Amrutvahini Sheti and Shikshan Vikas Sanstha's

AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER

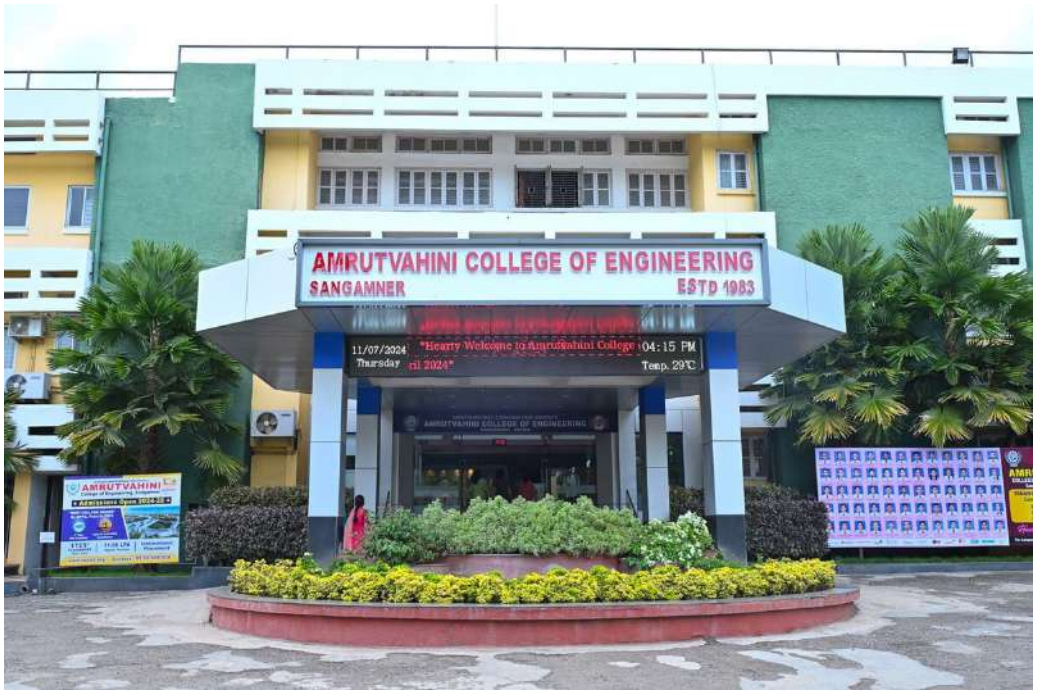
Amrutnagar, Ghulewadi, Sangamner - 422608

(An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune)

Curriculum Structure and Syllabus

of

First Year B. Tech.



(Effective from Academic Year 2025-26)

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Abbreviation

AEC - Ability Enhancement Course

AICTE - All India Council for Technical Education

CEP - Community Engagement Project

EEM - Entrepreneurship/Economics/Management Courses

MDM - Multidisciplinary Minor

MOOC - Massive Open Online Course

NEP - National Education Policy

NPTEL - National Programme on Technology Enhanced Learning

OE - Open Elective

PCC - Program Core Course

CCC – Cocurricular Course

PEO - Programme Educational Objectives

PSO - Program Specific Outcomes

SWAYAM - Study Webs of Active-learning for Young Aspiring Minds

UGC - University Grants Commission

VEC - Value Education Course

VSE - Vocational and Skill Enhancement Course

WK - Knowledge and Attitude Profile

CCE - Comprehensive and Continuous Evaluation

ISO - International Organization for Standardization

EOMS - Educational Organization Management System

Institute Vision

To create opportunities for rural students to become able engineers and technocrats through continual excellence in engineering education.

Institute Mission

Our mission is to create self-disciplined, physically fit, mentally robust and morally strong engineers and technocrats with high degree of integrity and sense of purpose who are capable to meet challenges of ever advancing technology for the benefit of mankind and nature.

We, the management, the faculty and staff, therefore promise to strive hard and commit ourselves to achieve this objective through a continuous process of learning and appreciation of needs of time.

ISO 21001:2018 - EOMS Policy

We, at AVCOE Sangamner, are committed to:

- Provide quality technical education to the rural students
- Provide conducive environment for all round development of the students.
- Develop as a premier institute for technical education & research as per the needs and expectations of all stake holders.
- Comply all applicable requirements.
- Develop students into technocrats having social responsibility.
- Keep abreast about the advances in technology and innovation.
- Enhance industry-institute interaction.
- Managing intellectual property.
- Maintain hygiene, health and safety for applicable requirements.
- Achieve continual improvement in academic and administrative processes.
- We shall strive to maintain Educational Organizational Management System.

Knowledge and Attitude Profile

A Knowledge and Attitude Profile (KAP), often represented as WK (Knowledge and Attitude Profile) in some contexts, is a framework or assessment tool used to evaluate an individual's knowledge and attitudes related to a specific area, topic, or domain.

WK1	A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
WK2	Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
WK3	A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
WK4	Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
WK5	Knowledge, including efficient resource use, environmental impacts, whole- life cost, re-use of resources, net zero carbon, and similar Concepts, that supports engineering design and operations in a practice area.
WK6	Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
WK7	Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
WK8	Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
WK9	Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Program Outcomes (POs)

PO1	Engineering knowledge	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	Problem analysis	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	Design / Development of Solutions	complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	Conduct Investigations of Complex Problems	Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	Engineering Tool Usage	Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	The Engineer and The World	Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
PO7	Ethics	Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	Individual and Collaborative Team work	Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication	Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project Management and Finance	Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning	Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Preface

It gives us great pleasure to present the 'Curriculum Structure and Syllabus' for the First Year B. Tech. programme under the autonomous status of Amrutvahini College of Engineering, Sangamner. This curriculum marks an important milestone as it is designed for the first batch of students under academic autonomy, following the principles of the National Education Policy (NEP) 2020 and focusing strongly on Outcome-Based Education (OBE).

The first year is the foundation of every engineering programme. This curriculum provides a balanced combination of basic engineering sciences, engineering fundamentals, and interdisciplinary learning to help students build strong conceptual and analytical skills for their future studies. It also introduces them to the basics of various engineering branches such as mechanical, civil, electrical, electronics, computer engineering, and related disciplines, giving them an understanding of how different engineering systems work together.

In line with NEP 2020, the syllabus includes skill-based and practical learning through laboratories, vocational and skill enhancement courses, co-curricular activities, and foreign language learning for global prospects. It encourages students to develop practical skills, creativity, and critical thinking through hands-on activities and project-based learning.

The inclusion of Professional Communication, Indian Knowledge Systems, Ethics, and Emerging Technologies supports the overall development of students by improving their technical knowledge, social and environmental awareness, and ethical values. In addition, exposure to digital technologies, programming, and innovation-oriented learning prepares students for the challenges of emerging and future technologies.

This curriculum aims at the 360-degree development of students focusing on academic excellence, professional competence, physical fitness, and moral strength. The underlined objective is to mold the students in such a way that they become capable and responsible engineers who can contribute to society and the nation. It reflects the institute's vision to create opportunities for rural students and help them become globally competent engineers through continuous excellence in education.

I sincerely thank the Board of Studies chairpersons and members, faculty, academic experts, and industry professionals for their valuable contributions in designing this outcome-based and future- ready curriculum. We believe that this document will serve as a useful guide for students, teachers, and all stakeholders in achieving the goals of holistic, flexible, and learner-centered education envisioned by the National Education Policy 2020.

Dr. M. A. Venkatesh,
Principal
Amrutvahini College of Engineering, Sangamner
(An Autonomous Institute affiliated to Savitribai Phule Pune University, Pune)

Program codes:

The institute has assigned a unique program code to each branch.

Table 1 – Program codes

Sr. No.	Program code	Code
UG Programs		
1	Engineering Science & Humanities	SH
2	Civil Engineering	CE
3	Automation and Robotics	AR
4	Computer Engineering	CO
5	Electronics and Computer Engineering	EC
6	Mechanical Engineering	ME
7	Electronics & Telecommunication Engineering	ET
8	Information Technology	IT
9	Electrical Engineering	EE
10	Artificial Intelligence and Data Science	AI
PG Programs		
1	Master of Business Administration	MBA
2	M. Tech Computer Engineering	MCO
3	M. Tech Civil Engineering	MCE
4	M. Tech Mechanical Engineering	MME

Subject code nomenclature:

The following nomenclature demonstrates the subject codes:

- **R-Year** (of designing/revising syllabus) – **Program code** (as given in table 1) - **Course Type** (as per NEP) – **Course Number** (101 – FY B. Tech Subject 1, 201 - SY B. Tech Subject 1, 301 - TY B. Tech Subject 1, 401 - B. Tech Subject 1 etc.)

Course Cycles:

The following table outlines the semester-wise course distribution for Cycle 1 and Cycle 2 divisions, indicating the subjects offered in Semester I and Semester II for each cycle.

Table 2 – Semester-wise course cycles

Cycle 1 (Div – AI&DS, Civil, ETC, ECE)		**Cycle 2 (Div – A&R, Comp, Electrical, IT, Mechanical)**	
Sem – I	**Sem - II**	**Sem – I**	**Sem - II**
Linear Algebra and Calculus	Advanced Calculus and Numerical Integration	Linear Algebra and Calculus	Advanced Calculus and Numerical Integration
Engineering Physics	Engineering Chemistry	Engineering Chemistry	Engineering Physics
Engineering Mechanics and Civil Engineering Systems	Systems of Mechanical Engineering	Systems of Mechanical Engineering	Engineering Mechanics and Civil Engineering Systems
Fundamentals of Electronics Engineering	Fundamentals of Electrical Engineering	Fundamentals of Electrical Engineering	Fundamentals of Electronics Engineering
Programming & Problem Solving Using Python	Program Core Course Programming in C Lab	Programming & Problem Solving Using Python	Program Core Course Programming in C Lab
Digital Technology Lab	Engineering Workshop Skills Lab	Engineering Workshop Skills Lab	Digital Technology Lab
Civil Engineering Lab	Engineering Graphics Lab	Engineering Graphics Lab	Civil Engineering Lab
Professional Communication Skill or Foreign Language (Japanese/German)	Indian Knowledge System	Indian Knowledge System	Professional Communication Skill or Foreign Language (Japanese/German)
Cocurricular Courses - I 1. Art & Crafts 2. Dance 3. Health & Wellness 4. Yoga 5. Sahyadri Trekking & Rock Climbing	Cocurricular Courses - II 1. Creative Arts & Design 2. Wellness & Lifestyle Education 3. Adventure Sports: Management, Safety and Career 4.Fire and Safety 5. Self Defence	Cocurricular Courses - I 1. Art & Crafts 2. Dance 3. Health & Wellness 4. Yoga 5. Sahyadri Trekking & Rock Climbing	Cocurricular Courses - II 1. Creative Arts & Design 2. Wellness & Lifestyle Education 3. Adventure Sports: Management, Safety and Career 4. Fire and Safety 5. Self Defence

Course Approval Summary:

	AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER **Amrutnagar, Ghulewadi, Sangamner- 422608** **(An Autonomous Institute, Approved by AICTE and Affiliated to SPPU, Pune)**

Sr. No.	Name of the course	Course Code	Signature of BoS Chairman (with stamp)
1	Linear Algebra and Calculus	R25-SH-BSC-101	
2	Engineering Physics	R25-SH-BSC-102	
3	Engineering Chemistry	R25-SH-BSC-103	
4	Systems of Mechanical Engineering	R25-ME-ESC-104	
5	Engineering Mechanics and Civil Engineering Systems	R25-CE-ESC-105	
6	Fundamentals of Electrical Engineering	R25-EE-ESC-106	
7	Fundamentals of Electronics Engineering	R25-ET-ESC-107	
8	Programming & Problem Solving Using Python	R25-CO-ESC-108	

9	Engineering Workshop Skills Lab	R25-ME-VSEC-109	
10	Digital Technology Lab (AI&DS)	R25-AI-VSEC- 115	
11	Digital Technology Lab (Civil)	R25-CE-VSEC- 115	
12	Digital Technology Lab (ECE)	R25-EC-VSEC- 115	
13	Digital Technology Lab (ETC)	R25-ET-VSEC- 115	
14	Engineering Graphics Lab	R25-ME-VSEC-110	
15	Civil Engineering Lab	R25-CE-VSEC-111	
16	Professional Communication Skill	R25-SH-AEC-112.1	
17	Foreign Language: Japanese	R25-SH-AEC-112.2	
18	Foreign Language: German	R25-SH-AEC-112.3	

19	Indian Knowledge System	R25-SH-AEC-113	
20	Cocurricular Courses – I (Art & Crafts)	R25-SH-CC-114.1	
21	Cocurricular Courses – I (Dance)	R25-SH-CC-114.2	
22	Cocurricular Courses – I (Health & Wellness)	R25-SH-CC-114.3	
23	Cocurricular Courses – I (Yoga)	R25-SH-CC-114.4	
24	Cocurricular Courses – I (Sahyadri Trekking and Rock Climbing)	R25-SH-CC-114.5	
25	Advanced Calculus and Numerical Integration	R25-SH-BSC-116	
26	Emerging Trends in AI&DS	R25-AI-PCC-118	

27	Foundations of Automation and Robotics Engineering	R25-AR-PCC-118	
28	Smart and Sustainable Civil Engineering	R25-CE-PCC-118	
29	Emerging Technologies in Computing	R25-CO-PCC-118	
30	Frontiers of Technology	R25-EC-PCC-118	
31	Advanced Technologies in Electrical Engineering	R25-EE-PCC-118	
32	Communication and Computing Technologies	R25-ET-PCC-118	
33	Modern IT Engineering Trends	R25-IT-PCC-118	
34	Emerging Trends in Mechanical Engineering	R25-ME-PCC-118	

35	Programming in C	R25-IT-PCC-119	
36	Digital Technology Lab (A&R)	R25-AR-VSEC- 115	
37	Digital Technology Lab (Computer)	R25-CO-VSEC- 115	
38	Digital Technology Lab (Electrical)	R25-EE-VSEC- 115	
39	Digital Technology Lab (IT)	R25-IT-VSEC- 115	
40	Digital Technology Lab (Mechanical)	R25-ME-VSEC- 115	
41	Cocurricular Courses – II (Creative Arts & Design)	R25-SH-CC-117.1	
42	Cocurricular Courses – II (Wellness & Lifestyle Education)	R25-SH-CC-117.2	

43	Cocurricular Courses – II (Adventure Sports: Management, Safety and Career)	R25-SH-CC-117.3	
44	Cocurricular Courses – II (Fire and Safety)	R25-SH-CC-117.4	
45	Cocurricular Courses – II (Self Defence)	R25-SH-CC-117.5	

Dr. M. A. Venkatesh
Chairman
Academic Council

Guidelines for Examination Scheme:

The evaluation of students shall be based on continuous academic performance in a course based on Comprehensive Continuous Evaluation (CCE) and End Semester Examination (ESE). Components of the Examination System:

1. **Comprehensive Continuous Evaluation (CCE):**
    - CCE of 40 marks based on all the Units of course.
    - To design a Comprehensive Continuous Evaluation scheme for a theory subject of 40 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

Table 3: Allocation of marks & structure

Sr. No.	Examination	Conduction Marks	Marks	Coverage of Units
1	**CCE –I** (Class test – 1)	32	16	Units 1 & Unit 2 (8 Marks/Unit)
2	**CCE –II** (Class test – 2)	32	16	Units 3 & Unit 4 (8 Marks/Unit)
3	**CCE –III** (Assessment tools: Assignments, seminar, quiz, course project, field visit etc.)	08	08	Unit 5

The distribution of marks across various assessment tools and their mapping to COs is detailed in the table below.

Table 4: Allocation of marks & structure

EXAM	Assessment tool	CO1	CO2	CO3	CO4	CO5
CCE	CT1	08	08			
	CT2			08	08	
	Assignments	Subject teacher should select any two of the assessment tool				08
	Course Project					
	Case study					
	Field Activity					
	Presentation					
	Quiz					
ESE	60	12	12	12	12	12
Total	**100**	**20**	**20**	**20**	**20**	**20**

Timeline for conduction of CCE:

- Weeks 1- 4 : Completion of Unit 1 and 2
  Week 5 : Conduct Unit Test 1 (16 marks)
- Weeks 6 - 8 : Completion of Unit 3 and 4
  Week 9 : Conduct Unit Test 2 (16 marks)
- Weeks 10 - 12 : Completion of Unit 5
  Week 13 : Conduct Seminar/Course project/Presentation/Quiz/Open Book test (8 marks)

Evaluation and Feedback:

- **Unit Test:** Student answer papers will be evaluated promptly, and constructive feedback will be provided highlighting strengths and areas for improvement.
- **Assignments / Case Study:** Student submissions will be assessed as per the given rubric, and meaningful feedback will be provided to help students understand their performance and scope for enhancement.
- **Seminar Presentation:** Students will be evaluated based on content accuracy, delivery, and responses during the Q&A session. Feedback will be shared on communication skills and conceptual understanding.
- **Open Book Test:** Evaluation will focus on the depth of analysis and the ability to apply concepts. Feedback will emphasize students' critical thinking and problem-solving skills.
- **Mini Project:** Students will be assessed on problem identification, design approach, implementation quality, and documentation. Innovation, teamwork, and practical application of concepts will be strongly considered.
- **Field Visit:** Evaluation will be based on the student's report and reflection, focusing on understanding of real-world practices and their relevance to the course outcomes. Marks will reflect clarity, insight, and active participation.

2. End Semester Examination (ESE):

The ESE is a compulsory examination for all students. The ESE examination will be conducted at the end of the semester by the institute Department of Examination and Evaluation (DEE). The ESE will be based on 100% syllabus (Unit 1 to Unit 5). The ESE shall be of 60 marks (12 Marks / Unit) conducted for all theory courses as mentioned in the programme structure.

Syllabus Structure

Sr. No.	Subject Code	Course Type	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks						Credit			
				TH	PR	TUT	CCE	ESE	TW	PR	OR	TOTAL	TH	PR	TUT	TOTAL
Semester-I																
1	R25-SH-BSC-101	Basic Sciences	Linear Algebra and Calculus	4	-	-	40	60	-	-	-	100	4	-	-	4
2	R25-SH-BSC-102 R25-SH-BSC-103	Basic Sciences	Engineering Physics / Engineering Chemistry	3	2	-	40	60	25	-	-	125	3	1	-	4
3	R25-ME-ESC-104 R25-CE-ESC-105	Engineering Science Course	Systems of Mechanical Engineering / Engineering Mechanics and Civil Engineering Systems	3	-	-	40	60	-	-	-	100	3	-	-	3
4	R25-EE-ESC-106 R25-ET-ESC-107	Engineering Science Course	Fundamentals of Electrical Engineering / Fundamentals of Electronics Engineering	2	2	-	40	60	25	-	-	125	2	1	-	3
5	R25-CO-ESC-108	Engineering Science Course	Programming & Problem Solving Using Python	2	2	-	40	60	25	-	-	125	2	1	-	3
6	R25-ME-VSEC-109 R25-Prog.Code-VSEC-115	Vocational & Skill Enhancement Course	Engineering Workshop Skills Lab / Digital Technology Lab	-	2	-	-	-	50	-	-	50	-	1	-	1
7	R25-ME-VSEC-110 R25-CE-VSEC-111	Vocational & Skill Enhancement Course	Engineering Graphics Lab / Civil Engineering Lab	-	2	-	-	-	50	-	-	50	-	1	-	1
8	R25-SH-AEC-112 R25-SH-AEC-113	Ability Enhancement Course	Professional Communication Skill or Foreign Language (Japanese/German) /Indian Knowledge System	-	-	2	-	-	50	-	-	50	-	-	2	2
9	R25-SH-CC-114	Cocurricular Courses	Cocurricular Courses - I	-	2	-	-	-	25	-	-	25	-	1	-	1
			Total	**14**	**12**	**2**	**200**	**300**	**250**	**0**	**0**	**750**	**14**	**6**	**2**	**22**

Sr. No.	Subject Code	Course Type	Course Name	Teaching Scheme (Hrs./week)			Examination Scheme and Marks						Credit			
				TH	PR	TUT	CCE	ESE	TW	PR	OR	TOTAL	TH	PR	TUT	TOTAL
Semester-II																
1	R25-SH-BSC-116	Basic Sciences	Advanced Calculus and Numerical Integration	4	-	-	40	60	-	-	-	100	4			4
2	R25-SH-BSC-103 R25-SH-BSC-102	Basic Sciences	Engineering Chemistry / Engineering Physics	3	2	-	40	60	25	-	-	125	3	1		4
3	R25-CE-ESC-105 R25-ME-ESC-104	Engineering Science Course	Engineering Mechanics and Civil Engineering Systems / Systems of Mechanical Engineering	3	-	-	40	60	-	-	-	100	3			3
4	R25-ET-ESC-107 R25-EE-ESC-106	Engineering Science Course	Fundamentals of Electronics Engineering / Fundamentals of Electrical Engineering	2	2	-	40	60	25	-	-	125	2	1		3
5	R25-Prog.code-PCC-118	Program Core Course	Program Core Course (To be proposed by department)	2	-	-	40	60	-	-	-	100	2			2
6	R25-IT-PCC-119	Program Core Course Lab	Programming in C	-	2	-	-	-	25	-	-	25		1		1
7	R25-Prog.Code-VSEC-115 R25-ME-VSEC-109	Vocational & Skill Enhancement Course	Digital Technology Lab / Engineering Workshop Skills Lab	-	2	-	-	-	50	-	-	50		1		1
8	R25-ME-VSEC-111 R25-CE-VSEC-110	Vocational & Skill Enhancement Course	Civil Engineering Lab/ Engineering Graphics Lab	-	2	-	-	-	50	-	-	50		1		1
9	R25-SH-AEC-113 R25-SH-AEC-112	Indian Knowledge System	Professional Communication Skill or Foreign Language (Japanese/German) / Indian Knowledge System	-	-	2	-	-	50	-	-	50			2	2
10	R25-SH-CC-117	Cocurricular Courses	Cocurricular Courses - II	-	2		-	-	25	-	-	25		1		1
			Total	**14**	**12**	**2**	**200**	**300**	**250**	**0**	**0**	**750**	**14**	**6**	**2**	**22**

Semester - I

Program:	**F. Y. B. Tech**			**Semester:**	**I**		
Course:	**Linear Algebra and Calculus**			**Course Code:**	**R25-SH-BSC-101**		
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
4	-	-	04	40	60	-	-

Course Description

To Provide foundational knowledge in linear algebra, multivariable calculus, partial differentiation, and numerical methods for engineering problem-solving.

Course Relevance

To Equip the students with essential mathematical tools for analyzing and solving real-world engineering challenges across Engineering disciplines.

Prerequisite:

1. Fundamentals of Matrices and Determinants
2. Basics of Differentiation,
3. Concepts of Maxima and Minima in one variable

Bridge Content:

Algebra of matrices, System of linear equations using determinants, Differentiation, Maxima - Minima in one variable & Problem-solving skills.

Course Objectives:

To educate the students with concepts and techniques in Linear Algebra, Calculus, and Numerical Differentiation. The aim is to develop the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking in their respective disciplines.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**SOLVE** systems of linear equations, linear dependence and transformations using matrix methods and the rank of matrices.	**3**
CO2	**DETERMINE** eigenvalues and eigenvectors of matrices for diagonalization of matrices and reduce quadratic forms to canonical form.	**3**
CO3	**APPLY** partial differentiation techniques to functions of several variables, including Euler's theorem and total derivatives.	**3**
CO4	**APPLY** Jacobian to evaluate functional dependence and optimization techniques like Maxima- Minima and Lagrange multipliers to various problems.	**3**
CO5	**SOLVE** nonlinear equations using numerical methods such as Bisection, Regula-Falsi and Newton-Raphson to find the roots and expand the functions using Taylor's and Maclaurin's theorem.	**3**

Course Contents			
Unit 1	**Linear Algebra – Matrices and System of Linear Equations**	**10 Hrs.**	**CO1**
Matrix algebra, Rank of a Matrix, System of Linear Equations, Linear Dependence and Independence, Linear and Orthogonal Transformations, Application to problems in - Electric Circuit, Rotation Branch-wise utilization of the unit.			
Exemplars / Practical Applications, Usage: • Solving network equations in electrical circuits using matrix methods. • Modeling and analyzing robot motion and rotation in mechanical systems. • Structural analysis of trusses and beams in civil engineering. • Computer engineers use them in graphics transformations, data processing, and simulation models, Transformations in computer graphics and image processing.			
Assignments: 1. System of Linear Equations: Analyzing an electrical circuit 2. Linear Dependence and Independence: Optimizing power distribution in an electrical grid.			
Unit 2	**Linear Algebra - Eigen Values, Eigen Vectors and Diagonalization**	**10 Hrs.**	**CO2**
Eigen Values and Eigen Vectors, Cayley Hamilton theorem, Diagonalization of a matrix, Reduction of Quadratic forms to Canonical form by Linear and Orthogonal transformations, Application to PCA algorithm. Branch-wise utilization of the unit.			
Exemplars / Practical Applications, Usage: • Vibration analysis of mechanical structures and systems. • Stability analysis of electrical circuits and control systems. • Dimensionality reduction in data science using Principal Component Analysis (PCA). • Analysis of stress and strain in structural engineering problems. • Civil engineers use them in structural vibration and stress analysis. • Computer / Data engineers employ them in PCA for efficient data processing and dimensionality reduction in machine learning applications.			
Assignments: 1. Eigen Values, Eigen Vectors: Modal analysis in mechanical vibration problems. 2. Cayley Hamilton theorem: Reducing dimensionality of large datasets in machine learning using PCA.			
Unit 3	**Functions of Several variables**	**10 Hrs.**	**CO3**
Introduction to functions of several variables, Partial Derivatives, Euler's Theorem on Homogeneous functions, Partial derivative of Composite Function, Total Derivative, Change of Independent variables Branch-wise utilization of the unit.			
Exemplars / Practical Applications, Usage: • Thermal analysis of systems involving multiple variables (temperature, pressure, volume). • Stress-strain relationships and structural analysis in Civil and Mechanical engineering. • Optimization of engineering processes with multiple parameters. • Analysis of electrical systems with multiple interacting variables. • Computer engineers for optimization and modeling in simulations and machine learning.			
Assignments: 1. Partial Derivatives: Assignment on Temperature gradient analysis in thermodynamics. & Euler's Theorem			

2. PD of Composite Function & Total Derivative: Analyzing fluid flow with variable velocity and pressure.

Unit 4	Applications of Functions of Several variables	10 Hrs.	CO4

Jacobian and its applications, Errors and Approximations, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers, Branch-wise applications of the unit.

Exemplars / Practical Applications, Usage:

- Jacobian determinants are used in coordinate transformations in mechanical and electrical systems.
- Errors and approximations help in ensuring precision in measurements and simulations.
- Maxima and minima analysis is crucial in optimizing engineering designs and processes.
- Lagrange multipliers are widely used for constrained optimization in mechanical design, structural engineering, electrical systems, and resource management in various engineering disciplines.

Assignments:

1. Jacobian: Assignment on Coordinate transformation in robotics and computer vision.
2. Errors & Approximations: Assignment on Minimizing material usage in civil engineering structures.
3. Maxima and Minima: Assignment on Energy minimization in mechanical systems.

Unit 5	Expansion of Functions and Numerical Solutions	10 Hrs.	CO5

Expansion of Functions – Taylor's and Maclaurin's Expansions, Numerical Methods- Bisection, Regula Falsi, Newton-Raphson Methods to Find Roots of equation Branch-wise utilization of the unit.

Exemplars / Practical Applications, Usage:

- In Electrical Engineering, This is use for Solving nonlinear circuit equations, approximating complex signal functions, analyzing stability in control systems.
- In Mechanical Engineering, This is use for Root-finding in vibration analysis, approximations in dynamics and thermodynamics, solving nonlinear motion equations.
- In Civil Engineering, This is use for Structural analysis of nonlinear systems, load-deflection curve approximations, solving equilibrium equations.
- In Computer Science, IT and AI&DS, This is use for Algorithm design for numerical approximations, solving equations in simulations, machine learning optimization.

Assignments:

1. Expansion of functions: Assignment on Function expansions in control system analysis.
2. Finding the roots of equation: Assignment on Finding equilibrium points in mechanical systems.
3. Presentation:

- How Engineers Approximate: Function Expansion and Numerical Solutions
- Real-World Engineering Through Approximation: From Series to Solutions
- Numerical Analysis in Engineering: From Mathematical Theory to Practical Computation

Course Projects:

1.----

Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Ltd. (10th Edition (2019))
2. Grewal, B. S., Higher Engineering Mathematics, Khanna Publishers. (45th Edition (2024–25))

Reference Books:

1. B. V. Ramana, Higher Engineering Mathematics. Tata McGraw Hill Education. (First Edition (2017))

2. M. D. Greenberg, Advanced Engineering Mathematics. Pearson Education. (2nd Edition (1998))
3. Peter V. O'Neil, Advanced Engineering Mathematics. Thomson Learning. (8th Edition (2018))
4. G. B. Thomas, Thomas' Calculus. Addison-Wesley, Pearson. (13th Edition (2018))
5. P. N. Wartikar, & J. N. Wartikar, Applied Mathematics (Vol. I & Vol. II). Vidyarthi Griha Prakashan, Pune. (9th Edition (2019))
6. Ron Larson, & David C. Falvo, Elementary Linear Algebra. Houghton Mifflin Harcourt Publishing Company. (7th Edition (2013))

MOOCs Links and additional reading material:

Unit -1: Matrices And System of Linear Equations
https://youtu.be/_RDF7My0Lfg?si=bGpMB1wF6_gMmXe6
https://youtu.be/XLCEpW2A5wo?si=sZlYaett4aA22T1X
https://youtu.be/NEpvTe3pFIk?si=2lyJ82XROJfZRx1v
https://youtu.be/89Z0tOvHjNU?si=Ri6WFQJgLKsDnv81
Unit-2: Eigen Values, Eigen Vectors and Diagonalization
https://youtu.be/h5urBuE4Xhg?si=3FNddmYuh8dKmSZL
https://youtu.be/k7rjICzxJ24?si=BxdqL0zUSlBcfVK7
https://youtu.be/Vq0WMU_GeL4?si=b9ZqNH17PMVnHqQf
Unit-3: Functions of Several variables
https://youtu.be/qCQQT2P5ojY?si=m-FFkVmAVmi5h1Ku
https://www.youtube.com/watch?v=XzaeYnZdK5o&list=PLtKWB-wrvn4nA2h8TFxzWL2zy8O9th_fy
https://www.youtube.com/watch?v=btLWNJdHzSQ
https://www.youtube.com/watch?v=_1TNtFqiFQo&list=PLtKWB-wrvn4nA2h8TFxzWL2zy8O9th_fy&index=10
Unit-4: Applications of Functions of Several variables
https://www.youtube.com/watch?v=jGwA4hknYp4&list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&index=18
https://www.youtube.com/watch?v=ArkDa6d5h9I&list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&index=19
https://www.youtube.com/watch?v=h23P5lrlrYU&list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&index=20
https://www.youtube.com/watch?v=Qodww3BcZZs&list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&index=21
Unit-5: Function Expansions & Numerical Solutions
https://youtu.be/LLHjZ5fhY4U?si=YvpDSnEOIxCOHgxx
https://youtu.be/06VYX7XmvUY?si=LWR-_7llDoWNYD0s
https://youtu.be/YkmMLD8ze8A?si=Y4TlBq37mUuG1Psz
https://youtu.be/wLl20WHPB-Y?si=f6XIgrAiwpQ9nQQx

Strength of CO-PO Mapping											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	-	-	-	-	2	2	1	-	2
CO2	2	2	-	-	-	-	2	2	1	-	2
CO3	2	2	-	-	-	-	2	2	1	-	2
CO4	3	3	-	-	-	-	2	2	1	-	2
CO5	3	3	-	-	-	-	2	2	1	-	2
Avg.	**2.6**	**2.4**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**2**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern							
BT Level	**CCE**						ESE
	CT1	**CT2**	**Assignments**	**Course Project**	**Field Activity / Case Study**	**Quiz / Presentation etc.**	
K1	✓	✓	✓	-	✓	✓	✓
K2	✓	✓	✓	-	✓	-	✓
K3	✓	✓	✓	-	✓	-	✓
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

1. **Finite Element Analysis** (FEA): Linear systems, matrix methods, interpolation
2. **Machine Learning**: Linear algebra, optimization, partial derivatives
3. **Robotics and Control Systems**: Jacobians, transformations, eigenvalues
4. **Data Science / Statistics**: Matrices, numerical methods, interpolation
5. **Simulation & Modeling:** Numerical methods, root finding, partial derivatives
6. **Digital Signal Processing:** Interpolation, approximations, transforms
7. **GATE Exam/ CAT Exam /Aptitude Tests**

Job Mapping:

Job opportunities that one can get after learning this course:

1. Applied Mathematician
2. Computational Scientist
3. Numerical Analyst
4. Tool Design Engineer

Program:	**F. Y. B. Tech**			**Semester:**		**I / II**	
Course:	**Engineering Physics**			**Course Code:**		**R25-SH-BSC-102**	
Teaching Scheme (Hrs./week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credits (TH+PR)**	**CCE**	**ESE**	**TW**	**PR**
03	02	-	03 + 01	40	60	25	-

Course Description

This course introduces fundamental concepts of Engineering Physics essential for all branches of engineering. It covers modern optics, quantum mechanics, lasers, optical fibers, semiconductor physics, magnetism, superconductivity, and nanotechnology. The emphasis is on both theoretical understanding and practical applications, enabling students to connect physical principles with engineering innovations. Through lectures, laboratory work, and problem-solving sessions, students develop analytical, experimental, and critical thinking skills required for engineering practice.

Course Relevance

Engineering Physics provides the scientific foundation necessary for understanding and applying core engineering principles. The course bridges fundamental physics with real-world engineering applications, enabling students to analyze, design, and innovate across diverse technological domains. It emphasizes critical thinking, experimental skills, and problem-solving abilities that support advanced learning in engineering subjects. By integrating concepts of optics, quantum mechanics, semiconductors, magnetism, superconductivity, and nanotechnology, students gain the ability to connect theory with practice, paving the way for innovation in modern technology, sustainable energy, materials science, and emerging fields such as quantum computing and nanotechnology.

Prerequisite:

Students are expected to be familiar with:

1. Basic wave properties (superposition principle, wavefronts, total internal reflection).
2. Fundamentals of semiconductors (P-type and N-type).
3. Mathematics background in trigonometry and calculus.

Bridge Content:

To ensure smooth transition from school-level physics to advanced engineering applications, the following bridging topics are introduced:

1. Optics: Stokes' law, Brewster's law.
2. Atomic & Solid-State Physics: Atomic energy levels, magnetism (domains, hysteresis).
3. Electronics & Conductivity: Basics of electrical conduction, resistance, and carrier dynamics.
4. Radiation & Materials: Absorption/emission processes, origin of resistance in solids.

Course Objectives:

Develop the students with a strong foundation in physics fundamentals, complemented by hands-on experiments, and empower them to apply this knowledge in innovative ways to drive advancements in engineering and technology, fostering a culture of experimentation, innovation, and lifelong learning.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**EXAMINE** interference and polarization phenomena to identify their applications in engineering and technology.	**3**
CO2	**ILLUSTRATE** the fundamentals of quantum mechanics using Schrödinger's equations for basic bound state problems.	**3**

CO3	**CLASSIFY** types of lasers and optical fibers to apply their principles to engineering applications.	**3**
CO4	**CLASSIFY** solids on the basis of band theory determine parameters of solar cells, and distinguish types of magnetic substances with their applications.	**3**
CO5	**DEMONSTRATE** the properties, applications, and synthesis methods of nanoparticles and superconductors in engineering contexts.	**3**

Course Contents

Unit 1	**Modern Optics**	**8 Hrs.**	**CO1**

INTERFERENCE: Introduction, Interference in thin parallel film due to reflected light, Interference in thin wedge-shaped film, formation of Newton's Rings, Diameters of bright and dark Newton's Rings, Numericals. Engineering applications of interference: Interferometry, Anti-reflection coating. Optical flatness of a surface.
POLARISATION: Introduction, Unpolarized light, Plane Polarised light, Plane of vibration, Plane of polarization. Methods for producing plane polarised light, Law of Malus, Numericals. Double Refraction, Geometry of Calcite crystal, Huygen's theory of double re fraction. LCD, 3D movies.

Exemplars / Practical Applications and usage:

1. Surface profile measurement: Light interferometry can be used to measure surface roughness and profile.
2. Anti-reflection coatings: Optical sensors and other devices like solar cells, camera, telescope use anti-reflection coatings to minimize reflection and maximize transmission.
3. Optical communication: Polarization is used in optical communication systems to transmit data.
4. 3D movies: Polarization is used to create 3D effects in movies.
5. LCD: use in screens of calculators, wristwatch, laptop, television, computer display etc.

Assignment:

1. Illustrate how principle of interference of light is applied in everyday or engineering applications such as anti-reflection coatings, Newton's rings, interferometry, surface profile measurement, thickness measurement, and determination of unknown wavelength, giving suitable examples.
2. Illustrate how principle of polarization of light is applied in devices such as LCDs, polarized sunglasses, and 3D movie to explain its importance in engineering and technology.

Unit 2	**Wave Mechanics**	**8 Hrs.**	**CO2**

WAVE PARTICLE DUALITY: Basic of quantum mechanics and classical mechanics, De - Broglie's Hypothesis, De - Broglie's wavelength in terms of kinetic energy and potential of a particle, definitions of wave packet, group velocity and phase velocity of matter waves, properties of matter waves, Heisenberg's Uncertainty Principle [H.U.P.], Numericals.
WAVE EQUATIONS: Concepts of wave function[ψ], physical significance of $|\psi|^2$, Schrodinger's wave equations and its importance, Schrodinger's wave equations - time independent and time dependent, Numericals. Engineering application: Particle confined in one-dimensional infinite potential well [Rigid Box], Tunneling effect, Introduction to quantum computing, limitations of classical computing Vs advantageous of quantum computing, Qbit, superposition and entanglement, possible applications of quantum computing.

Exemplars / Practical Applications and usage:

1. Quantum computing – Leverages superposition and tunneling for computation.
2. Scanning Tunneling Microscope (STM) – Images atomic surfaces using electron tunneling.
3. Semiconductor devices – Band theory explains diode and transistor behavior.

Assignments:

1. Apply the concept of quantum tunneling to explain operations and characteristics of tunnel diode or Scanning Tunneling Microscope.
2. Apply the fundamental principles of quantum computing to analyze its working and real-world applications.

Unit 3	**Laser And Optical Fibers**	**8 Hrs.**	**CO3**

LASER: Introduction, Ground state, Unstable excited state, Metastable state, Induced absorption, Spontaneous emission, Stimulated emission, Population inversion, Active medium, Pumping, Resonant/optical cavity, characteristics of LASER, Semiconductor LASER, Gas LASER: CO_2 LASER, Applications: Holography, industry, medical field, Defense.

OPTICAL FIBERS: Introduction, parameters of optical fibers: acceptance angle, numerical aperture, index difference, Numericals. Types of optical fibers: single mode step index, multi-mode step index, multi-mode graded index, attenuation and its reasons. Engineering application: Optical fiber communication with block diagram.

Exemplars / Practical Applications and usage:

1. Holography – Laser record 3D images for security and artistic purposes.
2. Fiber-optic communication – Enables high-speed internet and telecommunication.
3. Optical sensors – Detect strain, temperature, and pressure in structural monitoring.
4. Industrial cutting & welding – High-power lasers precision-cut metals.
5. Medical lasers – Used in surgeries (e.g., eye surgery, tumor removal).

Assignments:

1. Apply the principles of optical fiber technology to understand how fiber-optic sensors are used in monitoring and managing infrastructure, traffic, and environmental parameters in smart cities.

Unit 4	**Semiconductor Physics & Magnetism**	**8 Hrs.**	**CO4**

SEMICONDUCTOR PHYSICS: Introduction, Energy band theory and classification of solids, Fermi – level, Fermi – energy, Fermi Dirac probability distribution function [Fermi function], Fermi level in semiconductors, position of fermi level in intrinsic and extrinsic semiconductors, Energy band structure of pn – junction diode in unbiased, forward biased and reverse biased mode, Hall effect with derivation for Hall voltage and Hall coefficient, applications of Hall effect, Numericals.

RENEWABLE ENERGY DEVICE: Solar Cell - principle, construction and working, I-V Characteristics, parameters of solar cell (Open circuit voltage, short circuit current, Fill Factor & Efficiency). Ways to improve efficiency of solar cell, Applications of solar cell.

MAGNETISM: Magnetic Properties: Magnetic Permeability, Magnetic Susceptibility, classification of magnetism on the basis of permeability, Soft and Hard Magnetic Materials, Applications of magnetic materials: Transformer cores, magnetic storage.

Exemplars / Practical Applications and usage:

1. Hall effect sensors – Used in speedometers, current sensors, and brushless motors.
2. Solar cells – Convert sunlight into electricity (e.g., rooftop panels).
3. Magnetic storage – Hard drives use ferromagnetic materials for data storage.
4. Transformer cores – Soft magnetic materials (e.g., silicon steel) minimize energy loss.

Assignments:

1. Apply Semiconductor Physics Concepts to Improve Solar Cell Efficiency.
2. Apply Magnetic Property Concepts to Select Materials for Engineering Devices.

Unit 5	Superconductivity and Nanotechnology	8 Hrs.	CO5

SUPERCONDUCTIVITY: Introduction, superconductivity phenomenon, critical temperature, Properties: zero electrical resistance, Meissner's effect, critical magnetic field, Types of superconductors: Type - I and Type - II superconductors, Formation of Cooper pairs, AC and DC Josephson effect, Engineering Applications: SQUID, Maglev Train, hyperloop, High Power Transmission.

NANOTECHNOLOGY: Introduction to nanotechnology, nanostructured materials, synthesis of nanoparticles: Mechanical Method - Ball Milling, Physical Vapor Deposition method. Properties of nanoparticles: optical, electrical, mechanical, magnetic. Applications of nanotechnology: electronics, automobile, energy, medical, Space and Defense, Environment.

Exemplars / Practical Applications and usage:

1. Quantum dots – Used in displays (QLED TVs).
2. Drug delivery – Nanoparticles target cancer cells precisely.
3. SQUID (Superconducting Quantum Interference Device) – Detects tiny magnetic fields (e.g., brain scans).
4. Maglev trains – Superconducting magnets enable frictionless movement.
5. Electronics – Spin valves, Semiconductors, components, Flat monitors etc.

Case Study:

1. Application of Superconductivity in Magnetic Levitation (Maglev) Trains, real-world example of superconductors in transport technology, Use of Gold Nanoparticles for Targeted Drug Delivery and Imaging in Cancer Therapy.

Quiz:

1. Solve MCQs using basic concepts of superconductivity and nanotechnology.

Course Projects:

-

Textbooks:

1. A Textbook of Engineering Physics, M. N. Avadhanulu, P. G. Kshirsagar & TVS Arun Murthy, S. Chand Publications.
2. Engineering Physics, R. K. Gaur and S. L. Gupta, Dhanpat Rai Publications.

Reference Books:

1. David Halliday, Robert Resnick, Jearl Walker, Fundamentals of Physics, Wiley, 10th Edition.
2. Ajoy Ghatak, Optics, Tata McGraw-Hill, 6th Edition.
3. Charles Kittel, Introduction to Solid State Physics, Wiley, 8th Edition.
4. A. K. Ghatak, S. Lokanathan, Quantum Mechanics, Laxmi Publications, 6th Edition.
5. Dr. S. K. Kulkarni, Nanotechnology: Principles and Practices, Capital Publishing, 3rd Edition.
6. Raymond A. Serway, John W. Jewett, Principles of Physics, Saunders College Publishing, 5th Edition.

MOOCs Links :

Optic Fibers

1. https://youtu.be/AdF5hFQ9P0o?si=uZrduczvXjhbtaPS
2. https://youtu.be/7Jo8svhWD7A?si=JOY5IkSCIaa_gINy
3. https://youtu.be/ougKUUM3hJA?si=aOEO7Oc6H0AgsIyx

LASER & Holography

4. https://youtu.be/zq_qFvvFLfY?si=d4T73v6johZ6jcpX
5. https://youtu.be/jbctJ0rVS6I?si=jDcl9QtQ91nfpbkH

Semiconductor Physics: Hall Effect

6. https://www.youtube.com/watch?v=Tt8zwiniSPc&t=6s
7. https://www.youtube.com/watch?v=YpdQF6N9C1w&t=1s
8. https://youtu.be/Pqxun4_nePo?si=bKB2WbLdFC5Mse0w

Fermi energy, Level & function

9. https://youtu.be/knVD1AfiozA?si=vdLzevfpWYvPREu_

Magnetism

10. https://youtu.be/78raYWFWv6s?si=VnvmpVWtwGrom2g9

Physics of nanoparticles

11. https://youtu.be/2dj7Y0Um4LE?si=_smjHbTbZzu_oHeS

Superconductivity

12. https://youtu.be/QRvTAUjnbt8?si=Y193SUOx8UaouSE3

Quantum Physics: Schrodinger's wave equation & applications

13. https://youtu.be/4BZ1IK_YIpM?si=ComqaepyR6AIAmXS

https://youtu.be/O5hXpm_Sy6c?si=Fm35lKuJtXQ11OCK

List of Practical

Experiment No.1	**Newton's Rings**	**2 Hrs.**	**CO1**

Objective: To understand the formation of Newton's Rings Phenomenon and to determine wavelength of monochromatic light.

Associated Tasks:

1. Set up the apparatus with a plano-convex lens and a glass plate, ensuring proper alignment.
2. Measure the diameters of the Newton's Rings at different points and calculate the wavelength of light using the ring diameters.

Exemplars and Utility:

1. Surface roughness measurement in optical manufacturing.
2. Determine the refractive index of liquid.

Experiment No.2	**Numerical Aperture of optical fiber**	**2 Hrs.**	**CO3**

Objective: To determine the numerical aperture [N.A.] of an optical fiber.

Associated Tasks:

1. Launch light into the fiber and observe the acceptance angle using a protractor or angular measurement setup.
2. Measure the maximum acceptance angle to calculate the N.A. using the relation Numerical Aperture = sin θ.

Exemplars and Utility:

1. Design of efficient optical communication systems.
2. Optimization of fiber optic sensors.

Experiment No.3	**Law of Malus**	**2 Hrs.**	**CO1**

Objective: To verify cosine square law of Malus for plane polarized light using Photodiode.

Associated Tasks:

1. Pass polarized light through a polarizer and rotate the analyzer to measure transmitted intensity at different angles.
2. Record the intensity values and plot the intensity versus angle to verify the cosine square law

Exemplars and Utility:

1. Developing liquid crystal displays (LCDs).
2. Designing polarized sunglasses and filters.

Experiment No.4	**Diffraction due to plane diffraction grating using laser**	**2 Hrs.**	**CO3**

Objective: To determine the number of lines per centimeter on a diffraction grating.

Associated Tasks:

1. Direct the laser beam onto the diffraction grating and measure the angular positions of diffraction maxima.
2. Calculate the line density of the grating using the diffraction formula.

Exemplars and Utility:

1. Wavelength calibration of spectrometers.
2. Laser tuning and wavelength selection.

Experiment No.5	**Energy gap of semiconductor**	**2 Hrs.**	**CO4**

Objective: To determine the band gap in given semiconductor sample using pn - junction diode

Associated Tasks:

1. Measure the reverse current with fall in temperature of the diode.
2. Plot the graph of ln(I) versus 1/T to extract the energy gap from the slope.

Exemplars and Utility:

1. Development of semiconductor devices like LEDs and solar cells.
2. Material characterization in semiconductor manufacturing.

Experiment No.6	**Hall effect**	**2 Hrs.**	**CO4**

Objective: To determine the Hall coefficients of given semiconductor sample.

Associated Tasks:

1. Apply a magnetic field perpendicular to the current flow and measure the Hall voltage.
2. Calculate the Hall coefficient and carrier concentration from the measurements.

Exemplars and Utility:

1. Material purity and doping level assessment
2. Magnetic field sensor development.

Experiment No.7	**Solar cell characteristics**	**2 Hrs.**	**CO4**

Objective: To obtain I-V characteristics and determine fill factor of given solar cell.

Associated Tasks:

1. Vary the load resistance and measure the corresponding current and voltage.
2. Plot the I-V curve and calculate the fill factor and efficiency.

Exemplars and Utility:

1. Designing efficient photovoltaic systems.
2. Evaluating the impact of environmental conditions on solar cells.

Experiment No.8	**Ultrasonic Interferometer**	**2 Hrs.**	**CO1**

Objective: Determination of compressibility of given liquid by using Ultrasonic Interferometer.

Associated Tasks:

1. Measure the wavelength of ultrasonic waves in given liquid using stationary waves.
2. Calculate the speed of sound in the liquid and determine its compressibility.

Exemplars and Utility:

1. Non-destructive testing of liquids and materials.
2. Medical ultrasonography advancements.

Experiment No.9	**Wavelength of Spectral lines**	**2 Hrs.**	**CO1**

Objective: To determine wavelength of light by using diffraction grating.

Associated Tasks:

1. Record the positions of spectral lines on the screen at different diffraction angles.
2. Calculate the wavelength using the diffraction formula and known grating line density.

Exemplars and Utility:

1. Spectroscopic identification of elements.
2. Applying spectrometric techniques in optical analysis.

Experiment No.10	**Determination of polarizing angle [Brewster's angle]**	**2 Hrs.**	**CO1**

Objective: To determine polarizing angle by using prism.

Associated Tasks:

1. Vary the angle of incidence on the prism and measure the reflected and transmitted intensities.
2. Find the angle at which reflected light is completely polarized, i.e., Brewster's angle.

Exemplars and Utility:

1. Reducing glare in optical systems.
2. Optical communication systems using polarized light.

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	-	-	-	1	2	2	2	-	2
CO2	2	3	-	-	-	-	-	-	-	-	2
CO3	2	2	-	-	-	1	2	2	-	-	2
CO4	2	2	-	-	-	2	2	2	2	-	2
CO5	2	1	-	-	-	1	-	-	-	-	2
Avg.	**2.00**	**2.00**	**-**	**-**	**-**	**1.25**	**2.00**	**2.00**	**2.00**	**-**	**2.00**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern							
BT Level	**CCE**						**ESE**
	CT1	CT2	Assignments	Course Project	Field Activity / Case Study	Quiz / presentation etc.	
K1	✓	✓	-	-	✓	✓	✓
K2	✓	✓	-	-	✓	-	✓
K3	✓	✓	-	-	✓	-	✓
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:
Electronics, materials science, energy systems, communication and sensing technologies, modern electronic and photonic devices, energy applications, smart materials, advanced instrumentation, computing, healthcare, environment, and sustainable engineering solutions.

