course Name: Corporate and Social Etiquettes

Course Code: CC02

Category: General Education

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	-	25	050

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: HSSM_VEC

Preamble:

In an increasingly interconnected world, students must be prepared not only as professionals but also as informed and responsible global citizens. This course aims to develop an awareness of global interdependence, foster respect for cultural diversity, and encourage civic engagement in addressing complex global challenges such as inequality, climate change, conflict, and social justice. Through interdisciplinary and experiential learning, learners will critically reflect on their roles in shaping a more inclusive, peaceful, and sustainable future.

Prerequisite:

Open to all undergraduate students with an interest in societal issues, global affairs, and personal development. No prior experience in international studies is required.

Course Objectives:

1. Understand the foundational concepts and principles of global citizenship.
2. Examine global challenges including poverty, inequality, climate change, and conflict.
3. Foster respect for cultural diversity and promote intercultural communication skills.
4. Promote ethical reasoning, human rights awareness, and civic responsibility.
5. Encourage active engagement in sustainable practices and social justice initiatives.
6. Develop critical thinking, media literacy, and digital citizenship skills.CO1: Define and explain the principles of global citizenship.

Course Outcomes:

CO1: Define and explain the meaning, relevance, and scope of global citizenship.

CO2: Analyze the causes and effects of key global challenges and development goals.

CO3: Demonstrate intercultural sensitivity and communicate across diverse backgrounds.

CO4: Apply principles of human rights and ethics in real-world decision-making.

CO5: Propose or participate in local actions with global impact.

CO6: Critically evaluate media, technology, and social narratives influencing global understanding.

Course Scheme:

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

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	75	-	-	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.

Suggested Assessment & Evaluation:

1. Assignments: Reflective essay on the benefits of natural farming (20%).
2. Quizzes: On core principles and environmental impact (20%).
3. Case Study Analysis: Evaluate a case study on chemical farming's impact vs. natural farming's benefits (30%).
4. Group Presentation: Develop a plan to implement natural farming in a chosen area (30%).

Detailed Syllabus:

Module No.	Module Name	Content
1	Foundations of Global Citizenship	• Definition, scope, and importance of global citizenship. • The interconnected world: globalization, global systems, and responsibilities. • Overview of global issues: poverty, inequality, environment, migration. • Opportunities and roles of youth in global problem-solving. • Introduction to SDGs and their global significance.
2	Culture, Diversity, and Communication	• Understanding cultural identity, norms, and differences. • Developing cultural awareness and reducing stereotypes. • Skills for effective intercultural communication. • Diversity and inclusion in the global context. • Gender, LGBTQ, and social equity in cultural narratives.
3	Human Rights, Social Justice, and Peace	• Historical evolution and significance of human rights. • Universal Declaration of Human Rights and related frameworks. • Social justice movements (civil rights, women's rights, LGBTQ). • Conflict and peace: understanding root causes and resolution strategies. • Building inclusive, peaceful societies through civic engagement.

4	Environment, Sustainability, and Global Health	• Climate change causes, global impacts, and policy responses. • Conservation of biodiversity and ecosystems. • Individual actions for sustainability and responsible consumption. • Global health disparities and healthcare access. • Importance of mental health and well-being in the global agenda.
5	Economy, Technology, and Media Literacy	• Impact of globalization on economies and societies. • Fair trade principles and ethical consumer choices. • Role of technology in solving global challenges. • Digital divide, access, and digital citizenship. • Media's influence on shaping global narratives and critical media evaluation.
6	Action, Reflection, and Global Engagement	• Civic responsibility and youth-led advocacy and activism. • Ethical frameworks for decision-making in global contexts. • Sustainable living: practical steps to apply global citizenship daily. • Integrating global citizenship in education and experiential learning. • Final project: student-led presentations and action plans.

Reference Books:

1. Learning to Live Together: UNESCO Global Citizenship Education Guide
2. Pedagogy of the Oppressed by Paulo Freire
3. Educating for Global Citizenship by Lloyd Kornelsen
4. Factfulness: Ten Reasons We're Wrong About the World – and Why Things Are Better Than You Think by Hans Rosling

Course Name: Wellness: Body, Mind and Spirit

Course Code: CC04

Category: General Education

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

ISA: Quizzes

ESE: Performance

Detailed Syllabus:

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

This course introduces learners with an aim to focus on holistic personality development, a wide platter of General Education courses is offered to First Year Engineering students. 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: Demonstrate effective oral communication
CO2: Demonstrate the ability to think critically and creatively
CO3: Apply quantitative reasoning concepts and skills to solve problems CO4: Illustrate the ability to self-reflect and access relevant ethical values

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/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
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

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:

This course introduces learners with an aim to focus on holistic personality development, a wide platter of General Education courses is offered to First Year Engineering students. 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: Demonstrate effective oral communication
CO2: Demonstrate the ability to think critically and creatively
CO3: Apply quantitative reasoning concepts and skills to solve problems CO4: Illustrate the ability to self-reflect and access relevant ethical values

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/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
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.

Recommended Online Courses:

Nil

Reference Books:

As suggested by resource person/subject matter expert in session

Course Name: Facets of Astronomy

Course Code: CC07

NEP Vertical _Basket: LLC_CC

Preamble:

This course introduces learners with an aim to focus on holistic personality development; a wide platter of General Education courses is offered to First Year Engineering students. These courses will also help to create balance in the 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: Demonstrate effective oral communication

CO2: Demonstrate the ability to think critically and creatively

CO3: Apply quantitative reasoning concepts and skills to solve problems CO4: Illustrate the ability to self-reflect and access relevant ethical values

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/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
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.

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:

This course introduces learners with an aim to focus on holistic personality development, a wide platter of General Education courses is offered to First Year Engineering students. 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: Demonstrate effective oral communication
CO2: Demonstrate the ability to think critically and creatively
CO3: Apply quantitative reasoning concepts and skills to solve problems CO4: Illustrate the ability to self-reflect and access relevant ethical values

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/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
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. IndianRailways,Landandbridges,electrification, telecommunication, public sector undertakings, Reforms in railway sector.

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:

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	75	-	-	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
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.
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.
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.
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	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.
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.

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	75	-	-	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
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
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
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
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	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 • 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

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 nonverbal 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 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	75	-	-	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
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.
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.
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.
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	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.
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.

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

By the end of this course, students will: 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	75	-	-	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
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.
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.
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.
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	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.
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.