Job Mapping:
-

Program:	**F. Y. B. Tech**	**Semester:**	**I / II**
Course:	**Engineering Chemistry**	**Course Code:**	**R25-SH-BSC-103**

Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit (TH+PR)**	**CCE**	**ESE**	**TW**	**PR**
03	02	-	03 + 01	40	60	25	-

Course Description:

This course introduces the fundamental principles of chemistry essential for engineering students and emphasizes their direct applications in various technological and industrial fields. It covers water quality analysis, electroanalytical techniques, batteries, polymers, nanomaterials, fuels, and corrosion science. Through theory, practical sessions, and problem-solving, students gain the ability to analyse chemical processes, understand material behaviour, and apply chemistry-based solutions to engineering challenges.

Course Relevance

The course is highly relevant as it bridges core chemical concepts with real-world engineering applications. Knowledge of water treatment, corrosion prevention, electrochemistry, fuel technology, and advanced materials plays a crucial role in industries such as energy, environment, manufacturing, and materials engineering. By integrating chemistry with engineering practices, this course prepares students to design sustainable processes, develop innovative materials, and contribute to advancements in technology and society.

Prerequisite:

Students are expected to be familiar with:

1. Fundamental knowledge of basic chemistry concepts studied at higher secondary level.
2. Understanding of atomic structure, periodic classification, and types of chemical bonding.
3. Familiarity with common chemical reactions, states of matter, and basic solution chemistry.
4. Ability to perform simple chemical calculations and interpret experimental observations.

Bridge Content:

1. Atomic Structure and Chemical Bonding – fundamental understanding of atoms, molecules, orbitals, and types of bonds to explain material properties.
2. Electrochemistry – basic electrochemical principles required for batteries, corrosion studies, and analytical techniques.
3. Basic Organic Chemistry – introduction to functional groups, polymerization, and reaction mechanisms relevant for materials and industrial applications.
4. Analytical Chemistry – fundamental techniques of qualitative and quantitative analysis that form the basis for water quality testing, fuel analysis, and material characterization.

Course Objectives:

1. **ACQUIRE** knowledge of water quality analysis technology.
2. **ACQUIRE** the knowledge of electro-analytical techniques for chemical analysis and precise and fundamentals of battery.
3. **RELATE** basic knowledge of polymers, nanomaterials and their application in engineering.
4. **STUDY** conventional and alternative fuels.
5. **UNDERSTAND** corrosion mechanisms and prevention methods.

Course Outcomes: After successful completion of the course, learner will be able to:		
CO	**Course Outcome**	**Bloom's Level**
CO1	**ILLUSTRATE** the technology involved in analysis, improving quality of water as commodity and its implementation.	**3**
CO2	**APPLY** appropriate electro analytical techniques for analysis of materials and demonstrate different types of batteries.	**3**
CO3	**DESCRIBE** the structure and properties of advanced engineering materials for various technological applications.	**3**
CO4	**ANALYZE** different types of conventional and alternative fuels with respect to their properties and applications.	**3**
CO5	**EXPLAIN** causes of corrosion and methods for minimizing corrosion.	**3**

Course Contents

Unit 1	**Water Technology**	**8 Hrs.**	**CO1**

Impurities in water, hardness of water: Types, Units and Numerical. Determination of hardness by EDTA method and alkalinity, numerical. Chemical oxygen demand (COD) of water and biological oxygen demand (BOD) of water. Ill effects of hard water in boilers and heat exchangers: Boiler corrosion, scale and sludge. Water treatment: (i) Zeolite method and numerical (ii) Demineralization method. (iii)Reverse osmosis. Modern technique for atmospheric water generation. (i) Using Dew point method (ii) Using heat exchanger technology.

Exemplars / Practical Applications and usage:

1. Industrial water treatment
2. Environmental monitoring
3. Public health and domestic use
4. Agricultural applications
5. Modern innovations for atmospheric water generation

Assignments:

1. Collect a local water sample and determine parameters such as hardness and alkalinity prepare a short report.
2. Visit a nearby water treatment or wastewater plant and prepare a case study report on the treatment processes used.

Unit 2	**Electroanalytical Techniques and Batteries**	**8 Hrs.**	**CO2**

Electrode potential, Nernst equation, Reference Electrode-Calomel electrode, Indicator electrode- Glass electrode, Conductometry: Conductometric titration of strong acid vs strong base. pH metry: pH metric titration of strong acid vs strong base. Batteries: Construction, working and applications of Li-ion battery and Na-ion battery. Fuel Cells: PAFC and PEMFC. UV-Visible spectroscopy: Lamberts-Beers Law. Terms in UV-visible spectroscopy. Electronic transitions. Instrumentation in UV-visible spectrophotometer. Applications of UV-visible spectroscopy.

Exemplars / Practical Applications and usage:

1. pH measurement used in pharmaceutical, food, and environmental industries.
2. Conductometry used in water quality testing, and monitoring ionic strength in industrial processes.
3. A battery is core technology in mobile phones, laptops, electric vehicles (EVs), and renewable energy storage systems.

4. Fuel Cells provide clean energy in automobiles.
5. UV-Visible Spectroscopy used chemical and material analysis.

Assignments:

1. Collect a local water sample and determine parameters such as conductance and pH.
2. Create a comparison table showing the characteristics (voltage, efficiency, cost, and applications) of a Li-ion battery and Na-ion battery.

Unit 3	**Advanced Engineering Materials**	**8 Hrs.**	**CO3**

Polymers: Introduction, Definition Polymer, Monomer, Functionality of monomers, Classification of polymer (Thermal Behavior-Thermoplastics and Thermosetting). Specialty polymers: Introduction, preparation, properties and applications of the following polymers: 1. Engineering Thermoplastic: Polycarbonate, 2. Bio-degradable polymers (PHBV) 3. Conducting Polymer: Polyacetylene. Polymer composites- Classification and Preparation. Ex. Carbon fiber reinforced composite.

Nanomaterials: Introduction, classification of nanomaterials based on dimensions (zero dimensional, one-dimensional, two-dimensional and three-dimensional). Structure, properties and applications of graphene and carbon nanotubes, quantum dots (semiconductor nanoparticles).

Exemplars / Practical Applications and usage:

1. Polymer used in plastic packaging, pipes, and containers.
2. Polymer composites aerospace components, sports equipment, automotive panels.
3. Nanomaterials in the solar cells, transistors, electronics and various engineering field.

Assignments:

1. Prepare a case study on the use of advanced materials in electric vehicles, aerospace components, or biomedical implants.
2. Collect and analyze material property datasets (e.g., tensile strength, conductivity, density etc.)

Unit 4	**Fuels**	**8 Hrs.**	**CO4**

Introduction (definition, classification of fuel based on chemical reactions and characteristics of an ideal fuel), Calorific value, Higher calorific value and Lower calorific value, Determination of calorific value of fuel using Bomb calorimeter and Boy's gas calorimeter and numerical. Alternative fuels: Power alcohol and biodiesel. Hydrogen gas as a future fuel: Preparation hydrogen by steam reforming of methane and coke. Difficulties in storage and transportation of hydrogen. Composition, properties and applications of CNG.

Exemplars / Practical Applications and usage:

1. Transportation
2. Power Generation
3. Industrial Processes
4. Domestic Use
5. Emerging Clean Energy

Assignments:

1. Explore the role of emerging fuels (such as green hydrogen, ammonia, or synthetic fuels) in meeting future energy demands.
2. Prepare a case study on the transition from conventional to renewable fuels (e.g., bioethanol blending in petrol or biodiesel in diesel engines).

Unit 5	Corrosion And Its Prevention	8 Hrs.	CO5

Introduction, Types of corrosion – Dry and Wet corrosion, mechanism of dry corrosion, nature of oxide films and Pilling-Bedworth's rule, wet corrosion – mechanism: hydrogen evolution and oxygen absorption, Factors influencing rate of corrosion. Methods of corrosion control and prevention: Cathodic Protection (Sacrificial Anode and Impressed Current), metallic coatings and its types, surface preparation, methods to apply metallic coatings-hot dipping, electroplating. Anti corrosive paints.

Exemplars / Practical Applications and usage:

1. Construction
2. Automobile
3. Marine Industry
4. Metallic pipelines
5. Chemical Industry

Case Study:

1. Prepare a case study on corrosion prevention in industries such as oil & gas, marine, or infrastructure sectors.

Quiz:

1. Solve the MCQ quiz on Corrosion and its prevention.

Course Projects:

-

Textbooks:

1. Dr. S. S. Dara, Dr. S. S. Umare, Textbook of Engineering Chemistry, S. Chand & Company Ltd. 2nd edition.
2. O. G. Palanna, Engineering Chemistry, Tata Magraw Hill Education Pvt. Ltd., 2nd edition.
3. Dr. Sunita Rattan, Textbook of Engineering Chemistry, S. K. Kataria& Sons Publisher, 3rd edition.

Reference Books:

1. S. M. Khopkar, *Basic Concept of Analytical Chemistry*, New Age-International Publisher, 2nd edition.
2. G. R. Chatwal& S. K. Anand, *Instrumental Methods of Chemical Analysis*, Himalaya Publishing House, 5th edition.
3. P. S. Kalsi, *Spectroscopy of organic compounds*, New Age-International Ltd., Publisher, 2nd edition.
4. V. R. Gowarikar, N. V. Viswanathan, Jayadev Sreedhar, *Polymer Science*, Wiley Eastern Limited, 5th edition.
5. Shriver and Atkins, *Inorganic Chemistry*, Oxford University Press, 5th edition
6. G. L. Hornyak, J. J. Moone, G. L. Hornyak, J. J. Moone, *Fundamentals of Nanotechnology*, CRC press, 1st edition.
7. Kirby W. Beard, Linden's Handbook of Batteries, McGraw Hill, 5th edition.

MOOCs Links and additional reading material:

Water Technology

1. https://www.youtube.com/results?search_query=water+technology+engineering+chemistry+sppu

Electroanalytical techniques

2. https://www.youtube.com/results?search_query=electroanalytical+techniques+and+batteries+engineering+chemistry

Polymers

3. https://www.youtube.com/results?search_query=polymer+technology+engineering+chemistry+sppu

Fuels

4. https://www.youtube.com/results?search_query=fuels++engineering+chemistry

Corrosion

5. https://www.youtube.com/results?search_query=corrosion+engineering+chemistry

List of Practical			
Experiment No.1	**To determine hardness of water by EDTA method**	**2 Hrs.**	**CO1**

Objective: To understand the concept of water hardness and its importance in daily life and industry.

Associated Tasks:

1. Collect water from various regions.
2. Analysis of water.

Exemplars and Utility:

1. Industrial Water Treatment: Monitoring hardness helps in scaling prevention in boilers and cooling systems.
2. Environmental Monitoring: Assessing water quality in natural bodies and wastewater treatment.

Experiment No.2	**To determine alkalinity of water**	**2 Hrs.**	**CO1**

Objective: To understand the concept of alkalinity in water and its significance in water quality.

Associated Tasks:

1. Collect water from various regions.
2. Analysis of water.

Exemplars and Utility:

1. Industrial Process Control: Monitoring alkalinity is essential in industries like brewing, chemical manufacturing, and paper production to ensure product quality and prevent equipment scaling.
2. Water Quality Assessment: Determining alkalinity helps in evaluating the buffering capacity of water, which is crucial for maintaining stable pH levels in various applications.

Experiment No.3	**Titration of a mixture of weak acid and strong acid with strong base using conductometer**	**2 Hrs.**	**CO2**

Objective: To learn how to perform titration of a mixture containing both weak and strong acids using a strong base.

Associated Tasks:

1. Preparation of acids or base solutions of different concentrations.
2. Measurement of conductance of various solutions.

Exemplars and Utility:

1. Accurate determination of acid concentrations
2. Study of Acid-Base strength and behavior

Experiment No.4	**To determine strength of strong acid using pH meter**	**2 Hrs.**	**CO2**

Objective: To calculate the molarity (strength) of the acid solution from the pH data.

Associated Tasks:

1. Preparation of acids or base solutions of different concentrations.
2. Measurement of pH of various solutions.

Exemplars and Utility:

1. Monitoring Acid-Base reactions
2. Educational demonstrations

Experiment No.5	**To determine maximum wavelength of absorption of CuSO4 verify Beer's law and find unknown concentration of given sample**	**2 Hrs.**	**CO2**

Objective: To understand and verify Beer's Law by studying the relationship between absorbance and concentration.

Associated Tasks:

1. Prepare a standard solution of $CuSO_4$ with known concentration.
2. Record the absorbance values across this range.

Exemplars and Utility:

1. Quantitative analysis of concentration of solutions.
2. Determining the maximum absorption wavelength of given solution.

Experiment No.6	**Preparation of phenol-formaldehyde/urea-formaldehyde resin**	**2 Hrs.**	**CO3**

Objective: To gain hands-on experience in handling chemicals and controlling reaction parameters safely.

Associated Tasks:

1. Compare the two types of resins in terms of applications and chemical structure.
2. Identify the type of polymerization involved.

Exemplars and Utility:

1. Used in the manufacturing of molded products such as electrical insulators, handles, and automotive parts.
2. Predominantly used as a binder in the production of particleboard and plywood.

Experiment No.7	**To determine molecular weight of polyvinyl alcohol by viscosity measurement**	**2 Hrs.**	**CO3**

Objective: To understand the relationship between viscosity and molecular weight of polymers.

Associated Tasks:

1. Study and summarize the concept of viscosity and its relation to molecular weight.
2. Calculate the relative viscosity and specific viscosity for each concentration.

Exemplars and Utility:

1. Determining molecular weight
2. Quality Control

Experiment No.8	**To coat copper, nickel and zinc on an iron plate using electroplating**	**2 Hrs.**	**CO5**

Objective: To study the effect of process parameters like current, time, and electrolyte concentration on plating quality.

Associated Tasks:

1. Study the electrochemical reactions for plating copper, nickel, and zinc.
2. Set up the electroplating cell with power supply, electrodes, and electrolyte.

Exemplars and Utility:

1. Corrosion protection
2. Enhanced durability

Experiment No.9	**Proximate analysis of fuel**	**2 Hrs.**	**CO4**

Objective: This analysis is essential for evaluating fuel quality, optimizing combustion processes, and ensuring efficient energy production.

Associated Tasks:

1. Sample Preparation
2. Determination of various content

Exemplars and Utility:

1. Process optimization & control
2. Environmental impact & compliance

Experiment No.10	**Determination of Chemical oxygen (COD) demand of water sample**	**2 Hrs.**	**CO1**

Objective: COD measures the total amount of oxygen required to oxidize both biodegradable and non-biodegradable organic substances in a water sample, reflecting the overall organic pollutant load.

Associated Tasks:

1. Reagent & solution preparation
2. Sample digestion

Exemplars and Utility:

1. Pollution assessment & environmental protection
2. Regulatory compliance & discharge management

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	1	-	3	1	2	1	-	2
CO2	2	3	2	1	-	2	1	1	1	-	2
CO3	3	2	2	-	-	2	-	2	-	-	2
CO4	2	3	1	-	-	2	1	2	-	-	2
CO5	3	3	2	1	-	2	-	1	-	-	2
Avg.	**2.60**	**2.80**	**1.80**	**1.00**	**-**	**2.20**	**1.00**	**1.60**	**1.00**	**-**	**2.00**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Assignments	Course Project	Field Activity / Case Study	Quiz / presentation etc.	
K1	✓	✓	-	-	✓	✓	✓
K2	✓	✓	-	-	✓		✓
K3	✓	✓	-	-	✓		✓
K4		-	-	-	-	-	-
K5		-	-	-	-	-	-
K6		-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

Engineering Chemistry forms a vital foundation for all branches of engineering by linking basic chemical principles with technological applications. In Mechanical and Automation & Robotics Engineering, it aids in understanding fuels, lubricants, corrosion prevention, and materials used in engines and vehicles. For Civil Engineers, it provides insights into cement chemistry, water treatment, corrosion of steel reinforcement, and modern construction materials. In Electrical, Electronics & Telecommunication and Electronics & Computer Engineering, it supports the study of electrochemical cells, batteries, semiconductors, and corrosion control of conductors. Engineering Chemistry is fundamentally connected with every branch of engineering, including Computer Engineering, Artificial Intelligence & amp; Data Science and Information Technology. It provides the scientific basis for understanding materials, energy systems, and environmental sustainability relevant to computational and intelligent technologies.

Job Mapping: -

Program:	**F. Y. B. Tech**		**Semester:**	**I / II**			
Course:	**Systems of Mechanical Engineering**		**Course Code:**	**R25-ME-ESC-104**			
Teaching Scheme (Hrs./week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
03	-	-	03	40	60	-	-

Course Description:

This course introduces students to the foundational concepts of mechanical engineering systems, providing a broad understanding of key domains such as design engineering, thermal systems and heat transfer, manufacturing processes, automobile systems, and power plant engineering. Through conceptual learning, real-life examples, and system-level thinking, students will explore how mechanical components and subsystems function individually and in integration. The course not only lays the groundwork for advanced engineering subjects but also helps students appreciate the interdisciplinary nature of modern engineering solutions.

Course Relevance:

Mechanical engineering plays a pivotal role in the design and operation of physical systems that underpin all branches of engineering. A basic understanding of these systems benefits students from all disciplines by enhancing their ability to analyze and contribute to the development of physical and integrated systems. This foundational knowledge supports participation in interdisciplinary work involving technologies like IoT, automation, and robotics, while also nurturing problem-solving skills and engineering intuition. The course highlights mechanical engineering's critical role in industries such as aerospace, energy, healthcare, construction, and product development, preparing students to collaborate and innovate across diverse engineering domains.

Prerequisite:

Basic Physics for understanding mechanics, energy systems, and machine elements.

Basic Mathematics for analyzing motion, forces in mechanisms, and solving simple design problems.

Understanding of 2D/3D views, simple orthographic projections to visualize mechanisms, assemblies, machine elements and mechanical systems.

Bridge Content:

This syllabus bridges the gap between the basic science concepts learned in 12^{th} grade and their advanced applications in engineering. It helps students transition from theoretical understanding to practical problem-solving in mechanical and thermal systems.

Course Objectives:

1. **DEVELOP** an understanding of machine elements, mechanisms, and design principles used in real-world engineering systems.
2. **ENABLE** students to understand the fundamentals of thermal systems by exploring the core principles of thermodynamics, heat transfer, refrigeration, and air conditioning, with an emphasis on their practical applications in various engineering fields.
3. **EQUIP** students with fundamental knowledge of conventional and unconventional manufacturing processes and their applications.
4. **INTRODUCE** first-year engineering students to the fundamentals of automobile and engine technologies, and build foundational knowledge of electric vehicles (EVs).
5. **INTRODUCE** the fundamental concepts of energy sources, working principles of conventional and renewable power generation technologies, environmental impacts, and the importance of green energy systems for a cleaner future.

Course Outcomes: After learning the course, students will be able to

CO	Course Outcome	Bloom's Level
CO1	**EXPLAIN** the functions of basic machine and power transmission elements such as shafts, keys, bearings, couplings, and drives.	**2**
CO2	**DESCRIBE** the fundamental principles of thermal systems, encompassing thermodynamic concepts, heat transfer modes, and the operation of basic refrigeration and air conditioning systems.	**2**
CO3	**DEMONSTRATE** an understanding of conventional and unconventional manufacturing processes.	**2**
CO4	**UNDERSTAND** the basic working principles and classifications of IC engines and automobiles, and **DEMONSTRATE** awareness of emerging vehicle technologies.	**2**
CO5	**IDENTIFY** various energy sources, their working principles, environmental impacts, and emerging trends in sustainable power generation.	**2**

Course Contents

Unit 1	Fundamentals of Design Engineering	7 Hrs.	CO1

Design Engineering: Importance of design in real-world engineering, Shigley's Design Process, Design Thinking Process.

Machine and Power Transmission Elements: Classification, functions, and practical applications of fundamental machine elements such as shafts, axles, keys, bearings, and couplings. Types of drives: Belt, Chain and Gear drives. Introduction to clutch and brakes, ABS & EBD.

Mechanisms: Introduction to mechanisms, links and joints, Four-Bar Chain and Its Inversions.

Exemplars / Practical Applications and usage:

Engines, structures, robots, drones, consumer appliances, cycles, mixers, machine tools, toys, compressors Linkage systems in bicycles, sewing machines, engines, windshield wiper, automatic door closers and automation.

Unit 2	Thermal Systems	6 Hrs.	CO2

Concept of a system, types of systems, energy interactions: heat and work, First law of thermodynamics & its limitations. Second laws of thermodynamics (simple numericals).

Modes of Heat Transfer, Basic Terminology: Heat, temperature, thermal conductivity, heat flux, etc.

Fourier's Law, Thermal conductivity: concept and examples of materials;

Newton's Law of Cooling, Basic concept of thermal radiation and Stefan-Boltzmann Law.

Definition of Refrigeration, Concept of COP, Simple Refrigeration Cycle (vapor compression), Common refrigerants, Insulating materials.

Basics of Air Conditioning: Definition and necessity, Comfort conditions, Types of Air Conditioning Systems (central, split, window),

Exemplars / Practical Applications and usage:

Applications of heat transfer in daily life and engineering (e.g., heat exchangers in process industries, cooling of electronics components, building insulation, thermal management of batteries, radiators in cars for engine cooling, thermal protection systems.

Applications of Refrigeration like Domestic refrigerator, Cold storage and Industrial and transport refrigeration Applications: homes, offices, vehicles, data centers.

Unit 3	Manufacturing Processes	6 Hrs.	CO3

Introduction to manufacturing processes and their importance in engineering and industry, Classification and applications.

Introduction to Conventional Manufacturing Techniques such as Casting Processes, Metal Forming Processes, Machining and Metal Cutting, Metal Joining Techniques and Sheet Metal Working.
Definition and need for non-conventional manufacturing processes and Comparison with conventional manufacturing techniques; basic concept of Electrical Discharge Machining (EDM) and Laser beam machining, Introduction to 3D printing, additive manufacturing, CNC.

Exemplars / Practical Applications and usage:
Use of casting process in automobile engine blocks, pumps, and valve bodies manufacturing; use of Metal Forming Processes (e.g., forging, rolling, extrusion) in rail, construction, and automotive industries, use of machining in precision components such as gears, tool dies, and aerospace parts; use of metal joining in automobile body assembly, pipeline construction, bridge fabrication, electronics assembly; prototyping for rapid development of design concepts, Customized prosthetics and implants

Unit 4	**Automobile Engineering**	**6 Hrs.**	**CO4**

Introduction to Internal Combustion (IC) engines, Engine terminology, including the working principles of Spark Ignition (SI) and Compression Ignition (CI) engines (Two stroke & Four stroke), along with their classifications. Overview of automobile classifications and specifications of two-wheelers, four-wheelers, and multi-axle vehicles. Chassis layouts and types of drive systems. Fundamental concepts of electric vehicles (EVs), their environmental significance, construction, and working principles. Introduction to hybrid electric vehicles, autonomous vehicles, and hydrogen fuel cell technology; challenges, current trends, and future scope of electric and alternative energy vehicles.

Exemplars / Practical Applications and usage:
Two-wheelers: Scooters and Motorbikes used for personal and delivery transport; Four-wheelers: Hatchbacks, sedans, SUVs for private, commercial, and utility purposes; Multi-axle Vehicles: Transport of heavy goods (e.g., 10-wheeler trucks used in logistics and mining).
Front Engine Front Wheel Drive (FF-FWD), Front Engine Rear Wheel Drive (FR-RWD), Rear Engine Rear Wheel Drive (RR-RWD), All-Wheel Drive (AWD) / Four-Wheel Drive (4WD)
Passenger EVs, Electric Two-Wheelers, Electric Buses and Delivery Vans, Charging Infrastructure.
Self-driving Cars and ADAS Systems.

Unit 5	**Power Plants and Green Energy**	**6 Hrs.**	**CO5**

Classification: Renewable vs Non-Renewable, Global and national energy scenario, Need for sustainable energy solutions.
Introduction, components, working, environmental impact of conventional power plants such as thermal power plant, hydroelectric power plant, nuclear power plant.
Introduction, components, working of renewable and green energy technologies such as solar energy, wind energy, biomass and bioenergy & geothermal and tidal energy.
Environmental Impact (emission and carbon foot print) and Energy Conservation, climate change
Future trends in green energy: Hydrogen as a fuel, Carbon capture and storage.

Exemplars / Practical Applications and usage:
Power generation for cities and industries (e.g., Eklahare Thermal Power Station, SMBST Sugar Factory Co-generation power plant); hydro dams (e.g., Bhandardara, Koyana, Bhakra Nangal Dam), Large-scale nuclear power plants (Tarapur, Kakrapar, Kaiga, Kudankulam Atomic Power Station), Rooftop solar panels in residential buildings and agriculture purpose; Wind farms, hybrid solar-wind systems in coastal and desert regions; Bio-digesters and Biomass power plants (Rajhans).

Assignments:
Prepare a comparative analysis of at least one conventional power plant (e.g., thermal, nuclear, hydroelectric) and

one renewable/green energy systems (e.g., solar, wind, biomass) considering basic components and working principles of each system, fuel sources and energy conversion process, efficiency and operational characteristics, environmental impacts (e.g., emissions, land use, waste) and future potential and role in sustainable energy transition.

Visit to Roof Top Solar Power Plant / Cogeneration Power Plant.

Course Projects:

Students are encouraged to undertake a course project that enables them to apply the foundational knowledge gained in design engineering, thermal systems and heat transfer, manufacturing methods, automobile systems, and power plant engineering.

The objective of the project is to analyze, model, or study a real-world mechanical system, exploring how different subsystems integrate and function collectively in actual applications. Through this project, students will develop a basic yet practical understanding of system operation, efficiency, and its relevance in the context of modern engineering challenges.

The project can take various forms, such as a physical or digital prototype, virtual simulation, data analysis, comparative study of different mechanical systems, or research-based work. Additionally, students are encouraged to explore the application of emerging technologies like Artificial Intelligence (AI), the Internet of Things (IoT), and automation within mechanical systems, promoting innovation and interdisciplinary learning.

Textbooks:

1. V B Bhandari, Design of Machine Elements, Tata McGraw-Hill Publisher Co. Ltd.
2. R.S. Khurmi & J.K. Gupta, Machine Design, S. Chand Publishing.
3. Nag P. K, Engineering Thermodynamics, Tata McGraw-Hill Publisher Co. Ltd.
4. Khurmi, R.S., and Gupta, J. A Textbook of Thermal Engineering, K, S. Chand & Sons
5. P. K. Nag., Basic and Applied Thermodynamics (Different edition focused more on applications), Tata McGraw-Hill Publisher Co. Ltd.
6. Chaudhari and Hajra, Elements of Workshop Technology, Volume I and II, Media Promoters and Publishers, Mumbai3.
7. P.N. Rao, Manufacturing Technology – Vol-I &II, McGraw Hill Education.
8. Kripal Singh, Automobile Engineering, Vol-I &II, Standard Publishers Distributors.
9. M.L. Mathur & R.P. Sharma, Internal Combustion Engines, Dhanpat Rai & Sons.
10. G D Rai, Non-conventional energy sources, Khanna publication, New Delhi.
11. D.P. Kothari, K.C. Singal, Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI Learning.

Reference Books:

1. Richard G. Budynas & J.K. Nisbett, Shigley's Mechanical Engineering Design, Tata McGraw-Hill Publisher Co. Ltd.
2. Robert C. Juvinall & Kurt M. Marshek, Machine Component Design, Wiley India.
3. Ganeshan, V., Internal Combustion Engines, McGraw Hill
4. Jack Erjavec, Automotive Technology – A Systems Approach, Cengage Learning.
5. R.K. Rajput, Manufacturing processes, Laxmi Publications Pvt. Ltd.
6. P.C. Sharma, Production Technology, S. Chand Publishing.
7. Anderson, Curtis Darrel and Anderson, Judy, Electric and Hybrid Cars: A History, 2nd Ed., McFarland.
8. Boyle, Godfrey, Renewable Energy,2nd Ed., Oxford University Press
9. S.P. Sukhatme, Electric Vehicles and Renewable Energy, Universities Press

MOOC Links:

1. Keys and Couplings: https://www.scribd.com/document/632631388/MODULE-3-Keys-and-Couplings
2. Keys and Couplings: https://www.scribd.com/document/632631388/MODULE-3-Keys-and-Couplings
3. Laws of thermodynamics: https://onlinecourses.nptel.ac.in/noc21_me07/preview
4. Manufacturing Process: https://www.coursera.org/learn/manufacturing-processes
5. Electric Vehicles: https://onlinecourses.swayam2.ac.in/ntr25_ed127/preview
6. Hybrid vehicles: https://innovationspace.ansys.com/product/electric-and-hybrid-vehicles
7. EHV: .https://www.coursera.org/learn/hybrid-electric-vehicles-technical-system
8. Green Energy: https://www.prozealgreen

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	1	1	-	-	-	-
CO2	2	1	-	-	3	2	2	-	-	-	-
CO3	2	-	-	-	2	1	1	-	-	-	-
CO4	2	-	-	-	2	2	2	-	-	-	-
CO5	2	-	-	-	2	2	3	-	-	-	-
Avg.	**2**	**1**	**-**	**-**	**2.25**	**1.6**	**1.8**	**-**	**-**	**-**	**-**

Note : Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Assignments	Course Project	Field Activity / Case Study	Quiz/ presentation	
K1	✓	✓	-	-	-	-	✓
K2	✓	✓	✓	✓	-	-	✓
K3	-	-	-	-	-	-	-
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

Machine Design, Strength of Materials, Engineering Thermodynamics, Applied Thermodynamics, HVAC, Advanced manufacturing processes, IC Engines and Automobile engineering, Power plant engineering.

Job Mapping:

Job opportunities that one can get after learning this course:

1. Technical Assistant / Technician Trainee: Basic machine operations, CAD drawing support, Workshop/lab assistant roles
2. Manufacturing/Production Helper: Roles in small manufacturing firms, Machine shop assistant, Assembly line work
3. Apprenticeships / Internships: Many industries offer ITI-level apprenticeships for candidates with basic technical knowledge, PSU apprentice schemes under the National Apprenticeship Promotion Scheme (NAPS)
4. Field Technician: Jobs in installation and maintenance of machinery, HVAC, plumbing, or mechanical services for buildings.
5. Customer Service Support (Technical): Call center support for mechanical tools or software, Sales assistant in hardware/tool shops.

Program:	**F. Y. B. Tech**			**Semester:**		**I/II**	
Course:	**Engineering Mechanics and Civil Engineering Systems**			**Course Code:**		**R25-CE-ESC-105**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
03	-	-	3	40	60	-	-

Course Description:

This course introduces the foundational concepts of Engineering Mechanics and Civil Engineering systems essential for all branches of Engineering. The Engineering Mechanics component covers principles related to force systems, equilibrium, structural analysis, friction, and dynamics.

The Civil Engineering Systems component provides a broad overview of infrastructure systems such as transportation networks, water supply, waste management, and structural systems. It emphasizes the role of systems thinking in planning, designing, and managing civil engineering projects, integrating multidisciplinary approaches.

Course Relevance:

The Engineering Mechanics component provides the fundamental analytical skills required across Civil and Mechanical Engineering disciplines. The Civil Engineering Systems component broadens the student's perspective beyond their specific discipline, emphasizing context and integration.

Prerequisite:

Basic calculus, Trigonometry, Geometrical expressions, Laws of motion, Concept of mass and acceleration, fundamental knowledge of Engineering Mathematics, Physics and environmental studies.

Bridge Content:

Newton’s First law, Newton’s second law of motion.

Course Objectives:

1. To **ENABLE** students to understand and apply the fundamental principles of statics by analyzing force systems, their resolutions, compositions and resultant; to develop the ability to determine moments, couples and centroids and to gain theoretical knowledge of moment of inertia.
2. To **DEVELOP** the ability to analyze and apply fundamental principles of equilibrium in engineering systems and to build competence in solving problems related to friction and truss.
3. To **DEVELOP** fundamental understanding of the motion of particles and the forces governing them by studying the principles of kinetics and kinematic.
4. To **PROVIDE** students with a comprehensive understanding of various Civil Engineering systems and to familiarize students with modern surveying technologies.
5. To **INTRODUCE** students a smart city concept, modern technologies and essential Civil Engineering software for efficient planning, design, and management of infrastructure projects.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom’s Level**
CO1	**UNDERSTAND** the principles of statics to determine the resultant of different force systems and understand the concepts of moment, couple, centroid, and moment of inertia of plane areas	**2**
CO2	**EXPLAIN** the conditions of equilibrium for different force systems, types of supports and beams, and demonstrate understanding of basic friction and truss analysis concepts.	**2**
CO3	**ANALYZE** rectilinear motion and Projectile motion of particles, apply	**3**

	Newton's second law, impulse momentum principles for particles	
CO4	**EXPLAIN** various civil engineering systems such and explain the working principles and applications of smart surveying technologies like Total Station, GPS, drones, and LIDAR.	**2**
CO5	**UNDERSTAND** the concept of smart cities and emerging technologies in civil engineering, including AI, BIM, IoT, and 3D printing, and describe the basic applications of civil engineering software such as AutoCAD, REVIT, STAAD Pro, ETABS, and Tekla Structures.	**2**

Course Contents

Unit 1	**Force Systems, Centroid and Moment of Inertia**	**8 Hrs.**	**CO1**

Force and Force System: Introduction, fundamental concepts and principles of statics, force and force system, resolution and composition of forces, resultant of concurrent force system, moment of a force, Varignon's theorem, resultant of parallel force system, couple and resultant of general force system.
Centroid and MI: Moment of area, centroid of plane lamina, Moment of Inertia (only theory).

Exemplars / Practical Applications and usage:
The above content is practically used to analyze and design stable structures by determining force effects, locating centroids, and estimating resistance to bending in beams and other structural elements.

Assignments:
Theory questions :
Example:
1) Explain different types of force systems
2) State and explain Varignon's theorem with neat sketch
3) Identify two real-life engineering structures (bridges, cranes, towers, etc.) where:
4) a) Force systems are applied b) Centroid and Moment of Inertia concepts are important
Numerical Examples:
1) Three coplanar forces of 100 N, 150 N, and 200 N act at a point with mutual angles of 120°. Find the resultant force.
2) A horizontal beam 6 m long carries two parallel forces: 40 N upward at one end and 60 N downward at the other. Determine the resultant force and its position on the beam.

Unit 2	**Equilibrium, Friction and Analysis of Truss**	**8 Hrs.**	**CO2**

Equilibrium: Introduction, free body diagram, equilibrium of coplanar forces, equilibrium of two forces, three force principle, equilibrium of concurrent, parallel and general force system, type of load, type of support, type of beam and support reaction.
Friction and Analysis of Truss: Friction, Block and Belt friction, two force member, Analysis of truss by method of joint and Method of section.

Exemplars / Practical Applications and usage:
The concepts of equilibrium, friction, and truss analysis are practically used to determine support reactions, ensure structural stability

Assignments:
Theory questions:
Example**:** 1) What is a Free Body Diagram (FBD)? Why is it important in solving mechanics problems?
2) What are different types of loads acting on beams? Explain with neat sketches.
3) Explain the role of friction in engineering systems with examples
4) Write down the rules to identify zero force members of truss.

Numerical Example: 1

1) A beam of 6 m span is simply supported at both ends and carries a point load of 20 kN at midspan. Find the support reactions.
2) A smooth block of weight 100 N rests on a horizontal surface. A horizontal force of 30 N is applied. If the coefficient of friction is 0.3, determine whether the block will move.
3) Numerical based on method of joint and method of section.

Unit 3	**Kinematics and Kinetics of Particles**	**8 Hrs.**	**CO3**

Kinematics of Particles: Introduction, basic concept, rectilinear motion: motion with uniform acceleration, gravitational acceleration and variable acceleration, projectile motion, curvilinear motion Normal and Tangential, Radial and transverse coordinate system (only concept).

Kinetics of particle: Introduction, Newton's second law of motion, application of Newton's second laws to rectilinear motion, curvilinear motion, law of conservation of momentum, impulse momentum principle and impact, work energy principle.

Exemplars / Practical Applications and usage:

These concepts are practically used to analyze the motion of vehicles, projectiles, and mechanical components for safe and efficient design.

Assignments:

Theory questions:

Example:

1) State the equations of motion for a particle under constant acceleration.
2) What is uniform acceleration? How does it differ from variable acceleration?
3) Define impulse and impulse-momentum principle.

Numerical Examples:

1) A particle of mass 1.5 kg moves under a variable force F=6tF = 6tF=6t N. Find the work done by the force from t = 0 to t = 4 s.
2) A particle is projected at 20 m/s at an angle of 30° to the horizontal. Find: Time of flight, Maximum height, Horizontal range

Unit 4	**Civil Engineering Systems**	**8 Hrs.**	**CO4**

Types of Civil Engineering Systems: Introduction to systems in Civil engineering, definition, importance, Structural Systems (beams, columns, and frames), Transportation Systems (road networks, traffic flow), Water & Environmental Systems (water supply, drainage, and wastewater), and Geotechnical Systems (foundations and its types).

Smart Surveying Technology: Introduction, components and applications of Auto level, Total Station, GPS surveying, Drone surveying, 3D Laser scanner (LIDAR).

Exemplars / Practical Applications and usage:

The knowledge of civil engineering systems and smart surveying technologies is practically used to plan, design, and manage infrastructure projects accurately and efficiently using advanced tools

Assignments:

Example: 1) Enlist various systems in Civil Engineering and explain its importance.
2) Explain the working principle of a Total Station.
3) How is GPS used in Civil Engineering surveying?
4) Describe the applications of Drone surveying and 3D Laser Scanner (LIDAR).

Unit 5	Emerging Trends in Civil Engineering	8 Hrs.	CO5

Smart cities: Introduction, definition, Concept of smart Cities, AI in Civil engineering, Building Information modeling (BIM), IOT in infrastructure, 3D printing in Civil engineering.

Software in Civil Engineering: Basics of software, classification and applications of Auto CAD, REVIT architecture, STADD Pro, ETABS, TEKLA Structure.

Exemplars / Practical Applications and usage:

The concepts of smart cities and civil engineering software are practically used to design intelligent infrastructure, enhance construction efficiency, and improve project management through tools like BIM, IOT, AI, and CAD-based applications

Assignments:

Example: 1) Classify Civil Engineering software based on their applications.

2) Define a smart city and explain its importance in modern infrastructure development.

3) What are the key concepts and components of a smart city?

Course Projects:

-

Textbooks:

1. Ferdinand Singer, "Engineering Mechanics", Harper and Row, 3rd edition.
2. Hibbeler R.C., "Engineering Mechanics (Statics and Dynamics)", Pearson Education, 15th edition.

Reference Books:

1. S Timoshanko and Young, "Engineering Mechanics", Tata McGraw Hill Education Pvt. Ltd. New Delhi, 5th edition.
2. Beer and Johnston, "Vector Mechanics for Engineers – Statics", Tata McGraw Hill Education Pvt. Ltd. New Delhi, 12th edition.
3. Beer and Johnston, "Vector Mechanics for Engineers – Dynamics", Tata McGraw Hill Education Pvt. Ltd. New Delhi, 12th edition.
4. Meriam J. L. and Kraige L.G , "Engineering Mechanics - Statics and Dynamics", John Wiley and Sons publication, 9th edition (Global/Indian Adaptation).
5. Dr. L. R. Kadiyali, "Transportation Engineering: Planning, Design, and Operations", Khanna Publishers, 1st edition.
6. Dr. B. C. Punmia & Dr. Ashok Kumar Jain, "Water Supply Engineering", Laxmi Publications, 2nd edition.
7. Dr. K. R. Arora, "Soil Mechanics and Foundation Engineering". Bharatiya Book Corporation, 7th Edition.
8. Dr. R.N. Tiwari & A.K. Jain, "Smart Cities: Vision and Action", Discovery Publishing House, 1st edition.
9. Sham Tickoo, "AutoCAD 2024 for Engineers and Designers", Purdue Univ**.** Dreamtech Press India, 1st edition.
10. S.S. Bhavikatti, "Structural Analysis Vol. II", Vikas Publishing House, 5th edition

MOOCs Links and additional reading material:

1. https://onlinecourses.nptel.ac.in/noc21_me70/preview.
2. https://onlinecourses.nptel.ac.in/noc24_me148/preview.
3. Smart city- Sarvansathi (Marathi Edition Nov. 2016) by Sulakshana Mahajan.
4. Asavi Sundar Shahare Apuli Chan (Marathi Edition Jan. 2015) by Sulakshana Mahajan.

Strength of CO-PO Mapping											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	2	1	1	1	-	-	-	-	-	1
CO2	3	3	2	2	1	-	-	-	-	-	1
CO3	3	3	2	2	1	-	-	-	-	-	1
CO4	3	2	2	2	3	1	-	-	-	-	2
CO5	3	2	3	2	3	2	-	1	1	2	3
Avg.	**3**	**2.4**	**2**	**1.8**	**1.8**	**1.5**	**-**	**1**	**1**	**2**	**1.6**

Note : Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern							
BT Level	**CCE**						**ESE**
	CT1	**CT2**	**Assignments**	**Course Project**	**Field Activity / Case Study**	**Quiz/ presentation**	
K1	√	√	√	-	-	-	√
K2	√	√	√	-	-	-	√
K3	√	√	√	-	-	-	√
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

Engineering Mechanics and Civil Engineering Systems course forms the foundation for several advanced and applied Engineering courses. Here is a list of future courses.

1. Mechanics of Structures: Applies concepts of force, stress, moment, and equilibrium to material behavior.
2. Theory of Machines: Builds on kinetics and kinematics of particles for mechanisms and linkages.
3. Machine Design: Uses principles of static and dynamic equilibrium to design machine elements.
4. Dynamics of Machinery: Directly extends particle motion concepts to rotating and oscillating systems.
5. Structural Analysis: Understanding of structural systems (beams, columns, frames).
6. Construction Technology: Role of 3D printing, BIM, and smart planning tools.

Job Mapping:

Job opportunities that one can get after learning this course:

3. Design Engineer / Structural Engineer: Apply Mechanics principles to analyze loads, forces, and stresses in structures and components.
4. Construction Engineer / Site Engineer: Use Mechanics to understand stability, safety, and material behavior in real-world construction.
5. CAD/CAE Analyst: Use Mechanics knowledge with simulation software for structural and motion analysis.
6. Research and Development Engineer: Develop innovative solutions by applying Mechanics to new materials and systems.

Program:	**F. Y. B. Tech**			**Semester:**		**I / II**	
Course:	**Fundamentals of Electrical Engineering**			**Course Code:**		**R25-EE-ESE-106**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credits(TH+PR)**	**CCE**	**ESE**	**TW**	**PR**
02	02	-	2 + 1	40	60	25	-

Course Description:

This course provides foundational knowledge in electrical engineering, covering the basic principles of DC and AC circuits, magnetism, electromagnetic induction, transformers, and electric vehicles. It also introduces students to practical aspects such as domestic wiring, protection devices, and earthing, enabling a strong understanding of how theoretical principles are applied in real-world electrical systems.

Course Relevance:

The course is essential for building a solid base in core electrical concepts that are fundamental to all branches of engineering. By connecting classical electrical theory with modern applications like electric vehicles and energy systems, it prepares students to understand, analyze, and apply electrical engineering principles in both traditional and emerging technological contexts.

Prerequisite:

Atomic structure, Electric charges, Coulomb's laws.

Bridge Content:

Basic knowledge of physics (current, voltage, resistance, magnetism) and mathematics (algebra, trigonometry) for circuit analysis. Familiarity with simple DC circuits, household electrical systems, and basic electrical safety practices.

Course Objectives:

1. **EQUIP** the students with essential knowledge in electrical engineering and emphasizing on analysis of DC circuits
2. **UNDERSTAND** the basic principles of magnetism and electromagnetic induction.
3. **INCULCATE** the fundamental knowledge of AC circuit.
4. **DISPENSE** basics of transformer and electric vehicles.
5. **FAMILIARIZE** students with domestic electrical wiring system, protection devices and earthing.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**APPLY** Kirchhoff's Laws and network simplification techniques for DC circuit analysis.	**3**
CO2	**UNDERSTAND** the magnetic circuit parameters, self-Inductance, mutual Inductance and Electromotive Forces	**2**
CO3	**COMPUTE** the fundamental parameter of AC circuits.	**3**
CO4	**UNDERSTAND** the basics of single-phase transformers and key concepts of electric vehicles	**2**
CO5	**UNDERSTAND** different wiring systems along with their safety devices.	**2**

Course Contents

Unit 1	**Fundamental Concepts and DC Circuits**	**5 Hrs.**	**CO3**

Fundamental concepts: Resistance, EMF, current, Electric potential, potential difference, Ohm's law, Effect of temperature on resistance of various materials, RTC.

DC Circuits: Classification of electrical networks, simplifications of networks using series-parallel

Combinations and star delta transformation technique, current division rule, KVL, KCL and their applications for network analysis.			
Exemplars / Practical Applications and usage: Electrical Power System, Electrical and electronics circuits			
Unit 2	**Electromagnetism**	**6 Hrs.**	**CO2**
Magnetic Circuit: Magnetic material, Concept of flux density, field strength, permeability, MMF, reluctance, their units, and relationships. Simple series magnetic circuit, comparison of electric and magnetic circuit, B-H curve. **Electromagnetic Induction**: Faradays Laws of electromagnetic induction, Fleming's right-hand rule, Fleming's left-hand rule statically and dynamically induced emf, self and mutual inductance, coefficient of coupling. Energy stored in magnetic field.			
Exemplars / Practical Applications and usage: Motor, Generator, Loudspeaker, Magnetic levitation and Transformer			
Unit 3	**Single Phase and Three phase AC Circuits**	**7 Hrs.**	**CO3**
Representation of sinusoidal waveforms, Concept of cycle, period, frequency, instantaneous, peak, average and RMS values, peak factor and form factor. Phase difference, lagging, leading and in-phase quantities and phasor representation, rectangular and polar representation of phasor. Behavior of circuit elements (R, L,C) under AC supply Concept of three-phase AC symmetrical system, phase sequence, balanced and unbalanced load, Voltage, current and power relations in three phase balanced star and delta connected loads along with phasor diagrams.			
Exemplars / Practical Applications and usage: Induction machines, Electrical Power System, Transformer			
Unit 4	**Introduction to Electrical Machine**	**6 Hrs.**	**CO2**
Overview of Transformer Construction, working principle, EMF equation, transformation ratio, rating, types, losses, Transformer cooling, regulation and efficiency at direct loading conditions. Introduction of autotransformers. Overview of three phase transformer, types, connection and applications. Study of 12-0-12 volt. Center tapped Step down transformer. **Basic of Electric Motor** Electrical Motors: D.C. Motors: Construction, working principle, types and Applications. Three Phase Induction Motor: Working principle using rotating magnetic field theory, types and applications.			
Exemplars / Practical Applications and usage: Electrical and Electronics appliances, Electric vehicle.			
Unit 5	**Electrical Installations and Safety**	**6 Hrs.**	**CO2**
Introduction of wiring, selection of wiring, types of wiring, Introduction of Indian Standards, I.E. (Indian Electricity) rules of domestic wiring, testing and installation of domestic wiring. Insulating material Components of LT Switchgear: Switch Fuse Unit (SFU), ELCB, MCB, MCCB, RCCB Earthing: Purpose of earthing in electrical safety, Types of earthing: Plate, Pipe.			
Exemplars / Practical Applications and usage: Residential wiring, Maintenance and troubleshooting of power systems in domestic wiring.			
Course Projects:			

Textbooks:			
1. B.L. Theraja,A K Theraja "Electrical Technology Volume I and II", S Chand Publications,2012			

2. D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill Education, 2nd edition 2019.
3. Mittle and V. N. Mittle, “Basic Electrical Engineering”, McGraw Hill Education, 2nd edition, 2005.
4. Mehrdad Ehsani, Yimin Gao, Ali Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals”, CRC Press, 2010.

Reference Books:

1. C. L. Wadhwa, “Basic Electrical Engineering”, New Age International (P) Limited 5th edition 2024.
2. S K Bhattacharya, “Electrical Machines”, McGraw Hill Education, 2nd edition, 2008.
3. T. K. Nagsarkar, M. S. Sukhija, “Basic Electrical Engineering”, Oxford University Press, 2nd edition 2018.

MOOCs Links and additional reading material:

MOOC links

1. https://onlinecourses.nptel.ac.in/noc25_ee158/preview
2. https://onlinecourses.nptel.ac.in/noc25_ee160/preview
3. https://onlinecourses.nptel.ac.in/noc25_ee124/preview

Additional reading material

1. https://www.schandpublishing.com/books/tech-professional/electrical-engineering-electronics/abc-electrical-engineering/9788121939096/

List of Practical:

Experiment No.1	**To examine and comprehend the critical safety protocols and precautionary measures essential for operating within electrical system**.	**2Hrs**	**CO5**

Objective:

Analyze and understand essential safety protocols and precautionary measures required for safe operation within electrical systems.

Associated Tasks:

1. Demonstrate proper use of personal protective equipment (PPE) in electrical work.
2. Respond appropriately to electrical emergencies or faults following safety guidelines.

Exemplars and Utility:

Helps prevent electrical accidents and injuries in workplaces.

Experiment No.2	**Determination of temperature coefficient of resistance of motor winding.**	**2Hrs**	**CO2**

Objective:

Determine the temperature coefficient of resistance of a motor winding by measuring its resistance variation with temperature.

Associated Tasks:

1. Investigate how different winding materials affect the temperature coefficient by comparing multiple samples
2. Plot resistance versus temperature graph.

Exemplars and Utility:

Helps in predicting motor behavior under varying temperature conditions.

Experiment No.3	**Circuit response analysis by Kirchhoff's law for controller.**	**2Hrs**	**CO1**

Objective:
To analyze and understand the response of electrical circuits using Kirchhoff's Voltage and Current Laws.

Associated Tasks:
Identify all loops and junctions in a given electrical circuit.
1. Apply Kirchhoff's Current Law (KCL) at the nodes to set up current equations.
2. Apply Kirchhoff's Voltage Law (KVL) around loops to set up voltage equations.
3. Solve simultaneous equations to find unknown currents and voltages.
4. Verify the results by comparing with circuit simulation tools or measurements.

Exemplars and Utility:
Solving simple DC circuits with multiple loops and nodes using Kirchhoff's laws

Experiment No.4	**Design of single turn alternator by using electrical components for generation of emf.**	**2Hrs**	**CO2**

Objective:
To design and construct a single-turn alternator using electrical components to generate and observe electromotive force (emf).

Associated Tasks:
1. Identify and gather the necessary electrical components such as coils, magnets, and shafts.
2. Assemble the single-turn coil and set up the rotating mechanism.
3. Connect measuring instruments like a voltmeter or oscilloscope to detect emf.
4. Rotate the coil manually or with a motor to induce emf by changing magnetic flux.

Exemplars and Utility:
Building a basic alternator prototype to demonstrate electromagnetic induction principles.

Experiment No.5	**Line and phase quantity analysis for balanced three phase star and delta connected load.**	**2Hrs**	**CO3**

Objective:
To analyze and calculate line and phase voltages and currents in balanced three-phase star and delta connected loads.

Associated Tasks:
1. Understand the difference between star (Y) and delta (Δ) connections in three-phase systems.
2. Identify line and phase quantities (voltages and currents) in both connection types.
3. Apply formulas to calculate line currents and voltages from phase values for balanced loads.
4. Use phasor diagrams to visualize relationships between line and phase quantities.
5. Solve numerical problems involving balanced three-phase star and delta loads.

Exemplars and Utility:
1. Application in power system design and analysis where balanced three-phase loads are common.

Experiment No.6	**Direct loading test to determine transformer efficiency and regulation.**	**2Hrs**	**CO4**

Objective:
To perform a direct loading test on a transformer to determine its efficiency and voltage regulation under load conditions.

Associated Tasks:
1. Set up the transformer and necessary measuring instruments (voltmeters, ammeters, wattmeters).

2. Connect the transformer to a load and gradually increase the load current.
3. Measure input and output voltages, currents, and power at various load levels.
4. Calculate the efficiency of the transformer at each load condition using input and output power.
5. Determine voltage regulation by comparing no-load and full-load voltages.
6. Plot efficiency versus load current and analyze the transformer's performance characteristics.

Exemplars and Utility:

1. Hands-on experience in conducting transformer performance tests in a laboratory setting.

Experiment No.7	**Assembly of distribution box with LT switchgear devices.**	**2Hrs**	**CO5**

Objective: To assemble a distribution box incorporating low-tension (LT) switchgear devices ensuring proper electrical distribution and safety.

Associated Tasks:

1. Identify and understand the functions of various LT switchgear devices (MCBs, ELCBs, fuses, isolators).
2. Plan the layout for placing switchgear components within the distribution box.
3. Connect wiring and devices following standard electrical wiring practices and safety codes.
4. Test the assembled distribution box for correct operation and safety compliance.
5. Troubleshoot any connection or functionality issues in the assembly.
6. Document the assembly process and components used for future reference.

Exemplars and Utility:

Prepares students for installation and maintenance roles in electrical engineering

Experiment No.8	**Measurement of Earth Resistance for domestic installation.**	**2Hrs**	**CO5**

Objective:

To measure the earth resistance of a domestic electrical installation to ensure effective grounding and safety.

Associated Tasks:

1. Understand the importance of earthing in electrical safety systems.
2. Identify and set up the earth resistance tester (e.g., Megger or Earth Tester).
3. Place auxiliary electrodes (earth spikes) at proper distances from the earth electrode.
4. Connect the tester leads correctly to the earth electrode and auxiliary electrodes.
5. Perform the earth resistance measurement following standard procedures.
6. Record and analyze the readings to determine if the earth resistance meets safety standards.
7. Suggest improvements if resistance is above acceptable limits.

Exemplars and Utility:

Essential knowledge for electricians and electrical engineers working in residential and commercial installations.

Experiment No.9	**Comprehensive analysis of LT/HT Electricity billing.**	**2Hrs**	**CO3**

Objective:

To understand and analyze Low Tension (LT) and High Tension (HT) electricity billing, including tariff structures, demand charges, and consumption pattern

Associated Tasks:

1. Study different types of electricity tariffs applicable for LT and HT consumers.
2. Collect sample electricity bills for both LT and HT categories.
3. Identify components of the bill such as fixed charges, energy charges, demand charges, taxes, and penalties.
4. Calculate energy consumption costs based on meter readings and tariff rates.

5. Analyze peak demand and its impact on HT billing.
6. Compare LT and HT billing to understand cost differences and advantages.
7. Prepare a detailed report explaining billing components and suggesting ways to optimize electricity costs.

Exemplars and Utility:
Ability to interpret and verify electricity bills for residential and industrial consumers

Experiment No.10	**Assembly and disassembly of electric machine**	**2Hrs**	**CO4**

Objective:
To develop practical skills in the proper assembly and disassembly of an electric machine, ensuring understanding of its components and operational principles.

Associated Tasks:

1. Identify and understand the main parts of the electric machine (stator, rotor, bearings, brushes, etc.).
2. Follow safety protocols before starting disassembly.
3. Carefully disassemble the electric machine, noting the arrangement and condition of parts.
4. Inspect components for wear, damage, or defects.
5. Clean and prepare parts for reassembly.
6. Reassemble the machine correctly, ensuring proper alignment and fit of components.
7. Test the assembled machine for smooth operation and troubleshoot any issues.

Exemplars and Utility:
Hands-on experience with electric machine components and construction

Strength of CO-PO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	3	2	2	2	1	-	1	-	-	1
CO2	3	2	1	2	1	1	-	-	-	-	1
CO3	3	3	2	2	2	1	-	-	-	1	1
CO4	3	2	2	2	2	3	-	-	-	2	2
CO5	2	1	3	2	2	3	3	2	2	2	2
Avg.	**2.8**	**2.2**	**2**	**2**	**1.8**	**1.8**	**3**	**1.5**	**2**	**1.7**	**1.4**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	**CCE**						**ESE**
	CCE 1	**CCE2**	**Assignments**	**Course Project**	**Field Activity / Case Study**	**Quiz / presentation etc.**	
K1	√	√	-	-	-	√	√
K2	√	√	-	-	-	√	√
K3	√	√	-	-	-	-	√
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	

This course serves as a prerequisite for / maps with the following future courses: Electrical machine, Electrical measurement and instrumentation, Electric circuits and machines, Electrical Technology
Job Mapping: Job opportunities that one can get after learning this course: Electrical Supervisor, Maintenance Supervisor, *etc.*

Program:	**F. Y. B. Tech**			**Semester:**		**I / II**	
Course:	**Fundamentals of Electronics Engineering**			**Course Code:**		**R25-ET-ESC-107**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit (TH+PR)**	**CCE**	**ESE**	**TW**	**PR**
02	02	-	02 + 01	40	60	25	-

Course Description:

The course Fundamentals of Electronics Engineering introduces first-year students to the foundational concepts and principles that form the basis of modern electronics. It begins with an overview of semiconductor devices and basic circuits, covering diodes, transistors, and their applications. Students will explore the structure, operation, and characteristics of BJTs, MOSFETs and FinFETs along with their role in analog and digital circuit design. The course also introduces the basics of digital electronics, including logic gates, combinational and sequential circuits, operational amplifiers and their practical applications. In addition, learners will gain exposure to various sensors used in embedded and IoT systems and will be introduced to the fundamentals of communication systems, focusing on signal transmission and modulation techniques.

Course Relevance:

The knowledge and skills acquired serve as a basis for further learning in circuit design, signal processing, and system development.

Prerequisite: Basic Physics and Mathematics, Semiconductor Physics

Bridge Content: -

Course Objectives:

1. To **UNDERSTAND** the working principles of PN junction diode and Special purpose diodes.
2. To **STUDY** the operating principle and applications of BJTs, MOSFETs and FinFETs.
3. To **LEARN** the concepts of various logic gates, digital circuits, Microprocessor and Microcontroller.
4. To **UNDERSTAND** the concepts of operational amplifiers and their applications.
5. To **KNOW** the methods of measurement of physical parameters using sensors and transmission with the help of communication systems.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**ANALYZE** the characteristics and applications of basic electronic components and circuits	4
CO2	**COMPARE** BJT, MOSFET, FinFET and GAAFET.	2
CO3	**DESIGN** and implement simple logic circuits	3
CO4	**ANALYZE** basic Op-Amp circuits	4
CO5	**UNDERSTAND** working principle and applications of various sensors and communication systems.	2

Course Contents			
Unit 1	**Semiconductor Devices and Circuits**	**6 Hrs.**	**CO1**
Introduction to active and passive components and their comparison. P-N Junction Diode: P-N Junction diode construction and its working in forward and reverse bias conditions, V-I characteristics of P-N junction Diode, Half wave rectifier, Full wave and Bridge rectifier, Need for voltage regulation, IC 78xx series Fixed Positive Voltage Regulators. Special purpose diodes: Light Emitting Diode (LED) and photo diode along with V- I characteristics and their applications.			
Exemplars / Practical Applications and usage: SMPS, Mobile and Laptop Chargers, Power Supplies for domestic appliances and industrial equipment, LED TV, IR-Remote Controller, Rolling Displays.			
Unit 2	**Transistors and Technology**	**6 Hrs.**	**CO2**
Bipolar Junction Transistor (BJT): Construction, type, Operation, V-I Characteristics in common emitter mode, BJT as switch and Common Emitter (CE) amplifier. E-MOSFET: Construction, Types, Operation, V-I characteristics, MOSFET as a switch and amplifier, FinFET: Introduction to FinFET.			
Exemplars / Practical Applications and usage: Audio Amplifier / PA System, Semiconductor Chips/ ICs in Mobile Phones/ Computers/Laptops, Semiconductor memory (Pen Drive).			
Unit 3	**Digital Circuits**	**6 Hrs.**	**CO3**
Number System: Introduction of Binary, Decimal, Hexadecimal number system, Conversion of Binary to Decimal, Decimal to Binary. Logic Gates - AND, OR, NOT, XOR, XNOR. Universal Gates – NAND, NOR. De-Morgan's theorem. Digital circuits - Half & Full adders. SR & D Flip Flops. Basic CMOS logic gates- NAND, NOR, Inverter (NOT gate). Introduction to Microprocessor and Microcontroller (Only block diagram and explanation). Important Specifications/Features of any one State-of-the-art Microprocessor and Microcontroller. Graphics Processing Unit (GPU) and its importance in AI computing (only introduction)			
Exemplars / Practical Applications and usage: Electronic voting machine, Electronic Control Unit (ECU) in Cars/e-vehicles, Robot Controllers, Embedded controllers in domestic appliances and industrial equipment/machines.			
Unit 4	**Operational Amplifiers**	**6 Hrs.**	**CO4**
Operational amplifier: Pin Diagram IC 741, Functional block diagram of operational amplifier, Ideal and practical values of performance parameters, Virtual Short and Virtual Ground, Op-Amp applications: Inverting, Non-inverting amplifier, Summing Amplifier, Subtractor. Types of OP-AMPs, their applications and example ICs (General purpose, Low power, Ultra Low power, Low noise, High speed,precision, rail-to-rail)			
Exemplars / Practical Applications and usage: ECG Amplifier, ICU Monitor in Hospital, Audio preamplifier.			
Unit 5	**Sensors and Communication Systems**	**6 Hrs.**	**CO5**
Sensors: Active /Passive Sensors, Motion Sensors (LVDT), Mechanical Sensors (Strain Gauge, Tactile Sensor), Environmental and Process Monitoring Sensors (Temperature-RTD), IoT enabled Data Acquisition. Communication Systems: Block Diagram, Communication Media: Wired and Wireless, Electromagnetic Spectrum, Modulation and its Types (AM & FM), Block diagram of GSM system. Important features of 5G mobile networks.			

Exemplars / Practical Applications and usage:
Digital Thermometer, Weighing Machine, Green House Automation in Agricultural, Home Automation. 4G & 5G Technology, Satellite Communication, Radar/Military Communication

Course Projects:

1. Build and Test any Electronics Circuit using bread board and discrete components.

Textbooks:

1. Thomas L. Floyd, Electronics Devices , Pearson, 9th Edition
2. R. P. Jain Modern Digital Electronics, Tata McGraw Hill, 4th Edition
3. H. S. Kalsi Electronic Instrumentation, Tata McGraw Hill, 3rd Edition,
4. D. Patrnabis Sensors and Transducers, PHI, 2nd Edition,
5. Kennedy & Davis, Electronic Communication Systems , Tata McGraw Hill, 4th Edition

Reference Books:

1. Thomas. L. Floyd, Digital Fundamentals, Pearson, 11th Edition
2. J. Schiller, Mobile Communication, Pearson, 2nd Edition
3. S. Soloman Sensors Handbook, 2nd Edition.
4. Baker. CMOS Circuit Design, Layout & Simulation, Wiley IEEE Press
5. Corrado Di Natale, Introduction to Electronic Devices, Springer, 2023

MOOCs Links and additional reading material:

1. https://da-iitb.vlabs.ac.in/
2. https://nptel.ac.in/courses/117103063
3. https://archive.nptel.ac.in/courses/106/105/106105166/

List of Practical: (Any Eight)

Experiment No.1	**Identification and use of Electronic Components- Resistors (Fixed &Variable), Calculation of resistor value using color code. Capacitors (Fixed &Variable) Inductors, Calculation of inductor value using color code. Devices such as Diode, BJT, MOSFET, various IC packages. Switches & Relays**	**02 Hrs.**	**CO1**

Objective: To recognize basic electronic components, understand their usage and find their values.

Associated Tasks:

1. Identify different types of resistors(carbon film, metal film, wire-wound, SMD, etc.), Recognize fixed and variable resistors, Use the resistor color code chart to determine the resistance value, tolerance, Verify resistor values using a digital multimeter.

2. Identify different types of capacitors (ceramic, electrolytic, tantalum, polyester, variable capacitors), Read capacitance values marked on capacitors, Understand polarity markings, Measure capacitance using a DMM/LCR meter.

3. Identify different types of inductors (air-core, iron-core, ferrite-core, toroidal), Use the inductor color code (if applicable) to determine inductance value and tolerance.

4. Identify different semiconductor devices-Diodes (LED, Zener, Schottky, rectifier), BJT (NPN & PNP transistors), MOSFET (N-channel & P-channel), IC packages (DIP, SOP, QFP, BGA, etc.), Recognize pin configurations of common ICs

Identify different types of switches (SPST, SPDT, DPST, DPDT, push-button, toggle, rotary), Test switches for continuity using a DMM, Verify relay coil activation and contact switching.

5. Exemplars and Utility:

LED TV, IR-Remote Controller, Rolling Displays, SMPS, Mobile & Laptop Chargers.

Experiment No.2	**Measurements using various test and measuring instruments: Setup CRO/DSO and function generator for measurement of AC, DC voltages and frequency. Measure Voltage, Resistance using digital multimeter. Test diode and BJT using digital multimeter.**	**02 Hrs.**	**CO1**

Objective: To develop fundamental competencies in testing, debugging, and troubleshooting common electronic components and basic circuits using standard instruments.

Associated Tasks:

1. Identify the controls of CRO/DSO (time base, voltage/division, trigger, probe settings), Learn to adjust frequency, amplitude, and waveform (sine, square, triangle) on Function generator, measure DC voltage, AC voltage, Time period, Frequency.
2. Measure DC voltage, AC voltage, Resistance on DMM.
3. Test Diode and BJT Using a DMM, check forward bias, reverse bias, identify anode, cathode of diode, Identify the terminals (Emitter, Base, Collector) using datasheet/DMM, Check forward bias of Base-Emitter (BE) and Base-Collector (BC) junctions of transistors.

Exemplars and Utility:

DSO as ICU Monitor in Hospital, Repair, maintenance, fault finding, troubleshooting of electronic appliances/equipment/gadgets.

Experiment No.3	**V-I characteristics of P-N Junction Diode. (Study the datasheet of typical PN junction diode)**	**02 Hrs.**	**CO1**

Objective: To experimentally determine the V-I characteristics of a PN junction diode and analyze its parameters by comparing measured results with manufacturer datasheet specifications.

Associated Tasks:

1. Study the Datasheet of a Typical PN Junction Diode, Identify key parameters.
2. Build the circuit, Experimentally determine the V-I characteristics and plot on graph paper.

Exemplars and Utility:

Power Supplies for domestic appliances and industrial equipment, SMPS, battery chargers

Experiment No.4	**Rectifier circuits: Implementation of a DC Regulated Power Supply using Bridge Rectifier, Diodes, and 78XX Voltage Regulator IC**	**02 Hrs.**	**CO1**

Objective: To build a DC regulated power supply.

Associated Tasks:

1. Identify all required components.
2. Draw the circuit diagram.
3. Check the pulsating DC output across the bridge rectifier, the smoothing effect (reduction in ripple) of filter capacitor using CRO/DSO.
3. Measure regulated output voltage.

Exemplars and Utility:

Power Supplies for domestic appliances and industrial equipment, SMPS, battery chargers

Experiment No.5	**Build and test Common Emitter (CE) BJT Amplifier circuit. Calculate the Gain of CE Amplifier**	**02 Hrs.**	**CO2**

Objective: To build and test Common Emitter (CE) Amplifier Circuit.

Associated Tasks:

1. List and verify all components.
2. Draw the CE amplifier circuit, Calculate the values of base voltage (VB), emitter voltage (VE), and collector voltage (VC) to ensure proper transistor operation (Active Region)
3. Apply a small AC signal to the transistor base, Observe output at the collector. Verify signal amplification and phase shift (180°) and Measure input, output voltages and calculate voltage gain.

Exemplars and Utility:

Audio amplifiers, PA systems, RF transmitters, receivers.

Experiment No.6	**Linear applications of Op-amp: Build inverting and non-inverting amplifier using op-amp (Study the data sheet of typical Op-Amp IC741)**	**02 Hrs.**	**CO4**

Objective: To build inverting and non-inverting amplifier using op-amp

Associated Tasks:

Draw neat circuit diagrams.

Ensure proper power supply connection.

Apply a small amplitude sine wave (e.g., 100 mV at 1 kHz) from the signal generator to the amplifier circuit

Observe signal amplification on CRO/DSO, Measure input, output voltages and calculate voltage gain.

Exemplars and Utility:

ECG Amplifier, ICU Monitor in Hospital, Audio preamplifier.

Experiment No.7	**Implementation of digital circuits- Basic and Universal Gates (Study the datasheet of respective ICs) Half Adder and Full Adder**	**02 Hrs.**	**CO3**

Objective: To implement simple digital circuits and test their functionality.

Associated Tasks:

1. Gather ICs (7408, 7432, 7404, 7400, 7402, 7486) and digital Trainer kit for implementation of digital circuit and design adder circuit on kit.
2. Verify the truth table.

Exemplars and Utility:

Microprocessors, ALUs, Calculators

Experiment No.8	**Measurement using transducers/sensors Any one process/environmental monitoring sensor. Inductive, capacitive, optical proximity sensors (NPN and PNP type proximity sensors).**	**02 Hrs.**	**CO5**

Objective: To sense and measure physical parameters using suitable sensor.

Associated Tasks:

Understand working principle of sensors.

Ensure proper connections on the experimental kit.

Measure parameter value.

Perform object detection using proximity sensors. Compare and understand selection criteria of proximity sensors.

Exemplars and Utility:

Industrial process monitoring, weather monitoring, object detection

Experiment No.9	**Implementation of Infrared Remote-Based Switching Circuit (Application of IR pair, transistor as a switch and relay for security alarm/ obstacle detection/ proximity sensing/ actuator control).**	**02 Hrs.**	**CO5**

Objective: To build and test IR remote based circuit.

Associated Tasks:

1. Build the circuit.
2. Test the circuit for any one real life application.

Exemplars and Utility:

Remote control of appliances/vehicles, burglar alarm, obstacle detection.

Experiment No.10	**Virtual Tour of a Semiconductor Fab (Demonstration should cover key steps involved in semiconductor manufacturing such as Wafer processing, Photolithography and Etching, Deposition, Doping, Metallization, Assembly and Packaging, Testing)**	**02 Hrs.**	**CO1**

Objective: To understand modern semiconductor manufacturing process.

Associated Tasks:

1. Brainstorming on semiconductor manufacturing process, India's semiconductor mission.

Exemplars and Utility:

Semiconductor Foundry

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	2	1	-	-	-	-	2	1	-
CO2	3	2	2	1	-	-	-	-	2	1	-
CO3	3	2	2	1	-	-	-	-	2	1	-
CO4	3	2	2	1	-	-	-	-	2	1	-
CO5	3	2	2	1	-	-	-	-	2	1	-
Avg.	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**2**	**1**	**-**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Assignments	Course Project	Field Activity / Case Study	Quiz / presentation etc.	
K1	✓	✓	-	-	✓	✓	✓
K2	✓	✓	-	-	✓	✓	✓
K3	✓	✓	-	-	✓	✓	✓
K4	✓	✓	-	-	✓	✓	✓
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

1. Analog and Digital Electronics
2. Analog and Digital Communication
3. Fundamentals of IoT
4. Embedded System and Edge Computing
5. Power Electronics

Job Mapping:

Job opportunities that one can get after learning this course:

1. Electronics Hardware Maintenance Technician

Program:	**F. Y. B. Tech**			**Semester:**		**I**	
Course:	**Programming & Problem Solving using Python**			**Course Code:**		**R25-CO-ESC-108**	
Teaching Scheme (Hrs./week)			**Credits (TH+PR)**	**Examination Scheme**			
Lecture	**Practical**	**Tutorial**		**CCE**	**ESE**	**TW**	**PR**
02	02	-	02+01=03	40	60	25	-

Course Description and:
This course introduces problem-solving with Python, covering algorithms, data types, control statements, functions, and file handling, giving students practical skills to solve real-world problems.
Course Relevance: This course is essential in today's tech-driven world, where Python is key in software development, data science, automation, and AI. It builds strong programming and problem-solving skills, helping students handle data, write functions, and manage files for real-world use.

Prerequisite: Basic computer literacy

Bridge Content: -

Course Objectives:
1. To **UNDERSTAND** problem-solving skills, problem solving aspects and Python programming fundamentals.
2. To **INTRODUCE** various data structures like lists, tuples, sets, and dictionaries, along with control statements.
3. To **LEARN** concepts of functions, modular programming, and the use of Python libraries.
4. To **ENABLE** students to manipulate and process string data efficiently using Python's built-in methods.
5. To **LEARN** operations of file handling and manage files using python.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**APPLY** problem-solving fundamentals to develop Python programs using algorithms and flowcharts.	3
CO2	**USE** concepts of data structures and control statements for effective decision-making in programs.	3
CO3	**PERFORM** modular Python programs using functions and libraries for better code reusability.	3
CO4	**APPLY** string operations and built-in string functions for text processing.	3
CO5	**IMPLEMENT** operations of file handling and manage files using Python.	3

Course Contents

Unit 1	**Principles of Problem Solving and Programming using Python**	**6 Hrs.**	**CO1**

Problem solving concept, six steps in problem solving, importance of programming paradigm in software development to solve the problem, different type of paradigm: monolithic, procedural, structured, object oriented, functional, and logical. Algorithm, flowcharts, pseudo code.
Basics of Python Programming: Features of Python, history and need of Python, Literal constants, Variables and
Identifiers, Data Types, Comments, Reserved words, Indentation, Operators and Expressions.

Exemplars / Practical Applications and usage:
Study of Problem Solving Concepts in Real-life problems like calculating shopping costs

Assignments:
1. Choose a real-life problem (e.g., calculating electricity bill, student grade calculation, ATM transaction)

and Define the problem, Write the algorithm, Represent it using a flowchart, Convert the algorithm into pseudo code.

2. Demonstrate different data types in Python with examples.

Unit 2	**Literal Collections and Control Flow**	**6 Hrs.**	**CO2**

Literal Collections- Tuples, Lists, Sets and Dictionary and its operations.

Decision Control Statements: Branching Statements: if, if-else, nested if, if-elif-else statements.

Basic loop Structures/Iterative statements: while loop, for loop. Nested loops, The break, continue, pass, else statement used with loops.

Exemplars / Practical Applications and usage:

Study the use of tuples to Store fixed data like coordinates or RGB color values.

Assignments:

1. Create and print a **tuple, list, set, and dictionary** containing student details (name, roll no, marks, course).
2. Write a Python program that finds all the even numbers from specific range.

Unit 3	**Functions and Modules**	**6 Hrs.**	**CO3**

Function: Need for functions, types of functions, defining and calling functions, variable scope and lifetime, the return statement, types of arguments, Lambda or Anonymous function, documentation string, recursive functions.

Introduction to modules, and packages in Python, standard library modules.

Exemplars / Practical Applications and usage:

Study that, how functions help in organizing code into reusable blocks.

Assignments:

1. Create a Python program to demonstrate local and global variables.
2. Import and use various built-in modules using python program.

Unit 4	**String Handling**	**6 Hrs.**	**CO4**

Strings, Operations on strings- indexing, slicing, concatenation, appending, multiplication, immutable strings,

strings formatting operators, built in string methods and functions, ord() and chr() functions, in and not in operators, comparing strings, iterating strings, string module.

Exemplars / Practical Applications and usage:

Use of string operations in passwords or usernames.

Assignments:

1. Write a Python program for various string operations.
2. Write a Python program which shows string comparison operations

Unit 5	**Working with Files in Python**	**6 Hrs.**	**CO5**

File Handling: Introduction, types of files, Modes of file, Opening and Closing files, Reading and Writing files, file positions using seek() and tell(), renaming and deleting files, Exception Handling in file operations, Directory methods.

Exemplars / Practical Applications and usage:

To develop a simple system that can store, retrieve, and manage book records using file handling techniques.

Assignments:

1. Write a Python program to read the content of a text file and print it.
2. Write a Python program for various function using the os module.

Textbooks:

1. Reema Thareja, Python Programming Using Problem Solving Approach, Oxford University Press, 6th edition.
2. R. Nageswara Rao, Core Python Programming, Dreamtech Press, 2nd edition.

Reference Books:

1. R. G. Dromey, How to Solve it by Computer, Pearson Education India, 1st edition.
2. Maureen Spankle, Problem Solving and Programming Concepts, Pearson, 9th edition.
3. Romano Fabrizio, Learning Python, Packt Publishing Limited, 5th edition.
4. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education, 4th edition.

MOOCs Links and additional reading material:

1. Python for Everybody, https://pythonbooks.org/python-for-everybody-exploring-data-in-python-3
2. Python Basics: A Practical Introduction to Python 3, https://static.realpython.com/python-basics-sample- chapters.pdf
3. NPTEL, Python for Data Science, https://onlinecourses.nptel.ac.in/noc25_cs60/preview
4. NPTEL, The Joy of Computing using Python, https://onlinecourses.nptel.ac.in/noc25_cs69/preview

List of Practical:

Group A: Perform any 8 experiments.

Experiment No.1	To Design a simple calculator.	2 Hrs.	CO1

Objective:

To Design a simple calculator that performs basic tasks such as addition, subtraction, multiplication and division and average of n numbers.

Associated Task:

Design and implement a basic calculator performing addition, subtraction, multiplication, division, and average of n numbers.

Exemplars:

Simple command-line calculator program, menu-driven calculator, or function-based arithmetic module.

Utility:

Useful for understanding basic programming logic, input handling, arithmetic operations, and building foundational problem-solving skills.

Experiment No.2	Calculate the salary of an employee	2 Hrs.	CO1

Objective:

To calculate the net salary of an employee given his basic pay (take input from the user). Calculate gross salary of employee. Let HRA be 10 %, DA be 40%, and TA be 2% of basic pay. Let employees pay professional tax as 2% of total salary. Calculate net salary payable after deductions.

Associated Task:

Calculate gross salary and net salary of an employee using user-input basic pay, applying HRA (10%), DA (40%), TA (2%), and professional tax (2%).

Exemplars:

Menu-based salary calculator, payroll computation script, or program demonstrating salary breakup and deductions.

Utility:

Helps understand arithmetic operations, percentage calculations, input handling, and real-world payroll computation logic.

Experiment No.3	Calculate the result of a student.	2 Hrs.	CO2

Objective:

To accept a student's five courses marks and compute his/her result. Student is passing if he/she scores marks equal to and above 40 in each course. If student scores aggregate greater than 75%, then the class is “distinction”. If aggregate is 60>= and <75 then the class if “first class”. If aggregate is 50>= and <60, then the class is “second class”. If aggregate is 40>= and <50, then the class is “third class”.

Associated Task:
Accept five course marks, determine pass/fail status, calculate aggregate percentage, and classify the result into distinction/first/second/third class.
Exemplars:
Student result calculator program, grade classification script, or marks-processing module.
Utility:
Builds skills in conditional statements, percentage calculation, logical decision-making, and handling multiple inputs in programming.

Experiment No.4	**Check whether input number is Armstrong number or not.**	**2 Hrs.**	**CO2**

Objective:
To check whether input number is Armstrong number or not. An Armstrong number is an integer such that the sum of the cubes of its digits is equal to the number itself.
Associated Task:
Check whether a given number is an Armstrong number by comparing it with the sum of the cubes of its digits.
Exemplars:
Armstrong number checker program, digit-extraction logic demo, or number-property verification script.
Utility:
Strengthens understanding of loops, mathematical operations, condition checking, and digit-wise number processing.

Experiment No.5	**Perform program for prime and factorial.**	**2 Hrs.**	**CO2**

Objective:
To accept the number and Compute:
a) Check for prime b) factorial of number.
Associated Task:
Accept a number and compute whether it is prime, and also calculate its factorial.
Exemplars:
Prime number checker, factorial calculator, or menu-based number operations program.
Utility:
Enhances understanding of loops, conditional logic, mathematical computation, and function-based problem solving.

Experiment No. 6	**To reverse the string.**	**2 Hrs.**	**CO3, CO4**

Objective:
Program to reverse the string using user defined function.
Associated Task:
Reverse a given string using a user-defined function to process characters manually.
Exemplars:
String reversal function, character-by-character manipulation program, or simple text-processing module.
Utility:
Builds understanding of string handling, function creation, loop usage, and basic algorithmic thinking.

Experiment No.7	**Generate Fibonacci series.**	**2 Hrs.**	**CO2**

Objective:
To accept the number of terms to be generated from the user and prints the Fibonacci series.
Associated Task:
Accept the number of terms from the user and generate the Fibonacci series accordingly.
Exemplars:
Fibonacci sequence generator, iterative/recursive Fibonacci function, or number pattern printing program.
Utility:

Strengthens logic building, loop/recursion concepts, sequence generation, and mathematical pattern

Experiment No.8	**Perform various string operations.**	**2 Hrs.**	**CO4**

Objective:
Write a python program that accepts a string from user and perform following string operations:
i. Calculate length of string ii. Equality check of two strings iii. Check palindrome iv. Check substring.

Associated Task:
Accept a string from the user and perform length calculation, string equality check, palindrome verification, and substring search.

Exemplars:
String operations module, menu-driven string utility program, or basic text-processing script demonstrating multiple string functions.

Utility:
Improves understanding of string manipulation, conditional checks, user input handling, and implementing common text-processing operations in Python.

Experiment No.9	**Demonstrate some file handling operations.**	**2 Hrs.**	**CO5**

Objective:
To copy contents of one file to other. While copying a) all full stops are to be replaced with commas b) lower case are to be replaced with upper case c) upper case are to be replaced with lower case.

Associated Task:
Copy the contents of one file to another while replacing full stops with commas and swapping all lowercase letters to uppercase and vice versa.

Exemplars:
File copy utility program, text-transform script, or case-conversion and punctuation-replacement module.

Utility:
Develops skills in file handling, character processing, text transformation, and applying conditional logic during file operations.

Experiment No.10	**Count words, characters and lines in given file.**	**2 Hrs.**	**CO5**

Objective:
To count total characters in file, total words in file, total lines in file and frequency of given word in file.

Associated Task:
Read a file and compute total characters, total words, total lines, and the frequency of a user-specified word.

Exemplars:
File statistics analyzer, word-frequency counter, or text-processing utility program.

Utility:
Enhances understanding of file handling, text parsing, counting techniques, and real-world data processing

Group B: Perform any one experiment relevant to the respective branch of study.

Experiment No.1	**Simulate a gear selector system. (Preferred for Mechanical branch)**	**2 Hrs.**	**CO2**

Objective:
Simulate a gear selector system. Use if-else to print speed ranges for gear values 1–5 entered by the user.

Associated Task:
Simulate a gear selector where the user enters a gear (1–5) and the program displays the corresponding speed range using if-else conditions.

Exemplars:
Gear-speed simulator, menu-based vehicle control demo, or conditional mapping program for gear values.

Utility:
Builds understanding of decision-making statements, input handling, and mapping user inputs to real-world system outputs.

Experiment No.2	**Calculates concrete mix ratio. (Preferred for Civil branch)**	**2 Hrs.**	**CO3**

Objective:
Write a function that calculates concrete mix ratio for given strength requirements (e.g., M20, M25).
Associated Task:
Write a function that accepts a grade of concrete (e.g., M20, M25) and returns the corresponding standard mix ratio.

Exemplars:
Concrete mix ratio function, grade-to-ratio lookup program, or construction-material calculation module.
Utility:
Helps understand function design, mapping inputs to predefined standards, and applying practical

Experiment No.3	**Basic Ohm's Law calculator. (Preferred for Electrical branch)**	**2 Hrs.**	**CO1**

Objective:
Create a basic Ohm's Law calculator (V = IR) taking any two of the three values.
Associated Task:
Create an Ohm's Law calculator that takes any two values among voltage (V), current (I), and resistance (R) and computes the third.
Exemplars:
Ohm's Law solver, electrical parameter calculator, or menu-based circuit computation program.
Utility:
Builds understanding of formula-based calculations, conditional logic, and applying basic electrical engineering concepts in programming.

Experiment No.4	**Check if a frequency input is within communication bands. (Preferred for Electronics and Telecommunication branch)**	**2 Hrs.**	**CO2**

Objective:
Check if a frequency input is within communication bands (e.g., FM: 88–108 MHz).
Associated Task:
Accept a frequency value from the user and determine whether it falls within standard communication bands such as FM (88–108 MHz).
Exemplars:
Frequency band checker program, radio-spectrum validator, or range-based communication signal classifier.
Utility:
Strengthens conditional checking, range validation, and applying real-world communication system concepts in programming.

Experiment No.5	**Simulate robot arm movement logic. (Preferred for Automation and Robotics branch)**	**2 Hrs.**	**CO2**

Objective:
Simulate robot arm movement logic using nested if-else for axis selection and angles.
Associated Task:
Simulate robot arm movement by letting the user choose an axis and angle, and use nested if-else to determine valid motions.
Exemplars:
Robot arm control simulator, axis–angle decision program, or basic robotic movement logic demonstration.
Utility:
Develops understanding of nested conditions, decision flow, and applying logical structures to model real robotic movements.

Experiment No.6	**Simulate basic logic gates. (Preferred for Electronics and Computer branch)**	**2 Hrs.**	**CO2**

Objective:
Simulate basic logic gates (AND, OR, NOT) using conditional operators.
Associated Task:
Simulate the functioning of basic logic gates (AND, OR, NOT) using conditional operators based on user-provided inputs.
Exemplars:
Logic gate simulator program, binary input evaluator, or truth-table based output generator.
Utility:
Strengthens understanding of Boolean logic, conditional operations, and fundamental digital electronics concepts through programming.

Experiment No.7	**Sort list with even and odd numbers.**	**2 Hrs.**	**CO2**

Objective:
To accept list of N integers and partition list into two sub lists even and odd numbers.
Associated Task:
Accept a list of N integers and partition it into two separate lists containing even numbers and odd numbers.
Exemplars:
List partition program, even–odd separator, or basic data categorization script.
Utility:
Enhances list handling skills, conditional filtering, and understanding of data classification using simple logic.

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	2	-	-	-	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-
CO3	2	2	3	2	2	-	-	-	-	-	-
CO4	2	2	2	2	2	-	-	-	-	-	-
CO5	2	2	2	2	3	-	-	-	-	-	-
Avg.	**2.4**	**2.4**	**2.6**	**2**	**2.2**	**-**	**-**	**-**	**-**	**-**	**-**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Assignments	Course Project	Field Activity / Case Study	Quiz / presentation etc.	
K1	✓	✓	✓	-	-	✓	✓
K2	✓	✓	✓	-	-	✓	✓
K3	✓	✓	✓	-	-	✓	✓
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

- Data Structures and Algorithms
- Object Oriented Programming (OOP) in Python
- Embedded Systems
- Computational Modelling, Simulation
- Robotics Programming
- Cloud and DevOps with Python Scripts
- AI and ML

Job Mapping:

Job opportunities that one can get after learning this course:

Thiscoursebuildsthefoundationalskillsinprogrammingandlogicalproblem-solvingusingPython, which opens pathways to multiple entry-level and advanced IT and data-related job roles.

Entry-Level Job Roles:

- Junior Python Developer, Application Developer
- Data Analyst(Entry-level)
- ML Intern, AI Project Assistant
- Automation Intern

Program:	**F. Y. B. Tech**			**Semester:**		**I / II**	
Course:	**Engineering Workshop Skills Lab**			**Course Code:**		**R25-ME-VSEC-109**	
Teaching Scheme (Hrs./week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	2	-	1	-	-	50	-

Course Description:

The Engineering Workshop Skills Lab is designed and common for all streams of first-year B. Tech Engineering students to help them understand the basics of manufacturing processes. It provides a practical environment for students to gain hands-on experience with common engineering materials, tools, processes and machineries in various shops; to develop basic skills in fabrication and assembly; and to understand workplace safety regulations. This course provides industrial environment in the educational institute.

Course Relevance:

Bridging the Theory-Practice Gap: It allows students to apply theoretical knowledge from textbooks to physical scenarios, reinforcing core engineering concepts.

Developing Essential Practical Skills: It builds technical proficiency in using industry-standard tools, equipment, and software, making graduates "job-ready".

Enhancing Problem-Solving and Design Abilities: Hands-on troubleshooting and project implementation in a workshop environment improve analytical and creative problem-solving skills, which are essential for designing solutions to complex engineering problems.

Fostering an Entrepreneurial Mindset: Working on prototypes or small projects within a dedicated space can encourage innovation and an entrepreneurial outlook, allowing students to transform ideas into tangible results.

Instilling Professional Skills: It develops soft skills like teamwork, communication, and project management through collaborative projects and report writing.

Ensuring Safety Awareness: Students learn the importance of safety protocols and hazard avoidance, a critical responsibility in any engineering role.

Meeting Industry Demands: Employers highly value engineers who possess a balance of theoretical knowledge and practical application skills to meet the evolving demands of the global job market.

Prerequisite:

1. Basic knowledge of geometry and mathematics
2. Engineering Drawing
3. Prior exposure to commonly used hand tools - such as files, try square, spanner, hacksaw, measuring tape etc.
4. Basic Manufacturing knowledge

Course Objectives:

1. To **DEVELOP** safety awareness and discipline in handling workshop equipment.
2. To **FAMILIARIZE** students with the basic manufacturing processes and hand tools.
3. To **IMPART** practical knowledge of fitting, sheet metal, carpentry, welding, plumbing, and machining.
4. To **INTRODUCE** the concepts of measurement, quality checks and basic fabrication.
5. To **ENHANCE** the students ability to interpret drawings and execute hands-on tasks accordingly.

Course Outcomes: After learning the course, students will be able to		
CO	**Course Outcome**	**Bloom's Level**
CO1	**DESCRIBE** the different sections of a typical workshop and **EXPLAIN**	1
	the principles of effective workshop layout.	
CO2	**DEMONSTRATE** adherence to safety protocols and standard operating procedures in a workshop environment.	3
CO3	**IDENTIFY** and **EXPLAIN** the functions of various hand tools, conventional and advanced machine tools, and workshop equipment.	2
CO4	**INTERPRET** basic workshop drawings and perform fundamental operations in fitting, carpentry, sheet metal, welding, and plumbing.	3
CO5	**UNDERSTAND** basics of Conventional and CNC machine tools and their operations.	2

List of Practical:

Experiment No.1	**Plant layout and Industrial Safety**	**2 Hrs.**	**CO1, CO2**

Objective: 1. Introduction to workshop facilities and importance of safety in workshop/Industry.
2. Importance of safety in workshop/Industry.

Associated Tasks:

1. Draw a layout of workshop/visited industry with arrangement of equipment's considering a specific application.
2. Use of Personal Protective Equipment (PPE) i.e. goggles, gloves, aprons, shoes.
3. Safety signs and emergency protocols.

Exemplars and Utility:

1. Industrial visit to explore plant payout and safety.

Experiment No.2	**Develop and fabricate utility job by using operations performed in the following sections**	**18 Hrs.**	**CO3, CO4**

Objective: To prepare a utility job by performing operations in any three of the following sections, in order to become familiar with various workshop tools and measuring equipment.

a. Fitting Shop
b. Carpentry Shop
c. Sheet Metal Shop
d. Welding Shop
e. Plumbing Shop (GI & PVC Pipes)

a. Fitting Shop

Associated Tasks:

1. Preparation of simple fitting job having sawing, filing, drilling, tapping operations using different tools/equipment's such as files, hammers, drills & taps, etc.

Exemplars and Utility:

1. Nut
2. Paper weight etc.

b. Carpentry Shop

Associated Tasks:

1. Preparation of simple wooden job having marking, sawing, planning, chiseling operations using different tools/equipment's such as saws, Jack plane, chisel, hammer, mallet etc. needed for it.

Exemplars and Utility:

1. Drawer box
2. Clipboard

c. Sheet Metal Shop

Associated Tasks:

1. Fabrication of simple sheet metal job having shearing, bending and joining operations using different tools/equipment's such as hammers, mallet, stake block, snip, etc. needed for it.

Exemplars and Utility:

1. Tray
2. Dustpan

d. Welding Shop

Associated Tasks:

1. Fabrication of simple utility job that involve Lap joint, Butt joint, and T-joint using arc/TIG/MIG welding.

Exemplars and Utility:

1. Coconut opener
2. Farm equipment etc.

e. Plumbing Shop (GI & PVC Pipes)

Associated Tasks:

1. GI Pipe Operations: Cutting, threading, joining using elbows, tees, unions
2. PVC Pipe Operations: Cutting, joining using solvent cement, tap installation

Exemplars and Utility:

1. Construct a water supply model with one GI and one PVC line connection /Pipe joint using coupling, elbow, tee, and union.

Experiment No.3	**Conventional Machine Tools and Advance Machine Tools**	**2 Hrs.**	**CO5**

Objective: Introduction to conventional machine tools, advance machine tools and their operations.

Associated Tasks:

1. Demonstration of conventional machine Tools: Lathe, Drilling, grinding and Milling machine.
2. Demonstration of advance Machine Tools: CNC, VMC.

Textbooks:

1. S. K. Hajra Choudhury, "Workshop Technology Vol. I & II", Media Promoters
2. H. S. Bava, "Workshop Technology", Tata McGraw Hill Publishing Co. Ltd., 1995
3. P.N. Rao, "Manufacturing Technology", Tata McGraw-Hill

Reference Books:

1. W. A. J. Chapman, "Workshop Technology", ELBS Low Price Text, Edward Donald Pub. Ltd., 1961.
2. K. C. John, "Mechanical Workshop Practice", PHI Learning.
3. R.K. Rajput, Manufacturing processes, Laxmi Publications Pvt. Ltd.
4. P.C. Sharma, Production Technology, S. Chand Publishing

MOOCs Links :

1. NPTEL Course on Industrial Safety And Fire Safety Management, by Dr. P.K.Ghosh & Mrs.Annapurna Adiley, Chhattisgarh Swami Vivekanand Technical University (CSVTU), Bhilai https://onlinecourses.swayam2.ac.in/nou23_ge81/preview
2. NPTEL Course on Fundamentals of Manufacturing Processes, by Prof. D K Dwivedi, IIT Roorkee https://onlinecourses.nptel.ac.in/noc20_me67/preview
3. NPTEL Course on Computer Aided Design and Manufacturing II, by Prof. P.V. Madhusudan Rao, IIT Delhi https://nptel.ac.in/courses/112102103

Additional learning material:

1. NPTEL Course on Fundamentals of Industrial safety by Prof. Thomas, IIT Madras https://www.youtube.com/watch?v=3VReVbsmjKI
2. NPTEL Course on Computer Numeric Control Of Machine Tools And Processes by Prof. A. Roy Choudhary, IIT Kharagpur https://www.youtube.com/watch?v=ImtSsDLgAaI&list=PLSGws_74K01-KX9YtVZACpOoFYy6oaJIC

Strength of CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	3	3	3	3	3	3	2	-	3	-
CO2	-	1	3	2	3	1	3	2	-	1	-
CO3	1	3	3	3	3	1	1	2	-	3	3
CO4	3	3	2	2	1	-	-	-	2	1	-
CO5	1	3	2	3	3	-	3	1	-	3	3
Avg.	**1.6**	**2.6**	**2.6**	**2.6**	**2.6**	**1.6**	**2.5**	**1.75**	**2**	**2.2**	**3**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:

- Manufacturing Processes, Advanced Manufacturing Processes, Computer Aided Manufacturing, Advanced Forming and Joining Processes, Machine Design, Metrology

Job Mapping:

Job opportunities that one can get after learning this course:

1. Technical Assistant / Technician Trainee: Basic machine operations, CAM support, Workshop / lab assistant roles.
2. Manufacturing/Production Helper: Roles in small manufacturing firms, Machine shop assistant, and Assembly line work.
3. Apprenticeships / Internships: Many industries offer ITI-level apprenticeships for candidates with basic technical knowledge, PSU apprentice schemes under the National Apprenticeship Promotion Scheme (NAPS).
4. Field Technician: Jobs in installation and maintenance of machinery.
5. Customer Service Support (Technical): Call center support for mechanical tools or software, Sales assistant in hardware/tool shops.

Program:	**F. Y. B. Tech (AI & DS)**			**Semester:**			**I**
Course:	**Digital Technology Lab**			**Course Code:**			**R25-AI-VSEC-115**
Teaching Scheme (Hrs./week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	50	-

Course Description:

This practical course offers hands-on experience in computer hardware, software tools, networking, IoT, and AI technologies. Students will explore, assemble, configure, and troubleshoot digital systems through structured experiments. It bridges theoretical learning with real-world technical skills essential for modern engineers and innovators.

Course Relevance: The course develops practical problem-solving and system-integration skills needed in engineering and IT fields. It prepares learners for entry-level technical roles and builds a strong foundation for advanced digital and AI-based applications.

Prerequisite:

Basic Computer Fundamentals

Bridge Content:

Introduction to computers and technologies

Course Objectives:

1. To **EXPLORE, IDENTIFY, ASSEMBLE**, and **TROUBLESHOOT** computer hardware components.
2. To **INSTALL** and **CONFIGURE** modern IDEs and set up virtual machines for working with multiple operating systems.
3. To **LEARN** the basics of IoT using simulation tools and IDE platforms, and apply them in simple real-world projects like traffic light control, temperature sensing, and obstacle detection.
4. **DESIGN** and **SIMULATE** a basic virtual network using Cisco Packet Tracer to understand device connectivity and data flow.
5. To **GAIN** hands-on experience with AI tools for practical tasks and explore a popular educational AI tool for skill development.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**EXPLAIN** the functions of hardware components, basic computer system assembly and troubleshooting steps.	**2**
CO2	**DEMONSTRATE** the installation and configuration of modern IDEs, setup of virtual machines, and use of debugging techniques.	**3**
CO3	**APPLY** IoT simulation tools and IDE platforms to implement real-world applications.	**3**
CO4	**DEMONSTRATE** the identification of networking components and configuration of LAN settings to simulate and troubleshoot networks in Cisco Packet Tracer.	**3**
CO5	**APPLY** different AI tools to solve domain-specific problems and demonstrate their functionalities.	**3**

Any 8 experiments from A, B, C and D

Group-A (Basic Hardware and Software)

Experiment No. 1	**Hands-on to explore and identify computer hardware components, assembly and troubleshooting.**	**2 Hrs.**	**CO1**

Objective: To explore, identify, assemble, and troubleshoot computer hardware components

Associated Tasks:

1. Explore and name key parts like CPU, RAM, motherboard, power supply, GPU, HDD/SSD, etc.
2. Connect and install components inside the cabinet (case) correctly, following safety protocols.
3. Attach external devices such as monitor, keyboard, mouse, printer, and verify functionality.
4. Diagnose issues like loose connections, faulty RAM, or no display, and apply fixes.

Exemplars and Utility:

Exemplars:

1. Assemble a basic desktop PC using provided hardware components and verify successful boot.
2. Troubleshoot a non-starting PC by checking RAM placement, power connections, and display output.

Utility: Students can apply this knowledge to troubleshoot basic hardware issues at home or work

Experiment No. 2	**Learn various types of software and perform following operations** a. **Installation and configuration of modern IDEs (Spyder, Pycharm, Eclipse, VSCode etc.).** b. **Learn to use tools like terminals, debuggers, and code formatters available in IDEs using simple program.**	**2 Hrs.**	**CO2**

Objective: To understand and perform installation and configuration of modern IDEs for software development.

Associated Tasks:

1. Learn types of software: system software and application software
2. Install and configure IDEs like Spyder, PyCharm, and VS Code; set up languages, extensions, and terminals.
3. Write, debug, format, and run simple Python or Java programs using IDE tools like debuggers, formatters, and terminals.

Exemplars and Utility:

Exemplars: A student installs VS Code, adds Python extension, configures the interpreter, and runs a "Hello World" program.

Utility: Demonstrates hands-on ability to set up a working development environment — essential for software development roles.

Experiment No. 3	**Set up a virtual machine to install dual operating system on a single machine (Virtual Box).**	**2 Hrs.**	**CO2**

Objective: To set up and configure virtual machines for installing and using multiple operating systems.

Associated Tasks: Install and configure VirtualBox, create a virtual machine, and install two different operating systems (e.g., Windows and Linux/Ubuntu) on it, either using dual-boot setup or separate virtual machines, and verify their independent functioning.

Exemplars and Utility:

Exemplars: A student successfully installs Ubuntu and Windows on separate virtual machines using Virtual Box and switches between them for different tasks.

Utility: Enables flexibility to develop and test applications across multiple operating systems.

Experiment No. 4	**Perform a practical comparison of program execution flow (interpreter and compiler) in C/C++ and Python from source code to final output Identify and fix syntax and logical errors in a program by designing various test cases.**	**2 Hrs.**	**CO2**

Objective: To compare interpreter- and compiler-based execution and debug code by identifying syntax and logical errors.

Associated Tasks :

1. Write equivalent simple programs (e.g., addition of two numbers) in both Python and C/C++.
2. Observe and document the steps from writing source code to getting the output.
3. Introduce and debug both syntax and logical errors using test cases and the tools provided by their respective environments.

Exemplars and Utility:

Exemplars: A student writes a Python program and executes it directly using the interpreter, observing immediate output and error reporting.

Utility: Demonstrates how interpreter and compiler execute program and fixing various types of errors in program.

Group-B (Basics of IoT)

Experiment No.5	**Understanding the visualization and importance of IoT devices in real-world AI applications using simulation tools such as NetSim /Ansys/ Iotify etc.**	**2 Hrs.**	**CO3**

Objective: To explore how IoT devices interact in real-time AI systems and visualize their behavior using simulation tools

Associated Tasks:

1. Explore the functionality and roles of various IoT devices in real-time, AI-integrated applications.
2. Develop and simulate a smart environment (e.g., home or traffic system) using IoT devices through tools like Iotify or NetSim.
3. Visualize and analyze the connectivity and interaction between IoT components in building real-time intelligent systems.

Exemplars and Utility:

Exemplars: A student simulates a smart home where temperature sensors trigger AI-based climate control decisions.

Utility: Demonstrates how IoT devices are used for smart real-world applications.

Experiment No.6	**Installation of IDE platforms (Raspberry Pi, Arduino, ESP32 etc.) and Hands on exploration of IOT technology for Real world applications.** **a. Traffic Light control system** **b. Temperature and Humidity Sensing** **c. Obstacle detection**	**2 Hrs**	**CO3**

Objective: To install IDE platforms and hands-on experience with IoT technology by developing simple real-world application.

Associated Tasks:

1. Install and configure the Arduino IDE or Raspberry Pi OS to program microcontrollers.
2. Develop and test a traffic light control system using LEDs and a microcontroller.
3. Connect a DHT11 sensor or ultrasonic sensor to measure temperature/humidity or detect obstacles.

Exemplars and Utility:

Exemplars:

1. Basic LED-based traffic signal simulation using Arduino.
2. Using the Arduino IDE and an ultrasonic sensor, build a simple obstacle detection system that detects nearby objects and triggers an LED or buzzer alert

Utility: Learning IoT device setup and programming helps students build smart solutions for real-world problems

Group-C (Networking)			
Experiment No.7	**Understand use and working of various networking components (Eg. routers switches, Wifi, cables etc.) and Team-based activity for learning crimping of RJ45 cables for PC**	**2 Hrs**	**CO4**

Objective: To understand the use and working of various networking components and perform hands-on activity to crimp RJ45 Ethernet cables for establishing wired network connections.

Associated Tasks:

1. Assemble teams to identify and study key networking components
2. Strip, arrange, and crimp twisted pair cables using RJ45 connectors and a crimping tool
3. Test network connectivity of cables using a LAN tester.

Exemplars and Utility:

Exemplar: A group activity where students successfully crimp CAT6 Ethernet cables using the T568B standard and connect PCs to a switch to create a local area network (LAN).

Utility: Develops practical skills required in network setup and maintenance, provides foundational knowledge for network design, troubleshooting, and infrastructure planning in both home and enterprise environments

Experiment No.8	**Establish direct communication between two computers using a crossover cable, perform file sharing and device sharing (like printer)**	**2 Hrs.**	**CO4**

Objective: To establish direct communication between two computers using a crossover Ethernet cable and perform file and device sharing.

Associated Tasks:

1. Configure static IP addresses on both computers, connect them using a crossover cable
2. Enable file and printer sharing settings
3. Transfer files or access a shared printer between the systems.

Exemplars and Utility:

Exemplar:

1. Connect two desktop computers via a crossover cable with manually assigned IPs (e.g., 192.168.1.1 and 192.168.1.2),
2. Perform direct file sharing and access a shared network printer.

Utility: Useful for offline data transfer, small peer-to-peer networks, or printer sharing in isolated environments; teaches foundational skills in network configuration, IP addressing, and resource sharing without relying on complex infrastructure.

Experiment No.9	**Explain a basic local area network (LAN) using a switch, test communication and perform following operations:** **a. Configure IP addresses (static and dynamic)** **b. Check network connectivity using ping commands** **c. Explore basic networking commands like ipconfig, ping, and trace.** **d. Check Internet Speed and Latency** **e. Trace the path taken by a data packet to reach a destination websites with longer routes (e.g., ping facebook.com, tracert amazon.in)**	**2 Hrs.**	**CO4**

Objective: Understand a basic LAN using a switch and perform key network operations like IP configuration, connectivity testing, internet speed check, and data packet tracing.

Associated Tasks:

1. Observe and understand LAN setup.
2. Assign both static and dynamic IP addresses, verify connectivity using ping.
3. Explore commands like ipconfig, tracert, and nslookup, measure internet speed and
4. Trace the data route to external websites.

Exemplars and Utility:

Exemplars:

1. Observe LAN setup of college.
2. Execute commands like ping google.com and ipconfig
3. Use online tools like Speedtest.net to measure current internet download and upload speeds
4. Trace packet routes to amazon.in using tracert amazon.in.

Utility: Builds practical skills in network setup, troubleshooting, and analysis

Experiment No.10	**Use Cisco Packet Tracer to design and simulate Virtual Lab setup**	**2 Hrs.**	**CO4**

Objective: To design and simulate a virtual computer network lab using Cisco Packet Tracer, enabling the visualization and testing of network configurations, protocols, and device communication in a virtual environment.

Associated Tasks:

1. Use Cisco Packet Tracer to create a virtual network by adding routers, switches, PCs, and servers
2. Configure IP addresses, set up routing protocols, simulate data transfer, and verify connectivity using

Exemplars and Utility:

Exemplar:

1. Simulate a small office network by configuring a router with eight PCs in different networks and enable communication between them using routing protocols.
2. Set up a basic client-server network with a web server and multiple client PCs, test HTTP connectivity, and analyze packet flow in simulation mode.

Utility: Provides a risk-free, cost-effective platform for practicing network design and troubleshooting; supports learning of real-world networking concepts.

Group- D (AI Tools)			
Experiment No.11	**Hands-on practice of AI-based tools like Chat-GPT, Gemini, Deep seeker.** **a. Answer questions and solve doubts** **b. Draft emails and reports** **c. Generate ideas for projects and presentations** **d. Translate languages or improve grammar** **e. Practice for interviews**	**2 Hrs.**	**CO5**

Objective: To gain practical experience in using AI-powered tools for enhancing productivity in academic, professional, and personal tasks.

Associated Tasks:

1. Use ChatGPT or Gemini to answer academic questions and clarify subject-related doubts.
2. Draft professional emails or structured reports using AI assistance.
3. Generate creative and technical project ideas or presentation outlines.
4. Translate a paragraph from one language to another or improve grammar using AI tools.
5. Simulate interview practice by interacting with AI for common QSA formats.

Exemplars and Utility:

Exemplars:

1. Use ChatGPT to explain Ohm's Law and clarify related doubts with step-by-step examples.
2. Generate a formal email requesting permission for industrial visit using Gemini."
3. Brainstorm 5 innovative project ideas on renewable energy using DeepSeeker.
4. Translate a technical passage on computer networks from English to Marathi and refine grammar using Gemini.
5. Simulate an interview scenario where ChatGPT acts as an interviewer asking engineering-related questions.

Utility: Promotes the use of tools for day-to-day academic tasks, content writing, language learning, and career readiness

Experiment No.12	**Learn and practice Popular Educational AI Tools. (any one)** **a. Gamma AI to create presentations, documents, and websites** **b. Google Colab cloud-based tool to write and run Python code, analysis and use of GPU** **c. Teachable Machine (No-Code AI Experiment): Trains AI to classify simple emotions (happy, sad, angry) by facial expressions.**	**2 Hrs.**	**CO5**

Objective: To explore and apply a popular educational AI tool to enhance learning, creativity, and problem-solving through hands-on tasks in coding, content creation, or AI training.

Associated Tasks:

1. Create an AI-generated presentation on an academic or professional topic using Gamma AI, customize its design, structure the content, and share or present it digitally.
2. Write and run a Python program in Google Colab to perform basic data analysis (e.g., using NumPy or Pandas), visualize results using Matplotlib or Seaborn, and enable GPU runtime for performance-based tasks.
3. Use Teachable Machine to collect image data through a webcam for different emotions (happy, sad, angry), train a classification model, test it in real-time, and analyze the model's accuracy and behaviour.

Exemplars and Utility:

Exemplar:

4. Create a presentation on "Cybersecurity Awareness for Students", using Gamma AI
5. Use Google Colab to write a Python script that plots a graph of temperature data and run it using cloud GPU.
6. Train an AI model to classify facial expressions (happy, sad, angry) using webcam input without writing any code.

Utility: AI tools enhance presentation and content creation skills, saves time through automation, and supports digital communication and storytelling — essential in academic, professional, and entrepreneurial settings.

Text Books:

1. Sinha, P. K., S Sinha, P., "Computer Fundamentals", BPB Publications, 6th Edition.
2. Buyya, R., S Dastjerdi, A. V., "Internet of Things: Principles and Paradigms", Morgan Kaufmann (Elsevier), 2016, ISBN: 978-0128053959
3. Kurose, J. F., S Ross, K. W., "Computer Networking: A Top-Down Approach", Pearson Education, 8th Edition, ISBN: 978-0136681557
4. McMillan, T., "Cisco Networking Essentials" Wiley, 2nd Edition.
5. Mitchell, M. "Artificial Intelligence: A Guide for Thinking Humans", Farrar, Straus and Giroux, 1st Edition ISBN: 978-0374257835.

Reference Books:

1. Zacker, C., "PC Hardware: The Complete Reference", McGraw-Hill/Osborne. ISBN: 978-0072129405
2. Singh, R., Gehlot, A., S Bhargava, S. C., "Internet of Things with Arduino and Raspberry Pi", CRC Press, 2020. ISBN: 978-0367418275
3. Ciccarelli, P., S Faulkner, C. , "Introduction to Networking Basics" Wiley, 2nd Edition, 2008. ISBN: 978-0470112743

MOOCs Links and additional reading material:

1. Internet of Things-https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2. Arduino-https://projecthub.arduino.cc/
3. Computer Networks: https://onlinecourses.nptel.ac.in/noc22_cs19/preview
4. Google Colab-https://colab.research.google.com/notebooks/intro.ipynb
5. ChatGPT-https://help.openai.com/en/collections/3742473-chatgpt
6. Teachable Machine-https://teachablemachine.withgoogle.com

Strength of CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	2	-	-	-	-	-	-	-	3	2	2	2
CO2	2	1	2	-	3	-	1	-	-	-	3	3	3	2
CO3	2	1	2	-	3	-	2	-	-	-	3	3	3	2
CO4	2	-	2	-	3	-	2	-	-	-	3	2	2	2
CO5	2	-	2	-	-	-	2	-	-	-	3	2	2	3
Avg.	**2**	**1**	**2**	**-**	**3**	-	**2**	**-**	**-**	**-**	**3**	**2**	**2**	**2**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for/maps with the following future courses:

1. AI and Generative AI
2. Computer Networks
3. Internet of Things

Job Mapping:

Job opportunities that one can get after learning this course: Junior Software Developer, IT Support Engineer, IoT Project Developer, Network Support Technician, Technical Content Creator

Program:	**F. Y. B. Tech (Civil Engineering)**			**Semester:**		**I**	
Course:	**Digital Technology Lab**			**Course Code:**		**R25-CE-VSEC-115**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	2	-	1	-	-	50	-

Course Description:

This course provides a foundational understanding of Civil Engineering drawing, design, and analysis using modern software and field instruments. It begins with an introduction to AutoCAD, focusing on its interface, fundamental commands, and the creation of detailed 2D building plans, elevations and sections, which are essential for architectural and structural design communication.

Students will also gain proficiency in 3D modeling using Google SketchUp for visualizing building components. The curriculum extends to surveying techniques with hands-on experience using a Total Station to determine elevation differences.

Furthermore, it incorporates geographic information systems (GIS) by teaching QGIS for digitizing and analyzing topographic data, a critical skill for urban planning and environmental management.

The course also covers Non-Destructive Testing (NDT) methods like the Digital Rebound Hammer and UPV to assess concrete strength, a key aspect of structural integrity evaluation.

Finally, it integrates computational skills by applying Python programming to solve structural mechanics problems.

Course Relevance:

This course is highly relevant as it equips students with a comprehensive and modern skill set essential for the contemporary Civil Engineering industry.

Prerequisite:

Specifically, for experiments 1-5, a working knowledge of the AutoCAD interface, drawing commands, and layer management is essential.

For experiment 6, a basic familiarity with 3D modeling concepts and the Google SketchUp software is required.

Experiments 7 and 8 necessitate an understanding of surveying and geographic information systems (GIS), respectively, along with the ability to operate a Total Station and QGIS software.

Finally, experiment 9 requires a grasp of basic civil engineering and material science concepts, particularly regarding concrete properties and non-destructive testing methods, while the last experiment demands fundamental programming skills in Python, including knowledge of data types, variables, and basic mathematical operations, to solve structural analysis problems.

Bridge Content:

- These experiments progressively bridge foundational digital literacy with specialized Civil Engineering software and computational tools.
- This leads into core CAD skills with AutoCAD for precise 2D drafting of building components and plans, followed by Google SketchUp for rapid 3D visualization.
- The curriculum then extends to practical fieldwork and geospatial analysis using Total Stations and QGIS for surveying and mapping, culminating in the application of Python programming for foundational structural analysis, thus equipping civil engineers with a comprehensive toolkit for modern practice.

Course Objectives:

1. To **DEVELOP** fundamental skills in creating, modifying, and interpreting 2D building drawings using AutoCAD for architectural planning, detailing, and documentation in civil engineering applications.
2. To **ENABLE** students to understand and apply basic 2D and 3D modeling concepts using Google SketchUp for visualizing and designing building components effectively.
3. To **DEVELOP** fundamental skills in modern surveying and geospatial techniques, using Total Station and QGIS for accurate elevation measurement, data digitization, and spatial analysis.
4. To **DEVELOP** fundamental skills in evaluating concrete strength through non-destructive testing methods and analyzing structural behavior using Python-based computational techniques.

Course Outcomes: After learning the course, students will be able to:

CO	Course Outcomes	Bloom's Level
CO1	**UNDERSTAND AND UTILIZE** CAD Software for 2D Building Design and Documentation.	4
CO2	**APPLY** 3D Modeling Techniques for Building Visualization using Google SketchUp.	3
CO3	**PERFORM** Surveying and Geospatial Data Handling.	4
CO4	**APPLY** non-destructive testing (NDT) methods to assess concrete strength and **UTILIZE** Python programming skills to determine reactions.	4

Experiment No.1	**Introduction to AutoCAD Interface, Basic Settings, Drawing Commands and Layers.**	**2 Hrs.**	**CO1**

Objective:

To gain proficiency in the fundamental features of AutoCAD, including navigating the interface, configuring basic settings, utilizing core drawing and modification commands and organizing drawings using a layer-based system.

Associated Tasks:

- Identify and navigate the different components of the AutoCAD interface (ribbon, command line, status bar).
- Set up a drawing environment with appropriate units, limits, and grid settings.
- Master basic drawing commands like LINE, CIRCLE, ARC, and RECTANGLE.
- Practice using modification commands such as TRIM, EXTEND, MOVE, and COPY.
- Create and manage layers for different drawing elements (e.g., walls, dimensions, text, furniture).
- Assign lineweights, colors, and linetypes to different layers to create a visually organized and clear drawing.

Exemplars:

- A simple floor plan of a single room showing walls, a door, and a window, with each component on a separate, appropriately named layer.
- A mechanical drawing of a machine part with different lines for the part outline, centerlines, and hidden features, all managed by layers.
- A title block created with a specific layer for text and another for lines, demonstrating layer organization for document creation.

Utility:

This experiment is the foundational module for all computer-aided design (CAD) tasks in engineering, architecture, and construction

Experiment No.2	**Interactive 2D models of typical building components (foundations, columns, beams, slabs, walls, roofs) using Auto CAD software.**	**2 Hrs.**	**CO1**

Objective

To develop proficiency in creating accurate and detailed 2D architectural and structural drawings of essential building components using AutoCAD.

Associated Tasks:

- Drawing Foundational Elements
- Modeling Vertical Structures
- Designing Horizontal Elements
- Representing Roof Structures
- Applying Layering and Dimensioning

Exemplars:

- A detailed 2D drawing showing the plan and section of a reinforced concrete column with stirrups and main reinforcement bars.
- A plan view of a floor slab with a grid of beams, indicating their sizes and spacing.
- A section drawing of a building wall from the foundation to the roof, showing the wall's material, thickness, and connection details.

Utility:

This skill is fundamental for civil engineers, architects, and drafters. It enables them to:

- Communicate Designs
- Ensure Accuracy
- Facilitate Analysis
- Serve as Legal Documents

Experiment No. 3	**Generating Line Plan and Detailed plan in AutoCAD.**	**2 Hrs.**	**CO1**

Objective:

To create a complete and dimensionally accurate building plan, including both the conceptual line plan and the detailed working drawing, using AutoCAD software.

Associated Tasks:

- Line Plan
- Detailed Plan

Exemplars:

- Residential House Plan
- Commercial Building Layout
- Hospital Floor Plan

Utility:

- Communication
- Construction Guidance
- Material and Cost Estimation
- Permitting

Experiment No.4	**Generating Elevations and Sections Using AutoCAD.**	**2 Hrs**	**CO1**

Objective:

The objective of this experiment is to develop the skills to generate accurate and detailed elevations and sections of a building from its floor plan using AutoCAD.

Associated Tasks:

1. Understand Orthographic Projection
2. Setup Drawing Environment
3. Generate Elevations
4. Generate Sections
5. Add Hatching and Textures
6. Annotation and Dimensioning

Exemplars Utility:

- Learning Standard Practices:
- Problem-Solving Guide
- Demonstration of Detail
- Encourages Consistency
- Fosters Visual Literacy

Experiment No.5	**Prepare Area Statement and Schedule of Openings, Saving, Exporting, and Drawing Area Setup in Auto CAD.**	**2 Hrs.**	**CO1**

Objective:

The primary objective of this experiment is to develop proficiency in preparing accurate and professional-quality documentation from an AutoCAD drawing, specifically focusing on generating an Area Statement and a Schedule of Openings.

Associated Tasks:

1. Setup and Preparation:
2. Drawing Area Setup
3. Area Statement Generation
4. Schedule of Openings Creation
5. Saving and Exporting

Exemplars Utility:

- A fully detailed and annotated AutoCAD drawing
- An accurate and neatly formatted Area Statement
- A comprehensive Schedule of Openings
- A final exported PDF document

Experiment No.6	**Introduction to Google SketchUp for 2D/3D Building Component Modeling.**	**2 Hrs.**	**CO2**

Objective:

The objective of this experiment is to introduce students to the fundamental principles and interface of Google SketchUp.

Associated Tasks:

1. Interface Familiarization
2. Basic 2D Geometry Creation

3. Extrusion and 3D Modeling
4. Component Creation and Management
5. Adding Details and Textures
6. Organizing the Model
7. Saving and Exporting

Exemplars Utility:

- A simple, completed 3D model of a single
- A detailed 3D model of a standard window or door component
- A "before and after"
- A final rendered image (e.g., JPEG)

Experiment No.7	**Determination of difference in elevation between two consecutive points using Total Station.**	**2 Hrs.**	**CO3**

Objective:

The objective of this experiment is to accurately determine the difference in elevation between two consecutive points on the ground using a Total Station.

Associated Tasks:

1. Site Preparation and Setup
2. Instrument Calibration and Configuration
3. Measurement at Point A
4. Measurement at Point B
5. Data Processing and Calculation

Exemplars Utility:

- A completed field survey sheet
- A sample calculation sheet
- A digital output from the Total Station
- A final report or diagram

Experiment No.8	**Digitize the given part of Toposheet using QGIS software (eg. attribute, name, area, length etc.)**	**2 Hrs.**	**CO3**

Objective

The objective of this experiment is to develop the skills required to digitize geospatial data from a raster image (a toposheet) using QGIS, a free and open-source Geographic Information System (GIS) software.

Associated Tasks:

1. Project Setup and Geo referencing
2. Creating Vector Layers
3. Digitization and Data Entry
4. Attribute Management
5. Data Saving and Exporting

Exemplars Utility:

- A Geo referenced Toposheet
- Vector Layers with Digitized Features
- A Populated Attribute Table
- A Final Map Layout

Experiment No.9	**Non-Destructive Testing (NDT) strength of concrete using Digital Rebound Hammer and Ultra-Sonic Pulse Velocity Meter (UPV).**	**2 Hrs.**	**CO4**

Objective:

The objective of this experiment is to introduce students to the principles and applications of Non-Destructive Testing (NDT) for assessing the in-situ strength and quality of concrete structures.

Associated Tasks:

1. Preparation and Site Selection
2. Non-Destructive Testing (NDT) strength of concrete using Digital Rebound Hammer
3. Ultra-Sonic Pulse Velocity (UPV) Testing:
4. Data Analysis and Report Generation:

Exemplars Utility:

- **A** "Marked Grid" on a Concrete Surface
- Raw Data Sheets
- A Sample Calculation and Correlation Chart
- A Final Report

Experiment No.10	**Find the reactions of simply supported beam for various loading conditions using Python programming skills.**	**2 Hrs.**	**CO4**

Objective:

To develop a Python program that accurately calculates the reactions (vertical support forces) for a simply supported beam under various common loading conditions.

Associated Tasks:

1. Define Beam Properties
2. Define Loading Conditions
3. Implement Equilibrium Equations
4. Develop Calculation Logic
5. User Interface (Basic)
6. Error Handling and Validation

Exemplars and Utility:

Exemplar 1: Single Point Load

- **Scenario:** A simply supported beam of length L with a point load P at a distance a from the left support.
- **Input:**L=10 m, P=50 kN, a=3 m
- **Expected Output (Calculated by Program):**
  - RA=P×(L−a)/L=50×(10−3)/10=35 kN
  - RB=P×a/L=50×3/10=15 kN
- **Utility:** Demonstrates the fundamental application of equilibrium equations for the most basic loading condition. Useful for validating the core logic of moment and force summation.

Textbooks:

- AutoCAD 202 Tutorial First Level 2D Fundamentals (or current year), by Randy Shih, SDC Publications, Latest Annual Edition.
- Residential Design Using AutoCAD 202* (or current year), by Daniel John Stine, SDC Publications
- SketchUp for Dummies, by Aidan Chopra, Rebecca Huehmer, For Dummies (Wiley).
- Surveying (Vol. I S II), by B.C. Punmia, Ashok Kumar Jain, Arun Kumar JainLaxmi Publications / Firewall MediaLatest Edition.
- Surveying and Levelling by Dr. K.R. Arora, Standard Book House Latest Edition.
- QGIS Documentation and Manual, QGIS Project QGIS Website (Official)Latest Version.
- Python Programming and Numerical Methods: A Guide for Engineers and Scientists Qingkai Kong, Timmy Siauw, Alexandra de Siqueira Academic Press Latest Edition.

Reference Books:

- Mastering AutoCAD 202* (or current year) George Omura, Brian C. Benton Sybex (Wiley) Latest Annual Edition
- AutoCAD 202 for the Interior Designer* (focuses on plan/layout) Daniel John Stine, SDC publications Latest Annual Edition
- QGIS Documentation and Manual QGIS Project, QGIS Website (Official)Latest Version
- Python Manual: A Learning Guide for Structural Engineering Students Kennedy A. Gomez, et al. Cal Poly, 2021 (or latest**)**

MOOCs Courses:

- https://www.coursera.org/projects/autocad-architectural-drafting-basics
- Autodesk AutoCAD 2D Drafting for Civil Engineers
- https://www.openlearning.com/usmmooc/courses/autocad-built-environment-beginner-s- guide/
  - (Specifically Module 6: Printing and Review, which often includes final plan creation)
- https://www.autodesk.com/in/campaigns/autocad-tutorials
  - (Look for Architectural/Civil Drafting sections on Elevations/Sections)
- https://learn.sketchup.com/collections (Start with **SketchUp Fundamentals**)
- NPTEL Non-destructive Testing of Concrete MOOC Python for Structural Analysis Beam Reactions

Strength of CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3	-	3	-	-	2	2	1	2	3	2	3
CO2	3	2	3	-	3	-	-	2	2	1	2	3	2	3
CO3	2	2	1	3	3	1	-	2	1	-	2	2	2	1
CO4	3	3	1	3	3	1	1	2	2	1	3	3	3	1
Avg.	**2.75**	**2.25**	**2**	**3**	**3**	**1**	**1**	**2**	**1.75**	**1**	**2.25**	**2.75**	**2.25**	**2**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:
Civil Engineering Lab course forms the foundation for several advanced and applied Engineering courses. Here is a list of future courses.

1. Architectural Planning and Design of Building
2. Design of Steel Structures
3. Design of Reinforced Concrete Structure
4. Computer Programming in Civil Engineering
5. Concrete Technology

Job Mapping:

Job opportunities that one can get after learning experiments of Digital Technology:

1. Planning Engineer
2. Architectural Designer
3. GIS Analyst
4. Civil Software Developer

Program:	**F. Y. B. Tech (ECE)**			**Semester:**		**I**	
Course:	**Digital Technology Lab**			**Course Code:**		**R25-EC-VSEC-115**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	50	-

Course Description:

This course introduces students to essential tools and technologies used in software and hardware development. It covers the setup and use of development environments (like VS Code and WSL2), basic Linux commands, version control using Git and GitHub, fundamental networking practices, and hands-on work with Arduino-based circuits and open-source tools for simulation and PCB design.

Course Relevance:

The skills learned serve as a foundation for advanced courses, projects, and industry-oriented applications in the domains of IoT, embedded system, automation, and system design.

Prerequisite:

1. Fundamentals of Computing.
2. Basic knowledge of Electronic components

Bridge Content: --

Course Objectives:

1. **FAMILIARIZE** students with the use of Visual Studio Code, version control, and AI integration tools for software development.
2. **INTRODUCE** virtualization techniques through hands-on installation and configuration of Virtual Machines and WSL2 environments.
3. **DEVELOP** proficiency in executing basic and essential Linux commands for system and file management.
4. **DEMONSTRATE** fundamental networking concepts, including addressing, diagnostics, and physical LAN setup.
5. **ENABLE** practical application of embedded systems concepts using Arduino, sensors, and open-source tools for circuit simulation and PCB design.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**INSTALL** and **CONFIGURE** development environments like VS Code, WSL2, and Virtual Machines to support cross-platform coding.	**3**
CO2	**EXECUTE** essential Linux commands for navigating, managing packages, and performing system operations.	**3**
CO3	**INTEGRATE** Git and GitHub with VS Code for version control and collaborative software development.	**3**
CO4	**CONSTRUCT** and **TEST** basic electronic and sensor-based circuits using Arduino and open-source EDA/simulation tools.	**3**
CO5	**DEMONSTRATE** understanding of IP addressing and networking basics by operating diagnostic commands and assembling LAN cables.	**3**

List of Practical: (Any 08)

Experiment No.1	**Introduction to Visual Studio Code: Installation, extension management, Testing simple Python code, and AI integration with GitHub Copilot.**	**02 Hrs.**	**CO1**

Objective:

- Learn to install VS Code and use AI (GitHub Copilot) to write basic Python code.

Associated Tasks:

1. Install VS Code and extensions.
2. Write and test a simple Python program
3. Demonstrate AI integration with GitHub Copilot.

Exemplars and Utility:

1. Used in Software Development industry for writing and debugging code efficiently.
2. AI tools like Copilot help increase productivity in real-world software companies.

Experiment No.2	**Virtual Machines: Installation, Configuration, and Usage for OS Virtualization. (host Ubuntu Linux on a Windows operating system using Virtual Box/VMware/QEMU/Hyper- V)**	**02 Hrs.**	**CO1**

Objective:

- Set up a virtual OS like Ubuntu Linux using tools such as VirtualBox or VMware.

Associated Tasks:

1. Install and configure Ubuntu on VirtualBox.
2. Run Linux in a virtual environment.

Exemplars and Utility:

1. Used in IT companies and DevOps to test software in safe, isolated environments.
2. Cloud and Cybersecurity professionals regularly use virtual machines for system simulations.

Experiment No.3	**Hands-on Practice with Essential Linux Commands for File Management, Navigation, Package management (apt) and System Operations.**	**02 Hrs.**	**CO2**

Objective:

- Use Linux terminal commands for file handling and installing software.

Associated Tasks:

1. Navigate folders, create/delete files.
2. Install/update software/packages using apt commands.

Exemplars and Utility:

1. System administrators and backend engineers use Linux daily.
2. Essential for jobs in cloud, cyber security, and server management**.**

Experiment No.4	**Installation and configuration of Windows Subsystem for Linux (WSL2) and Execution of Basic Linux Commands.**	**02 Hrs.**	**CO1, CO2**

Objective:

- Install Linux inside Windows and practice Linux commands using WSL2.

Associated Tasks:

1. Set up WSL2 and install Ubuntu.
2. Run Linux commands from Windows terminal.

Exemplars and Utility:

1. Software developers use WSL2 for running Linux tools on Windows laptops.
2. Saves time and improves workflow in cross-platform development**.**

Experiment No.5	**Introduction to Version Control using Git and GitHub on Ubuntu Linux. Usage of VS code with Git and GitHub.**	**02 Hrs.**	**CO3**

Objective:

- Learn version control with Git and GitHub integration in VS Code.

Associated Tasks:

1. Create and commit a project to GitHub.
2. Use VS Code to manage changes.

Exemplars and Utility:

1. Every software company uses Git and GitHub for team collaboration.

2. Essential **for** tracking code, open-source contribution, and CI/CD pipelines**.**

Experiment No.6	**Fundamentals of Networking: Understanding IP and MAC Addresses with Basic Network Commands (ping, ipconfig, trace route). Demonstration of Crimping process using RJ-45 connector for LAN Cables. LAN cable testing.**	**02 Hrs.**	**CO5**

Objective:

- Understand networking basics and create a working LAN cable.

Associated Tasks:

1. Run commands like ping, ipconfig.
2. Crimp and test a LAN cable.

Exemplars and Utility:

1. Used by network engineers and IT support teams for troubleshooting and setup.
2. Industries like telecom and internet service providers rely on these skills.

Experiment No.7	**Implementation of Infrared Remote-Based Switching Circuit with Ardiuno. (Application of IR pair, Ardiuno and relay for security alarm/ obstacle detection/ proximity sensing/ actuator control)**	**02 Hrs.**	**CO4**

Objective:

- Create a switching system using IR remote, Arduino, and relay.

Associated Tasks:

1. Connect and code IR sensor and relay module.
2. Switch a device like LED or motor using remote.

Exemplars and Utility:

1. Home automation systems use IR for lights, fans, and appliances.
2. Useful in consumer electronics and IoT product development**.**

Experiment No.8	**Temperature Monitoring Using LM35 Sensor and Arduino Serial Interface**	**02 Hrs.**	**CO4**

Objective:

- Read temperature data from LM35 sensor and display it using Arduino.

Associated Tasks:

1. Connect LM35 sensor to Arduino.
2. Write code to show temperature on serial monitor.

Exemplars and Utility:

1. Used in industrial machines, HVAC systems, and medical devices.
2. Part of smart environment monitoring and IoT solutions.

Experiment No.9	**Simulation of Basic Electronic Circuit Using Open-Source Tools**	**02 Hrs.**	**CO4**

Objective:

1. Simulate electronic circuits virtually using open source tools.

Associated Tasks:

1. Design and test a basic circuit in simulation software.
2. Check output without real components.

Exemplars and Utility:

1. Electronics engineers use simulation to test circuits before building.
2. Saves cost and time in R&D, startups, and hardware companies.

Experiment No.10	**PCB Design for simple electronic circuit Using Open-Source EDA Tool.**	**02 Hrs.**	**CO4**

Objective:

- Design a printed circuit board (PCB) for an electronic circuit.

Associated Tasks:

1. Create a circuit schematic and layout in software.
2. Export design files for manufacturing.

Exemplars and Utility:

1. PCB design is core to electronics manufacturing in industries.
2. Used in mobile phones, gadgets, automotive, and defense equipment.

Textbooks:

1. William E. Shotts, Jr.,The Linux Command Line: A Complete Introduction, No Starch Press, 2nd Edition, 2019. ISBN-13: 978-1593279523
2. Scott Chacon & Ben Straub, Pro Git, Apress, 2nd Edition, 2014. ISBN-13**:** 978-1484200773
3. Michael Margolis, Arduino Cookbook: Recipes to Begin, Expand, and Enhance Your Projects, O'Reilly / Maker Media, 3rd Edition, 2022.
4. Brian Ward, How Linux Works: What Every Superuser Should Know, No Starch Press, 3rd Edition, 2021.

Reference Books:

1. Michael Kerrisk**,** The Linux Programming Interface: A Linux and UNIX System Programming Handbook**,** 1st Edition**,** 2010**.** ISBN-13: 978-1593272203
2. Richard E. Silverman, Git Pocket Guide, O'Reilly, 1st Edition**,** 2013**.** ISBN-13: 978-1449325862
3. Andrew S. Tanenbaum and David J. Wetherall**,** Computer Networks (Global Edition), Pearson, 6th Edition**,** 2021**.**
4. Gerald L. Peterson S Bruce S. Davie**,** Computer Networks: A Systems Approach, Morgan Kaufmann / Elsevier, 5th Edition**,** 2019**.**

MOOCs Links and additional reading material:

1. Introduction to Internet of Things: https://nptel.ac.in/courses/106105166
2. Linux Operating System: https://onlinecourses.swayam2.ac.in/aic20_sp24/

Strength of CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1	1	1	2	2	2	3	2	3
CO2	2	3	2	2	2	1	1	1	2	2	1	3	2	3
CO3	2	2	2	2	3	1	1	1	3	3	2	3	2	3
CO4	3	2	3	2	3	2	1	1	2	2	2	3	3	3
CO5	2	2	2	2	2	1	1	1	2	2	2	3	2	2
Avg.	**2.4**	**2.2**	**2.2**	**2.0**	**2.6**	**1.2**	**1.0**	**1.0**	**2.2**	**2.2**	**1.8**	**3.0**	**2.2**	**2.8**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:

- Computer Networks
- Embedded Systems
- Internet of Things (IoT)

Job Mapping:

Job opportunities that one can get after learning this course:

- IT support specialist
- PCB Design and Prototyping Engineer

Program:	**F. Y. B. Tech (ETC)**			**Semester:**		**I**	
Course:	**Digital Technology Lab**			**Course Code:**		**R25-ET-VSEC-115**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	50	-

Course Description:

The Digital Technology Lab is designed to introduce students to foundational tools, platforms, and techniques used in electronics and digital systems development. It blends hands-on experiments in circuit design, PCB fabrication, microcontroller programming (Arduino), simulation tools, embedded systems, and modern productivity software.

Course Relevance:

Students develop critical practical skills that serve as a bridge to advanced courses in electronics, IoT, embedded systems, and digital communication.

Prerequisite:

1. Basic knowledge of electronic components and logic gates.
2. Familiarity with computer operations and file handling.

Bridge Content:

1. Resistor colour codes, principle of working of electronics components.
2. Basic use of multimeter and breadboard.

Course Objectives:

1. To **DEVELOP** skills in designing, simulating, and fabricating basic electronic circuits and PCBs.
2. To **GAIN** proficiency in interfacing sensors, actuators, and embedded programming using Arduino and related tools.
3. To **ENHANCE** productivity, and innovation through mini projects addressing real-life applications.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**DEMONSTRATE** practical knowledge of basic electronic components and circuits.	2
CO2	**APPLY** simulation and prototyping skills to build and test circuits.	3
CO3	**DEVELOP** embedded solutions using Arduino and sensor interfacing.	4
CO4	**CREATE** and present mini-projects solving real-life problems.	4

Instructor Guidelines:

1. Demonstrate every experiment before hands-on session.
2. Ensure students maintain a lab record with circuit diagrams, code, and observations.
3. Encourage creativity in mini-projects and documentation style.
4. Provide both individual and group tasks for collaborative learning.
5. Regularly update students with examples of real-world applications (IoT, smart cities, etc.).

Assignments Must Include:

1.Circuit diagrams (hand-drawn or using simulation tools)
2.Code snippets and screenshots of output (if applicable)
3.Observations and reflection on what were learned
4.Application notes – How the experiment can be scaled for real use
5.Documentation using Google Docs or MS Word/Excel where applicable

Instructors are expected to:
1. Use multimedia resources (videos, online simulators) to aid understanding.
2. Monitor each student's engagement and practical skill progression.
3. Provide feedback on lab reports and project documentation.
4. Promote safety in handling soldering tools and electronic instruments.
5. Guide students on project selection and encourage innovation.

Evaluation should consider:
1. Timely completion of experiments
2.Viva and conceptual understanding
3.Lab Journal and documentation
4.Mini Project (Design & Execution)
5.Presentation and Communication

Experiment No.1	**Identification and handling of basic electronic components and tools (resistors, diodes, soldering iron, different types of wires, cables and Connectors (coaxial, jumper, USB, ribbon, etc.) Desoldering Pump, Breadboard, Cutting Pliers, Wire Strippers, Multimeter (Digital), IC Base Sockets, Component Tester etc)**	**2Hrs.**	**CO1**

Objective: To identify and handle basic electronic components and tools used in electronic systems.

Associated Tasks:
1. Identify components: resistors, diodes, IC sockets, connectors (coaxial, jumper, ribbon, etc.)
2. Practice tool usage: multimeter, soldering/desoldering pump, breadboard, pliers, wire stripper

Exemplars and Utility:
1. Foundation skill for any hardware prototyping or repair.
2. Prepares students for future lab work.

Experiment No.2	**Perform soldering and desoldering of an LED-based circuit on general-purpose PCB and troubleshoot errors.**	**2Hrs.**	**CO2**

Objective: To perform soldering and desoldering operations on an LED-based circuit.

Associated Tasks:
1. Create LED circuit on general-purpose PCB.
2. Solder, desolder, and troubleshoot connection errors.

Exemplars and Utility:
1. Hands-on practice of through-hole soldering.
2. Understanding circuit continuity and repair skills.

Experiment No.3	**Circuit design using breadboard: LED chaser or simple switch-based buzzer**	**2Hrs.**	**CO2**

Objective: To design and test basic circuits on breadboards using switches and LEDs.

Associated Tasks:
1. Assemble an LED chaser or buzzer-based circuit.
2. Verify behavior and connections manually.

Exemplars and Utility:
1. Teaches circuit logic and hands-on prototyping.
2. Useful for basic electronics validation.

Experiment No.4	**Simulate basic analog/digital circuits, verify circuit behavior (before physical implementation), using circuit simulation Multisim Software.**	**2Hrs.**	**CO3**

Objective: To simulate analog/digital circuits using NI Multisim.

Associated Tasks:
1. Use NI Multisim to simulate basic logic/analog circuits.
2. Validate outputs before hardware implementation.

Exemplars and Utility:
1. Reduces design errors before building hardware.
2. Builds familiarity with simulation workflows.

Experiment No.5	**Use manual methods or software (e.g., EasyEDA) to create simple PCB layouts. And implementation of PCB fabrication steps: layout transfer, etching, drilling, and tinning (demo + partial hands-on)**	**2Hrs.**	**CO3**

Objective: To create and partially implement a PCB layout using manual/software-based methods.

Associated Tasks:
1. Use EasyEDA or manual drawing to design layout.
2. Demonstrate layout transfer, etching, drilling, tinning (hands-on or demo).

Exemplars and Utility:
1. Introduces fabrication lifecycle of real PCBs.
2. Teaches industry-relevant prototyping techniques.

Experiment No.6	**Introduction to Arduino Hardware and IDE Setup**	**2Hrs.**	**CO3**

Objective: Identity types of Arduino board (Arduino UNO and Arduino NANO Boards)

Associated Tasks:
1. Identify different types of Arduino boards (UNO, NANO, MEGA) and their pin configurations.
2. Install and set up the Arduino IDE on a computer.
3. Configure the appropriate board and COM port.
4. Test IDE functionality using basic code compilation (without uploading).

Exemplars and Utility:
1. Provides foundational knowledge of microcontroller hardware and development tools.
2. Helps students understand the role of IDE, compiler, and board drivers.
3. Builds readiness for writing and uploading actual programs.

Experiment No.7	**Writing and Uploading the First Arduino Program – Blinking LED**	**2Hrs.**	**CO3**

Objective: To verify successful Arduino setup by writing, uploading, and executing a simple LED blink program.

Associated Tasks:
1. Open the Arduino IDE and load the built-in “Blink” example.
2. Upload the program to the Arduino board.
3. Observe the LED blinking pattern and modify delay parameters.
4. Explain the code structure (setup() and loop() functions).

Exemplars and Utility:
1. Demonstrates the complete workflow from coding to hardware execution.
2. Reinforces understanding of embedded programming concepts.
3. Prepares students for sensor/actuator interfacing experiments.

Experiment No.8	**Interface sensors (LDR, DHT11) with Arduino and visualize output on Serial Monitor/LEDs.(controlling output devices like buzzer, relay, or motor)**	**2Hrs.**	**CO4**

Objective: To interface sensors with Arduino and monitor their output.

Associated Tasks:
1. Connect LDR or DHT11 to Arduino and visualize data.
2. Control output devices like a buzzer, motor, or LED.

Exemplars and Utility:

1. Fundamental skill for IoT system design.
2. Applies theoretical sensor knowledge practically.

Experiment No.9	**Design and present a small working model (e.g., automatic light, security alarm, smart dustbin, automatic night lamp, door alarm, or temperature alert).**	**2Hrs.**	**CO4**

Objective: To design a working embedded system model based on a real-life problem.

Associated Tasks:

1. Plan and build a mini project (e.g., automatic light, security alarm).
2. Present the solution and demonstrate functionality.

Exemplars and Utility:

1. Encourages innovation and problem-solving.
2. Strengthens presentation and integration skills.

Experiment No.10	**Installation and basic interface of MATLAB/ Scilab**: Perform basic matrix operations and simple signal visualization	**2Hrs.**	**CO3**

Objective: To perform matrix and signal operations using MATLAB or Scilab.

Associated Tasks:

1. Install the software and practice basic matrix manipulation.
2. Visualize signals using plots.

Exemplars and Utility:

1. Strengthens analytical and numerical understanding.
2. Supports further coursework in signals and systems.

Experiment No.11	**Installation of Eclipse IDE**: Install Eclipse and write simple programs in C or C++ OR Java	**2Hrs.**	**CO3**

Objective: To program microcontrollers using Eclipse IDE.

Associated Tasks:

1. Install Eclipse IDE with relevant plugins.
2. Write simple embedded programs and test on simulator or microcontroller.

Exemplars and Utility:

1. Prepares students for professional-grade development environments.
2. Supports modular embedded design workflows.

Experiment No.12	**Interfacing an LCD Display with Arduino to Display Sensor Data**	**2Hrs.**	**CO4**

Objective:

To interface a 16x2 LCD display with Arduino and program it to display real-time sensor readings.

Associated Tasks:

1. Connect a 16x2 LCD to Arduino using appropriate wiring (4-bit or I2C interface).
2. Interface a basic sensor (e.g., LDR or DHT11) with Arduino.
3. Write and upload an Arduino program to read sensor data and display it on the LCD.

Exemplars and Utility:

1. Builds skills in embedded hardware interfacing and data visualization.
2. Forms the foundation for standalone embedded systems without computer monitoring.
3. Useful for industrial panels, IoT devices, and automation displays.

Textbooks:

1. Paul Horowitz and Winfield Hill, The Art of Electronics, Cambridge University Press, 3rd Edition, 2015.
2. M. Morris Mano and Michael D. Ciletti, Digital Design, Pearson Education, 5th Edition, 2013.
3. Ramesh S. Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085/8086, Penram International Publishing, 6th Edition, 2013.4.
4. John Boxall, Arduino Workshop: A Hands-On Introduction with 65 Projects, No Starch Press, 2nd Edition,2021.
5. Joshua M. Pearce, Open-Source Lab: How to Build Your Own Hardware and Reduce Research Costs, Elsevier,1stEdition,2014.

Reference Books:

1. Albert Paul Malvino and Donald P. Leach, Digital Principles and Applications, McGraw-Hill, 8th Edition,2017.2.
2. Simon Monk, Programming Arduino: Getting Started with Sketches, McGraw-Hill Education, 2nd Edition,2016.
3. James K. Peckol, Embedded Systems: A Contemporary Design Tool, Wiley India, 2nd Edition, 2019.
4. Ian Sinclair and John Dunton, Practical Electronics Handbook, Newnes (Elsevier), 7th Edition, 2013.

MOOCs Courses:

1. https://www.classcentral.com/course/freecodecamp-arduino-course-for-beginners-open-source-electronics-platform-104943?utm_source=chatgpt.com
2. https://www.coursera.org/learn/arduino-platform?utm_source=chatgpt.com
3. https://www.coursera.org/learn/introduction-embedded-systems?utm_source=chatgpt.com

Strength of CO-PO-PSO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	1	1	2	1	1	1	2	1
CO2	3	3	2	1	3	2	1	1	2	1	1	1	3	2
CO3	3	2	3	2	3	2	1	2	2	2	1	1	3	3
CO4	3	3	3	2	2	2	1	2	3	S3	2	2	3	3
Avg.	**3**	**2.5**	**2.25**	**1.5**	**2.5**	**1.75**	**1**	**1.5**	**2.25**	**1.75**	**1.25**	**2.75**	**2.75**	**2.25**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:
Project Based Learning, Mini project, Major Project, Analog /Digital Communication, Embedded System Design.

Job Mapping: Technical careers in electronics, embedded systems, and automation.

Job opportunities that one can get after learning this course: Electronics Technician, Maintenance Tech, Soldering Technician.

Program:	**F. Y. B. Tech**			**Semester:**		**I / II**	
Course:	**Engineering Graphics Lab**			**Course Code:**		**R25-ME-VSEC-110**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	50	-

Course Description:

Engineering Graphics is a foundational technical course essential for students across all branches of engineering, including mechanical, civil, electrical, electronics, and computer science. It serves as the basis for engineering communication, visualization, and design documentation. The course introduces first-year students to the core principles of engineering drawing through both manual and computer-aided drafting (CAD). Students will learn to use drawing instruments, understand sheet layouts and standard line types, apply correct dimensioning methods, and construct basic geometric shapes. The curriculum includes detailed study and practice in orthographic and isometric projections to build spatial visualization skills and accurately interpret engineering objects and assemblies. Alongside traditional drawing techniques, the course emphasizes the use of modern CAD software, enabling students to create and modify 2D and 3D engineering drawings in line with current industry standards.

Course Relevance:

Engineering Graphics is crucial for effective visual communication in the engineering domain. It trains students to clearly and accurately express complex ideas using standardized graphical language, a vital skill for technical collaboration and documentation. A key learning outcome is the ability to interpret and analyze engineering drawings, mechanical systems, and assemblies. Through projection techniques and visualization exercises, students enhance their analytical thinking, creativity, and spatial reasoning. This course lays the groundwork for advanced learning in areas such as CAD modeling, product design, computer graphics, manufacturing, AR/VR applications, and simulations. Moreover, early exposure to industry-standard CAD tools equips students with practical, job-relevant skills, making them better prepared and more confident as they progress through their engineering education and careers.

Prerequisite:

1. Basic knowledge of geometry and mathematics
2. Spatial visualization ability
3. Basic computer skills
4. Logical thinking and attention to details
5. High school-level drawing or technical drawing (preferred but not mandatory).

Bridge Content:

1. Introduction to drawing instruments: pencils (grades), set squares, T-square, compass, divider, scales, erasers, protractors; Drawing sheet sizes and title block; setting up a drawing sheet (border, margins, title block, scale).
2. Guidelines for engineering lettering and numerals (standard styles and heights)
3. Dimensioning basics: size and location dimensions, placement rules, units.

Course Objectives:

1. To **INTRODUCE** the fundamentals of engineering drawing using manual drafting techniques and familiarize students with drawing instruments, sheet layouts, and standard practices.
2. To **DEVELOP** students' understanding of orthographic projections, including first angle projection, and enable them to interpret and draw multiple views of mechanical components.
3. To **TRAIN** students in isometric projection techniques and help them visualize and represent

3D objects accurately using 2D orthographic views.

4. To **PROVIDE** hands-on experience in CAD software, enabling students to use digital tools for drafting and dimensioning.
5. To **ENHANCE** students' visualization and technical communication skills, preparing them for interpreting and creating engineering drawings in academic and professional settings.

Course Outcomes: After learning the course, students will be able to

CO	Course Outcome	Bloom's Level
CO1	**APPLY** drawing instruments and standard drawing conventions including types of lines, dimensioning methods, and lettering in technical drawings	**3**
CO2	**CONSTRUCT** orthographic projections using first angle method from given pictorial views and understand the application of different types of projections.	**3**
CO3	**CREATE** accurate isometric projections of machine components from orthographic views, demonstrating an understanding of isometric principles.	**6**
CO4	**USE** CAD software to produce and modify 2D engineering drawings, including orthographic and isometric projections with appropriate dimensioning.	**3**
CO5	**INTERPRET and VISUALIZE** basic engineering components and assemblies from given views, applying graphical methods for effective technical communication.	**4**

Course Contents

List of Practical:

Experiment No.1	Introduction to Engineering Drawing	04 Hrs.	CO1

Objective:

To introduce students to the fundamental concepts and practices of engineering drawing, including the proper use of drawing instruments, drawing sheet layout, types of lines, lettering, dimensioning techniques, scales, and standard geometrical constructions.

Associated Tasks:

1. Demonstrate different types of lines (e.g., visible, hidden, center, cutting-plane) and their appropriate applications.
2. Apply correct dimensioning methods and terminology (e.g., size dimension, location dimension, aligned and unidirectional systems).
3. Draw a simple standard machine component integrating types of lines and dimensioning principles.

Exemplars and Utility:

1. Draw and label at least five standard line types with a note on their usage.
2. Practice dimensioning a simple rectangular block using both aligned and unidirectional methods.
3. Draw a standard machine component, such as a square nut or washer, showing correct lines, dimensioning, and scale.

Experiment No.2	**Orthographic Projections**	**6 Hrs.**	**CO2**

Objective:

To develop the ability to visualize and represent 3D objects through 2D orthographic projections using the first angle method. This includes understanding the theory of projection, types of projection systems, and the generation of multiple views from a pictorial representation.

Associated Tasks:

1. Understand the theory of projection and quadrant system used in technical drawing.
2. Differentiate between types of projections: Orthographic, and isometric projection.
3. Interpret and apply the first angle projection method based on BIS standards.
4. Identify and construct front, top, and side views of a given pictorial or isometric object.
5. Understand and apply sectional views to represent internal features (full sectional view only).
6. Draw TWO orthographic projection problems with correct line types, layout, and dimensioning using the first angle method.

Exemplars and Utility:

1. Draw orthographic views (front, top, side) of a given simple mechanical component using the first angle method.
2. Create orthographic projections of a simple machine component like a flange or bracket.
3. Produce a sectional orthographic projection of a simple mechanical component like a bush or hollow cylinder to show hidden internal details.

Experiment No.3	**Isometric Projections**	**6 Hrs.**	**CO3**

Objective:

To develop students' ability to visualize and construct isometric projections of engineering objects using orthographic views, including the understanding of isometric axes, scaling, and conventions for isometric and non-isometric lines.

Associated Tasks:

1. Understand the principles of isometric projection, including the use of isometric axes and isometric scale.
2. Identify and correctly draw isometric and non-isometric lines.
3. Construct standard geometric shapes (e.g., circles, squares) on isometric planes using appropriate methods (like ellipse construction for circles).
4. Convert orthographic views into an isometric projection of an object or component, ensuring proper visualization and proportion.
5. Complete TWO isometric projection problems based on orthographic views of simple machine components.

Exemplars and Utility:

1. Draw an isometric projection of a cube, cylinder, and cone using proper isometric angles (30° to horizontal).
2. Convert orthographic views (front, top, side) of an simple mechanical component into an isometric projection.
3. Construct isometric view of a square / hex nut or a washer, showing internal features with poor dimensions.

Experiment No.4	**Computer-Aided Drafting (CAD) - I**	**4 Hrs.**	**CO4**

Objective:

To introduce students to the fundamentals of Computer-Aided Drafting (CAD) using industry-standard software (such as AutoCAD), and to enable them to create accurate orthographic projections through digital tools, enhancing their drawing speed, precision, and industry readiness.

Associated Tasks:

1. Understand the basic interface and workspace of CAD software (AutoCAD or equivalent).
2. Learn the fundamental operations of CAD: creating, saving, and opening of drawing files.
3. Use basic drawing commands such as LINE, CIRCLE, POLYGON, ARC etc.
4. Apply dimensioning commands to annotate objects according to standard practices.
5. Utilize editing and modifying commands: MOVE, COPY, OFFSET, MIRROR, TRIM, EXTEND, etc.
6. Draw Orthographic projections (front, top, and side views) of a given object using the AutoCAD.

Exemplars and Utility:

1. Launch AutoCAD and set up a new drawing with proper units and limits.
2. Draw a 2D orthographic projection (front, top & side) of a simple object using AutoCAD tools.
3. Apply dimensioning and text annotation using standard dimension styles and settings.
4. Use layers to separate views or drawing elements like object lines, hidden lines, and center lines.
5. Plot or print the final drawing as a hard copy or PDF with a title block using standard sheet size (A3/A4).

Experiment No.5	**Computer-Aided Drafting (CAD) - II**	**6 Hrs.**	**CO5**

Objective:

To develop the ability to construct accurate isometric projections of engineering components using AutoCAD software by effectively utilizing drawing, editing, and dimensioning commands.

Associated Tasks:

1. Set up the isometric environment in AutoCAD (snap/grid settings, isometric plane selection).
2. Complete the isometric projection of a machine component using given orthographic views.
3. Use plot and print commands to generate a scaled drawing output (A4 or A3) with title block.

Exemplars and Utility:

1. Create an isometric view of a stepped block or machine bracket based on orthographic projections.
2. Construct isometric circles (e.g., holes or cylindrical features) using isocircle option.

Textbooks:

1. Bhatt, N. D. and Panchal, V. M., (2016), Engineering Drawing, Charotar Publication, India
2. Venugopal, K, (2015), Engineering and Graphics, New Age International, New Delhi
3. Rathnam, K., (2018), A First Course in Engineering Drawing, Springer Nature Singapore Pte. Ltd., Singapore
4. P.S. Gill ,Text Book of Engineering Graphics S.K. Kataria & Sons Publications.
5. K.L. Narayana and P. Kannaiah, Engineering Drawing and Graphics,New Age International Publisher

6. Jolhe D. A (2015), Engineering Drawing with introduction to AutoCAD, Tata McGraw Hill.
7. Munir Hamad, AutoCAD 2014: Beginning and Intermediate, Mercury Learning and Information.
8. Elise Moss ,AutoCAD 2014 Fundamentals ,SDC Publications
9. Coimbtore PSG College of Technology," Design Data Handbook - Data Book of Engineers", Kalaikathir Achchagam -Coimbatore Publication

Reference Books:

1. Madsen, D. P. and Madsen, D. A., (2016), Engineering Drawing and design, Delmar Publishers Inc., USA
2. Bhatt, N. D., (2018), Machine Drawing, Charotor Publishing House, Anand, India
3. Dhawan, R. K., (2000), A Textbook of Engineering Drawing, S. Chand, New Delhi
4. Basant Agrawal and C. M. Agrawal ,Engineering Graphics , McGraw Hill Education
5. Maheshwari Pradeep Jain, A.P. Gautam, and Anita , Engineering Graphics and Design,Khanna Publishing House
6. Mastering AutoCAD 2014 by G.Omura Autodesk Official press

MOOCs Links and additional reading material:

1. Orthographic Projections: https://nptel.ac.in/courses/124107157
2. Engineering Graphics and Modeling: https://onlinecourses.nptel.ac.in/noc21_me128/preview
3. Isometric Projections: https://youtu.be/Vo9LC9d7FQA?si=7lH-C1wLG60Xj6dD
4. Introduction to CAD: https://nptel.ac.in/courses/112102101
5. AutoCAD Basics: https://www.youtube.com/watch?v=a4jW2J8wnzI

Strength of CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	-	-	-	-	-	1	3	-	1
CO2	2	2	2	1	2	-	-	1	2	1	1
CO3	3	2	2	1	2	-	-	1	2	1	1
CO4	3	3	2	2	3	1	1	1	2	3	1
CO5	3	3	2	2	3	1	1	1	2	3	1
Avg.	**3**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**3**	**2**	**1**

Note - 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:
Engineering Graphics is a fundamental subject that deals with creating visual repetition and technical drawing to communicate design ideas and specifications.
Prerequisites typically includes Mathematics (geometry), Engineering drawing, Computer Aided Design (AutoCAD, Solid works, Fusion software's), Machine Drawing, Mechanical System Design, Building Design, Surveying, Machine Design, 3D software's, etc.

Job Mapping:
Job opportunities that one can get after learning this course:
Some potential job mapping for engineering graphics is –Design Engineer, CAD Designer, Draftsman, Product designer, Architectural visualizer, Industrial Design Engineer. Aerospace, automotive manufacturing gaming and animations industries.

Program:	**F. Y. B. Tech**			**Semester:**		**I / II**	
Course:	**Civil Engineering Lab**			**Course Code:**		**R25-CE-VSEC-111**	
Teaching Scheme(Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	2	-	1	-	-	50	-

Course Description:

This practical course aims to provide first-year Civil Engineering students with hands-on experience in fundamental concepts of Engineering Mechanics and Civil Engineering Systems. The Engineering Mechanics component focuses on understanding the behavior of physical systems under the action of forces, friction, and motion. Students will verify laws of forces, analyze support reactions, and explore frictional behavior and projectile motion through laboratory experiments.

The Systems in Civil Engineering component introduces students to environmental monitoring, modern surveying technologies, and material awareness. Students will perform tests on ambient air and soil quality, use Total Station and GPS instruments for data collection and mapping, and conduct a market survey of construction materials.

Course Relevance:

The course solidifies abstract concepts from Engineering Mechanics by allowing students to verify fundamental principles in a laboratory setting. It introduces students to the broader context of Civil Engineering systems and modern professional practices early on.

Prerequisite:

Basic Calculus, Trigonometry, Geometrical expressions, Laws of motion, Concept of mass, acceleration, fundamental knowledge of Engineering Mathematics and Physics and environmental studies.

Bridge Content: Enable students to visualize and validate fundamental laws of statics and dynamics.

Course Objectives:

1. To experimentally **VERIFY** fundamental principles of Engineering Mechanics such as equilibrium of forces, support reactions in beams, frictional behavior, projectile motion, and impact properties through practical demonstrations and measurements.
2. To **PROVIDE** hands-on experience in assessing environmental and geospatial parameters by conducting experiments related to air quality, soil properties, land measurement using Total Station and GPS, and evaluating construction materials through market survey.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**DETERMINE** the resultant of force system and verification of law of polygon of forces.	**2**
CO2	**CALCULATE** the vertical reaction forces at the supports of a simplysupported and overhang beam under point loading and **FIND** out the coefficient of static friction by using belt friction apparatus.	**3**
CO3	**FIND** the coefficient of restitution using concept of impact and impulse momentum principle and **DETERMINE** the parameters of projectile motion.	**3**
CO4	**CALCULATE** the results of air pollution data to assess environmental quality in accordance with national standards. Determine the pH of soil samples and assess its suitability for construction and agricultural applications.	**3**

CO5	**DEMONSTRATE** the ability to use Total Station and GPS instruments to measure distances, coordinates, and areas accurately, and apply the data for mapping and Civil Engineering applications.	**1**

List of Practical: A. Engineering Mechanics list of experiments (any four)

Experiment No.1	**Verification of the Polygon law of forces.**	**2 Hrs.**	**CO1**

Objective: To verify the Polygon Law of Forces using a physical model (force table) through experimental observation.

Associated Tasks:

1. Review theoretical background of force systems and vector addition.
2. Study the Polygon Law of Forces and understand equilibrium of concurrent forces.

Exemplars and Utility:

1. Understanding force balance is critical in analyzing trusses, frames, and beams in civil, mechanical, and aerospace engineering.
2. Improves Problem-Solving and Observation Skills
3. Reinforces key concepts from physics and mathematics (vector resolution, equilibrium, and trigonometry).

Experiment No.2	**To find support reaction of simply supported beam and overhang beam.**	**2 Hrs.**	**CO2**

Objective: To experimentally determine the support reactions in simply supported beam and overhang beam.

Associated Tasks:

1. Understand hinged and roller supports.
2. Distinguish between simply supported and overhang beams.

Exemplars and Utility:

1. Students will successfully apply $\sum Fx=0$, $\sum Fy = 0$ and $\sum M=0$ to calculate support reactions analytically.
2. Students recognize and explain practical deviations due to friction, beam weight, or apparatus imperfections.

Experiment No.3	**To determine coefficient of friction for block and belt using belt friction apparatus.**	**2 Hrs.**	**CO2**

Objective: To experimentally determine the coefficient of friction (μ) between a belt and a pulley surface using the belt friction apparatus, and to verify the belt friction equation under different loading conditions.

Associated Tasks:

1. Review the derivation of the belt friction equation.
2. Learn the function of the belt, pulley, hangers, and how to adjust and measure tension forces.

Exemplars and Utility:

1. Belt friction is fundamental in the design of belt drives, conveyor systems, brakes, and clutches.
2. Reinforces Interdisciplinary Learning: Integrates concepts from Physics (friction), Mathematics (logarithms, exponents), and Engineering Mechanics (statics and dynamics).

Experiment No.4	**To determine the parameters of projectile motion.**	**2 Hrs.**	**CO3**

Objective: To experimentally determine key parameters of projectile motion, such as: Initial velocity(u), Time of flight(T), Maximum height (Hmax), Horizontal range (R)

Associated Tasks:

1. Understand horizontal and vertical components of motion.
2. Recall key formulas for time of flight, range, and maximum height.

Exemplars and Utility:

1. Students successfully measure the projectile's range, time of flight, and maximum height with minimal error.

Experiment No.5	**To determine coefficient of restitution for plastic and rubber ball.**	**2 Hrs.**	**CO3**

Objective: To experimentally determine the coefficient of restitution (e) for plastic and rubber balls by measuring their rebound height after free fall, and compare their elastic behavior.

Associated Tasks:

1. Revise types of collisions—elastic, inelastic, and perfectly inelastic.
2. Learn the definition and physical significance of the coefficient of restitution.

Exemplars and Utility:

1. Strongly connects theoretical physics with practical applications in Engineering mechanics.
2. Applicable in design and analysis of:Ballistics and defense systems, Sports science (e.g., optimal angle for long jumps or throws), Civil and mechanical engineering (e.g., water jet systems, concrete pouring trajectories).

List of Practical: B. Systems in Civil Engineering (any four)

Experiment No.6	**Determination of particulate matter in the ambient air.**	**2 Hrs.**	**CO4**

Objective: To measure and analyze the concentration of particulate matter present in ambient **air** using appropriate sampling and filtration techniques.

Associated Tasks:

1. Understand types of air pollutants (PM_{10}, $PM_{2.5}$) and their health impacts.
2. Learn the principles and operation of high-volume and low-volume air samplers.

Exemplars and Utility:

1. Bridges textbook knowledge with real-time environmental data collection and analysis.
2. Educates students on how particulate matter affects respiratory health, cardiovascular diseases, and overall urban livability.

Experiment No.7	**Determination of pH and N P K concentration of Soil Samples.**	**2 Hrs.**	**CO4**

Objective: To determine the pH and the macronutrient content—Nitrogen (N), Phosphorus (P), and Potassium (K)—in soil samples, in order to assess soil fertility and suitability for agricultural use.

Associated Tasks:

1. Understand the importance of pH and nutrients (N, P, K) in plant growth and soil health.
2. Collect the soil sample form nearby area or from own farm to find out the N, P, K, value.

Exemplars and Utility:

1. This practical is essential in agriculture, Civil Engineering, and Geotechnical Engineering where soil quality assessment is critical.
2. Skills gained are directly applicable in: Agriculture and soil testing labs.

Experiment No.8	**Measurement of area using Total Station.**	**2 Hrs.**	**CO5**

Objective: To determine the area of a given plot or field using Total Station, an advanced electronic surveying instrument that combines electronic theodolite, electronic distance measurement (EDM), and microprocessor with data storage.

Associated Tasks:

1. Study the working principles of a Total Station (integration of EDM, electronic theodolite, microprocessor, and data storage).
2. Learn the names and functions of Total Station components (eyepiece, keypad, tribrach, reflector, etc.).

Exemplars and Utility:

1. This practical introduces students to industry-grade tools used in Civil engineering, construction, and land development.
2. Useful in: Road and highway Engineering, Building construction, Land parceling and urban planning, Irrigation and topographical surveys.

Experiment No.9	**Measurement Coordinates and Area using GPS.**	**2 Hrs.**	**CO5**

Objective: To measure geographic coordinates (latitude, longitude) and compute the area enclosed by multiple points using a Global Positioning System (GPS).

Associated Tasks:

1. Understand how GPS works: satellites, receivers, and coordinate systems (latitude/longitude).
2. Identify or outline the area to be measured (field, playground, plot, etc.).

Exemplars and Utility:

1. Introduces practical use of surveying technology to complement theoretical knowledge.
2. Used in preparing land records, property boundaries, and topographic maps.

Experiment No.10	**Market Survey of construction materials.**	**2 Hrs.**	**CO5**

Objective: To conduct a market survey of commonly used construction materials, gather real-time data on their types, availability, specifications, and prices, and understand their suitability for various Civil engineering applications.

Associated Tasks:

1. Understand the goal: collecting information on types, specifications, availability, and prices of Civil construction materials.
2. Choose 8–10 key materials to survey (e.g., cement, steel, bricks, sand, tiles, plumbing fixtures, paints, wood, and aggregates).

Exemplars and Utility:

1. Builds foundation for: Quantity Surveying, Estimating and Costing, Construction Management
2. Enhances understanding of material specifications used in BOQ (Bill of Quantities).

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	1	2	2	-	1	2	1	-	2
CO2	3	3	2	2	2	-	1	2	1	-	2
CO3	3	3	2	3	2	1	1	2	1	-	2
CO4	3	3	2	3	2	3	2	2	2	-	2
CO5	3	3	3	3	3	2	3	2	2	-	2
Avg.	**3**	**3**	**2**	**2.6**	**2.2**	**2**	**1.6**	**2**	**1.4**	**-**	**2**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:
Civil Engineering Lab course forms the foundation for several advanced and applied Engineering courses. Here is a list of future courses.

1. Mechanics of Structures: Applies concepts of force, stress, moment, and equilibrium to material behavior.
2. Structural Analysis: Understanding of structural systems (beams, columns, frames).
3. Surveying
4. Air Pollution and Control

Job Mapping:

Job opportunities that one can get after learning experiments of Civil Engineering Systems:
It develop skills relevant to environmental monitoring, geotechnical testing, land surveying, and construction management, preparing students for careers as environmental engineers, surveyors, geotechnical engineers, and construction material analysts in civil engineering projects.
Job opportunities that one can get after learning experiments of Engineering Mechanics:
The experiments in Engineering Mechanics develop skills applicable to roles such as design engineer, structural analyst, site engineer.

Program:	**F. Y. B. Tech**			**Semester:**		**I / II**	
Course:	**Professional Communication Skill**			**Course Code:**		**R25-SH-AEC-112.1**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	**-**	**02**	**02**	**-**	**-**	**50**	**-**

Course Description

This course is designed to develop the linguistic competence, interpersonal communication, and professional presentation skills required for academic and workplace success. It focuses on strengthening the four core language skills—Listening, Speaking, Reading, and Writing (LSRW)—through structured learning activities, interactive sessions, and real-life communication scenarios. The course introduces students to active listening, effective speaking, professional writing, and workplace etiquette. Through practical exercises such as group discussions, presentations, report writing, and interview simulations, learners gain confidence and proficiency in expressing their ideas clearly and effectively in professional and social contexts.

Course Relevance

Effective communication is a fundamental skill for engineers in every professional domain. This course bridges the gap between technical expertise and interpersonal competence by enhancing students' ability to communicate ideas, collaborate in teams, and engage with diverse audiences.

It equips learners with:

- Strong verbal and written communication skills for technical and managerial settings.
- The ability to participate effectively in interviews, meetings, and group discussions.
- Professional etiquette, cross-cultural sensitivity, and adaptability in corporate communication.
- Competence in preparing technical documents such as reports, proposals, and correspondence.

Thus, Professional Communication Skills serves as a foundation for employability, leadership, and lifelong learning in the engineering profession.

Prerequisite:

- Basic understanding of English grammar and vocabulary at secondary school level.
- Willingness to engage in interactive speaking and writing activities.
- Openness to feedback and active participation in individual and group exercises.

Bridge Content:

To ensure smooth transition from school-level English learning to professional-level communication, the following bridge modules are introduced at the beginning of the course:

1. Basic Grammar Refresher: Parts of speech, tenses, sentence structure, and punctuation.
2. Vocabulary Enrichment: Synonyms, antonyms, idioms, and usage of technical terms.
3. Functional Communication: Common expressions used in greetings, introductions, and day-to-day academic interactions.
4. Listening and Comprehension Practice: Exposure to short audio clips, speeches, and interviews to enhance listening accuracy.
5. Introduction to Public Speaking: Confidence-building exercises such as "Just a Minute" (JAM) sessions and self-introductions.
6. Digital Communication Skills: Basics of email writing, virtual meeting etiquette, and presentation design tools (MS PowerPoint, Google Slides).

Course Objective:

- **DEVELOP** effective listening, speaking, reading, and writing skills.
- **IMPROVE** pronunciation, fluency, and professional speaking etiquette.

- **STRENGTHEN** reading comprehension and analytical ability.
- **BUILD** written communication skills required in professional and academic contexts.
- **ENABLE** students to communicate confidently in workplace situations.

Course Outcomes: After learning the course, students will be able to

CO	Course Outcomes	Bloom's Level
CO1	APPLY effective listening techniques for academic and workplace settings.	**3**
CO2	DEMONSTRATE clarity, accuracy, and fluency in speaking	**4**
CO3	INTERPRET and ANALYZE written texts using appropriate reading strategies.	**4**
CO4	COMPOSE grammatically correct, concise, and structured written communication.	**5**
CO5	EXHIBIT professional etiquette, politeness, and confidence in workplace communication.	**4**

Course Contents

Unit 1	Fundamentals of Listening and Communication	5 Hrs.	CO1

- Basics of Listening: Introduction, Process, Importance, and Types
- Effective Listening: Principles, Barriers, and Guidelines
- Active Listening: Sub-skills (Predicting, Clarifying, Inferencing, Evaluating, Note-taking)
- Listening in Business Contexts (Telephony and Meetings)
- Importance of Communication in Professional Life

Assignments:

1. Listen to an audio/video clip and answer comprehension questions.
2. Take structured notes from a short lecture.
3. Write a reflection on the importance of active listening.

Unit 2	Speaking Skills and Oral Communication	5 Hrs.	CO2

- Speaking Parameters: Accuracy, Fluency, and Pronunciation
- Pronunciation Guide: Sound Scripting, Stress, and Intonation
- Fluency Activities: JAM, Role Plays, Picture/Audio-Visual Based Speaking
- Group Discussion: Principles, Preparation, and Practice
- Presentation Skills: Basics, Micro Presentations
- Situational Conversations: Introductions, Descriptions, and Inquiries

Assignments:

1. Participate in a JAM session or role play.
2. Deliver a short (3–5 min) micro presentation.
3. Take part in a group discussion on a current topic.

Unit 3	Reading and Comprehension Skills	5 Hrs.	CO3

- Effective Reading: Process, Types, and Reading Rate Adjustment
- Tips for Improving Reading and Vocabulary
- Reading Comprehension and Analytical Exercises
- Interpreting Technical and Literary Texts
- Critical and Contextual Reading

Assignments:
1. Solve a reading comprehension exercise.
2. Write a short book/film/article review.
3. Summarize a given text in your own words.

Unit 4	Writing Skills for Professional and Academic Contexts	5 Hrs.	CO4

- Importance and Structure of Written Communication
- Writing Book / Article / Film Reviews
- Letter Writing: Types, Formats, and Official Correspondence (Memos, Notices, Circulars)
- Report Writing: Principles and Types (Project & Internship Reports)
- Precise Writing, Editing, Proofreading, Abstract and Conclusion Writing

Assignments:
1. Write a formal letter or email.
2. Draft a short event or visit report.
3. Prepare a notice, memo, or circular.

Unit 5	Workplace Communication and Etiquette	4 Hrs.	CO5

- Greeting, Welcoming, Giving Instructions, Handling Complaints
- Providing Information: Directions, Facilities, and Local Guidance
- Polite and Persuasive Communication Techniques
- Accepting Praise and Criticism, Apologizing Professionally
- Developing Fluency, Etiquette, and Confidence

Assignments:
1. Draft a polite workplace conversation or email.
2. Participate in a mock interview or feedback activity.
3. Write a reflection on workplace communication etiquette.

Textbooks:

1. M. Ashraf Rizvi, *Effective Technical Communication*, Tata McGraw-Hill Education, 2010.
2. Meenakshi Raman and Sangeeta Sharma, *Technical Communication: Principles and Practice*, Oxford University Press, 2018.
3. Krishna Mohan and Meera Banerji, *Developing Communication Skills*, Macmillan Publishers India, 2009.

Reference Books:

1. Lehmann, Donna, *Business Communication*, Cengage Learning, 2018.
2. Lesikar, R.V. and Flatley, M.E., *Basic Business Communication*, Tata McGraw-Hill, 2011.
3. Raymond V. Lesikar, Marie E. Flatley, Kathryn Rentz, *Business Communication: Making Connections in a Digital World*, McGraw Hill Education, 2014.
4. Courtland L. Bovee and John V. Thill, *Business Communication Today*, Pearson Education, 2019.
5. Andrea J. Rutherford, *Basic Communication Skills for Technology*, Pearson Education, 2011.

MOOCs links

1. **NPTEL – Professional Communication Course (IITs)** – Covers listening, speaking, reading, and writing skills with workplace communication modules: https://nptel.ac.in/courses/109/106/109106176/
2. **SWAYAM – Communication Skills** – Government-approved MOOC on business and professional communication: https://swayam.gov.in/
3. **Coursera – Business Communication by University of British Columbia** – Develops clarity, confidence, and persuasion in communication: https://www.coursera.org/learn/business-communication

4. **edX – English for Workplace Communication (UPValenciaX)** – Practical course for professional speaking and writing: https://www.edx.org/
5. **LinkedIn Learning – Communication Foundations** – Focuses on active listening, presentation, and interpersonal skills: https://www.linkedin.com/learning/
6. **BBC Learning English – Business English** – Free resources for improving workplace English and communication etiquette: https://www.bbc.co.uk/learningenglish/businessenglish
7. **Toastmasters International** – Global platform for developing public speaking and leadership communication: https://www.toastmasters.org/

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	-	-	-	-	-	-	2	3	-
CO2	2	1	-	-	-	-	-	-	3	3	2
CO3	3	2	-	-	-	-	-	-	2	3	-
CO4	1	-	-	-	-	1	1	2	3	3	-
CO5	1	-	-	-	1	2	3	2	3	3	2
Average	**1.8**	**1.3**	-	-	**1**	**1.5**	**2**	**2**	**2.6**	**3**	**2**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:

This course lays the foundation for advanced communication-based and professional development courses such as Business Communication, Managerial Communication, Soft Skills and Personality Development, Corporate Readiness, and Technical Report Writing. It also maps with Project Communication, Internship Presentations, and Entrepreneurship Development courses that require effective verbal and written communication in professional environments.

Job Mapping:

Job opportunities that one can get after learning this course:

- Corporate Communication Executive / Public Relations Officer
- Technical Writer / Content Developer
- HR Executive / Recruiter
- Customer Relationship Manager / Client Support Executive
- Training and Development Coordinator
- Administrative or Front Office Executive
- Marketing and Sales Associate requiring strong communication skills
- Anchor, Presenter, or Event Coordinator

Program:	**F. Y. B. Tech**			**Semester:**		**I / II**	
Course:	**Foreign Language : Japanese**			**Course Code:**		**R25-SH-AEC-112.2**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	-	02	02	-	-	50	-

Course Description

This foundational course introduces students to Basic Japanese Language (JLPT N5 Level), focusing on Hiragana, Katakana, and basic grammar structures essential for elementary communication. It aims to develop reading, writing, listening, and speaking skills for simple, day-to-day interactions. Students will learn to greet, introduce themselves, describe objects and people, ask questions, and understand short spoken/written passages. The course also provides insights into Japanese culture, manners, and traditions, helping learners build global awareness and cross-cultural competence.

Course Relevance

As Japan plays a key role in global technology, engineering, and innovation, basic proficiency in Japanese offers students a competitive advantage in their professional careers. This course enhances students' linguistic and cultural adaptability—essential traits for global engineers.

It enables learners to:

- Build foundational communication skills in Japanese (Listening, Speaking, Reading, Writing).
- Understand Japanese workplace and social etiquette.
- Strengthen employability in Japanese companies and international collaborations.
- Develop a multicultural mindset for global professional success.

Prerequisite:

- Basic English literacy and an interest in learning a new language.
- Enthusiasm for intercultural learning and practice.
- Willingness to participate in speaking and listening activities regularly.

Bridge Content:

To ensure smooth initiation into Japanese learning, the following bridge modules are introduced at the beginning of the course:

- Introduction to Japanese Culture: Overview of Japan, people, customs, and daily life.
- Language Orientation: Understanding Japanese scripts (Hiragana, Katakana, Kanji) and pronunciation.
- Basic Grammar Concepts: Subject–object–verb sentence structure, particles, and greetings.
- Functional Communication Practice: Introducing self, asking names, nationalities, and occupations.
- Digital Tools for Language Learning: Use of Duolingo, Jisho.org, and Quizlet for vocabulary and script practice.

Course Objectives:

1. To **INTRODUCE** students to Japanese writing systems: *Hiragana*, *Katakana*, and basic *Kanji*.
2. To **DEVELOP** ability to read, write, and pronounce simple Japanese words and expressions.
3. To **ENABLE** understanding and use of basic Japanese grammar and sentence patterns.
4. To **ENHANCE** communication through basic listening and speaking practice.
5. To **PROMOTE** cultural awareness and appreciation of Japanese customs and etiquette.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**Identify** and write basic Japanese scripts (*Hiragana*, *Katakana*, *Kanji*).	**2**

CO2	**Use** common greetings, expressions, and self-introductions appropriately.	**3**
CO3	**Form** and **interpret** simple Japanese sentences using particles and sentence patterns.	**3**
CO4	**Demonstrate** basic listening and speaking skills in day-to-day conversations.	**4**
CO5	**Exhibit** awareness of Japanese culture, etiquette, and communication style.	**2**

Course Contents

Unit 1	**Introduction to Japanese Language & Culture**	**4 Hrs.**	**CO1**

- History and features of Japanese language
- Japanese culture, etiquette, greetings, and customs
- Self-introduction expressions (Name, Country, Profession)

Assignment:
1. Write a short paragraph (in English): *Why do you want to learn Japanese?*

Unit 2	**Hiragana (あ – ん) – Reading and Writing Practice**	**5 Hrs.**	**CO2**

- Introduction to *Hiragana* script
- Practice through vocabulary (common nouns and verbs)
- Writing and pronunciation exercises

Assignments:
1. Practice Sheet – Write each *Hiragana* character 5 times
2. Write 10 *Hiragana*-based words with English meanings

Unit 3	**Katakana (ア – ン) – Foreign Loan Words**	**5 Hrs.**	**CO3**

- Introduction to *Katakana* script
- English loanwords and pronunciation
- Writing practice and small character usage

Assignments:
1. Match 15 English loanwords with their *Katakana* equivalents
2. Create a mini-dictionary of 10 *Katakana* words

Unit 4	**Basic Grammar and Sentence Structure**	**5 Hrs.**	**CO4**

- Sentence pattern: AはBです
- Common particles: は, の, も
- Framing self-descriptive and interrogative sentences

Assignments:
1. Create a Japanese calendar (Days, Months, Numbers)
2. Frame 5 self-descriptive sentences using AはBです
3. Fill-in-the-blanks using particles (は, の, も)

Unit 5	**Vocabulary and Numbers & Kanji**	**5 Hrs.**	**CO5**

- Numbers, days, months, and time expressions
- Family, classroom, and daily activity vocabulary
- Reading comprehension exercises
- *Kanji I* – Numbers, Time, Basic Actions
- *Kanji II* – Family, Daily Routine, Directions

Assignments:

1. Create a family tree in Japanese (with labels)
2. Listen to 3 audio clips, answer comprehension questions
3. Final oral presentation on daily routine

Textbooks:

1. Marugoto Starter A1 (Katsudou + Rikai) – Japan Foundation.
2. Minna no Nihongo I – Beginner (3A Corporation).

Reference Books:

1. Genki: An Integrated Course in Elementary Japanese (3rd Edition) – Eri Banno et al., The Japan Times.
2. Minna no Nihongo I – Beginner Level – 3A Corporation, Tokyo.
3. Remembering the Kanji (6th Edition) – James W. Heisig, University of Hawai'i Press.

Online Learning Resources:

1. **Marugoto by Japan Foundation** – Free structured online courses for all levels: https://minato-jf.jp/
2. **Tae Kim's Guide to Learning Japanese** – Comprehensive grammar and usage guide: https://www.guidetojapanese.org/learn/
3. **NHK World Easy Japanese** – Audio lessons with cultural and pronunciation notes: https://www.nhk.or.jp/lesson/english/
4. **JapanesePod101** – Audio/video lessons for listening and speaking practice: https://www.japanesepod101.com/
5. **WaniKani** – Kanji and vocabulary learning through spaced repetition: https://www.wanikani.com/
6. **Duolingo Japanese** – Interactive and gamified Japanese learning: https://www.duolingo.com/course/ja/en/Learn-Japanese
7. **Tofugu** – Cultural insights, grammar tips, and script learning guides: https://www.tofugu.com/

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	2	-	-	-	-	-	1	1	2	3	-
CO3	3	2	-	-	-	-	-	-	2	2	-
CO4	2	-	-	-	-	-	1	2	3	3	-
CO5	1	-	-	-	-	2	3	2	2	2	-
Avg.	**2.2**	**2**	**-**	**-**	**-**	**2**	**1.66**	**1.66**	**2.25**	**2.5**	**-**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:

This course serves as a prerequisite for / maps with the following future courses: **This foundational course in Basic Japanese Language serves as a prerequisite for advanced language studies such as** Intermediate and Advanced Japanese (JLPT N4–N3 levels)**, as well as** Japanese for Business Communication, Cross-Cultural Communication, and Global Employability Skills**. It also maps with courses related to** Foreign Language for Engineers **and** Professional Communication in Multicultural Environments**.**

Job Mapping:

Job opportunities that one can get after learning this course:

- Japanese Language Translator / Interpreter (Beginner Level)
- Customer Support Executive for Japanese-speaking clients
- Language Associate in BPO / KPO / IT sectors
- Junior Japanese Language Trainer or Teaching Assistant
- Cultural Exchange Program Participant or Internship in Japan
- Foundation for Technical or Engineering roles in Japanese companies operating in India or abroad

Program:	**F. Y. B. Tech**			**Semester:**		**I / II**	
Course:	**Foreign Language: German**			**Course Code:**		**R25-SH-AEC-112.3**	
Teaching Scheme(Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	-	02	02	-	-	50	-

Course Description

This course introduces students to **Basic German Language (A1 Level)**, focusing on everyday communication and foundational grammar. Students will learn to read, write, listen, and speak German for simple interactions related to personal, academic, and professional contexts.

It covers essential vocabulary, sentence structures, greetings, and conversational patterns along with insights into German culture, festivals, and etiquette. By the end of the course, learners will be able to handle basic conversations and understand short texts and spoken passages in German.

Course Relevance Germany is one of the world's leaders in **engineering, technology, and research**, and numerous Indian professionals collaborate with German organizations. Learning German gives students a **global edge** in higher education, internships, and professional placements.

This course helps students:

Acquire basic German communication skills (Listening, Speaking, Reading, Writing). Understand German culture, manners, and workplace etiquette.

Build confidence to interact in multicultural environments.

Improve employability for German collaborations and higher studies.

Prerequisite:

Students should, however:

- Have basic English literacy and interest in languages.
- Participate regularly in speaking and listening sessions.
- Show curiosity about European culture and cross-cultural communication.

To facilitate smooth learning, the following bridge modules are introduced:

1. **Introduction to Germany** – Geography, culture, and people.
2. **Language Orientation** – Overview of the German alphabet, pronunciation, and greetings.
3. **Basic Grammar Concepts** – Subject–verb agreement, articles, and gender of nouns.
4. **Functional Communication Practice** – Simple introductions and everyday phrases.
5. **Digital Learning Tools** – Use of *Duolingo*, *Babbel*, and *Quizlet* for practice.

Course Objectives:

1. **LEARN** the German alphabet, pronunciation, and phonetics.
2. **BUILD** essential vocabulary for everyday use.
3. **UNDERSTAND** and **APPLY** basic German grammar structures.
4. **READ** and **WRITE** short German texts and dialogues.
5. **COMMUNICATE** in simple social and professional situations.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**RECOGNIZE** and use German alphabet, pronunciation, and sounds correctly.	**2**
CO2	**USE** basic vocabulary and expressions for greetings, self-introduction, and daily routines.	**3**

CO3	**FORM** simple sentences using correct grammar and verb conjugation.	**4**
CO4	**ENGAGE** in short conversations and oral exchanges.	**3**
CO5	**DEMONSTRATE** awareness of German culture and etiquette.	**5**

Course Contents

Unit 1	**Introduction to German Language & Culture**	**2 Hrs.**	**CO1**

- Overview of Germany, culture, and traditions
- German alphabet and pronunciation
- Basic greetings and courtesy phrases

Assignments:
1. Write a short note on "Why I want to learn German."
2. Practice German alphabet and pronunciation sheet.

Unit 2	**Basic Vocabulary & Expressions**	**4 Hrs.**	**CO2**

- Days, months, numbers, colors, family, classroom objects
- Self-introduction and nationality
- Simple dialogues (Wie heißt du? Woher kommst du?)

Assignments:
1. Vocabulary worksheet – family, days, numbers.
2. Record a 30-sec voice clip introducing yourself in German.

Unit 3	**Grammar Fundamentals**	**9 Hrs.**	**CO3**

Nouns and gender (der, die, das)

- Articles and plurals
- Pronouns (ich, du, er/sie/es)
- Verb conjugation (sein, haben, regular verbs)
- Sentence structure: Subject–Verb–Object
- Negation with nicht and kein
- Questions and answers (Was, Wo, Wie)
- Prepositions of place and time

Assignments:
1. Grammar exercise on verb conjugation (sein, haben, machen).
2. Fill-in-the-blank grammar sheet with articles and pronouns.

Unit 4	**Reading & Writing Skills**	**3 Hrs.**	**CO4**

- Short paragraph reading and comprehension
- Writing simple sentences and descriptions
- Fill-in-the-blanks and translation activities

Assignments:
1. Create a "Mein Stundenplan" (My Weekly Timetable).
2. Mini-dialogue writing – at a café, in the classroom

Unit 5	**Listening & Speaking Skills, Cultural & Practical Applications**	**6 Hrs.**	**CO5**

- Listening to short dialogues and identifying key words
- Role-plays: shopping, directions, greetings
- Oral pronunciation practice
- Festivals, food, etiquette in Germany
- Mini cultural project / presentation
- Course review and oral evaluation

Assignments:

1. Listening comprehension task from audio clips.
2. Prepare a poster – "Germany: Land of Engineers."
3. Oral presentation – "My Family / Meine Familie."
4. Final oral and written evaluation activity.

Textbooks:

1. Studio d A1 – Cornelsen Verlag
2. Menschen A1 – Hueber Verlag
3. Fit fürs Goethe-Zertifikat A1 – Goethe-Institut

Reference Books:

1. The Everything Learning German Book – Ed Swick
2. German for Beginners – Angela Wilkes (Usborne)
3. Duolingo, Babbel, Quizlet, Memrise apps
4. DW Learn German – Deutsche Welle (Online platform with audio-video lessons

MOOCs links:

1. Goethe-Institut – Free German exercises (A1-C2) – https://www.goethe.de/en/spr/ueb.html (Goethe- Institut)
2. Duolingo – German course for English speakers – https://www.duolingo.com/course/de/en/Learn- German (Duolingo)
3. Deutsche Welle – German learning portal – https://www.germany.info/us-en/welcome/language-study- research/where-to-learn-german-1305980 (Germany.info)
4. Deutsch.info – Free German courses (A1-B2) with multimedia resources – https://deutsch.info/?hl=en (deutsch.info)

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	-	-	-	-	-	-	1	2	-
CO2	1	-	-	-	-	-	-	-	2	3	-
CO3	2	1	-	-	-	-	-	-	2	3	-
CO4	-	-	-	-	-	1	-	1	2	3	-
CO5	2	2	-	-	-	-	-	-	1	2	-
Avg.	**1.4**	**1.5**	**-**	**-**	**-**	**1**	**-**	**1**	**1.6**	**2.6**	**-**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:

- Intermediate German Language (JLPT A2 Level / CEFR A2 Equivalent)
- Advanced German for Technical Communication
- German for Business and Engineering Applications
- Cross-Cultural Communication and Global Studies

Job Mapping:

Job opportunities that one can get after learning this course:

- German Language Translator / Interpreter (Beginner Level)
- Customer Support Executive for German-speaking clients
- Language Associate in BPO / KPO / IT sectors
- Junior Language Trainer or Teaching Assistant (German)
- Cultural Exchange or Internship Programs in German-speaking countries
- Foundation for Technical or Engineering roles in German companies operating in India or abroad

Program:	**F. Y. B. Tech**			**Semester:**		**I / II**	
Course:	**Indian Knowledge System**			**Course Code:**		**R25-SH-AEC-113**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	-	02	02	-	-	50	-

Course Description

This course introduces learners to the vast and diverse Indian Knowledge System (IKS) — the ancient and indigenous body of knowledge encompassing philosophy, science, engineering, architecture, arts, and culture. It explores India's civilizational heritage, major dynasties, intellectual traditions, and UNESCO World Heritage Sites.

Students will study foundational texts like the Vedas, Upanishads, and Shastras, understand ancient Indian education systems, and analyze the scientific and technological achievements of ancient India.

Course Relevance

- The course also connects ancient wisdom with modern learning, promoting sustainability, ethics, and cultural awareness.
- Understanding India's indigenous knowledge systems helps students appreciate the nation's intellectual depth and its contribution to global civilization. The course:
- Builds awareness of India's philosophical and scientific heritage.
- Enhances critical and comparative understanding of ancient and modern systems.
- Encourages sustainability-oriented thinking through traditional practices.
- Promotes cultural literacy and national pride among future engineers and professionals

Prerequisite:

Students are expected to possess:

- Basic understanding of history and culture.
- Interest in learning about ancient Indian achievements and philosophies.
- Curiosity to explore the roots of science, technology, and arts in India.

Bridge Content:

Before starting the course, the following introductory modules will be covered:

1. Introduction to Indian Civilization and Cultural Heritage.
2. Overview of Knowledge Systems in India — Vedic and Post-Vedic.
3. Understanding BC/BCE and AD/CE timelines.
4. Linking Ancient Indian Science to modern STEM principles.
5. Awareness about UNESCO Heritage and Global Cultural Legacy.

Course Objective:

- To **INTRODUCE** students to the foundational concepts and sources of Indian Knowledge Systems.
- To **EXPLORE** the philosophical, educational, and scientific achievements of ancient India.
- To **STUDY** Indian dynasties and their cultural, political, and technological contributions.
- To **EXAMINE** India's artistic, architectural, and musical traditions.
- To **UNDERSTAND** the global influence of ancient Indian knowledge and heritage.

Course Outcomes: After learning the course, students will be able to

CO	Course Outcome	Bloom's Level
CO1	**UNDERSTAND** the significance of Vedas, Upanishads, the Six Schools of Philosophy, Gurukul education system, and Varna system.	**2**
CO2	**ANALYZE** ancient Indian Shastras, astronomy, astrology, and scientific achievements in historical and cultural contexts.	**4**
CO3	**EXAMINE** the contributions of music, dance, arts, and architecture to Indian cultural heritage and traditions.	**5**
CO4	**RECOGNIZE** the governance, achievements, and contributions of major Indian dynasties and civilizations including Indus Valley Civilization.	**4**
CO5	**EXPLORE** ancient Indian engineering, technology, UNESCO World Heritage sites, and assess their influence on modern practices and global knowledge systems.	**6**

Course Contents

Unit 1	Foundations of Indian Knowledge	4 Hrs.	CO1

- Vedic Period: Vedas and their significance
- Upanishads: Philosophy and knowledge
- Six Schools of Indian Philosophy
- Gurukul Education System
- Varna System

Assignments:

1. Write a report on the significance of the Vedas or Upanishads.
2. Discuss the Gurukul education system and its relevance today.
3. Compare the ancient Varna system with modern social structures.

Unit 2	Philosophy, Literature, and Scientific Thought	4 Hrs.	CO2

- Introduction to Shastras: Yoga Shastra, Nyaya Shastra, Dharmashastra, Arthashastra
- Ancient Indian Astronomy and Astrology
- Ancient Indian Arts and Architecture

Assignments:

1. Prepare a presentation on any one Shastra (Yoga, Nyaya, Dharmashastra, or Arthashastra).
2. Write a report on ancient Indian contributions to astronomy or astrology.
3. Analyze a key scientific achievement from ancient India (e.g., Aryabhata's mathematics)

Unit 3	Music, Dance, and Cultural Heritage	5 Hrs.	CO3

- Ancient Indian Music and Dance
- Cultural traditions and festivals
- Indian culture through ages: ethics, rituals, and symbolism

Assignments:

1. Write an essay on a classical Indian music or dance form.
2. Prepare a visual presentation on Indian cultural festivals and traditions.
3. Study an ancient architectural style and summarize its features.

Unit 4	**Civilization and Dynastic Heritage**	**5 Hrs.**	**CO4**

- Indus Valley Civilization: Mohenjo-Daro and Harappa
- Major Indian Dynasties: Haryanka, Nanda, Maurya, Shunga, Gupta, Kushan, Maratha, Chola, Pandya, Chera, Satavahana, Pallava, Chalukya, Varman, Mlechchha, Kamrupa-Palas, Ahom

Assignments:

1. Create a timeline of major Indian dynasties and their achievements.
2. Prepare a short report on Indus Valley Civilization (Mohenjo-Daro or Harappa).
3. Analyze the governance and cultural contributions of any one dynasty.

Unit 5	**Architectural, Engineering, UNESCO Sites & Global Influence**	**4 Hrs.**	**CO5**

- Ancient Indian Engineering and Technology
- Temples and structural design
- Metallurgy, town planning, irrigation, and water management systems
- Overview of UNESCO World Heritage Sites: Ajanta, Ellora, Hampi, Mahabalipuram, Khajuraho, Bhimbetka, Konark, Champaner, Mahabodhi, Sanchi, Pattadakal, Nanda Devi, etc.
- Ancient Indian Knowledge and its global influence

Assignments:

1. Write a report on any one UNESCO World Heritage Site in India.
2. Prepare a case study on ancient Indian engineering or metallurgy techniques.
3. Discuss the global influence of Indian knowledge systems in a short essay.

Textbooks:

1. Indian Knowledge System – AICTE, 2022
2. Knowledge Traditions and Practices of India – Kapil Kapoor & Michel Danino
3. Essence of Indian Knowledge Tradition – NPTEL/SWAYAM Course Material

Reference Books:

1. A.L. Basham – The Wonder That Was India
2. Subhash Kak – The Astronomical Code of the Rigveda
3. Indian Knowledge System: Concepts and Applications – CBSE Publication

MOOCs links

1. Introduction to Indian Knowledge System (SWAYAM) – https://onlinecourses.swayam2.ac.in/nou25_ge95/preview (Swayam)
2. IKS Division, AICTE – https://iksindia.org/ (Indian Knowledge Systems)
3. IKS: Concepts & Applications in Engineering (SWAYAM) – https://onlinecourses.swayam2.ac.in/imb23_mg53/preview (Swayam)
4. Indian Knowledge System: Concepts & Applications in Science (SWAYAM) – https://onlinecourses.swayam2.ac.in/imb24_mg21/preview (Swayam)
5. SWAYAM Platform – https://swayam.gov.in/ (swayam.gov.in)

Strength of CO-PO Mapping											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	1	–	–	–	1	2	-
CO2	2	1	-	-	–	1	–	1	2	3	-
CO3	2	2	-	-	1	–	2	2	2	3	-
CO4	1	–	-	1	2	2	–	1	2	2	-
CO5	2	1	-	1	2	2	1	1	2	3	-
Avg.	**2.16**	**1.6**	**-**	**1**	**1.4**	**1.66**	**1.5**	**1.25**	**1.66**	**2.5**	-

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:
Courses on Indian Philosophy, Heritage Studies, Ethics and Values in Engineering, Art and Architecture of India, Environmental Sustainability inspired by Ancient Practices, and Interdisciplinary Studies on Science and Technology in Ancient India.

Job Mapping:

Job opportunities that one can get after learning this course:
Knowledge of Indian Knowledge Systems enhances opportunities in fields such as education, heritage management, cultural tourism, archaeology, art and architecture conservation, research and documentation, museum curation, civil services, and interdisciplinary roles promoting India's cultural and scientific heritage.

Program:	**F. Y. B. Tech**			**Semester:**		**I**	
Course:	**Cocurricular Course - I Art And Crafts**			**Course Code:**		**R25-SH-CC-114.1**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	25	-

Course Description

This course provides an introduction to the fundamental concepts, techniques, and creative processes involved in arts and crafts. It explores various art forms such as drawing, painting, paper craft, textile art, clay modelling , and eco-friendly crafts. Students will gain hands-on experience through practical projects that enhance creativity, fine motor skills, and aesthetic appreciation.

Course Relevance

Arts and Crafts play a vital role in developing creativity, imagination, and self-expression. This course is relevant for learners seeking to : Understand the cultural and historical significance of art and craft traditions. Develop practical artistic skills applicable in education, design, and community projects. Promote sustainable practices through recycled and eco-friendly materials. Foster teamwork and communication through collaborative art projects.

Course Outcomes: After learning the course, the student will

1. Understand the meaning, history, and importance of arts and crafts in human culture.
2. Learn and apply basic drawing and painting techniques, including sketching, shading, and color theory.
3. Create paper crafts and origami models using folding and cutting techniques.
4. Experiment with textile and fabric art methods such as tie-dye, block printing, embroidery, and fabric painting.
5. Explore clay modeling and pottery basics for three-dimensional artistic expression.

CO	**Course Outcome**	**Bloom's Level**
CO1	Explain the meaning, history, importance, and evolution of arts and crafts and demonstrate basic drawing and painting techniques.	**3**
CO2	Create decorative items using paper craft and origami techniques and apply basic textile and fabric art methods such as tie-dye, block printing, embroidery, and fabric painting.	**3**
CO3	Develop clay models using hand-building and sculpting techniques and demonstrate basic pottery and surface finishing skills.	**3**
CO4	Produce eco-friendly craft items using recycled materials and practice sustainable art-making methods.	**3**
CO5	Design, execute, and present creative individual or group art projects and organize exhibitions effectively.	**3**

Course Contents			
Unit 1	**Introduction to Arts and Crafts**	**4 Hrs.**	**CO1**
Meaning, history, importance, and evolution of arts and crafts across cultures, Basic Drawing and Painting Techniques Sketching, shading, color theory, brushwork, and composition.			
Unit 2	**Paper Craft, Origami, Textile and Fabric art**	**4 Hrs.**	**CO2**

Paper Craft and Origami Techniques of folding, cutting, and creating decorative items; greeting cards and paper sculptures. Textile and Fabric Art - Tie-dye methods, block printing, basic embroidery stitches, and fabric painting.			
Unit 3	**Clay and Modeling**	**4 Hrs.**	**CO3**
Hand-building techniques, sculpting, introduction to pottery and surface finishing.			
Unit 4	**Recycled and Eco-Friendly Craft**	**4 Hrs.**	**CO4**
Creating art using waste materials, sustainable art practices, and environmental awareness.			
Unit 5	**Creative Projects and Exhibitions**	**4 Hrs.**	**CO5**
Designing, executing, and presenting individual or group art projects; organizing exhibitions.			

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	–	–	–	–	–	–	–	1	–
CO2	1	1	2	–	–	–	1	–	–	–	–
CO3	1	–	2	1	–	–	–	–	–	–	–
CO4	1	–	2	–	–	–	2	–	–	–	–
CO5	–	–	2	–	–	–	–	–	2	2	1
Average	**1.25**	1	**2**	**1**	**-**	**-**	1.5	**-**	2	**1.5**	1

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Program:	**F. Y. B. Tech**			**Semester:**		I	
Course:	**Cocurricular Course- I** **Dance**			**Course Code:**		**R25-SH-CC-114.2**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	25	-

Course Description

This course introduces students to the art and discipline of dance as a form of physical expression, cultural heritage, and creative movement. It explores the meaning, importance, and various forms of dance, ranging from folk and classical traditions to contemporary and creative styles. Students will develop fundamental dance skills, including posture, balance, rhythm, coordination, and spatial awareness. Through theory and practical sessions, learners will gain insights into choreography, group formations, and performance techniques. The course also emphasizes the role of dance in fitness, emotional expression, stress relief, and personal confidence**.**

Course Relevance

Dance is not only a performing art but also a powerful medium for cultural preservation, self-expression, and physical fitness. In today's context, where holistic well-being and creative communication are increasingly valued, dance serves as a bridge between tradition and modernity, nurturing both body and mind. This course is relevant for students pursuing careers in performing arts, physical education, choreography, and wellness, or anyone seeking to enhance their creativity and confidence through movement.

Course Objectives:

1. Understand the meaning, history, and significance of dance as a cultural and artistic expression.
2. Demonstrate basic dance movements involving posture, rhythm, balance, and coordination.
3. Explore and perform selected folk and classical dance forms.
4. Engage with contemporary and creative dance styles, emphasizing freedom of expression.
5. Apply choreographic principles in creating and organizing dance sequences.

Course Outcomes: After learning the course, the student will

CO	**Course Outcome**	**Bloom's Level**
CO1	Exhibit foundational skills in diverse dance styles and techniques.	**3**
CO2	Identify and appreciate the cultural diversity of dance forms.	**3**
CO3	Design and perform original choreographic pieces with effective group coordination.	**3**
CO4	Demonstrate improved physical fitness, rhythm, and body awareness.	**3**
CO5	Use dance as a medium for self-expression and stress management.	**3**

Course Contents			
Unit 1	**Introduction to Dance**	**4 Hrs.**	**CO1**
• Meaning and definition of dance • Importance in culture, expression, and fitness • Overview of folk, classical & contemporary form			
Unit 2	**Basic Dance Movements**	**4 Hrs.**	**CO2**
• Posture & body alignment • Balance & coordination • Rhythm, timing, basic steps, gestures			

Unit 3	**Folk and Classical Dance Forms**	**4 Hrs.**	**CO3**
• Major Indian folk dance styles • Classical dance forms & basic elements			
Unit 4	**Contemporary & Creative Dance**	**4 Hrs.**	**CO4**
• Modern dance styles & evolution • Freestyle, expressive dance • Improvisation & creativity • Basics of choreography (sequencing, patterns, transitions, group formations, storytelling)			
Unit 5	**Dance, Fitness & Well-being**	**4 Hrs.**	**CO5**
• Physical benefits (strength, flexibility, stamina) • Mental & emotional benefits (stress relief, confidence, teamwork) • Dance as fitness & lifestyle activity			

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	–	2	–	–	1	–	–	1	–	–
CO2	1	1	–	–	–	–	–	–	–	1	–
CO3	–	–	3	–	–	–	–	–	2	2	1
CO4	–	–	2	–	–	2	–	–	1	–	–
CO5	–	–	–	–	–	2	–	–	1	1	–
Average	**1.0**	**1.0**	**2.33**	**–**	**–**	**1.67**	**–**	**–**	**1.25**	**1.33**	**1.0**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Program:	**F. Y. B. Tech**			**Semester:**		**I**	
Course:	**Cocurricular Course-I Health And Wellness**			**Course Code:**		**R25-SH-CC-114.3**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	25	-

Course Description

This course provides an introduction to the fundamental concepts of health and wellness, emphasizing the importance of a balanced lifestyle for personal and community well-being. Students will explore various dimensions of health—physical, mental, emotional, and social—while learning about nutrition, fitness, mental health, hygiene, and preventive health practices. The course also promotes self-awareness, positive health behaviours, and the adoption of lifelong wellness habits.

Course Relevance

This course is relevant to all individuals seeking to improve their overall quality of life. It builds awareness of the interconnection between physical, mental, and social well-being. For students, it fosters healthier habits that enhance academic performance and resilience. For future professionals, it provides foundational knowledge to maintain productivity, prevent lifestyle diseases, and promote wellness in community or organizational contexts.

Course Outcomes: After learning the course, the student will

1. Understand the meaning, dimensions, and importance of health and wellness.
2. Identify the principles of good nutrition and the role of macro- and micronutrients in maintaining health.
3. Develop knowledge of physical fitness and various forms of exercise for optimal body functioning.
4. Recognize the importance of mental health and learn strategies for managing stress.
5. Adopt healthy lifestyle habits that prevent diseases and promote overall well-being.

CO	Course Outcome	Bloom's Level
CO1	Explain the concept and dimensions of health and wellness.	**3**
CO2	Design a balanced diet plan based on nutritional requirements.	**3**
CO3	Demonstrate understanding of different fitness components and their benefits.	**3**
CO4	Apply stress management and mindfulness techniques for emotional stability.	**3**
CO5	Implement lifestyle practices that promote disease prevention and health maintenance.	**3**

Course Contents			
Unit 1	**Introduction to Health & Wellness**	**4 Hrs.**	**CO1**
Introduction to Health and Wellness Meaning and definition of health and wellness Dimensions of health: physical, mental, social, and emotional Determinants of health Importance of holistic wellness in modern life			
Unit 2	**Nutrition & Balanced Diet**	**4 Hrs.**	**CO2**
Nutrition and Diet Concept of a balanced diet Macronutrients (carbohydrates, proteins, fats and micronutrients (vitamins, minerals) Role of hydration and water balance Healthy eating habits and dietary planning Malnutrition and lifestyle-related disorders (obesity, diabetes, hypertension)			
Unit 3	**Physical Fitness & Exercise**	**4 Hrs.**	**CO3**
Physical Fitness and Exercise Concept and importance of physical fitness Types of exercises: aerobic, strength,			

flexibility, functional fitness Benefits of regular physical activityExercise safety and injury prevention			
Unit 4	**Mental Health & Stress Management**	**4 Hrs.**	**CO4**
Mental Health and Stress Management Definition and importance of mental health Common mental health issues among students and adults Stress – causes, symptoms, and effects Stress management techniques: mindfulness, meditation, yoga, and relaxation exercises Coping strategies and emotional resilience			
Unit 5	**Healthy Lifestyle & Disease Prevention**	**4 Hrs.**	**CO5**
Lifestyle and Disease Prevention Concept of healthy lifestyle Role of sleep and rest (sleep hygiene) Avoiding addictions: tobacco, alcohol, drugs, and digital addiction Preventive health practices: immunization, screening, and early diagnosis			

Strength of CO-PO Mapping

CO / Average	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	–	–	–	–	–	–	–	–	–
CO2	2	2	–	–	–	–	1	–	–	–	1
CO3	1	–	2	–	–	2	–	–	–	–	–
CO4	–	–	–	–	–	3	–	–	–	1	–
CO5	1	–	–	–	–	2	2	–	–	–	1
Average	**1.5**	**1.5**	**2.0**	**-**	**-**	**2.33**	**1.5**	**-**	**-**	**1.0**	**1.0**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Program:	**F. Y. B. Tech**			**Semester:**		**I**	
Course:	**Cocurricular Course-1 Yoga**			**Course Code:**		**R25-SH-CC-114.4**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	25	-

Course Description

This course provides a comprehensive understanding of the meaning, origin, and philosophy of Yoga. It explores the historical development of Yoga, its objectives, and its relevance in contemporary life. Students will learn about the four major paths of Yoga—Karma, Bhakti, Jnana, and Raja Yoga—as well as Patanjali's Ashtanga Yoga (Eightfold Path). The practical component includes the performance of basic asanas (postures), pranayama (breathing techniques), and meditation and relaxation practices for overall well-being. The course emphasizes Yoga as a holistic lifestyle promoting physical health, mental clarity, emotional balance, and spiritual growth. It also highlights the role of Yoga in modern contexts such as education, workplace wellness, and sustainable living.

Course Relevance

Yoga education is essential in today's fast-paced world where stress, sedentary habits, and lifestyle diseases are on the rise. This course equips learners with lifelong skills to maintain health, enhance concentration, and achieve emotional balance. By integrating Yoga into daily life, individuals cultivate mindfulness, self-discipline, and inner harmony. Moreover, with the global acceptance of Yoga—celebrated through the International Day of Yoga—this course contributes to creating a healthier, more peaceful, and sustainable society.

Course Objectives:

1. Introduce students to the meaning, origin, and historical evolution of Yoga.
2. Explain the philosophical foundations of Yoga through its major paths and principles.
3. Develop awareness about Yoga as a holistic way of life that integrates body, mind, and spirit.
4. Teach basic Yogic practices including asanas, pranayama, and meditation for physical and mental well-being.
5. Demonstrate the role of Yoga in promoting health, managing stress, and preventing lifestyle-related diseases.

Course Outcomes: After learning the course, the student will

CO	**Course Outcome**	**Bloom's Level**
CO1	Describe the origin, meaning, and philosophy of Yoga.	**3**
CO2	Identify and explain the four paths of Yoga and Patanjali's Ashtanga Yoga..	**3**
CO3	Perform basic Yoga asanas with correct posture and alignment.	**3**
CO4	Practice breathing techniques (pranayama) and relaxation methods effectively.	**3**
CO5	Apply Yoga principles for physical fitness, emotional balance, and mental clarity.	**3**

Course Contents			
Unit 1	**Warm-up & Loosening Practices**	**4 Hrs.**	**CO1**
Warm-up, loosening exercises, Surya Namaskar, breathing coordination.			
Unit 2	**Basic Standing Asanas**	**4 Hrs.**	**CO2**
Tadasana, Trikonasana, Vrikshasana, Padahastasana – posture & balance.			
Unit 3	**Sitting Asanas**	**4 Hrs.**	**CO3**
Sukhasana, Vajrasana, Ardha Matsyendrasana – flexibility & spinal mobility.			
Unit 4	**Prone & Supine Asanas**	**4 Hrs.**	**CO4**
Bhujangasana, Shalabhasana, Dhanurasana, Pavanamuktasana, Setubandhasana.			
Unit 5	**Relaxation & Mind–Body Practices**	**4 Hrs.**	**CO5**
Shavasana, Yoga Nidra – relaxation, mindfulness, body–mind integration.			

Strength of CO-PO Mapping											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	1	–	–	–	–	–	–	–	1	–
CO2	2	2	–	–	–	–	1	–	–	1	–
CO3	–	–	3	–	–	2	–	–	1	–	–
CO4	–	–	2	–	–	3	–	–	1	–	–
CO5	1	–	1	–	–	3	1	–	1	1	–
Avg.	**1.67**	**1.50**	**2.00**	–	–	**2.67**	**1.00**	–	**1.00**	**1.00**	–

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Program:	**F. Y. B. Tech**			**Semester:**		**I**	
Course:	**Cocurricular Course-** I **Sahyadri Trekking and Rock Climbing**			**Course Code:**		**R25-SH-CC-114.5**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	25	-

Course Description: This course is designed to instill a sense of regional pride through the exploration of Sahyadri geography and history while developing physical endurance, technical climbing skills, and environmental stewardship in the youth.

Course Relevance: This course connects youth with the geographical and historical heritage of the Sahyadris, fostering regional pride while building physical endurance and essential climbing skills. It promotes environmental awareness and encourages conservation of natural resources. Overall, it shapes responsible and confident individuals who value nature and local culture.

Course Objectives:

1. To introduce students to the geography and historical significance of the Sahyadri ranges.
2. To provide training in outdoor safety, hazard management, and first aid.
3. To teach technical skills related to rock climbing, knots, and equipment handling.
4. To promote ethical outdoor practices and Leave No Trace principles.

CO	**Course Outcome**	**Bloom's Level**
CO1	Explain the historical and geographical significance of Sahyadri forts.	**2**
CO2	Identify outdoor hazards and demonstrate basic First Aid procedures	**3**
CO3	Apply "Leave No Trace" ethics during camping and trekking.	**3**
CO4	Demonstrate technical proficiency in knot tying, belaying, and rappelling.	**4**

Course Contents

Unit 1	**Introduction to Mountaineering and Sahyadri Heritage**	**4 Hrs.**	**CO1**

Introduction to Mountaineering and Sahyadri Heritage

- History of Mountaineering: Global and Indian context.
- Geography of Sahyadris: Basalt rock formation, range spans.
- Fort History: Significance of Shiv-kalin forts, architecture, and water management systems.

Unit 2	**Hazards in Outdoors and First Aid**	**4 Hrs.**	**CO2**

Hazards in Outdoors and First Aid

- Objective Hazards: Rockfall, weather, terrain
- Subjective Hazards: Fear, dehydration, poor fitness.
- Outdoor First Aid: Treating cuts, sprains, burns, and snake/insect bite protocols.

Unit 3	**Outdoor Lifestyle, Preparation, and Ethics**	**6 Hrs.**	**CO3**

- Outdoor Lifestyle, Preparation, and Ethics
- Physical conditioning and mental preparation for treks.
- Camping skills: Tent pitching, campsite selection, hygiene.

• Outdoor Ethics: Leave No Trace (LNT) principles, • respecting local culture.			
Unit 4	**Introduction to Rock Climbing Gear and Knots**	**8 Hrs.**	**CO4**
• Equipment: Harness, Carabiners, Belay devices, Ropes (Static vs Dynamic). • Knots: Figure of 8 (Trace/Loop), Bowline, Clove Hitch, Fisherman's knot. • Care and maintenance of equipment.			
Unit 5	**Rock Climbing, Rappelling, and Jumaring**	**8 Hrs.**	**CO4**
• Climbing techniques: 3-point contact, weight transfer, hand/foot holds. • Rappelling: Setup, safety checks, descent techniques. • Jumaring (Ascending): Technique and safety backup.			

Strength of CO-PO mapping											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	-	-	-	-	1	-	-	1	1	-
CO2	2	1	-	1	1	-	1	1	1	1	-
CO3	-	-	-	-	-	2	1	1	-	1	-
CO4	2	1	2	1	2	-	1	1	1	1	1
Avg.	**2**	**1**	**2**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**1**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Semester – II

Program:	**F. Y. B. Tech**			**Semester:**		**II**	
Course:	**Differential Equations And Numerical Integration**			**Course Code:**		**R25-SH-BSC-116**	
Teaching Scheme				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
4	--	--	04	40	60	--	--

Course Description

This course covers essential mathematical concepts including differential equations, multiple integrals, interpolation, and numerical integration. It equips students with analytical and numerical skills to model and solve real-world engineering and physical science problems.

Course Relevance

The syllabus has direct applications in engineering mechanics, thermodynamics, electrical circuits, naval navigation, and computational analysis. It builds a strong foundation for using mathematical tools in motion analysis, structural calculations, and data estimation—critical in marine, aerospace, and technical domains.

Prerequisite:

1. Introduction of syllabus & Prerequisite: 2D and 3D Geometry
2. Concepts of Series
3. Basic Fundamental of Differentiation and Integration

Bridge Content:

Foundational topics such as algebra, calculus, coordinate geometry, and introduction of essential concepts in differential equations

Course Objectives:

To **FAMILIARIZE** the students with Multiple integrals and their applications, Mathematical modeling of physical systems using differential equations. The aim is to equip them with the concept and tools to understand advanced level mathematics and its applications, that would enhance thinking power, useful in their disciplines.

Course Outcomes: On completion of the course, learner will be able to -:

CO	**Course Outcome**	**Bloom's Level**
CO1	**APPLY** the effective mathematical tools for solving first order ordinary differential equations such as Exact and Reducible to exact Linear and reducible to Linear.	**3**
CO2	**SOLVE** Differential equation formed in Newton's law of cooling, electrical circuit, rectilinear motion, mass spring systems, heat transfer etc.	**3**
CO3	**EVALUATE** double and triple integrals in various coordinate systems.	**3**
CO4	**APPLY** of multiple integrals to find area bounded by curves, volume bounded by surfaces, Centre of gravity and Moment of inertia.	**3**
CO5	**OBTAIN** Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step methods used in modern scientific computing.	**3**

Course Contents			
Unit 1	**Differential Equations**	**10 Hrs.**	**CO1**
Solution of first order first degree differential equations, Homogeneous DE, Exact differential equations, Equations reducible to exact form, Linear differential equations, Equations reducible to linear form. Branch-wise utilization of the unit.			
Exemplars / Practical Applications, Usage: Differential equations are used to model the growth and decay of populations and radioactive material, analyze dynamic systems like electrical circuits and mechanical vibrations, and describe the rates of change in fluid flow, heat transfer, and chemical reactions.			
Assignments: 1. Differential equations: Water Tank Draining Problems 2. Apply to a control system where input-output relation is a DE reducible to exact form.			
Unit 2	**Applications of Differential Equations**	**10 Hrs.**	**CO2**
Applications of Differential Equations to Orthogonal Trajectories, Newton's Law of Cooling, Application to Electric Circuit, Rectilinear Motion, Heat conduction. Branch-wise utilization of the unit.			
Exemplars / Practical Applications, Usage: Orthogonal trajectories help in designing families of curves in physics and electrostatics. Newton's law of cooling models temperature change in bodies and is widely used in thermal engineering and food processing. Rectilinear motion equations are used to model linear movement under variable forces in mechanical systems. Heat conduction is modeled using the heat equation, essential in thermal analysis of materials, insulation design, and electronic cooling systems. Transient response of circuits and thermal systems			
Assignments: 1. Orthogonal Trajectories: Determine path of fluid flow orthogonal to equipotential lines. 2. Application of DE: Determine time taken for a vehicle to stop under braking force. 3. Application of DE: Application to refrigeration cycle.			
Unit 3	**Multiple Integral**	**10 Hrs.**	**CO3**
Co-ordinate Geometry, Double integrations- Evaluation, change of order of integration, use polar co-ordinates, Triple integrations- Evaluation, use spherical polar and cylindrical co-ordinates. Branch-wise utilization of the unit.			
Exemplars / Practical Applications, Usage: Coordinate geometry, double integrals, and triple integrals are used to calculate the mass, volume, and other physical properties of objects with both uniform and variable densities, with multiple integrations in polar, cylindrical, or spherical coordinates used to simplify these calculations, particularly for objects with circular or spherical symmetry.			
Assignments: 1. Change order for evaluating $\int_0^1 \int_x^1 \boldsymbol{f(x,y)dydx}$ in thermal analysis. 2. Multiple integral: Problems on Fluid flow rate through a region.			
Unit 4	**Applications of Multiple Integrals**	**10 Hrs.**	**CO4**
Double Integration- Area, Mass, Centre of Gravity and Moment of Inertia Tripal Integration- Volume, Dirichlet's theorem Branch-wise utilization of the unit.			
Exemplars / Practical Applications, Usage: These integrals are used to evaluate quantities over regions and solids with varying density or geometry, commonly found in structural and mechanical engineering. Applications include locating the center of gravity for stability analysis, and computing the moment of inertia for analyzing rotational motion in mechanical systems.			

Assignments:

1. Triple Integral: Volume of irregular mechanical part in design.
2. Dirichlet's theorem: Problems on electromagnetic field computations.

Unit 5	Numerical Methods	10 Hrs.	CO5

Interpolation- Newtons Forward and Backward Interpolation, Lagrange's Interpolation,
Numerical Integration: Trapezoidal Rule, Simpson's $1/3^{rd}$, $3/8^{th}$ Rules
Branch-wise utilization of the unit.

Exemplars / Practical Applications, Usage: Interpolation methods are used to estimate intermediate values from discrete data, which is especially useful in signal processing, control systems, and experimental data analysis. Numerical integration techniques like the Trapezoidal rule and Simpson's 1/3rd and 3/8th rules are applied to approximate definite integrals when functions are complex or data-driven. Numerical solutions where analytical integration is complex, Signal processing, structural simulation, aerodynamics

Assignments:

1. Use Newton's interpolation to estimate temperature at an intermediate time in a heat transfer experiment.
2. Numerical Integration to approximate area under stress-strain curve.
3. Numerical integral for thermal energy calculations.
4. Presentation:
   - Interpolation and Integration: Essential Tools for Engineering Computation
   - Mathematics Behind Data Estimation and Area Computation
   - From Experimental Data to Results: Interpolation and Integration in Practice

Course Projects:

1.----

Textbooks:

1. Erwin Kreyszig, Advanced Engineering Mathematics, Wiley Eastern Ltd. (10th Edition (2019))
2. Grewal, B. S., Higher Engineering Mathematics, Khanna Publishers. (45th Edition (2024–25))

Reference Books:

1. B. V. Ramana, Higher Engineering Mathematics. Tata McGraw Hill Education. (First Edition (2017))
2. M. D. Greenberg, Advanced Engineering Mathematics. Pearson Education. (2nd Edition (1998))
3. Peter V. O'Neil, Advanced Engineering Mathematics. Thomson Learning. (8th Edition (2018))
4. G. B. Thomas, Thomas' Calculus. Addison-Wesley, Pearson. (13th Edition (2018))
5. P. N. Wartikar, & J. N. Wartikar, Applied Mathematics (Vol. I & Vol. II). Vidyarthi Griha Prakashan, Pune. (9th Edition (2019))
6. Ron Larson, & David C. Falvo, Elementary Linear Algebra. Houghton Mifflin Harcourt Publishing Company. (7th Edition (2013))

MOOCs Links and additional reading material:

Unit 1: Differential Equations

- https://www.youtube.com/watch?v=Im242eBqaxw&list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&index=52
- https://www.youtube.com/watch?v=De-yi95YILE&list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&index=53
- https://www.youtube.com/watch?v=6r5jfT8xrXM&list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&index=54
- https://www.youtube.com/watch?v=Wx19LXs77mM&list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&index=55

- https://www.youtube.com/watch?v=AEHTsXRaQmE&list=PLbRMhDVUMngeVrxtbBz-n8HvP8KAWBpI5&index=56

Unit 2: Applications of Differential Equations

- https://www.youtube.com/watch?v=5sphfNn4YYM
- https://www.youtube.com/watch?v=IICR-w1jYcA
- https://www.youtube.com/watch?v=nsf9KwRT98s
- https://www.youtube.com/watch?v=rw30_ONcHQo

Unit 3: Multiple Integral

- https://www.youtube.com/watch?v=gQ-u_HlSKNk
- https://youtu.be/KgItZSst2sU?si=2hAdQzkaGZxAonDC
- https://youtu.be/T7XPoJmdUZ8?si=9aRrCuJumL2B5nRE

Unit 4: Applications of Multiple Integrals

- https://www.youtube.com/watch?v=usMCKWyZZiU
- https://www.youtube.com/watch?v=cHk_BKIoIXM&list=PLbRMhDVUMngfIrZCNOyPZwHUU1pP66vQW&index=25
- https://www.youtube.com/watch?v=zYObFXyDLJY&list=PLbRMhDVUMngfIrZCNOyPZwHUU1pP66vQW&index=26
- https://www.youtube.com/watch?v=FtUBwF4ppjw&list=PLtKWB-wrvn4nA2h8TFxzWL2zy8O9th_fy&index=27

Unit 5: Numerical Methods

Interpolation-

- https://www.youtube.com/watch?v=oY1F9QGLdTY&list=PLyqSpQzTE6M_Fy0lgicmuEyWZ-BhXyG6Y&index=74
- https://www.youtube.com/watch?v=Lp2MdAvk2MY&list=PL6E313980EF23CA6E&index=25
- https://www.youtube.com/watch?v=nhfCY43iAP0&list=PL6E313980EF23CA6E&index=26
- https://www.youtube.com/watch?v=_7BWFgJNNkA&list=PL6E313980EF23CA6E&index=28
- https://www.youtube.com/watch?v=zvqXMA8OKYA&list=PL6E313980EF23CA6E&index=29
- https://www.youtube.com/watch?v=HJg2OabtsgM&list=PLyqSpQzTE6M_Fy0lgicmuEyWZ-BhXyG6Y&index=50

Numerical Integration:

- https://www.youtube.com/watch?v=YTHt4Sp8Hag&list=PLyqSpQzTE6M_Fy0lgicmuEyWZ-BhXyG6Y&index=61
- https://www.youtube.com/watch?v=DyOS2BuHL3A&list=PLyqSpQzTE6M_Fy0lgicmuEyWZ-BhXyG6Y&index=59
- https://www.youtube.com/watch?v=Cfcc1WceJOw&list=PLyqSpQzTE6M_Fy0lgicmuEyWZ-BhXyG6Y&index=56

Strength of CO-PO Mapping											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	2	-	-	-	-	2	2	1	-	2
CO2	3	3	-	-	-	-	2	2	1	-	2
CO3	2	2	-	-	-	-	2	2	1	-	2
CO4	3	3	-	-	-	-	2	2	1	-	2
CO5	3	3	-	-	-	-	2	2	1	-	2
Avg.	**2.6**	**2.6**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**-**	**2**

Note - 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern							
BT Level	**CCE**						**ESE**
	CT1	**CT2**	**Assignments**	**Course Project**	**Field Activity / Case Study**	**Quiz / presentation etc.**	
K1	✓	✓	✓	-	✓	✓	✓
K2	✓	✓	✓	-	✓	-	✓
K3	✓	✓	✓	-	✓	-	✓
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

1. Modeling and simulation
2. Real-world data analysis
3. Mechanical/electrical system design
4. Advanced software tools like MATLAB, ANSYS, CFD, and ML algorithms
5. **GATE Exam/ CAT Exam /Aptitude Tests**

Job Mapping:

Job opportunities that one can get after learning this course:

1. Applied Mathematician
2. Computational Scientist
3. Numerical Analyst
4. Data Analyst
5. Tool Design Engineer

Program:	**F. Y. B. Tech (AI & DS)**			**Semester:**	**II**		
Course:	**Emerging Trends in AI&DS**			**Course Code:**	**R25-AI-PCC-118**		
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
02	-	-	02	40	60	-	-

Course Description:

This course introduces the fundamentals of Artificial Intelligence (AI) and Data Science (DS), covering core concepts, tools, and real-world applications. It explains how AI and DS technologies work across various domains and addresses key ethical considerations.

Course Relevance:

This course aligns with current industry needs by introducing modern tools and methodologies used in AI and Data Science. It helps students understand the roles, responsibilities, and essential skills required for careers in this growing field, thereby preparing them for future opportunities in AI-driven industries and research.

Prerequisite:

1. Programming & Problem Solving
2. Digital Technology Lab

Bridge Content:

Basics of Computer Science and Programming

Course Objectives:

1. To **INTRODUCE** fundamental concepts and scope of Artificial Intelligence and Data Science.
2. To **UNDERSTAND** basic technologies used in AI applications with example.
3. To **ACQUAINT** with advance AI techniques and its applications in real world.
4. To **PROVIDE** foundational knowledge of IoT, its integration with AI and data science tools for modern solutions.
5. To **DEVELOP** an understanding of various career roles, ethical considerations and challenges in AI development.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**EXPLAIN** the scope, components, and significance of AI and Data Science.	**2**
CO2	**APPLY** AI technologies to solve real-world problems.	**3**
CO3	**DEMONSTRATE** the use of advanced technologies in solving practical problems and highlight related emerging trends in AI.	**3**
CO4	**APPLY** AI techniques in smart IoT applications and use data science tools to solve real-world problems.	**3**
CO5	**APPLY** the understanding of career opportunities, essential skills, ethical considerations, and key challenges in the field of AI & DS to analyze real-world scenarios and make appropriate decisions.	**3**

Course Contents

Unit 1	**Introduction to Artificial Intelligence and Data Science**	**6 Hrs.**	**CO1**

Definition and Scope of AI, Brief History and Evolution of AI, Types of AI: Narrow AI, General AI, Super-intelligent AI, Myths and Facts about AI, AI techniques: Knowledge representation, search, reasoning, learning

Definition and Scope of Data Science, Data Science Workflow: Data collection, data cleaning, data analysis, data visualization, model building, and interpretation. Types of Data: Structured vs. Unstructured data, Big Data. Importance and scope of AI & DS in today's world.

Exemplars / Practical Applications and usage:

A self-driving car like Tesla uses sensors (vision), decision-making algorithms, and past experience (learning) to safely navigate roads—this is AI in action.

Assignments:

1. Identify and explain at least 3 real-life applications of AI in daily life.
2. Why AI and DS is considered as a future-ready technology?

Unit 2	Fundamentals of AI Technologies	6 Hrs.	CO2

Machine Learning: Relation between AI and ML, Types of Machine Learning, Machine Learning Workflow Real-life examples of ML: spam filters: Gmail, Netflix recommendation systems, AlphaGo by DeepMind.
Deep Learning: Introduction of Neural Network, Components of a Neural Network, Difference between AI, ML and Deep Learning (DL), Why is it called "deep"? Real-life examples of Deep Learning: Tesla Autopilot, Face ID on iPhones
Basics of Natural Language Processing: Key Components of NLP, Importance of NLP in AI, Applications of NLP in daily life: Google Translate – Real-time Multilingual NLP, ChatGPT – Conversational AI
Computer Vision: Key Tasks in Computer Vision, Computer vision in AI, Real-life examples of Computer vision: Google Lens, Medical Imaging – Detecting Diseases from X-rays

Exemplars / Practical Applications and usage:

Create an innovative AI Timeline/ AI&DS department digital Poster using AI tools

Assignments:

1. How does AI enhance user experience in common apps like Netflix, Google Maps, or Instagram?
2. Prepare a short presentation on how AI helps doctors in the early detection of diseases.

Unit 3	Generative AI and Applications of AI	6 Hrs.	CO3

Generative AI: Introduction to Generative AI, Differences between Generative AI and Traditional AI, Evolution from Rule-Based to Generative Models.
Advanced Generative AI Models: ChatGPT 5, Grok 4, Deep Seeker, DALL·E, Google Gemini, Alpha Genome, Sora, Meta AI etc.
AI in Daily Life: Smartphones, Siri, Alexa, Spotify Wrapped, Grammarly, Social Media reels etc.
AI in Industries: Healthcare, Agriculture, Transport, Education, Banking, Smart devices and automation (smart homes, robots, self-driving cars)
Emerging Trends: AI and Robotics, AI drones

Exemplars / Practical Applications and usage:

Traditional AI can detect a cat in a photo. Generative AI can draw a completely new cat from your description—'a cat wearing sunglasses in space

Assignments:

1. If you were designing a chatbot for college admission help, would you use a rule-based or generative model? Why?
2. How can AI help farmers in the early detection of crop diseases? Give one real-world example.

Unit 4	AI in IOT, Data Science Tools and Applications	6 Hrs.	CO4

Overview of IoT, Evolution of IoT, IoT Devices and Components, IoT Hardware & Software Platforms, Role of AI in IoT
AI Applications in IoT: Smart Cities, Smart agriculture, Smart health, Smart home, Smart Vehicles, Industrial

IoT

Overview of Data Science Tools, Programming & Analysis Data Science Tools: Python (Pandas, NumPy, Scikit-learn), R, Google Colab, Jupyter Notebook

Data Visualization Tools: Power BI, Tableau

Real-World Applications of Data Science in Engineering: healthcare, finance, social media, Role of data in decision-making

Exemplars / Practical Applications and usage:

Use Google Colab to do a simple data analysis task

Assignments:

1. Can data always lead to the right decision? Give an example where data may mislead.
2. Identify an IoT device you use or see every day. Which sensors or connectivity does it have?

Unit 5	**Career & Ethics in AI**	**6 Hrs.**	**CO5**

Career Roles in AI: AI Engineer, Data Scientist, ML Engineer, Data Analyst, Research Scientist, Big Data engineer etc.

Required Skills: Programming, data handling, problem solving,

AI Ethics: Why AI ethics matters, Fairness, Accountability, and Transparency in AI (FAT Principles), Examples of biased AI systems, Explainable AI (XAI) – making AI decisions understandable, Sustainable AI Challenges in AI: Bias, privacy, ethical concerns, Future of AI and human collaboration

Exemplars / Practical Applications and usage:

A facial recognition system wrongly identifies a person and causes legal trouble—raises concern over accountability and fairness.

Assignments:

1. "AI is powerful, but in the wrong hands, it can be dangerous." Justify
2. Should AI be used in schools or exams? If yes, why?

Course Projects:

1. Compare life before and after IoT in daily use (e.g., traditional watch vs. smart watch).
2. Which AI career role would you choose and why—AI Engineer, Data Scientist, or ML Engineer? What excites you about it?

Textbooks:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Pearson, Third edition, 2003, ISBN :10:0136042597
2. Vijay Kotu, Bala Deshpande, “Data Science Concepts and Practice”, Morgan Kaufmann, 2nd Edition, ISBN 978-0-12-814761-0.
3. Bahga, Arshdeep, and Vijay Madisetti, “Internet of Things: A Hands-On Approach” Universities Press, 2014.
4. Feuerriegel, S., Hartmann, J., Janiesch, C., & Zschech, P. “Generative AI” arXiv preprint 2023 arXiv:2307.08680.
5. M. Coeckelbergh “AI Ethics”, MA: MIT Press, Cambridge, 2020

Reference Books:

1. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education (India), 2013, ISBN :978-1-25-902998-1
2. Dirk P. Kroese et.al., “Data Science and Machine Learning: Mathematical and Statistical Methods”, CRC Press, 1st Edition, ISBN 978-1-138-49253-0.
3. V. Dignum, “Responsible Artificial Intelligence: How to Develop and Use AI in a Responsible

Way", Switzerland: Springer, 2019.

MOOCs Links and additional reading material:

1. Introduction to Artificial Intelligence-https://nptel.ac.in/courses/106105078
2. Deep Learning-https://onlinecourses.nptel.ac.in/noc20_cs62/preview?utm_source=chatgpt.com
3. Generative AI and Large Language Models-https://onlinecourses.swayam2.ac.in/imb24_mg116/preview?utm_source=chatgpt.com
4. Introduction to IOT- https://onlinecourses.nptel.ac.in/noc19_cs65/preview?utm_source=chatgpt.com
5. Data Science & Visualization tools- https://nptel.ac.in/courses/106108705?utm_source=chatgpt.com

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	-	2	-	-	-	-	-	-	-	3
CO2	2	1	2	-	3	-	1	-	-	-	3
CO3	2	1	2	-	3	-	2	-	-	-	3
CO4	2	-	2	-	3	-	2	-	-	-	3
CO5	2	-	2	-	-	-	2	-	-	-	3
Avg.	2	1	2	-	3	-	2	-	-	-	3

Note : Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Assignments	Course Project	Field Activity / Case Study	Quiz/ presentation	
K1	-		-	-	-	-	-
K2	√	√	-	-	-	-	√
K3	√	√	-	√	√	√	√
K4	-		-	-	-	-	-
K5	-		-	-	-	-	-
K6	-		-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

1. Artificial Intelligence
2. Data Science
3. IoT
4. Generative AI Applications

Job Mapping:

Job opportunities that one can get after learning this course: AI Content Reviewer, IoT Device Testing Assistant, Data Entry Assistant, AI Content Creator

Program:	**F. Y. B. Tech (A & R)**			**Semester:**		**II**	
Course:	**Foundations of Automation and Robotics Engineering**			**Course Code:**		**R25-AR-PCC-118**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
02	-	-	02	40	60	-	-

Course Description: This course offers an introduction to the fundamental principles of automation and robotics. It emphasizes essential concepts, technologies, and practical applications, utilizing straightforward explanations and illustrative examples.

Course Relevance: The course establishes a comprehensive foundation and fosters early awareness of the tools, methodologies, and career prospects within the fields of automation and robotics, thereby equipping students for more in-depth studies in subsequent years.

Prerequisite:

Engineering Mathematics I, Engineering Physics (Mechanics), Introduction to Programming, Basic Electrical and Electronics Engineering, Engineering Graphics.

Bridge Content:

This course bridges foundational theory with practical applications, guiding students from basic robotics principles and control systems to AI integration, mechanical design, and ethical considerations, preparing them for real-world automation and robotics challenges.

Course Objectives:

1. **UNDERSTAND** the basic principles of robotics and automation, including the USA principle (Understand, Simplify, Automate), in a simple and practical way.
2. **IDENTIFY** and **DESCRIBE** basic technologies used in robotics such as control systems, embedded electronics, and mechanical design.
3. **APPLY** beginner-friendly software tools and simulators to **DESIGN** and **TEST** simple robotic tasks.
4. **RECOGNIZE** real-life applications of robotics in fields like farming, healthcare, and manufacturing.
5. **EXPLAIN** simple ethical issues and explore possible career paths in robotics and automation.

Course Outcomes: After learning the course, students will be able to:

CO	**Course Outcome**	**Bloom's Level**
CO1	**RECALL** and **EXPLAIN** the meaning of robotics, automation, the USA principle, and basic types of robots.	2
CO2	**DESCRIBE** the role of simple control systems, sensors, and microcontrollers in basic robotic applications.	2
CO3	**USE** a simulator or beginner-friendly software to **CREATE** and **TEST** a basic robotic task (e.g., pick-and-place).	3
CO4	**IDENTIFY** and give examples of how robotics and AI are used in agriculture, healthcare, and industry.	3
CO5	**RECOGNIZE** basic ethical concerns and **LIST** possible career opportunities in robotics.	2

Course Content			
Unit 1	**Robotics & Autonomous Systems**	**6 Hrs.**	**CO1**
Historical development of industrial robots, robot anatomy, laws of robots, Classification of robots, basic performance and selection criteria of robots. Categories of tools for robot design, degrees of freedom, joint types, configurations, workspace, types of robot programming, robot languages and simulators, economic analysis, Use-cases: warehouse automation, surveillance bots, social robots.			
Exemplars / Practical Applications and usage: In small e-commerce warehouses (e.g., local Amazon fulfillment centers), robotic arms like the ABB IRB 6700 perform pick-and-place tasks to sort packages, improving efficiency and reducing manual labor. Simulations help optimize arm movements for speed and accuracy.			
Assignments: Design a simple 2D simulation of a robotic arm for a warehouse pick-and-place task using a free simulator like RoboDK or GeoGebra. Simulate the arm moving a 2 kg package from a conveyor to a shelf, ensuring it follows a smooth path within a 1 m workspace.			
Unit 2	**Control & Embedded Technology**	**6 Hrs.**	**CO2**
Open-loop and closed-loop systems, basic structure of control system, Types of controllers and their significance PID control, PLC, microprocessor and microcontroller, Arduino/Microcontroller architecture: digital I/O, analog sensors, PWM control (Pulse Width Modulation), Overview of Mechatronics system integration, Industrial applications: bottling plant, water level controller.			
Exemplars / Practical Applications and usage: In small-scale agriculture (e.g., local farms), Arduino-based controllers manage water pumps for drip irrigation, ensuring consistent watering schedules to save water and improve crop yield.			
Assignments: Build an Arduino-based circuit to control a water pump motor that turns on for 5 seconds every minute, simulating a basic water level controller for a small irrigation system.			
Unit 3	**AI & Human-Robot Interaction**	**6 Hrs.**	**CO3**
Basics of AI and ML: supervised/unsupervised learning, Human-Robot Interaction (HRI), Cognitive robotics, Introduction to IoT and cloud computing in automation, Applications of GenAI in automation: ChatGPT, LLMs, Basics of data analytics and visualization using Python, NDVI (Normalized Difference Vegetation Index) in Agri-robots, emerging trends: AR/VR, block-chain, digital twins.			
Exemplars / Practical Applications and usage: In precision agriculture, Agri-robots use sensors to collect temperature or soil data, visualized with Python tools to help farmers make decisions, such as when to irrigate or plant crops (e.g., NDVI-based monitoring for crop health).			
Assignments: Use Python to create a simple data visualization of temperature sensor data (simulated or real) from a robotic weather station, plotting the data to identify trends for an agricultural application.			
Unit 4	**Mechanical Design & Smart Manufacturing**	**6 Hrs.**	**CO4**
Historical evolution and definition of automation and robotics, Types of automation, USA principle, Role of CAD in robot and automation system design, Basics of modern manufacturing processes: CNC, 3D Printing, Injection Molding, Introduction to Flexible Manufacturing Systems (FMS) and lean manufacturing, Digital Twin & QA. Smart materials.			

Exemplars / Practical Applications and usage:
In small-scale electronics manufacturing (e.g., local circuit board assembly), 3D-printed gripper bases are used on robotic arms to hold components, enabling cost-effective customization for specific tasks.

Assignments:
Design a simple 3D model of a robotic gripper base using Tinkercad, suitable for holding a small object (e.g., a 100 g component) in a manufacturing assembly line.

Unit 5	**Robotics Career & Ethics**	**6 Hrs.**	**CO5**

Scenario of robotics in India industries. Robotics and AI applications in various domains: healthcare, defense, agriculture, logistics, manufacturing and automobile, Professional ethics in AI and automation, Career paths: job roles, essential skills, professional organizations, Future technologies: space robotics, collaborative robots, bionics, brain-machine interface.

Exemplars / Practical Applications and usage:
In healthcare clinics, cobots like Universal Robots' UR5 assist with tasks like delivering medical supplies, improving efficiency but raising ethical concerns about patient trust and staff job security.

Assignments:
Use online resources (e.g., articles from IEEE or Robotics Business Review) to identify one ethical issue (e.g., patient privacy) and one career opportunity (e.g., cobot programmer), and summarize their impact in a simple report.

Course Projects:

1. Arduino-Based Automatic Plant Watering System

- **Description:** Design and build a basic automatic irrigation system using an Arduino, soil moisture sensor, and a small water pump.
- **Learning Outcome:** Apply basic embedded system programming and understand control systems in an agricultural context.

2. 2D Simulation of a Robotic Pick-and-Place Arm

- **Description:** Create a simple 2D simulation using RoboAnalyser/GeoGebra to move an object from one position to another, optimizing path and movement.
- **Learning Outcome:** Use simulation software to design and test a basic robotic application.

Textbooks:

1. D. K. Pratihar. (2019), Fundamentals of Robotics, Narosa Publishing House, ISBN: 978-81-8487-577-5
2. M. P. Groover. (2015). Automation, Production Systems, and Computer-Integrated Manufacturing (4th ed.). Pearson. ISBN: 978-9332572492
3. S. B. Niku. (2020). Introduction to Robotics: Analysis, Control, Applications (3rd ed.). Wiley. ISBN: 978-1-119-52760-2
4. Prateek Joshi. (2017), Artificial Intelligence with Python: A Comprehensive Guide to Building Intelligent Apps for Python Beginners and Developers, Packt Publishing, ISBN: 978-1786464392
5. Massimo Banzi, Michael Shiloh. (2022), Getting Started with Arduino 4e: The Open-Source Electronics Prototyping Platform, Make Community, LLC, ISBN: 978-1680456936
6. S. R. Deb & S. Deb. (2017). Robotics technology and flexible automation (2nd ed.). Tata McGraw-Hill Education. ISBN: 978-0070077911

Reference Books:

1. Y. Koren. (1985). Robotics for Engineers. McGraw-Hill. ISBN: 978-0070353992
2. Robert J. Schilling. (2015), Fundamentals of Robotics Analysis and Control, Pearson, ISBN:

9789332555235

MOOCs Links and additional reading material:

1. Arduino tutorials: https://www.arduino.cc/en/Tutorial/HomePage
2. GeoGebra guides: https://www.geogebra.org
3. TinkerCAD for 3D design: https://www.tinkercad.com
4. Robotics Business Review for industry insights: https://www.roboticsbusinessreview.com
5. IEEE Robotics and Automation Society: https://www.ieee-ras.org
6. V. B. Shinde, P. J. Pawar, V. S. Gadakh, "Research Progress on Industrial Robots: A Review", Recent Patents on Mechanical Engineering. 19 (1), 27-61, 2026. https://dx.doi.org/10.2174/0122127976326652241018114550.

Strength of CO-PO-PSO Mapping

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

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Assignments	Course Project	Field Activity / Case Study	Quiz / presentation etc.	
K1	√	√	√	√	-	-	√
K2	√	√	√	√	-	-	√
K3	-	√	√	-	-	-	-
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

- Sensors and Actuators for Robotics
- Mechatronics and Control Systems
- Industrial Robotics and Automation
- Artificial Intelligence in Robotics
- Robot Kinematics and Dynamics

Job Mapping:

Job opportunities that one can get after learning this course:

- Robotics Engineer/ Analyst
- Automation System Analyst
- Process Simulation Analyst

- Embedded Systems Analyst
- Field Analyst in Agricultural/Industrial Automation

Program:	**F. Y. B. Tech (Civil)**			**Semester:**		**II**	
Course:	**Smart and Sustainable Civil Engineering**			**Course Code:**		**R25-CE-PCC-118**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
2	-	-	2	40	60	-	-

Course Description:

A course in Smart and Sustainable Civil Engineering typically encompasses a blend of core Civil Engineering subjects with specialized modules focusing on modern technologies and sustainable practices.

Course Relevance:

The curriculum is designed to equip students with the knowledge and skills to tackle complex infrastructure challenges in the context of rapid urbanization, climate change, and resource scarcity.

Prerequisite:

Basic knowledge of Civil Engineering fundamentals, environmental studies, construction materials, infrastructure systems, and elementary concepts of sustainability

Bridge Content:

Modernization of construction industry to meet the need of mankind through recent techniques and materials.

Course Objectives:

1. To **INTRODUCE** students with the evolution, significance, and sustainability of civil engineering, highlighting emerging technologies, smart infrastructure, and diverse career opportunities through real-world case studies.
2. To **EQUIP** students with knowledge and practical skills in modern surveying instruments, GPS/GNSS, GIS, remote sensing, and drone/LIDAR technologies for accurate mapping, analysis, and sustainable infrastructure plan.
3. To **ENABLE** students to understand and apply innovative, sustainable, and smart construction materials and modern techniques, promoting efficiency, durability, and environmental responsibility in civil engineering projects.
4. To **ENABLE** students to understand the development, classification, and design of highways, expressways, and railways, and to explore intelligent, urban, and prefabricated transport and building systems for sustainable infrastructure.
5. To **INTRODUCE** concepts of green, energy-efficient, and sustainable construction practices, emphasizing environmental protection, resource conservation, and assessment methods for resilient Civil Engineering projects.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**DESCRIBE** the evolution, scope, and societal importance of civil engineering and its contribution to national development.	**2**
CO2	**EXPLAIN** the use of modern surveying equipment, GPS, GIS, and remote sensing technologies in civil engineering applications.	**2**
CO3	**IDENTIFY** and **DIFFERENTIATE** between traditional and innovative construction materials and methods used in modern infrastructure projects.	**2**
CO4	**DEMONSTRATE** awareness of smart transportation systems including bridges, expressways, railways, and metro rail, along with their planning and construction principles.	**2**
CO5	**APPLY** sustainable Civil Engineering principles such as green building concepts,	**3**

	environmental impact assessment, and climate-resilient infrastructure planning.	

Course Contents

Unit 1	Evolution and Scope of Civil Engineering	5 Hrs.	CO1

Introduction and National/International Significance

• Definition and evolution of Civil Engineering from ancient to modern times.
• Key contributions of Civil Engineering to infrastructure: buildings, roads, bridges, dams, etc.
• Role in economic development and improving quality of life through infrastructure.
• Introduction to Sustainable Development and 17 SDGs.

Emerging Trends and Career Outlook

• Introduction to smart infrastructure, automation in construction industry.
• Use of emerging tools: BIM (Building Information Modeling), IoT, robotics
• Diverse career opportunities and roles in modern civil engineering projects.
• Case studies: Iconic Indian projects like Atal Tunnel, Statue of Unity, UNESCO World Heritage Sites, Burj Khalifa…etc

Exemplars / Practical Applications and usage:

- BIM is more than just 3D modeling; it's a collaborative process that integrates data-rich models with smart workflows.
- Design and Planning Optimization, Project Management and Scheduling, Infrastructure and Structural Health Monitoring, Risk Assessment and Mitigation, Sustainability and Environmental Impact.

Assignments:

1. How can increase the quality of life through infrastructure.
2. Report on Smart Cities guidelines.

Unit 2	Advanced Surveying and Geospatial Techniques	5 Hrs.	CO2

Modern Surveying Instruments and Methods

• Working principles of Total Station and its application in fieldwork.
• Comparison of traditional instruments (chain, theodolite) with modern tools (Total Station, EDM)
• GPS and GNSS: Introduction, Working Principles, uses.

Geospatial Technology Applications

• Fundamentals of GIS and RS and its application in mapping, urban planning and analysis.
• Remote sensing basics: satellite imagery and interpretation.
• Introduction to drone surveys and LIDAR for terrain and infrastructure mapping.

Exemplars / Practical Applications and usage:

- Operate advanced surveying equipment for real-world applications.
- Conduct topographical, cadastral, and infrastructure surveys.
- Create accurate maps, profiles, and 3D models.
- Analyze spatial data for planning, design, and decision-making.

Assignments:

1. Enlist the modern surveying instruments and explain any one with proper function.
2. Elaborate practical application of geospatial technology in the field of Civil Engineering

Unit 3	Modern Construction Materials and Methods	5 Hrs.	CO3

Innovative and Sustainable Materials

• Types and applications of advanced concrete: self-compacting, fiber-reinforced, nano concrete.
• Eco-friendly and sustainable materials: fly ash bricks, geopolymer concrete, recycled aggregates.
• Smart and high-performance materials: carbon fiber, smart glass, phase change materials.

Smart sensors in construction, carbon footprint reduction

Modern Construction Techniques

• 3D printing in building components and on-site construction.
• Prefabrication and modular systems for speed and precision.
• Pre-engineered buildings: concept, benefits, and case studies.

Exemplars / Practical Applications and usage:

- Extends the lifespan of infrastructure like bridges, roads, tunnels, and buildings, significantly reducing maintenance costs and increasing durability.
- Speeds up construction, improves quality control, enhances structural integrity, reduces on-site waste, and allows for greater customization, lowers on-site labor requirements.

Assignments:

1. Choose three to five sustainable building materials and for each, discuss their environmental benefits, construction techniques, and current market adoption.
2. Describe in detail application of modern construction techniques.

Unit 4	**Smart Transportation Infrastructure**	**5 Hrs.**	**CO4**

Highways, Expressways & Railways

• **Role and Importance:** Importance of road transportation, history of road development (e.g., Roman roads, Indian road development plans like Nagpur, Bombay, and Lucknow plans).
• **Road Classification:** Various classifications (National Highways, State Highways, Major District Roads, Other District Roads, Village Roads, Expressways).
• **Expressways:** classification and case study (Delhi–Mumbai Expressway, Samruddhi Expressway).

Intelligent and Urban Transport Systems

• Introduction to Intelligent Transportation Systems (ITS) for smart mobility.
• Concepts of smart roads: plastic roads, solar roads, and piezoelectric roads.
• Urban transport advancements: Metro rail systems – need, design, construction, operation and
Case Study: Delhi Metro or Mumbai Metro.

Exemplars / Practical Applications and usage:

Highways for inter-city Connectivity, Commercial and Freight Transport, Commuting, Tourism and Personal Travel, Emergency Services and National Defense.
Expressways for High-Speed, Long-Distance Travel, Reducing Congestion, Economic Corridors, Bypassing Urban Areas, Regional Connectivity.
Railways for Mass Passenger Transport, Heavy Freight Transport, Specialized Transport, Land Use Optimization.

Assignments:

1. List out the agencies involved in the transportation/ highway system in India.
2. Explain Intelligent Transportation Systems (ITS) for smart mobility.

Unit 5	**Sustainable Civil Engineering Practices**	**5 Hrs.**	**CO5**

Green and Energy-Efficient Construction

• Definition and benefits of green buildings.
• Green building materials and techniques: low energy and low carbon.
• Rating systems: LEED, GRIHA – overview and criteria for certification.

Environmental Protection and Resilience

• Basics of Environmental Impact Assessment (EIA) in civil projects.
• Waste management and water conservation practices on construction sites.
• Rain Water Harvesting

Exemplars / Practical Applications and usage: Renewable Energy Integration Smart Building Systems Passive Design Strategies, Hybrid Energy Systems Gravity-Based Energy Storage Grey water Recycling Rainwater harvesting
Assignments: 1. Definition of green building? Explain in detail green building rating system. 2. What is mean by EIA and their project criteria for sanctioning?
Course Projects:
-
Textbooks:
1. S.S. Bhavikatti, "Basic Civil Engineering", New Age International Publisher, 3rd edition. 2. S.K. Khanna, C.E.G. Justo, "Highway Engineering", Nem CHand and Bros. Roorkee, 10th edition. 3. R. Subramanian, "Surveying and Levelling", Oxford University
Reference Books:
1.Handbook of Green Building design and construction by Charles Kibert 2. Sustainable Building Materials by J. KhatibPress, 2nd edition.
MOOCs Links and additional reading material:
1. Website of LEED https://www.usgbc.org/leed 2. Website of GRIHA https://www.grihaindia.org/griha-rating 3. Environment Protection Act 1986 (EIA)

Strength of CO-PO-PSO Mapping														
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	2	1	2	3	-	-	-	2	2	3	3	3
CO2	3	1	2	1	2	3	-	-	-	-	2	3	3	3
CO3	3	1	2	1	2	3	-	-	-	2	2	3	3	3
CO4	3	1	2	1	2	3	-	-	-	2	2	3	3	3
CO5	3	1	2	1	2	3	2	-	-	2	2	3	3	3
Avg.	3.0	1.0	2.0	1.0	2.0	3.0	2.0	-	-	2.0	2.0	3.0	3.0	3.0

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern							
BT Level	**CCE**						**ESE**
	CT1	**CT2**	**Assignments**	**Course Project**	**Field Activity / Case Study**	**Quiz / presentation etc.**	
K1	√	√	√	-	√	-	√
K2	√	√	√	-	√	-	√
K3	√	√	√	√	√	√	√
K4	-	-	-	-	√	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

1. Architectural Planning and Design of Building
2. Architecture and Town Planning
3. Transportation Engineering
4. Environmental Engineering
5. Green Building and Smart Cities

Job Mapping:

Job opportunities that one can get after learning this course:

1. Government Sector
2. Construction and Real Estate Sector
3. Consultancy Firms
4. Research and Academia
5. Tech and Innovation Startups

Program:	**F. Y. B. Tech (Computer)**			**Semester:**	**II**		
Course:	**Emerging Technologies in Computing**			**Course Code:**	**R25-CO-PCC-118**		
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
02	-	-	02	40	60	-	-

Course Description:

The contemporary technological landscape is defined by rapid, disruptive innovation. Fields once considered futuristic—Artificial Intelligence, Cloud Computing, and advanced Data Science—are now fundamental to global industry and commerce. This course introduces key emerging technologies like AI, ML, Data Science, Cyber security, Blockchain, and Cloud Computing. It explains the fundamentals, real-life applications, and impact on various domains. Students explore tools, technologies, and practical case studies to understand real-world usage.

Course Relevance:

The course also highlights career opportunities in each technology domain. It builds a strong foundation for future-ready computing professionals. Mastering these technologies over the graduation years allow engineering graduates to become immediate, adaptive contributors, securing high-value roles and gaining the fundamental skills—such as scalable architecture design and risk management—required to **future-proof their careers** in a rapidly transforming industrial landscape.

Prerequisite: Basic knowledge of Computer Fundamentals

Bridge Content: -

Course Objectives:

1. To **PARAPHRASE** the fundamentals of Artificial Intelligence and Machine Learning.
2. To **EXPLORE** the basics of Data Science and Analytics.
3. To **GAIN** knowledge of Cyber security threats and Blockchain technology.
4. To **COMPREHEND** the core concepts of Cloud Computing.
5. To **LEARN** the foundations and real-world applications of Software Testing.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**DESCRIBE** the fundamental concepts of Artificial Intelligence, Machine Learning, and their applications in various sectors.	1
CO2	**EXPLAIN** the role and tools of Data Science, types of data, and real-world applications across different domains.	2
CO3	**APPLY** knowledge of Cyber security and Blockchain to identify threats and understand digital safety practices.	3
CO4	**IDENTIFY AND RELATE** applications of cloud computing in business and personal life.	3
CO5	**USE** appropriate software testing methods to test functionalities in banking and web-based systems	3

Course Contents			
Unit 1	**Fundamentals of Artificial Intelligence**	**6 Hrs.**	**CO1**
Overview of Artificial Intelligence: AI Vs Human Intelligence, Types of AI – Narrow AI, General AI, Super AI, Applications of AI in real life – Health, Agriculture, Education, Finance. Overview of Machine Learning, Real-world applications – Voice Assistants, Recommendation Engines, Types of Learning – Supervised, Unsupervised, Reinforcement Learning, Career			

Exemplars / Practical Applications and usage: Autonomous Vehicles - Self-driving cars using AI planning and perception			
Assignments: **1.** In your view, explain the importance of Artificial Intelligence. How do you think it differs from Human Intelligence? Support your answer with a suitable example from daily life. **2.** Why do you think Machine Learning is needed today? Describe two real-world applications of ML that you find interesting, and list a few career opportunities in the field of AI and ML that you would like to explore.			
Unit 2	**Basics of Data Science and Analytics**	**6 Hrs.**	**CO2**
Role of a Data Scientist, Types of Data – Structured and Unstructured Data, Real-life examples – Instagram photos, YouTube comments, Online shopping data, Applications of Data Science – Healthcare: Disease prediction, Drug discovery, E-commerce: Product recommendations (Amazon), Social Media: Trending topics, Content moderation, Tools and Technologies in Data Science – Excel as a basic tool, Introduction to Data Visualization – Bar chart, Pie chart, Line chart.			
Exemplars / Practical Applications and usage: Predictive model for student performance prediction			
Assignments: **1.** Classify structured and unstructured data. Give one real-life example of each. 2. Discuss two applications of Data Science in healthcare and e-commerce.			
Unit 3	**Cybersecurity and Blockchain Essentials**	**6 Hrs.**	**CO3**
Necessity of cybersecurity in the digital era, Cyber threats – Phishing, Malware, Ransomware, Digital safety best practices – Strong passwords, Two-factor authentication, Recognizing fake emails and links, Basics of Blockchain technology – Concept of blocks and chains, Distributed ledger system, Driving factors behind cryptocurrency development, Popular cryptocurrencies – Bitcoin (BTC), Ethereum (ETH).			
Exemplars / Practical Applications and usage: Cryptocurrency Mining and Its Role in the Banking Sector.			
Assignments: **1.** Describe phishing and ransomware and how do they pose a threat in the digital era? 2. Explain the concept of blockchain and illustrate how it is used in real-world applications like cryptocurrencies.			
Unit 4	**Cloud Computing and Future Trends**	**6 Hrs.**	**CO4**
Fundamentals of Cloud Computing, Cloud applications in daily life and business, Personal use – Cloud storage, Streaming, Email, Photos, Business use – E-commerce hosting, Team collaboration tools, Green Cloud Basic concepts of Quantum Computing, Qubit, Quantum Superposition, Entanglement, Quantum Gates, Quantum Measurement, Quantum Speedup, Applications of Quantum Computing. Real-World Applications of Quantum Computing-Drug Discovery and Healthcare, Supply Chain and Logistics Optimization			
Exemplars / Practical Applications and usage: Google Workspace, Dropbox, AWS for Startup.			
Assignments: **1.** List and explain common **personal** and **business** applications of cloud computing with suitable examples. **2.** Describe how quantum computing is used in the field of healthcare.			
Unit 5	**Modern Software Testing and its Application in Real World Systems**	**6 Hrs.**	**CO5**
Importance of Software Testing, Levels of Software Testing, Emerging Applications of Software Testing – Web and Mobile App Testing, Real-world examples of testing in banking – ATM Software Testing, Mobile Banking App – Bill payment testing, QR code scan for UPI, Credit Card Transaction Testing.			

Exemplars / Practical Applications and usage: Google Search Engine Testing: Functionality Testing: Does the search button work?

Assignments:

1. Why is software testing critical in safety-critical domains such as banking, healthcare, or transportation?
2. Give two real-world examples of software testing in the banking sector.

Textbooks:

1. Dr. K. S. Anitha, Dr. N. Priya, Dr. R. Subhashini "Emerging Technologies in Computing: Fundamentals and Applications, CRC Press, Taylor & Francis Group, 2024.
2. Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Pearson, 4th Edition (2020).
3. Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly Media, 2nd Edition (2019).

Reference Books:

1. Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, Cybersecurity Essentials, 1st Edition, Jones & Bartlett Learning, 2018.
2. Thomas Erl, Cloud Computing: Concepts, Technology & Architecture, 1st Edition, Pearson, 2013.
3. Srinivasan Desikan, Gopalaswamy Ramesh, Software Testing: Principles and Practices, Pearson Education India.
4. Rex Black, Erik van Veenendaal, Dorothy Graham, Foundations of Software Testing: ISTQB Certification, Cengage Learning.

MOOCs Links and additional reading material:

1. AI For Everyone – Andrew Ng (Coursera), https://www.coursera.org/learn/ai-for-everyone.
2. Introduction to Data Science in Python – University of Michigan (Coursera), https://www.coursera.org/learn/python-data-analysis.
3. Introduction to Cyber Security – NYU (Coursera), https://www.coursera.org/learn/intro-cyber-security.
4. Introduction to Cloud Computing on AWS for Beginners https://www.udemy.com/share/10bfK2/
5. Introduction to Software Testing https://www.coursera.org/learn/introduction-software-testing

Strength of CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	-	-	-	-	-	2	3	2	2
CO2	3	2	1	1	2	-	-	-	-	-	2	3	2	2
CO3	2	2	1	1	2	3	3	-	-	-	2	3	2	2
CO4	2	2	1	1	2	-	-	-	-	-	2	3	2	2
CO5	3	2	1	1	2	3	-	-	-	-	2	3	2	2
Avg.	**3**	**2**	**1**	**1**	**2**	**3**	**3**	**-**	**-**	**-**	**2**	**3**	**2**	**2**

Note - 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment pattern:							
BT Level	**CCE**						**ESE**
	CT1	**CT2**	**Assignments**	**Course Project**	**Field Activity / Case Study**	**Quiz / presentation etc.**	
L1	✓	✓	✓	-	-	✓	✓
L2	✓	✓	✓	-	-	✓	✓
L3	✓	✓	✓	-	-	✓	✓
L4	-	-	-	-	-	-	-
L5	-	-	-	-	-	-	-
L6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

1. Artificial Intelligence and Machine Learning
2. Data Science and Analytics
3. Cybersecurity and Blockchain
4. Cloud Computing
5. Software Testing

Job Mapping:

Job opportunities that one can get after learning this course:

Key Roles: AI Engineer, Machine Learning Engineer, Data Analyst (AI-focused), Cybersecurity Analyst, Information Security Officer, Ethical Hacker, Cloud Engineer, Cloud Solutions Architect, Automation Tester

Employers: Google, Amazon, Microsoft, TCS, Infosys, NVIDIA, Cognizant, AI Startups
IBM, Accenture, Deloitte, Capgemini.

Program:	**F. Y. B. Tech (ECE)**			**Semester:**		**II**	
Course:	**Frontiers of Technology**			**Course Code:**		**R25-EC-PCC-118**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
02	-	-	02	40	60	-	-

Course Description:

A frontier of Technology is an introductory course that exposes students to emerging and transformative technologies driving the future of engineering and modern society. The course provides a broad overview of key areas such as semiconductor technology, the Internet of Things (IoT), cloud computing, AI & ML, highlighting their fundamental principles and real-world applications to understand the revolutionizing automation and data-driven decision-making. The course also explores advancements in 5G and next-generation wireless communication systems, Robotics and autonomous systems, components and their intelligent behavior in machines.

Course Relevance:

Frontiers of Technology are acting as the foundation for almost all modern innovations. The technologies are convergence of both hardware and software, leading to smarter, more efficient, and more interconnected systems. They are evolving landscape to drive progress across numerous industries, fundamentally reshaping how we live, work, and interact.

Prerequisite: Fundamentals of computers

Bridge Content: --

Course Objectives:

1. To **RECOGNIZE** and explore emerging technologies relevant to personal and professional development.
2. To **ASSESS** the societal implications and transformative potential of emerging technologies.
3. To **EMPHASIZE** the importance of lifelong learning to adapt the rapid technological progress.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**UNDERSTAND** key semiconductor fabrication technologies, global and national developments, and emerging trends in materials and device architectures.	**2**
CO2	**DESCRIBE** the architecture and components of IoT, and explain the applications of IoT and cloud computing in real-world scenarios.	**2**
CO3	**ILLUSTRATE** the key concepts and real-life applications of Artificial Intelligence and Machine Learning.	**2**
CO4	**DESCRIBE** the components and advancements in wireless communication technologies including 5G and satellite communication.	**2**
CO5	**UNDERSTAND** the fundamental components, types, applications, and future challenges of robotics and autonomous systems across various domains.	**2**

Course Contents			
Unit 1	**Semiconductor Technology**	**6 Hrs.**	**CO1**
Semiconductor Fabrication Process, Fab vs Fabless companies, Major global foundries (TSMC, Intel, Samsung),India's semiconductor mission, recent progress in development of domestic semiconductor and display ecosystem, significant projects underway. Emerging semiconductor materials -SiC, GaN. MOSFETs and their role in modern electronics. IC integration scale- SSI, MSI, LSI, VLSI and ULSI. Moore's Law and beyond Moor's law. Advances in Semiconductor Technology- Introduction to FinFETs, Trends in System-on-Chip (SoC) and 3D ICs.			
Exemplars / Practical Applications and usage: Microprocessors, Microcontrollers, Computers, Smart phones, Global Semiconductor Industry			
Unit 2	**Internet of Things (IoT) and Cloud computing**	**6 Hrs.**	**CO2**
Definition of Embedded System and its block diagram. Concept and definition of IoT. IoT Architecture/ Block diagram. IoT Sensors, Actuators (List of sensors and actuators). Applications of IoT – Smart homes, Smart City, Smart factory, wearable IoT. Introduction to Cloud computing, Types of cloud, Services offered in Cloud computing. Cloud Computing Architecture, Applications of cloud computing.			
Exemplars / Practical Applications and usage: IOT farming, IoT Weather Station, Smart City, smart grid, Google Cloud Platform, Data Backup on Google Drive, Microsoft Azure,			
Unit 3	**Artificial Intelligence and Machine Learning**	**6 Hrs.**	**CO3**
Concept of Artificial Intelligence (AI), Types of AI- Artificial Narrow Intelligence (ANI),Artificial General Intelligence (AGI),Artificial Super Intelligence (ASI). Concept of Machine Learning(ML) Key concepts of AI-ML such as: Algorithms, Data, Training, Prediction/Decision, Supervised Learning, Unsupervised Learning. Applications of AI and ML.			
Exemplars / Practical Applications and usage: Voice Assistants (Siri, Alexa), AI Chatbots, Social Media Content Recommendation, Language Translation Tools, Facial Recognition Systems, Stock Price Prediction, Autonomous Vehicles, Healthcare Diagnosis, Crop Disease Detection			
Unit 4	**5G and Next-Gen Wireless Communication**	**6 Hrs.**	**CO4**
Introduction to wireless technology, Components of wireless communication, Types of cellular networks.5G technology and its working. Advantages of 5G technology. Applications of 5G, Future Trends in Wireless Communication. Satellite communication – Case study of Starlink satellite internet constellation, Case study of GPS constellation.			
Exemplars / Practical Applications and usage: Wi-Fi, Bluetooth, NFC Payments, Mobile Phone, Satellite Phone service, Starlink, GPS.			
Unit 5	**Robotics and Autonomous Systems**	**6 Hrs.**	**CO5**
Robotics: Introduction to Robotics, key components of Robotics, Types of robots, Applications and Challenges **Autonomous Systems**: Introduction, key components, Applications in electronic and software industry, automobile, healthcare, agriculture, space, transportation, future scope and challenges.			

Exemplars / Practical Applications and usage:
Unmanned Aerial Vehicle (UAV), Drones, Industrial robot, robots in bomb disposal squad, Surgical Robots, Home Cleaning Robots

Textbooks:

1. Vasudha Tiwari. Sunil Kumar Chaudhary and Iqbal Ahmed Khan, "Emerging Technology For Engineers", Vayu Education of India, 1st Edition.
2. Chanagala Shankar, "Emerging Technologies", Bluerose Publishers Pvt. Ltd, 1st Edition.
3. Chandradev Yadav, "The Evolution of Immersive Technologies: A Journey into the Extraordinary", 1st Edition.
4. Neil Wilkins,"Robotics", Bravex Publications, 2019.
5. Neil Wilkins, "Artificial Intelligence: The Ultimate Guide to AI, The Internet of Things, Machine Learning, Deep Learning + a Comprehensive Guide to Robotics", Bravex Publications, 2020.

Reference Books:

1. Erik Dahlman, Stefan Parkvall, Johan Skold, "5G/5G-Advanced: The New Generation Wireless Access Technology ", Elsevier Science Publications: Academic Press Inc. 2023.
2. Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice-Hall, 2022 edition.
3. Raj Kamal, "Internet of Things (IOT): Architecture and Design Principles, McGraw Hill,|2nd Edition-2022

MOOCs Links and additional reading material:

1. Introduction of IOT: https://nptel.ac.in/courses/106105166
2. Introduction to AI: https://nptel.ac.in/courses/106102220
3. Introduction to ML: https://nptel.ac.in/courses/106106139
4. Robotics: https://nptel.ac.in/courses/107106090

Strength of CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	-	-	-	1	2	2	1	1	-	2	1	1	1
CO2	2	-	-	-	1	2	2	1	1	-	2	1	1	1
CO3	2	-	-	-	1	2	2	1	1	-	2	1	1	1
CO4	2	-	-	-	1	2	2	2	2	-	2	1	1	1
CO5	2	-	-	-	1	2	2	2	2	-	2	1	1	1
Avg.	2	-	-	-	1	2	2	1.4	1.4	-	2	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Assignments	Course Project	Field Activity / Case Study	Quiz / presentation etc.	
K1	✓	✓	✓	-	-	✓	✓
K2	✓	✓	✓	-	-	✓	✓
K3	-	-	-	-	-	-	-
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses: 1. Analog and Digital Electronics 2. Analog and Digital Communication 3. Fundamentals of IoT 4. Embedded System and Edge Computing 5. Artificial Intelligence and Machine Learning 6. Robotics and Automation
Job Mapping: -

Program:	**F.Y. B. Tech (Electrical)**			**Semester:**			**II**
Course:	**Advanced Technologies in Electrical Engineering**			**Course Code:**			**R25-EE-PCC-118**
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
02	-	-	2	40	60	-	-

Course Description:
This course introduces first-year engineering students to modern electrical technologies such as electric mobility, renewable energy systems, smart grids, AI in power systems and wireless power transfer.

Course Relevance:
It builds strong foundation in sustainable energy and intelligent systems, preparing students for future careers in green energy, smart infrastructure, and advanced power technologies.

Prerequisite:
Basic concepts of electrical circuits and components, Knowledge of supply configurations, Semiconductor

Bridge Content:
Basic knowledge of machines, power systems and energy conversion principles. Familiarity with programming fundamentals and mathematical concepts like algebra and statistics.

Course Objectives:

1. **DEVELOP** a fundamental understanding AC circuit, power supplies, EV motors, and charging methods.
2. **UNDERSTAND** solar, wind, hybrid renewable, and net metering basics.
3. **UNDERSTAND** smart grid communication technologies.
4. **DESCRIBE**wirelesspowertransferandassessspacesolarpowerapplications.
5. **APPLY**AI/MLtechniquestoimproveforecasting,faultdetection,andgridmanagement

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**DESCRIBE** the fundamentals of AC circuits, power supplies, electric vehicle motors, and charging methods.	**2**
CO2	**RECOGNIZE** and **EXPLAIN** key concepts of solar, wind, hybrid renewable energy systems, and net metering.	**2**
CO3	**UNDERSTAND** basics smart grid communication technologies.	**2**
CO4	**DESCRIBE** how wireless power transfer works and its applications in space solar power.	**2**
CO5	**DEMONSTRATE** knowledge of AI/ML concepts relevant to power systems	**2**

Course Contents

Unit 1	**Introduction to AC circuits and E Mobility**	**6Hrs.**	**CO1**

AC circuits, Supply configuration in power system, Electric Vehicle Fundamentals: Classification of drives, Electric Motors for EVs (BLDC), Basics Charging Infrastructure, types of charging methods.

Exemplars/Practical Applications and usage: Electric Trains and Metro Systems, Elevators and Escalators

Unit 2	**Renewable Energy Systems**	**6Hrs.**	**CO2**

Sustainable Energy System: Solar Panels: Electrical Perspective, floating solar PV, application of solar system, Wind Energy, offshore wind farms, hybrid renewable energy system. Concept of net metering

Exemplars/Practical Applications and usage: Residential Solar Panels, Solar-Powered Water Pumps

Unit 3	**Smart Grids and circuit analysis techniques**	**6Hrs.**	**CO3**
Introduction to Smart Grids: Importance of Smart Grid, Smart Grid Components and Architecture, Smart grid communication technology, benefits of smart grid, overview of micro grid.			
Exemplars/Practical Applications and usage: Power System			
Unit 4	**Introduction Wireless Power Transmission**	**6Hrs.**	**CO4**
Concept of Wireless Electricity (WPT), Need and Future of Wireless Energy Transfer , Basic Principles of Wireless Power Transfer, Role of Wireless Power in Smart Cities, Space solar power stations: Applications.			
Exemplars/Practical Applications and usage : Wireless Charging of Devices, Medical Implants			
Unit 5	**Artificial Intelligence (AI) & Machine Learning (ML) in Electrical Engineering.**	**6Hrs.**	**CO5**
Definitions– Introduction of AI, Evolution of AI-Applications of AI, Classification of AI systems with respect to environment. Introduction to Machine Learning, Examples of Machine Learning Applications, Learning Types, Artificial Intelligence Vs Machine learning,			
Exemplars/Practical Applications and usage: Load Forecasting, Fault Detection and Diagnosis			

Textbooks:

1. **"**Smart Grid: Fundamentals of Design and Analysis" –James Momoh.
2. "Electrical Circuit Analysis"–A. Chakrabarti
3. "Wind Energy Explained: Theory, Design and Application"– Manwell, McGowan& Rogers
4. "Smart Grid using AI & Big Data Analytics" –Himanshu Karki
5. "Space- Based Solar Power: The First International Assessment of Space Solar Power" John C Mankins
6. Russell, S. and Norvig, P.2015. Artificial Intelligence- A Modern Approach,3rd edition, Prentice Hall
7. Introduction to Machine Learning Edition 2, by Ethem Alpaydin

Reference Books:

1. "Fundamentals of Electric Drives"–Mohamed A. El-Sharkawi
2. "Renewable Energy: Power for a Sustainable Future"–Godfrey Boyle
3. "Artificial Intelligence Techniques in Power Systems"–Kevin Warwick
4. "Machine Learning for Smart Energy Systems"–Christoph Klemenjak
5. "Wireless Power Transfer: Principles and Engineering Explorations"–Triviño- Cabrera González-González
6. "Smart Grids: Infrastructure, Technology and Solutions"–Stuart Borlase,
7. Introduction to Artificial Intelligence & Expert Systems, DanWPatterson,PHI.,20102.S Kaushik, Artificial Intelligence, Cengage Learning, 1st ed.2011

MOOCs Links and additional reading material:

MOOC Links

1. https://www.coursera.org/learn/ai-for-everyone
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007/
3. https://www.coursera.org/learn/solar-energy-basics

Additional reading material

1. Introduction to Power Electronics by University of Colorado Boulder on Coursera
2. Electric Motors and Drives by NPTEL
3. Wireless Communications for Everybody by Yonsei University on Coursera
4. Smart Grid: Fundamentals of Design and Analysis by James Momoh

5. Solar Photovoltaic Power Generation: Technology, New Concepts & Policy by Chetan Singh Solanki
6. Artificial Intelligence for Smart Grid: Applications, Challenges and Future Trends by N. Hadjsaid
7. Wireless Power Transfer: Principles and Engineering Explorations by John M. Miller

Strength of CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	**3**	1	-	-	1	1	-	-	-	1	-	3	2	-
CO2	2	1	-	-	-	2	3	-	-	1	-	1	3	-
CO3	2	2	-	-	2	1	-	-	-	1	-	-	2	3
CO4	2	1	1	-	1	1	-	-	-	1	-	3	2	-
CO5	2	2		-	3	-	-	-	-	1	1	1	2	3
Avg.	**2.2**	**1.4**	**1**	**-**	**1.75**	**1.25**	**3**	**-**	**-**	**1**	**1**	**2**	**2.2**	**3**

1:Slight(Low)2: Moderate(Medium) 3: Substantial(High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Assignments	Course Project	Field Activity / Case Study	Quiz/ Presentation	
K1	√	√	-	-	-	√	√
K2	√	√	-	-	-	√	√
K3	-	-	-	-	-	√	√
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for /maps with the following future courses:
Hybrid Electric Vehicle, Power System

Job Mapping:
Electrical supervisor, Electrical operator

Program:	**F. Y. B. Tech (ETC)**			**Semester:**			**II**
Course:	**Communication and Computing Technologies**			**Course Code:**			**R25-ET-PCC-118**
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
02	-	-	02	40	60	-	-

Course Description: This course is designed to explore cutting-edge technologies shaping modern industry to first-year Electronics and Telecommunication Engineering students. By introducing them early to real-world applications and Indian/global initiatives, the course aims to inspire future-ready career choices in areas like VLSI, embedded systems, IoT, computing, and communication systems

Course Relevance: Students completing this course will gain awareness and basic competency in domains driving Industry 4.0 and 5.0. They will be better equipped to pursue careers in semiconductor design, automation, software engineering, telecommunications, AI/ML development, and embedded systems. The course is designed to align with emerging job roles in India's booming tech ecosystem and global innovation hubs.

Prerequisite:

1. Basic Electronics Engineering
2. Communication System Fundamentals

Bridge Content:

Not Applicable

Course Objectives:

1. **To UNDERSTAND** the fundamental principles of semiconductor devices and VLSI such as MOS, CMOS, and Nano electronics.
2. To **UNDERSTAND** Closed loop control system in industrial automation and use of PLC.
3. To **KNOW** 1G to 5G mobile generation, Wireless technologies and space technology.
4. To **UNDERSTAND** emerging computing technologies and elaborate its industrial applications.
5. To **UNDERSTAND** Microcontroller architectures, Embedded Systems, IoT applications and drone technology.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**EXPLAIN** fundamental concepts of semiconductors, CMOS and VLSI design technology.	2
CO2	**UNDERSTAND** key components used in control systems, architecture and applications of PLC in automation system.	2
CO3	**KNOW** evolution of mobile generation, wireless and space technology.	2
CO4	**UNDERSTAND** emerging computing technologies such as Software Engineering, Cloud computing and Quantum Computing.	2
CO5	**UNDERSTAND** the applications of embedded system and drone technology.	2

Course Contents

Unit 1	**Semiconductor and VLSI Design Technology**	**6 Hrs.**	**CO1**

Overview of IC Technology, MOS & CMOS fundamentals, Analog vs Digital CMOS, VLSI Design Methodologies: Medium Scale Integration, Large Scale Integration, and VLSI

Exemplars / Practical Applications and usage:

Apple's A-series chips**,** Qualcomm's Snapdragon (SoCs)

Unit 2	**Automation and Control Systems**	**5 Hrs.**	**CO2**
Basics of Automation: Need, open vs closed loop control, Overview of PLC and introduction to industrial automation, Introduction to Electrical Vehicle, Industry 4.0, Digital Twin Technology.			
Exemplars / Practical Applications and usage: Real-world systems: Bosch India, ABB, Siemens smart automation			
Unit 3	**Next Generation Communication Systems and Space Technology**	**5 Hrs.**	**CO3**
Evolution of Communication systems: Electromagnetic Spectrum, 1G to 5G and beyond, Optical Fiber Communication, **Space Technology:** Satellite Communication fundamentals, Types of satellites: LEO, MEO, GEO, and their characteristics, Applications of Communication in agriculture, logistics and defense, Navigation, Remote Sensing			
Exemplars / Practical Applications and usage: 5G base stations in urban areas, JioFiber, DTH Services (e.g., Tata Sky, Airtel DTH)			
Unit 4	**Computing Technologies**	**5 Hrs.**	**CO4**
Fundamentals of Computer Architecture, Cloud computing (IaaS, PaaS, SaaS), Blockchain fundamentals, Quantum Computing overview, History and scope of Artificial Intelligence and Machine Learning			
Exemplars / Practical Applications and usage: AI in Indian agriculture (CropIn, DeHaat), AI in healthcare (eSanjeevani), AI in smart hiring (Apna, Naukri)			
Unit 5	**IOT & Drone Technology**	**5 Hrs.**	**CO5**
IOT: Basics of IoT, components of IOT, IOT applications, advantages and challenges **Drone Technology:** Block diagram, basic components, types, applications such as: Mapping, Surveying, precision agriculture etc.			
Exemplars / Practical Applications and usage: 1. Smart village projects. 2. IoT in farming (KhetiGaadi), IoT in smart cities (Surat, Pune, Bhopal). 3. Idea Forge, Garuda Aerospace - Drone manufacturers			
Textbooks:			
1. Douglas A. Pucknell, Kamran Eshraghian, “Basic VLSI Design” PHI Publications 2. John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications" PHI Publications 3. S.K. Singh, "Industrial Automation and Control", Tata McGraw-Hill 4. Theodore S. Rappaport, "Wireless Communications: Principles and Practice", Pearson Education 5. Dennis Roddy, "Satellite Communications", McGraw-Hill 6. David A. Patterson, John L. Hennessy, "Computer Organization and Design" Morgan Kaufmann Publishers India 7. Rajkumar Buyya, "Cloud Computing: Principles and Paradigms", Wiley Publications 8. Raj Kamal, "Internet of Things (IoT): Architecture and Applications", McGraw Hill			
Reference Books:			
1. Rainer Waser, **“**Nanoelectronics and Information Technology”, Wiley-VCH Publications 2. Jochen Schiller, **“**Mobile Communications” Pearson Publications 3. Stuart Russell, Peter Norvig, *“*Artificial Intelligence: A Modern Approach” Pearson Publications 4. Adam Juniper, “Drones: The Professional Drone Pilot’s Manual”, Thames & Hudson Publications			
MOOCs Links and additional reading material:			

1. https://nptel.ac.in/courses/106106167 (Wireless Communication)
2. https://nptel.ac.in/courses/108102169 (Embedded Systems Design)
3.https://onlinecourses.nptel.ac.in/noc25_ae30/preview?utm (Drone Systems and Control)

Guidelines: As the objective of the course is to explore cutting-edge technologies shaping modern industry to first-year E&TC students, Guest/ Expert lectures can be conducted on Indian & Global Industry Integration topics The various career paths can be explored with awareness of different tools.

Unit I: Semiconductor and VLSI Design Technology
Indian & Global Industry Integration:
Role of India Semiconductor Mission, CDAC, ISRO, Tata Elxsi
Career paths: VLSI Engineer, ASIC/FPGA Designer, EDA Developer
Tools: EDA and AI-powered verification

Unit II: Indian & Global Industry Integration:
Real-world systems: Bosch India, ABB, Siemens smart automation
Case study: Sugar and textile industry automation
Career paths: Automation Engineer, Embedded Developer, IoT System Integrator
Tools: Arduino IDE, TIA Portal (Siemens), SCADA software (Ignition, LabVIEW, etc.), MATLAB/Simulink for control system modelling, Proteus for embedded simulation

Unit III: Indian & Global Industry Integration:
Bharat 6G Vision, ISRO's GSAT/Nav IC applications, Private 5G use-cases in Indian industries, Startups: Pixxel, IN-SPACe, Bharti-OneWeb, PSLV.
Indian Space Missions and Infrastructure, Overview of ISRO and its key missions (INSAT, GSAT, NavIC, Chandrayaan, Gaganyaan)
Career Paths: Network Planning Engineer, Telecom Analyst, Satellite Systems Engineer
Tools: ns-3, OMNeT++/Simu5G, MATLAB 5G Toolbox, ISRO STEM portals, Bhuvan, Student Sat programs, software satellite simulators

Unit IV: Indian & Global Industry Integration:
India Stack, Digital India initiatives, Aadhaar, Tech Mahindra and Infosys in cloud and blockchain, AI in Indian agriculture (CropIn, DeHaat), AI in healthcare (eSanjeevani), smart hiring (Apna, Naukri)
Career Path: Cloud Engineer, Blockchain Developer, Quantum Research Assistant, Data Analyst, ML Engineer
Tools: BRISC-V, Ripes, CPU lator, GitHub, Jira, SonarQube, Azure Dev Tools, Qiskit SDK, IBM Tutorials, Coursera

Unit V: Indian & Global Industry Integration:
Smart village projects (Hiware Bazar), IoT in farming (Kheti Gaadi), IoT in smart cities (Surat, Pune, Bhopal), Idea Forge – India's leading manufacturer of drones used in defense, surveillance, and agriculture. Collaborated with Indian Army and Police Forces. Garuda Aerospace – Develops drones for precision agriculture, delivery, and industrial inspections
Career Path: Embedded Developer, IoT Solution Architect, Edge AI Engineer, Drone Pilot (DGCA Certified), UAV Systems Engineer, Payload Integration Engineer
Tools: Arduino Platform & IDE (2.0), Tinker cad Circuits (Web), ESP32 + ESP-IDF

Strength of CO-PO-PSO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	3	1	-	-	-	1	2	-	3	2	2
CO2	2	3	3	2	3	-	-	1	1	2	1	3	3	3
CO3	2	2	3	2	2	-	-	1	1	2	-	3	3	2
CO4	2	3	2	3	2	1	-	1	2	3	1	2	3	3
CO5	2	2	3	2	3	-	1	1	1	2	1	3	3	3
Avg.	**2.2**	**2.4**	**2.6**	**2.4**	**2.2**	**1.0**	**1.0**	**1.0**	**1.2**	**2.2**	**1.0**	**2.8**	**2.8**	**2.6**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern							
BT Level	**CCE**						**ESE**
	CT1	**CT2**	**Assignments**	**Course Project**	**Field Activity / Case Study**	**Quiz / presentation etc.**	
K1	✓	✓	-	-	✓	✓	✓
K2	✓	✓	-	-	✓	✓	✓
K3	✓	✓	-	-	✓	✓	✓
K4	✓	✓	-	-	✓	✓	✓
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:
Digital communication, Control system, VLSI

Job Mapping: Job opportunities that one can get after learning this course:
First year course will introduce the career avenues for graduate electronics and telecommunication technocrat.

Program:	**F. Y. B. Tech (IT)**			**Semester:**		**II**	
Course:	**Modern IT Engineering Trends**			**Course Code:**		**R25-IT-PCC-118**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
02	-	-	02	40	60	-	-

Course Description

This course explores the evolving landscape of Information Technology by examining recent trends and emerging smart technologies shaping the future of the field. The course emphasizes real-world case studies, hands-on tools, and project-based learning to foster an understanding of the practical challenges and opportunities in implementing cutting-edge IT solutions.

Course Relevance:

It covers innovations such as Artificial Intelligence (AI), Internet of Things (IoT), Edge and Cloud Computing, Blockchain, and Smart Systems integration. Students will gain insights into the application of these technologies across industries including healthcare, finance, education, manufacturing, and smart cities.

Prerequisite:

1. Basic to intermediate knowledge and awareness of Recent Technology.
2. Familiarity and use of different Technology.

Bridge Content:

Course Objectives:

1. **KNOW** and working on basic AI tools and generative AI concept.
2. **UNDERSTAND** the fundamental of Emerging technologies.
3. **FAMILIARIZE** students with Web Programming basic concepts
4. **EXPLORATION** of Smart Technologies.
5. **FOSTER** Innovation and Critical Thinking in virtual reality and augmented reality.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**APPLY** concept of AI tool and Generative AI on documents.	**3**
CO2	Students will **UNDERSTAND** recent emerging technologies in IT.	**2**
CO3	**DEMONSTRATE** Static website using technologies like HTML, CSS, Bootstrap	**3**
CO4	**DISCUSS** fundamentals, architecture and framework of IoT.	**2**
CO5	**DESCRIBE** how VR systems work and list the applications of VR.	**2**

Course Contents

Unit 1	**Intelligence System**	**6 Hrs.**	**CO1**

AI Tools: CHAT GPT tool, DEEP SEEK, DOPHLER Technology, GROK, Use of AI for human learning, Application of AI in business and finance. Generative AI**:** AI models that can create new content, like text, images, or code. Profession Opportunities: AI Engineer, ML Engineer. Case Study: Use of any one of studied AI tool and its applications.

Exemplars / Practical Applications and usage:

1. Identify different AI tools for business and finance.
2. Identify use of AI for human learning.

Assignments:

1. List any three fields or industries where AI is being used today. Briefly describe one career opportunity related to AI?

2. What is the difference between traditional AI and generative AI?

Unit 2	**Introduction To Emerging Technologies**	**6 Hrs.**	**CO2**

Emerging Technologies in IT- Big Data and Block chain Technology**,** Cloud Services: IAAS, SAAS, PAAS, Quantum Computing – Quanta, Understanding of Quantum and Quantum Computing, Green IT and Sustainable Development. -Cyber Security: Authentication, Authorization, Application of Cyber Security.
Profession Opportunities: Data Analyst, Cybersecurity Analyst, Cloud Engineer.
Case Study: "How Netflix Uses Emerging Technologies to Personalize Your Experience": AI help Netflix recommend shows and stream globally.

Exemplars / Practical Applications and usage:

1. Identify different cloud servers and Its applications.
2. Analysis of Big data in finance and social media and Marketing and Quantum Technology in Communication.

Assignments:

1. Describe application of Big Data and Block chain Technology.
2. Differentiate between different cloud Services

Unit 3	**Web Technologies**	**6 Hrs.**	**CO3**

Web Concept: WWW, Types of browsers, WEB Server, HTML5,
CSS- Types of CSS, Bootstrap- Why Bootstrap, Bootstrap Components (Button, Table, Navbar, Card, Form)
Case Study**:** Design of simple Website for any application.
Profession Opportunities**:** Web Developer.

Exemplars / Practical Applications and usage:

1. It used for Web Development.
2. Development of E-Commerce Platforms.

Assignments:

- Explain the client-server architecture with a neat diagram?
- Write HTML code to create a form with input fields: Name, Email, Password and Submit button.
- Explain the CSS box model with neat diagram?
- Explain Grid System in Bootstrap?

Unit 4	**Smart IoT Application Services**	**6 Hrs.**	**CO4**

Internet of Things (IoT): Definition, IoT Applications, Examples of Embedded System, Characteristics of IoT, Types of IoT Sensors and Actuators. IoT Platform- ARDUINO Pin diagram, Raspberry-Pi Pin diagram, NODE MCU ESP 8266 Pin diagram Case Study: “Smart Farming in India Using IoT Sensors" – How farmers use soil moisture sensors and mobile alerts to save water and improve crop yield. Profession Opportunities: Embedded Programs Engineer, IoT Software and Hardware Developer, IoT Engineer, IoT Researchers.

Exemplars / Practical Applications and usage:

1. Knowledge of embedded system identical to AC, Washing Machine, Oven.
2. Identify awareness of any Smart Application System.

Assignments:

1. List different sensors and actuators used in IoT.
2. List different IoT components use in smart farming Application.

Unit 5	**Augmented Reality And Virtual Reality**	**6 Hrs.**	**CO5**

Virtual Reality: Defining Virtual Reality, Key elements of virtual reality experience. Augmented Reality**:** Applications and Examples of Augmented reality (Snapchat, Google Glass , Google Street View), Compare Virtual and Augmented Reality. Case Study**:** Study the use of AR and VR on the International Space Station. Profession Opportunities**:** AR, VR Designer and Developer, XR Game Developer, Animation Engineer.

Exemplars / Practical Applications and usage:

1. Virtual gaming application used in 3D animation. Training & Construction.
2. Design animated structure of construction and manufacturing as well VR use in Medical Application.

Assignments:

1. What is Virtual Reality (VR) and Augmented Reality (AR).
2. Explain different real-world applications of AR and VR in daily life and industry.

Textbooks:

1. Vijay Madisetti, ArshdeepBahga, "Internet of Things: A Hands-On Approach", 2014, Universities Press (India) Pvt Ltd., ISBN: 9788173719547.
2. Kogent Learning Solutions Inc, Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Black book, Dream tech Press, Second Edition, ISBN: 9788177228496.
3. Andrew Hoffman, Web Application Security-Exploitation and Countermeasures for Modern Web Applications, O'Reilly publication.
4. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann (Chapter 5 text book).

Reference Books:

1. Eric Barceló Monroy Thomas Erl (Author) Format "Cloud Computing: Concepts, Technology, Security & Architecture" Pearson 2nd Edition.
2. Peter Waher, "Learning Internet of Things", 2015, Packet Publishing, ISBN: 978-1-78355-353-2
3. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition, 978- 81-265-1635-3.
4. Alan B Craig, William R Sherman and Jeffrey D Will "Developing Virtual Reality Applications: Foundations of Effective Design" , Morgan Kaufmann, 2009.

MOOCs Links and additional reading material:

1. Introduction to AI: https://www.coursera.org/learn/intro-to-ai-arm
2. Introduction to Quantum Computing: https://onlinecourses.nptel.ac.in/noc21_cs103/preview
3. Web Technology: https://www.w3schools.com/Css/
4. Overall IoT Course Contents: https://onlinecourses.nptel.ac.in/noc21_cs17/preview
5. Industry 4.0: Augmented Reality and Virtual Reality https://youtu.be/zLMgdYI82IE?si=ti-bCwT5abThM8C2

Strength of CO-PO-PSO Mapping														
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	3	2	3	2	1	1	1	-	2	3	2	3
CO2	3	2	2	2	3	2	2	1	1	-	2	3	2	2
CO3	3	2	2	2	2	2	1	2	1	-	2	2	2	2
CO4	3	2	2	2	2	2	2	1	1	1	2	2	2	2
CO5	2	2	2	2	2	2	1	2	1	-	2	2	2	2
Avg.	**2.8**	**2**	**2.2**	**2**	**2.4**	**2**	**1.4**	**1**	**1**	**1**	**2**	**2.4**	**2**	**2.2**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern							
BT Level	**CCE**						**ESE**
	CT1	**CT2**	**Assignments/ Case Studies**	**Course Project**	**Field Activity / Case Study**	**Quiz / presentation etc.**	
K1	-	-	-	-	-	-	-
K2	✓	✓	✓	-	-	✓	✓
K3	✓	✓	✓	-	-	✓	✓
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for maps with the following future courses:

1. Artificial Intelligence and Machine Learning
2. Data Science and Analytics
3. Cybersecurity and Blockchain
4. Internet of Things
5. Web Designing

Job Mapping:

Job opportunities that one can get after learning this course:

Key Roles: AI Engineer, Machine Learning Engineer, Data Analyst (AI-focused), Cybersecurity Analyst, Information Security Officer, Ethical Hacker, Cloud Engineer, Cloud Solutions Architect, Automation Tester

Employers: Google, Amazon, Microsoft, TCS, Infosys, NVIDIA, Cognizant, AI Startups
IBM, Accenture, Deloitte, Capgemini.

Program:	**F. Y. B. Tech (Mechanical)**			**Semester:**		**II**	
Course:	**Emerging Trends in Mechanical Engineering**			**Course Code:**		**R25-ME-PCC-118**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
02	-	-	02	40	60	-	-

Course Description:

This course provides first-year mechanical engineering students with a foundational understanding of how emerging technologies are transforming the field of mechanical engineering. It introduces students early to cutting-edge tools and innovations that are shaping the future of mechanical systems. It familiarizes key tools and concepts such as Additive Manufacturing (3D Printing), Digital Manufacturing, Computer-Aided Design (CAD), Computer-Aided Engineering (CAE), Simulation, Artificial Intelligence (AI), Internet of Things (IoT), Automation, and Augmented/Virtual Reality (AR/VR).Students will explore the evolution of traditional mechanical engineering into a smart, data-driven, and digitally empowered discipline. By fostering an interdisciplinary perspective, the course connects core mechanical engineering concepts with electronics, computing, and data science, reflecting the integrated nature of modern engineering.

Course Relevance

Through real-world examples and case studies, students will gain insight into how these technologies are applied across mechanical domains like design, manufacturing, thermal systems, automotive engineering, and energy systems.

The course fosters a future-ready mindset, encourages interdisciplinary thinking, and builds appreciation for the modern role of mechanical engineers in addressing technological and societal challenges.

Prerequisite:

1. Basic understanding of physics and mathematics
2. Fundamentals of engineering graphics
3. Basic computer skills
4. Curiosity and willingness to learn about technology
5. Exposure to school-level projects or tinkering is desirable but not necessary.

Bridge Content:

Encouraging observation and critical thinking: "How does this work?" mindset.

Course Objectives:

1. To **INTRODUCE** the fundamentals of emerging technologies that are transforming the field of mechanical engineering.
2. To **INTRODUCE** the evolution of mechanical design toward digital and intelligent systems using emerging technologies like CAE, AI, IoT, and AR/VR across the product lifecycle &and the classification, properties, and applications of advanced materials for sustainable engineering solutions.
3. To **FAMILIARIZE** the transformation of manufacturing from traditional to smart and digital manufacturing processes and systems.
4. To **ACQUAINT** with the emerging technologies transforming the automotive industry, including intelligent systems, digital design and manufacturing, AI, IoT connectivity, automation, and immersive visualization.
5. To **PRESENT** new technologies like CAE simulations, IoT, AI, and machine learning are used in thermal engineering, HVAC systems, power plants, and smart systems for better monitoring, control, and efficiency.

Course Outcomes: After learning the course, students will be able to		
CO	**Course Outcome**	**Bloom's Level**
CO1	**UNDERSTAND** the fundamental concepts of emerging technologies shaping modern mechanical engineering practices and systems.	**2**
CO2	**EXPLAIN** how emerging tools enhance and optimize stages of the mechanical design process and INTRODUCE advanced materials.	**2**
CO3	**DESCRIBE** the role and application of emerging technologies in modern manufacturing systems.	**2**
CO4	**DESCRIBE** the use of modern technologies like CAD/CAE, AI, IoT, automation, and VR in design, build, and improvement of modern vehicles.	**2**
CO5	**DESCRIBE** the use of modern tools in simulating, monitoring, and improving thermal systems, HVAC operations, and power plant performance.	**2**

Course Contents

Unit 1	**Fundamentals of Emerging Technologies**	**6 Hrs.**	**CO1**

Definition and characteristics of emerging technologies, Need for innovation and technology adoption in mechanical engineering, Overview of interdisciplinary integration in modern engineering.

Concept and pillars of Industry 4.0, Digital transformation in manufacturing, design, and energy systems; the role of data, connectivity, and automation in engineering workflows.

Additive Manufacturing (3D Printing): Basic principles, materials, and process types, Benefits over conventional manufacturing, Applications in prototyping and custom part production.

Basic idea of AI/ML and data-driven decision-making.

Internet of Things (IoT): Basic Idea, Concept of smart, connected systems and sensors, Introduction to automation technologies.

Basics of AR/VR technologies.

Introduction to computer-aided design and engineering tools, Concept of virtual testing and digital replicas.

Exemplars / Practical Applications and usage:

Smart Electric / Autonomous Vehicle Design, Robotic Arms in Car Manufacturing, Google Cardboard or a mobile AR app to visualize a mechanical component in 3D and explore it interactively, Smart Factories, Digital Manufacturing, Intelligent consumer devices like Smart Refrigerators, Air conditioners; Sustainable Smart Homes, VR Training for Aircraft pilots and maintenance, medical implants.

Unit 2	**Emerging Technologies and Design Engineering**	**6 Hrs.**	**CO2**

Evolution from traditional design to digital and intelligent design systems, Interdisciplinary nature of modern design: Mechanical + Electronics + Software, Introduction to the Product Lifecycle and the role of digital tools at each stage, Overview of CAE tools for stress / crash analysis, thermal analysis, and vibration testing, AI in design validation and intelligent design recommendations, Introduction to Design for IoT (DFIoT) – products that interact with the environment, Visualizing 3D models using AR/VR for design reviews and remote collaboration. Introduction to Advanced Materials: Definition of materials and their role in engineering. Limitations of conventional materials. Need for advanced materials in aerospace, automotive, biomedical, and electronics. Classification: Composites, Smart Materials, Nano-materials, High-performance Alloys, Biodegradable Materials for sustainable development. Introduction to Nanomaterial.

Exemplars / Practical Applications and usage:
Crash analysis of an automotive bumper, Lightweight bracket for aerospace/automotive applications, Smart HVAC duct system with temperature/humidity sensors, Designing a smart irrigation valve.

Unit 3	**Emerging Technologies and Manufacturing Engineering**	**6 Hrs.**	**CO3**

Evolution from traditional to smart manufacturing, Introduction to Industry 4.0 and Cyber-Physical Production Systems (CPPS), Interdisciplinary integration: mechanical systems, data, electronics, and control; Role of additive manufacturing, CNC, flexible manufacturing systems, digital manufacturing (process and production simulation); Tool path simulation in CAM, Applications of AI in maintenance, process optimization, and quality control; Smart machine monitoring and production tracking, Use of automation and robotics in assembly lines, material handling, and quality inspection; Use of AR/VR for operator training, remote diagnostics, and factory layout planning.

Exemplars / Practical Applications and usage:
A smart factory with real-time production monitoring and feedback loops, Pick-and-place robotic arm with real-time feedback from sensors, 3D printing of a customized mechanical component, CNC milling machine integrated in a flexible cell with automatic tool changers and conveyors, CAM-based tool path generation for a simple component manufacturing, Robot-assisted assembly line for automotive components, AR-assisted operator training for machine setup, Virtual walkthrough of a manufacturing cell or plant.

Unit 4	**Emerging Technologies and Automotive Engineering**	**6 Hrs.**	**CO4**

Evolution of the automotive industry: from mechanical to intelligent systems, Introduction to Electric Vehicles (EVs), Autonomous Vehicles, and Connected Cars, Use of CAD tools to design vehicle components and Role of CAE in simulating crash analysis, thermal behavior, and structural integrity, Digital manufacturing for vehicle assembly and smart factory workflows; AI in autonomous driving: object detection, path prediction, and adaptive cruise control, Use of IoT in Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication, real-time diagnostics, performance monitoring, and infotainment systems, Role of robotic arms in welding, painting, and assembling automotive components, automated inspection systems using vision and sensors, Use of VR for virtual prototyping and immersive design reviews.

Exemplars / Practical Applications and usage:
Transition from manual transmission to automatic and smart transmission systems, Design of an EV battery cooling system, Mechanical design of LIDAR or camera mounting systems for autonomous vehicles, Use of robotic arms and conveyors in assembling a car door or engine block, AI-driven adaptive cruise control system reacting to real-time traffic conditions, OBD (On-board diagnostics) system transmitting real-time engine data to a mobile app, Immersive review of a vehicle dashboard layout in VR.

Unit 5	**Emerging Technologies and Thermal Systems**	**6 Hrs.**	**CO5**

Introduction to CAE tools for thermal, fluid flow, and stress simulations, IoT-enabled smart HVAC systems, Role of IoT sensors in monitoring temperature, pressure, flow, and energy usage, AI for predictive maintenance, efficiency optimization, and fault detection in power plants and process equipment, ML in thermal load forecasting and smart HVAC control, Smart monitoring and control of power plants, Prevention of thermal runaway in computers, electronics and smart systems.

Exemplars / Practical Applications and usage:

Simulation of airflow and heat dissipation in a laptop cooling system, Smart air conditioning system in a modern commercial building, IoT-based boiler monitoring system, ML algorithm that learns and predicts daily cooling load patterns for an office building, Centralized dashboard displaying real-time performance of turbines, boilers, and condensers in a thermal power plant, Use of thermal sensors and automatic shutdown systems in electric vehicle battery packs to prevent overheating.

Assignments:

Choose a domestic thermal product (e.g., smart air conditioner, refrigerator, water heater/geyser, or microwave oven) and prepare a case study report on the application and role of emerging technologies and benefits.

Course Projects:

Students are encouraged to undertake a course project that applies foundational knowledge from design engineering, thermal systems, heat transfer, manufacturing methods, automobile systems, and power generation to the study of a daily-use mechanical product. This could include smart household appliances, modern consumer products, or intelligent automobile subsystems that incorporate technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), automation, simulation, and digital design tools.

The objective of the project is to study and analyze a real-world product, focusing on how mechanical components and smart technologies work together to improve functionality, user experience, energy efficiency, and sustainability. Students will gain practical insight into system integration, performance evaluation, and how modern innovations are transforming everyday engineering applications.

Textbooks:

1. Dr. Vikram Bansal, Industry 4.0 Sustainable Industrial Approach, S Chand and Sons, 1st Edition ,2025.
2. S R Navar, Introduction to AI/ML and Data Science, blue rose publishers Pvt. Ltd., 1st Edition, 2022.
3. M. M. M. Islam, M. L. Baptista, and F. Tariq, Eds., Artificial Intelligence for Smart Manufacturing and Industry 5.0. Cham: Springer, 2025.
4. V. Vijayan, R. P. Shetty, and S. P. Pai, Eds., Smart Materials and Manufacturing Technologies for Sustainable Development. Cham: Springer, 2024.
5. W. A. Khan, V. Esat, M. Hammad, H. Ali, M. Q. Zafar, and R. Ali, Computer Aided Engineering Design and Manufacturing: A Fourth Industrial Revolution Perspective. Cham: Springer, 2025.

Reference Books:

1. Vibha Soni, IOT for beginners, BPB publishers, 1st Edition, 2022.
2. Dr Ramanuj, Augmented Reality and Virtual Reality for bingers, scientific international Publishing House, 1st Edition ,2025.
3. Thomas Molas , Artificial Intelligence and Autonomous Vehicles ,Discovery Publishing House, 1st Edition ,2025.
4. I. Gibson, D. Rosen, B. Stucker, and M. Khorasani, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 3rd ed. Cham: Springer, 2021.
5. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 7th ed. Harlow Pearson, 2021.
6. S. J. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, 4th ed. Hoboken, N J Pearson, 2021.
7. A. Kumar, H. Singh, P. Parveen, and B. Almangour, Eds., Handbook of Smart Manufacturing: Forecasting the Future of Industry 4.0. Boca Raton, FL, USA: CRC Press, 2023.

MOOCs Links and additional reading material:

1. Automation and Robotics: https://onlinecourses.nptel.ac.in/noc25_me154/preview
2. AI for Design and Optimization: https://online.umich.edu/courses/ai-for-design-and-optimization

3. AI/MLfor-autonomous-vehicles:https://online.umich.edu/courses/ai-for-autonomous-vehicles-and-robotics
4. Industry4.0/IOT: https://onlinecourses.nptel.ac.in/noc25_cs146/preview
5. Introduction to thermodynamics: https://www.coursera.org/learn/thermodynamics-intro#modules
6. Introduction to Thermodynamics & Heat Transfer : https://nptel.ac.in/courses/103105140
7. AI Fundamentals: https://www.coursera.org/learn/ai-for-everyone

Strength of CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	-	-	3	2	2	-	-	-	-	-	-	-
CO2	3	2	-	-	3	2	2	-	-	-	-	3	.2	2
CO3	3	2	-	-	3	2	2	-	-	-	-	2	.2	2
CO4	3	2	-	-	3	2	2	-	-	-	-	2	3	2
CO5	3	2	-	-	3	2	2	-	-	-	-	2	2	3
Avg.	**3**	**2**	**-**	**-**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**2.25**	**2.25**	**2.25**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Assessment Pattern

BT Level	CCE						ESE
	CT1	CT2	Assignments	Course Project	Field Activity / Case Study	Quiz / presentation etc.	
K1	✔	✔	-	-	-	-	✔
K2	✔	✔	✔	✔	-	-	✔
K3	-	-	-	-	-	-	-
K4	-	-	-	-	-	-	-
K5	-	-	-	-	-	-	-
K6	-	-	-	-	-	-	-

This course serves as a prerequisite for / maps with the following future courses:

This course builds foundational knowledge in simulation, IoT, and AI integration for thermal and energy systems. It prepares students for advanced topics like Industry 4.0, robotics, and smart manufacturing.

The concepts learned support future studies in product design, mechatronics, and automation. It serves as a prerequisite for courses such as Advanced Manufacturing and Digital Twin applications.

Job Mapping:

Job opportunities that one can get after learning this course:

Key role:

- After completing this course, students can pursue entry-level roles such as IoT Engineer, Automation Assistant, Product Design Trainee, and Mechatronics Technician.
- They can find opportunities in industries like automotive, manufacturing, and automation.

Program:	**F. Y. B. Tech.**			**Semester:**			**II**
Course:	**Programming in C**			**Course Code:**			**R25-IT-PCC-119**
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	**02**	**-**	**01**	**-**	**-**	**25**	**-**

Course Description:

This course introduces students to the fundamentals of C programming language, emphasizing structured and modular programming techniques. It covers essential programming constructs such as operators, control structures, arrays, strings, functions, and structures. Students will learn problem-solving through algorithmic thinking and coding practices. The course provides extensive hands-on experience via lab experiments and mini-projects. It lays a strong foundation for learning advanced programming and software development concepts.

Course Relevance:

C programming forms the backbone of Information Technology Engineering. The course equips students with logical reasoning and analytical skills essential for software development. It enhances students' ability to design and implement efficient computational solutions. Knowledge of C is crucial for understanding modern languages like C++, Java, and Python. The skills gained are highly relevant for placements, technical interviews, and future courses in data structures, algorithms, and system programming.

Prerequisite:

1. Basics of Computers
2. Basic Mathematics

Course Objectives:

1. **UNDERSTAND** the fundamental Concepts of C Programming
2. **ACQUIRE** knowledge and Compare usage of Operators and Expressions in C Programming
3. **APPLY** Control Flow structures in C Programming for Problem solving
4. **DESIGN** a solution using Arrays, Character and String Arrays in C programming
5. **DESIGN** a develop solution for simple computational problems using User Defined Functions and structures in C Programming

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**Use** algorithms for simple computational problems.	3
CO2	**Use** mathematical, Logical Operators and Expressions.	3
CO3	**Apply** Control Flow structures for decision making.	3
CO4	**Apply** a solution using Arrays, Character and String Arrays.	3
CO5	**Apply** user defined functions and structures.	3

List of Assignments

Group A (Any Five)

Experiment No. 1	To accept the number and Compute a) Square root of number, b) Square of number, c) Cube of number d) Check for prime, d) Factorial of number e) Prime factors.	2 Hrs	CO1, CO3

Objective:

1. To understand and implement basic mathematical computations using programming.
2. To develop logical thinking for performing number-based operations.
3. To enhance problem-solving skills in mathematics and computer science.

Associated Tasks:
Accept an integer input from the user. Compute the square root of the number, square and cube of the number, factorial of the number. Check whether the number is a prime number & display all prime factors of the number.

Exemplars and Utility:
1. Useful for students to understand fundamental programming constructs and control structures.
2. Supports mathematical logic understanding in competitive exams and coding interviews.

Experiment No. 2	To accept the Fibonacci numbers from user to be generated and print the Fibonacci series.	2 Hrs	CO1,CO4

Objective:
To develop a program that Accepts a user input for the number of terms in the Fibonacci sequence, Generate and display the Fibonacci series up to the specified number of terms.

Associated Tasks:
Prompt the user to input a number. Validate the input to ensure it is a positive integer. Use an iterative or recursive approach to generate the Fibonacci sequence of 'n' terms.

Exemplars and Utility:
1. Understanding Recursion and Iteration
2. Mathematical Insight
3. Problem Solving

Experiment No. 3	Write a C program using appropriate loops to generate following shapes on display screen using * characters: a. Square b. Rectangles c. Right Angle Triangle	2 Hrs	CO1,CO4

Objective:
To understand the usage of nested loops in C. To apply logic for pattern generation.
To gain experience with user input and conditional logic.

Associated Tasks:
Accept dimensions (side/length/height) from the user. Display each pattern using * characters.

Exemplars and Utility:
1. Useful for understanding loop nesting.
2. Forms a foundation for graphical logic in text-based output.

Experiment No. 4	Write a C program that accepts a string from the user and performs the following string operations - a. Calculate length of string b. String reversal c. Equality check of two Strings d. Check palindrome e. Check substring	2 Hrs	CO1,CO3

Objective:
To understand and implement basic string operations in C. To develop skills in using character arrays and string handling functions. To practice string comparison, manipulation, and logical checking through programming.

Associated Tasks:
1. Accept strings as input from the user. Calculate the length of the input string. Reverse the string and display it. Accept a second string and check for equality.
2. Accept another string and check whether it is a sub-string of the first string.

Exemplars and Utility:
1. Enhances string handling skills in C.
2. Fundamental for programming interviews and competitive coding.

Experiment No. 5	Implement array as following: 1. Find given element in array 2. Find Max and Min element 3. Find frequency of given element in array 4. Find Average of elements in Array.	2 Hrs	CO1,CO4

Objective: To understand basic operations on arrays in C. To enhance logical thinking through search, comparison, and statistical computation on arrays.

Associated Tasks:
1. Accept elements into an array from the user.
2. Calculate the average of array elements.

Exemplars and Utility:
1. Forms the foundation for data manipulation in programming.
2. Prepares students for array-based problem-solving in interviews and competitive programming.

Experiment No. 6	Menu-Driven C Program for finding areas of following shapes: a. To find area of Circle b. To find area of rectangle, c. To find area of square d. To find area of triangle e. To find area of a Regular Hexagon	2 Hrs	CO1,CO2

Objective:
To understand and apply mathematical formulas for computing areas of shapes. To improve modular programming and logical structuring skills.

Associated Tasks:
1. Accept appropriate inputs (e.g., radius, length, base) from the user.
2. Allow the user to perform multiple operations until they choose to exit.

Exemplars and Utility:
1. Strengthens understanding of geometry in programming context.
2. Helps in developing reusable and modular code structures.

Experiment No. 7	Write a C program for Matrix Operations that accept two 3x3 matrices. Perform the following using functions: a. Display Matrices b. Addition of two matrices c. Subtraction of two matrices	2 Hrs	CO1,CO2

Objective:
To understand matrix representation and operations in C. To develop function-based modular programming skills. To apply arithmetic operations (addition and subtraction) on matrices.

Associated Tasks:
1. Accept two 3x3 matrices from the user.
2. Use appropriate loops and function calls to structure code modularly.

Exemplars and Utility:

1. Forms the base for higher-level operations like matrix multiplication, transposition, and determinant calculation.
2. Promotes clean, modular, and reusable code using functions.

Group B (Any Five)

Experiment No. 1	Write a program for Student Attendance Tracker system: Accept attendance of N students for a week. a. Use two-dimensional array to store attendance (1=Present, 0=Absent) b. Display attendance report (Roll Number and Present-Absent) c. Calculate percentage attendance of students.	2 Hrs	CO1, CO5

Objective: Tracks and reports student attendance over a week (5 working days), enabling attendance management and performance analysis.

Associated Tasks:

1. Accept number of students (N).
2. Input daily attendance (1 = Present, 0 = Absent).
3. Display student-wise attendance.
4. Calculate and show attendance percentage.

Exemplars and Utility:

1. Helps automate and analyze weekly attendance.
2. Supports easy extension for monthly or term tracking.

Experiment No. 2	Write a C program to calculate monthly electricity bill based on units consumed: ▪ For first 100 units – ₹4.5/unit ▪ 101 to 300 units – ₹7.0/unit ▪ Above 300 units – ₹12/unit ▪ Add ₹120 fixed charge for all customers. ▪ Use simple structure to store Customer ID, name, units and bill amount.	2 Hrs	CO2

Objective: To calculate the monthly electricity bill of a customer based on units consumed using a structure C program and fixed slab rates.

Associated Tasks:

1. Define a structure to store customer details.
2. Accept input: Customer ID, Name, Units Consumed.
3. Display the final bill amount.

Exemplars and Utility:

1. Helps utility companies quickly compute electricity bills.
2. Helps students understand conditional logic and structure usage in C.

Experiment No. 3	Design Library Management System using array of structure: Maintain each book ID, title, author, and availability (Yes/No) & Implement following Operations: a. Add new books b. Display book list c. Search by title or author (Use linear search) d. Count available books	2 Hrs	CO2,CO5

<table>
<tr><td colspan="4">Objective: Design a simple Library Management System using array of structure to store and manage book records.
Associated Tasks:
1. Define a Structure to hold book data: ID, Title, Author, and Availability.
2. Implement Add Operation to add new books to the array.
3. Implement Display Operation to list all books.
4. Implement Search Operation (linear search) to find books by title or author.
5. Implement Count Operation to count the number of available books.
Exemplars and Utility:
1. Educational: Understand array of structures, linear search, and basic data management.
2. Practical: Simulates how small library systems maintain book records.</td></tr>
<tr><td>Experiment No. 4</td><td>Write C program using array of structure for Bank Account Management System:
Accept and display account holder information: Account Number, Name, Balance. Perform operations:
a. Deposit Amount
b. Withdraw Amount
c. Display account balance
d. Search by account number</td><td>2 Hrs</td><td>CO2, CO5</td></tr>
<tr><td colspan="4">Objective: Design a Bank Account Management System in C using an array of structures to store customer account details and perform basic banking operations like deposit, withdraw, search, and balance check.
Associated Tasks:
1. Define a structure to store account details: Account Number, Name, Balance.
2. Accept data for multiple customers.
Exemplars and Utility:
1. Educational: Demonstrates structured data handling using arrays and functions.
2. Practical: Simulates mini banking system for understanding transactions and data handling.</td></tr>
<tr><td>Experiment No. 5</td><td>Write a C program using user defined functions. Create separate functions to perform each of the following options and call them using a switch-case.
a. Number is even or odd
b. Check if number is prime
c. Calculate power of the given number</td><td>2 Hrs</td><td>CO3, CO5</td></tr>
<tr><td colspan="4">Objective: Design a menu-based C program using user-defined functions to perform basic mathematical operations like checking even/odd, prime, power.
Associated Tasks:
1. Create a menu-driven program using switch-case.
2. Implement the above functionalities in separate functions.
Exemplars and Utility:
1. Demonstrates use of modular programming with functions.
2. Reusable and easy to manage for various mathematical tasks.</td></tr>
<tr><td>Experiment No. 6</td><td>Accept angle and perform following operations using user defined functions:
a. Find sin(angle)</td><td>2 Hrs</td><td>CO2, CO5</td></tr>
</table>

	b. Find cos(angle) c. Find tan(angle)		

Objective: To develop a C program using user-defined functions that accepts an angle in degrees and calculates its trigonometric values such as sin, cos, tan.

Associated Tasks:

1. Accept an angle in degrees from the user.
2. Convert the angle from degrees to radians.
3. Implement separate user-defined functions for above.

Exemplars and Utility:

1. Understand how to use the math library and user-defined functions.
2. Useful in fields like physics, engineering, and computer graphics.

Experiment No. 7	Write a C program to develop an Income Tax Calculator that accepts the annual income of an individual and calculates the total tax payable based on applicable income tax slabs. ▪ Income range: Up to ₹12.0 lakh:: Tax:Nil ▪ Income range:₹12.0 lakh – ₹16.0 lakh:: Tax:15% ▪ Income range:₹16.0 lakh – ₹20.0 lakh:: Tax:20% ▪ Income range:Above ₹20.0 lakh lakh:: Tax:30%	2 Hrs	CO3, CO5

Objective: To design a C program that calculates the total income tax payable by an individual based on their annual income, using progressive tax slabs as per simplified Indian income tax rules.

Associated Tasks:

1. Accept the annual income from the user.
2. Apply the appropriate tax slabs
3. Calculate total tax payable by accumulating slab-wise tax.
4. Display the final tax amount to the user.

Exemplars and Utility:

1. Demonstrates conditional logic and arithmetic in C programming.
2. Can be used for rough estimation of income tax liability.

Group B: Mini Projects (Any One)

Statement 1:

Generate Result of N students in a class using array of structure: Enter following details of N students a class: Roll Number, Name of student, Marks of 5 subjects. Calculate Total, Percentage, Grade of each student. Display Congratulation message for class topper.

- If student scores aggregate greater than 75%, then the grade is distinguished.
- If aggregate is 60>= and <75 then the Grade of first division.
- If aggregate is 50>= and <60, then the grade is second division.
- If aggregate is 40>= and <50, then the grade is third division.

Statement 2: User Friendly Calculator application

Design the calculator application that performs basic arithmetic operations along with advanced scientific and engineering calculations.

a) Basic Arithmetic Operations: Addition of two numbers, Subtraction, Multiplication, Division,

Modulus (remainder)

b) Advanced Mathematical Operations: Power function (x^y), Factorial of a number, Square and Cube of a number, Square Root, Logarithmic function, Trigonometric functions (sin, cos, tan), Percentage calculation, Absolute value

c) Provide User Interface (Console-based): The interface will:
   - Display a main menu with categorized options
   - Accept user input and validate it
   - Display results clearly
   - Loop until the user exits the application

Statement 3: Online Shopping Cart System (Mini Billing System)

Accept multiple products with name, quantity, unit price. Use array of structure
- Calculate bill per product
- Apply 10% discount if bill > ₹500
- Display total payable amount
- Display most frequently sold products
- Display monthly profit

Statement 4: Simple Calendar Generator

The generation of the calendar view for a given month and year by calculating:
- The number of days in the entered month.
- The starting day of the week for the month.
- Appropriate formatting using spaces and loops to align dates with weekdays.

Textbooks:

1. E. Balagurusamy, Programming in ANSIC, 8th Edition.
2. H. M. Deitel and P. J. Deitel, C: How to Program, Pearson Education, 2015, 8th ed.
3. B. S. Gottfried, Programming with C (Schaum's Outline Series), McGraw-Hill, 1996, 2nd ed.

Reference Books:

1. B. W. Kernighan and D. M. Ritchie, The C Programming Language, UK: Prentice Hall, 1988, 2nd ed.
2. S. C. Kochan, Programming in C, Sams Publishing, 2004, 3rd ed.
3. W. Kernighan and B. Pike, The Practice of Programming, UK: Addison-Wesley, 1999.
4. P. Prinz & T. Crawford, C in a Nutshell: The Definitive Reference, O'Reilly Media, 2016, 2nd ed.

MOOCs Links and additional reading material:

1. **Introduction to Programming in C- NPTEL / Swayam (IIT Kanpur)**
   https://onlinecourses.nptel.ac.in/noc25_cs119/preview NPTEL Online Courses
2. **C Programming and Assembly Language-NPTEL / Swayam**
   https://onlinecourses.nptel.ac.in/noc25_cs114/preview NPTEL Online Courses
3. **Introductory C Programming Specialization-Coursera**
   https://www.coursera.org/specializations/c-programming Coursera
   Simplilearn's Free C Programming Course
   https://www.simplilearn.com/free-c-course-skillup Simplilearn.com

4. **C Fundamentals**
   https://www.w3schools.com/c/

Strength of CO-PO Mapping											
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	2	1	2	1	1	1	1	1	-
CO2	2	2	2	1	1	1	1	1	1	1	-
CO3	2	2	2	1	2	1	1	1	1	1	-
CO4	2	2	1	1	1	1	1	1	1	1	-
CO5	2	1	2	1	1	1	1	1	1	1	-
Avg.	**2**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**-**

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:
Data Structures, Computer Graphics, Design and Analysis of Algorithms, Problem Solving & Design.

Job Mapping:
Job opportunities that one can get after learning this course:

1. Embedded Software Developer (Trainee/Junior)
Writing firmware for micro controllers.
Industries: Consumer electronics, IoT, Automotive.

2. System Programmer (Junior)
OS-level programming, device drivers, utilities.
Industries: Operating Systems, Compilers, Networking.

3. Application Support Engineer
Debugging and maintaining legacy C applications.
Industries: Banking, Telecom, Government systems.

Program:	**F. Y. B. Tech (A&R)**			**Semester:**		**II**	
Course:	**Digital Technology Lab**			**Course Code:**		**R25-AR-VSEC-115**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
--	2	--	1	--	--	--	50

Course Description:

This course offers practical experience in essential digital technologies related to automation and robotics. Students engage in simulations, hardware interfacing, programming, and prototyping through hands-on experiments.

Course Relevance: The competencies acquired are directly applicable to establishing foundational expertise in automation, thereby equipping students for advanced studies in robotics, embedded systems, and artificial intelligence applications in the subsequent semesters.

Prerequisite:

Basic knowledge of Physics, simple mathematics, and fundamentals of computer usage.

Bridge Content:

1. Introduction to basic electronics and microcontroller concepts.
2. Overview of coordinate systems and simple robot movement principles.
3. Familiarization with simulation tools (GeoGebra, MATLAB, Python) and basic safety protocols in robotics labs.

Course Objectives:

1. **DEVELOP** proficiency in designing and simulating robotic-arm movements utilizing software tools.
2. **ACQUIRE** hands-on experience in operating robotic interfaces and hardware for various applications.
3. **COMPREHEND** and **IMPLEMENT** electronic circuits for robotic systems using microcontrollers.
4. Programming techniques are applied to **CONTROL** and **SIMULATE** robotic systems.
5. **INVESTIGATE** advanced robotic platforms while adhering to safety protocols.
6. Functional prototypes are **FABRICATED** using 3D printing and everyday materials.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**DESIGN** and **SIMULATE** robotic arm movements using basic simulators, demonstrating geometric and kinematic principles.	3
CO2	**OPERATE** robotic systems like Rotorix and ABB IRB 1410 for tasks such as printing and industrial applications, adhering to safety protocols.	3
CO3	**BUILD** and **PROGRAM** Arduino-based circuits and robots, including LED blinking and light/line-following robots, integrating hardware and software	3
CO4	**IMPLEMENT** and **VERIFY** digital logic circuits, such as flip-flops, using breadboards and logic trainers	3
CO5	**DEVELOP** robotic applications using MATLAB and **PROGRAM** humanoid robots (UBTECH Yanshee/AiNex) for advanced control tasks	3
CO6	**FABRICATE** functional automation prototypes using 3D printing and everyday materials like cardboard and syringes, showcasing creativity and prototyping skills	6

List of Practical: (Any ten out of twelve)

Experiment No.1	**Basic frame transformations using RoboAnalyzer**	**2 Hrs.**	**CO1**

Objective:

To understand basic frame by visualizing and computing them using RoboAnalyzer

Associated Tasks:

1. Input DH Parameters in HTM Module
2. Visualize Local and Global Frames
3. Compute HTMs Using HTM Module
4. Analyze difference between Local vs. Global Frame transformation

Exemplars and Utility:

1. Provide clear examples to contrast local and global frame transformations, using HTM
2. Interpret HTM components (rotation and translation) to understand frame differences.

Experiment No.2	**3D Printing of mechanical component using RotricsDexArm**	**2 Hrs.**	**CO2,CO4**

Objective:

Learn 3D Printing technology used for bringing ideas into reality in the form of products.

Associated Tasks:

1. Calibrate the Rotorix arm.
2. Import .dxf file of requisite geometric shapes.
3. Generate G-code and print job.

Exemplars and Utility:

1. Building prototype components before actual manufacturing.
2. Develops skills in additive manufacturing use for component manufacturing.

Experiment No.3	**Robotic Laser Engraving on Wooden Pallet**	**2 Hrs.**	**CO2**

Objective:

To integrate robotic control with laser engraving technology.

Associated Tasks:

1. Configure laser settings.
2. Program engraving paths.
3. Ensure safe operation.

Exemplars and Utility:

1. Branding furniture or gift boxes in small woodworking shops.
2. Demonstrates automated customization and traceability in production.

Experiment No.4	**LED Blinking and Timer-based Circuit using Arduino**	**2 Hrs.**	**CO3**

Objective:

To implement timing-based control circuits for robotic indicators.

Associated Tasks:

1. Connect LED and timer via Arduino.
2. Write loop code for blinking intervals.
3. Test timing accuracy.

Exemplars and Utility:

1. Status indicator lights on robotic arms in factories.
2. Teaches basic Arduino I/O control for machine status monitoring.

Experiment No.5	**Building a Light-following or Line-following Robot using Arduino**	**2 Hrs.**	**CO4**
Objective: To design autonomous robots for path navigation. **Associated Tasks:** Install IR sensors. Program following algorithms. Test on different paths. **Exemplars and Utility:** Line-following robots in warehouse inventory transport. Provides foundation for autonomous guided vehicle (AGV) systems.			
Experiment No.6	**Flip-Flop Circuit Implementation & Truth Table Verification**	**2 Hrs.**	**CO3**
Objective: To design basic sequential logic circuits for robotic control. **Associated Tasks:** Assemble flip-flop circuit. Verify operation against truth table. Test toggling control with pushbuttons. **Exemplars and Utility:** Gripper open/close control in packaging systems. Builds understanding of digital control logic for automation.			
Experiment No.7	**Robotics Application using MATLAB**	**2 Hrs.**	**CO1,CO4**
Objective: To simulate robotic motions and trajectories in MATLAB. **Associated Tasks:** Model arm kinematics. Define motion paths. Plot and analyze trajectories. **Exemplars and Utility:** Component sorting in small electronics workshops. Enhances computational skills for robot motion planning.			
Experiment No.8	**Simulation of Robotic Arm Movement in 2D Space using Python**	**2 Hrs.**	**CO2,CO4**
Objective: To apply Python programming for robotic motion simulation. **Associated Tasks:** Write motion simulation script. Visualize arm trajectory. Optimize movement path. **Exemplars and Utility:** Tool-picking automation in local machine shops. Strengthens coding skills for simulation and path optimization.			

Experiment No.9	**Hands-on Programming with Humanoid Robot (UBTECH Yanshee/AINex)**	**2 Hrs.**	**CO2,CO4**

Objective:
To program humanoid robots for interactive tasks.
Associated Tasks:
1. Load movement scripts.
2. Sync gestures with speech.
3. Test interaction flow.

Exemplars and Utility:
1. Customer greeting robots in retail spaces.
2. Demonstrates human-robot interaction applications in service robotics.

Experiment No.10	**Familiarization with ABB Industrial Robotic Arm & Safety Procedures**	**2 Hrs.**	**CO5**

Objective:
To operate industrial robotic arms while adhering to safety protocols.
Associated Tasks:
1. Power up and calibrate ABB IRB 1410.
2. Explore movement modes (Joint, Linear, Reorient).
3. Learn emergency stop procedures.

Exemplars and Utility:
1. Circuit board assembly using ABB arms.
2. Prepares students for safe and efficient industrial robot operations.

Experiment No.11	**Fabrication of Functional Prototype using 3D Printing for Automation Application**	**2 Hrs.**	**CO6**

Objective:
To design and produce custom robotic attachments.
Associated Tasks:
1. Model part in CAD software.
2. Configure 3D printer.
3. Assemble with robot.

Exemplars and Utility:
1. Sensor holders in sorting robots.
2. Introduces rapid prototyping for robotic customization.

Experiment No.12	**Constructing a Basic Robotic Arm Using Everyday Materials**	**2 Hrs.**	**CO6**

Objective:
To demonstrate mechanical design principles using low-cost materials.
Associated Tasks:
1. Build structure from cardboard and syringes.
2. Create pneumatic or manual actuation.
3. Test movement with light objects.

Exemplars and Utility:
1. Educational robot models in schools.
2. Encourages creativity and mechanical problem-solving with minimal resources.

Course Projects:

1. **Line-Following Delivery Robot**

- **Description:** Design and build an Arduino-based robot that follows a designated path (black tape on white surface) to deliver small payloads between two points.
- **Skills Covered:** Arduino programming, sensor integration, motor control, path optimization.
- **Real-World Link:** Similar to robots used in small warehouses for moving items between storage areas.

2. **Robotic Arm Simulation & 3D-Printed End-Effector**

- **Description:** Simulate a 2D robotic arm in MATLAB or Python for pick-and-place tasks, then 3D print a custom gripper or holder designed for a specific object.
- **Skills Covered:** Kinematic simulation, CAD design, 3D printing, motion planning.
- **Real-World Link:** Used in manufacturing to develop custom tooling for robotic manipulators.

3. **Interactive Humanoid Robot Greeter**

- **Description:** Program a humanoid robot (UBTECH Yanshee/AiNex) to greet users, provide simple instructions, and respond to voice commands.
- **Skills Covered:** Humanoid robot programming, HRI (Human-Robot Interaction), embedded control.
- **Real-World Link:** Mimics customer service robots deployed in retail or reception areas.

Textbooks:

7. M. P. Groover. (2015). Automation, Production Systems, and Computer-Integrated Manufacturing (4th ed.). Pearson. ISBN: 978-9332572492
8. S. B. Niku. (2020). Introduction to Robotics: Analysis, Control, Applications (3rd ed.). Wiley. ISBN: 978-1-119-52760-2
9. S. R. Deb & S. Deb. (2017). Robotics Technology and Flexible Automation(2nd ed.). Tata McGraw-Hill Education. ISBN: 978-0070077911
10. S. K. Saha. (2024). Introduction to Robotics, (3rd ed.). McGraw Hill Education (India) Pvt. Ltd.ISBN:978-9355326461
11. John J. Craig. (2022). Introduction to Robotics Mechanics and Control, (4th ed.) Pearson.ISBN:978-9356062191
12. Malvino, A. P., & Leach, D. P. (2014). Digital Principles and Applications, (8th ed.) McGraw-Hill Education.978-9339203405
13. Monk, S. (2023). Programming Arduino: Getting Started with Sketches, (3rd ed.). McGraw-Hill Education. ISBN: 9781264676989

Reference Books:

3. Y. Koren. (1985). Robotics for Engineers. McGraw-Hill. ISBN: 978-0070353992
4. Robert J. Schilling. (2015), Fundamentals of Robotics Analysis and Control, Pearson, ISBN: 9789332555235
5. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2020). Robot Modeling and Control. (2nd ed.). Wiley. ISBN: 978-1-119-52404-5
6. Bolton, W. (2010). Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, (4th ed.) Pearson.ISBN:978-8131732533

MOOCs Links and additional reading material:

1. Introduction to Robotics – Coursera (University of Pennsylvania) https://www.coursera.org/learn/robotics
2. Control of Mobile Robots – Coursera (Georgia Institute of Technology)

https://www.coursera.org/learn/mobile-robot

3. Arduino Platform and C Programming – Coursera (University of California, Irvine) https://www.coursera.org/learn/arduino-platform
4. Robotics: Kinematics and Mathematical Foundations – edX (IIT Bombay) https://onlinecourses.nptel.ac.in/noc24_me140
5. 3D Printing and Additive Manufacturing – Coursera (University of Illinois) https://www.coursera.org/learn/3d-printing
6. Digital Systems: From Logic Gates to Processors – edX (MITx) https://online-learning.mit.edu/course-catalog
7. Arduino Official Tutorials: https://www.arduino.cc/en/Tutorial/HomePage
8. GeoGebra Robotics Simulations: https://www.geogebra.org/
9. Tinkercad Circuits & 3D Design: https://www.tinkercad.com/
10. MATLAB Robotics Toolbox Documentation: https://www.mathworks.com/help/robotics/
11. UBTECH Robotics Platform: https://www.ubtrobot.com/
12. ABB RoboAnalyzer (Simulation Software): http://www.roboanalyzer.com/
13. Raspberry Pi + Python Robotics Guides: https://projects.raspberrypi.org/
14. IEEE Robotics and Automation Society Resources: https://www.ieee-ras.org/

Strength of CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	1	1	1	1	2	1	3	2	2
CO2	2	2	3	2	3	3	2	2	2	3	2	3	3	2
CO3	3	3	3	3	3	1	1	1	1	2	1	3	3	3
CO4	3	3	3	2	3	1	1	1	1	2	1	3	2	3
CO5	3	3	3	3	3	1	1	1	1	2	1	3	3	3
CO6	3	3	3	3	3	2	2	2	2	3	2	3	3	3
Avg.	3	3	3	3	3	2	1	1	1	2	1	3	3	3

Note - 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:

1. Builds foundation for Control Systems, Mechatronics, Embedded Systems, Robotics Kinematics & Dynamics, Industrial Automation, and AI in Robotics.
2. Skills directly link to advanced labs in Robot Programming, Machine Vision, and 3D Printing Applications.

Job Mapping: Job opportunities that one can get after learning this course:

1. Robotics Analyst / Programmer
2. Automation Engineer / PLC Programmer
3. Embedded Systems Developer
4. CAD/3D Printing Designer for Robotics
5. Field Service Engineer (Automation & Robotics)
6. AI/ML Developer in Automation Applications

Program:	**F. Y. B. Tech (Computer)**			**Semester:**		**II**	
Course:	**Digital Technology Lab**			**Course Code:**		**R25-CO-VSEC-115**	
Teaching Scheme(Hrs./week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	2	-	1	-	-	50	-

Course Description:

Digital Technology Lab provides hands-on experience in basic computing, networking, operating systems, hardware, and cloud tools. It introduces first-year engineering students to essential digital concepts and practical skills through interactive lab sessions.

Course Relevance:

This course builds the foundational digital competencies required for advanced engineering studies and real-world technical applications. It helps students understand core technologies, boosts their problem-solving skills, and prepares them for future technical courses and industry environments.

Prerequisite: Basic Computer Literacy

Bridge Content: -

Course Objectives:

1. To **INTRODUCE** students to basic installation and configuration of operating systems and software tools.
2. To **DEVELOP** hands-on skills in assembling computer hardware and identifying components.
3. To **ENABLE** students to understand and apply basic networking concepts and commands.
4. To **FAMILIARIZE** students with the use of virtual machines, cloud storage, and antivirus tools.
5. To **ENHANCE** students' ability to use digital tools like Google Forms and Excel for data handling and documentation.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**DESCRIBE** the process of installing and configuring various operating systems and software tools.	1
CO2	**EXPLAIN** the function and connectivity of computer hardware components and peripherals.	2
CO3	**DEMONSTRATE** the ability to configure basic networking settings and use network diagnostic commands.	3
CO4	**INSTALL AND CONFIGURE** cloud storage services, virtual machines, and system security tools.	3
CO5	**CREATE AND MANAGE** digital documents, forms, and data using productivity tools like Google Forms and Excel.	6

List of Experiments (Perform any 8 experiments):

Experiment No.1	**Installation and Configuration of Windows Operating System**	**2 Hrs**	**CO1**

Objective:

To perform installation and basic configuration of the Windows operating system.

Associated Tasks:

1. Creating a bootable USB drive using tools like Rufus.
2. Booting the system from the USB drive.
3. Installing Windows and configuring regional settings.

Exemplars and Utility:

1. Installing Windows 11 on PC.

2. Builds confidence in handling OS-level issues independently

Experiment No.2	**Installation and Setup of Open-Source Operating Systems (Ubuntu/Fedora/Red Hat)**	**2 Hrs.**	**CO1**

Objective:
To install and set up open-source operating systems like Ubuntu, Fedora, or Red Hat on a PC.
Associated Tasks:
1. Create a bootable USB drive with the selected Linux distribution.
2. Install the OS and configure basic system settings (user, time zone, updates).
Exemplars and Utility:
1. Installing Ubuntu alongside Windows for a dual-boot setup.
2. Setting up Fedora.

Experiment No.3	**Computer Security Essentials: Installation and Usage of Free Antivirus Software**	**2 Hrs.**	**CO4**

Objective:
To install and use free antivirus software for protecting a computer system from security threats.
Associated Tasks:
1. Download and install a trusted free antivirus program (e.g., Avast, AVG).
2. Perform system scans and update virus definitions
Exemplars and Utility:
1. Installing antivirus software on a newly set up Windows PC.
2. Running a full system scan to detect and remove malware.

Experiment No.4	**PC Assembly and Hardware Component Identification with Functional Overview**	**2 Hrs.**	**CO2**

Objective:
To identify, assemble, and understand the function of key computer hardware components.
Associated Tasks:
1. Identify and explain the purpose of components like CPU, RAM, motherboard, and power supply.
2. Assemble the components to build a working desktop PC.
Exemplars and Utility:
1. Assembling a desktop system for lab or personal use.
2. Replacing or upgrading components like RAM or hard drive.

Experiment No.5	**Networking Fundamentals: Exploring IP/MAC Addresses and Basic Network Commands**	**2 Hrs.**	**CO3**

Objective:
To understand IP and MAC addresses and use basic network commands for connectivity testing. **Associated Tasks:**
1. Identify IP and MAC addresses using commands like ipconfig or ifconfig.
2. Use ping and traceroute to test and trace network connections.
Exemplars and Utility:
1. Diagnosing network issues using ping and traceroute.
2. Builds foundational skills in network troubleshooting.

Experiment No.6	**LAN Cable Preparation: Demonstration of RJ-45 Connector Crimping Process**	**2 Hrs.**	**CO3**

Objective:
To demonstrate the crimping process for preparing LAN cables using RJ-45 connectors.

Associated Tasks:

1. Arrange cable wires as per T568A or T568B standards.
2. Use ping and traceroute to test and trace network connections.
3. Crimp the RJ-45 connector using a crimping tool and test connectivity.

Exemplars and Utility:

1. Creating a custom Ethernet cable for a lab network setup.
2. Repairing a damaged LAN cable by re-crimping connectors.

Experiment No.7	**Installation and Configuration of MySQL Server for Database Connectivity**	**2 Hrs.**	**CO4**

Objective:

To install and configure MySQL Server for enabling database creation and connectivity.

Associated Tasks:

1. Download and install MySQL Server and Workbench.
2. Configure root user, create a sample database, and test connectivity.

Exemplars and Utility:

1. Setting up MySQL for a student record management project.
2. Builds foundational skills in database setup and management.

Experiment No.8	**Virtualization Setup: Creating and Configuring Virtual Machines using VirtualBox/VMware**	**2 Hrs.**	**CO4**

Objective:

To create and configure virtual machines using VirtualBox or VMware for simulating multiple operating systems.

Associated Tasks:

1. Install VirtualBox/VMware and set up a new virtual machine.
2. Configure OS installation, memory, and storage settings within the VM.

Exemplars and Utility:

1. Running Ubuntu on a Windows PC using VirtualBox.
2. Creating a testing environment for software without affecting the host OS.

Experiment No.9	**Cloud Storage Integration: Installation and Configuration of Dropbox Service**	**2 Hrs.**	**CO4**

Objective:

To install and configure Dropbox for cloud-based file storage, access, and synchronization.

Associated Tasks:

1. Download, install, and sign in to the Dropbox desktop application.
2. Upload, sync, and share files between devices using Dropbox.

Exemplars and Utility:

1. Backing up project files from a local PC to Dropbox.
2. Sharing lab reports or documents with team members via cloud.

Experiment No.10	**Peripheral Device Setup: Installation and Configuration of Printers, Scanners, and Related Hardware**	**2 Hrs.**	**CO2**

Objective:

To install and configure hardware peripherals like printers and scanners for effective system integration.

Associated Tasks:

1. Connect and install drivers for printers or scanners on a computer.
2. Configure device settings and perform test operations (print/scan).

Exemplars and Utility:

1. Develops practical skills in handling essential peripheral devices.
2. Setting up a wireless printer in a computer lab

Experiment No.11	**Digital Branding Assignment**	**2 Hrs.**	**CO5**

Objective:

To build a strong personal digital identity by creating and managing an online presence across platforms (LinkedIn, portfolio, etc.).

Associated Tasks:

1. Create/upscale LinkedIn profile, design a personal logo, write a bio/vision statement.
2. Integrate all into a professional portfolio or blog.

Exemplars and Utility:

1. Enhances visibility and credibility in academic and professional circles.

2. Supports networking, career opportunities, and personal branding.

Experiment No.12	Build a Personal Portfolio Website	2 Hrs.	CO5

Objective:

To design and develop a **personal portfolio website** that showcases a student's skills, experiences, and achievements through structured sections including a **resume**, **blog**, and **project portfolio**.

Associated Tasks:

1. Design and develop a responsive portfolio with sections for resume, blog, and projects. Add navigation, contact info.
2. Deploy it online.

Exemplars and Utility:

1. Design and develop a responsive portfolio with sections for resume, blog, and projects.
2. Add navigation, contact info, and deploy it online.

Strength of CO-PO-PSO Mapping

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	-	-	2	-	-	-	-	-	-	2	3	3	2
CO2	3	2	-	-	-	-	-	-	-	-	-	2	3	2	2
CO3	2	3	2	-	3	-	-	-	-	-	-	2	2	3	2
CO4	2	3	2	-	3	-	-	-	-	-	-	2	2	3	2
CO5	2	2	2	-	3	-	-	-	-	-	-	2	-	2	3
Avg.	**2**	**2**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**3**	**3**	**2**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Job Mapping:

Job opportunities that one can get after learning this course:

IT Support Technician / Helpdesk Support, System Administrator (Junior Level), Hardware Technician, Data Entry & Document Management Executive.

Program:	**F. Y. B. Tech (Electrical)**			**Semester:**		**II**	
Course:	**Digital Technology Lab**			**Course Code:**		**R25-EE-VSE-115**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	1	-	-	50	-

Course Description:

This course introduces first-year engineering students to fundamental concepts and practical skills in electrical engineering. It covers basic wiring systems, domestic earthing, and safety practices, along with control of induction motors using various starters. Students learn repair and maintenance of household electrical appliances and gain exposure to smart net metering in renewable energy systems. The course also introduces MATLAB/Simulink for basic calculations, circuit simulations, solving ODEs, and analyzing electrical signals, including RMS values of waveforms.

Course Relevance:

The course equips students with essential practical and analytical skills required in electrical engineering. It emphasizes safe electrical installations, motor control, and appliance maintenance while familiarizing students with modern renewable energy systems. The MATLAB component strengthens problem-solving and simulation abilities, bridging theory with real-world applications in circuit analysis, signal processing, and electrical system modeling.

Prerequisite:

Basic knowledge of Physics, Familiarity with fundamental Mathematics, Basic computer literacy

Bridge Content:

Revision of basic concepts of current, voltage, resistance, and power, Introduction to series and parallel circuits with simple numerical examples, Basic idea of AC vs. DC supply. Recap of safety precautions while handling electrical equipment, Introduction to basic computer usage and MATLAB environment for simple calculations and plots.

Course Objectives:

1. **UNDERSTAND** basic electrical wiring, earthing, and safety practices.
2. **UNDERSTAND** the operation and control of induction motors using different starters.
3. **APPLY** repair and maintenance techniques for domestic electrical appliances.
4. **UNDERSTAND** the concept and benefits of smart net metering.
5. **APPLY** MATLAB for basic circuit simulation, ODE solving, and signal analysis.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**APPLY** knowledge to design and implement basic electrical wiring systems safely.	**3**
CO2	**APPLY** techniques to operate and test induction motors using different starters	**3**
CO3	**EXPLAIN** how various domestic electrical appliances function and the causes of common faults.	**3**
CO4	**DESCRIBE** how smart net metering works and its advantages for efficient energy management.	**3**
CO5	**USE** MATLAB/Simulink to perform basic circuit simulations, solve ODEs, and analyze electrical signals	**2**

List of Practical:			
Experiment No. 1	**Wiring scheme for 1. Domestic wiring, 2. Stair case wiring, 3. Godown wiring.**	**2Hrs**	**CO1**

Objective:
To understand, design, and implement basic electrical wiring schemes (domestic, staircase, and godown) using proper connections, safety measures, and practical applications in real-life situations.

Associated Tasks:

1. Draw neat circuit and wiring diagrams for domestic, staircase, and godown wiring.
2. Identify and select electrical components (switches, lamps, fuse, MCB, sockets, etc.).
3. Perform wiring connections on a training board or lab setup.
4. Test and verify correct operation of each wiring scheme using tester/multimeter.
5. Observe safety precautions during wiring work.

Exemplars and Utility:

1. Used in every household for daily needs and safe electricity usage.

Experiment No. 2	**Demonstration of domestic earthing.**	**2Hrs**	**CO1**

Objective:
To understand the necessity, construction, and working of domestic earthing, and to demonstrate how earthing provides safety by preventing electric shock and protecting appliances.

Associated Tasks:

1. Study the need and principle of earthing.
2. Identify the materials used (earth electrode, GI/copper plate, charcoal, salt, earthing wire).
3. Draw the schematic diagram of a plate or pipe earthing system.
4. Demonstrate the earthing setup on a model/training kit or observe a real installation.
5. Measure earth resistance using an earth tester.
6. Record observations and relate to safety standards (IS codes)

Exemplars and Utility:

1. Demonstration of earthing connection in an actual building.
2. Ensures safety of human life by avoiding electric shock.
3. Protects household and industrial appliances from damage due to leakage current or lightning

Experiment No. 3	**Study of Starters**	**2Hrs**	**CO1**

Objective:
To study and demonstrate the control of induction motors using different types of starters (Direct-On-Line, Star-Delta, Auto-transformer, etc.) and understand their role in safe starting and protection of motors.

Associated Tasks:

1. Identify the need for starters in motor control (high starting current problem).
2. Study the working principle of common starters (DOL, Star-Delta, Auto-transformer, Resistance starter).
3. Draw neat wiring/circuit diagrams for each type of starter.
4. Connect a motor to different starters in the laboratory under supervision.
5. Operate and observe the motor starting characteristics (current drawn, speed rise).
6. Record observations and compare performance between different starters.
7. Relate the application of each starter to industry use-cases.

Exemplars and Utility:

1. Widely used in industries, pumps, elevators, and conveyors

Experiment No. 4	Repairing and maintenance of domestic electrical home appliances.	**2Hrs**	**CO3**

Objective:

To learn the basic principles, common faults, and repair/maintenance procedures of domestic electrical appliances.

Associated Tasks:

1. Identify different home appliances and their working principles.
2. Study the internal parts and wiring of selected appliances.
3. Learn the use of basic tools (screwdriver, plier, tester, multimeter, soldering iron).
4. Diagnose common faults such as loose connections, blown fuse, damaged wire, or heating element failure.
5. Carry out minor repairs (e.g., rewiring, fuse replacement, cleaning, and lubrication of fan bearings).
6. Test the repaired appliance for safe and proper working.
7. Record safety precautions and preventive maintenance tips

Exemplars and Utility:

1. Reduces cost of maintenance and dependency on technicians

Experiment No. 5	**Learn Smart Net metering.**	**2Hrs**	**CO4**

Objective:

To understand the concept, working, and benefits of smart net metering in renewable energy systems, and to learn how it enables two-way power flow between consumers and the utility grid.

Associated Tasks:

1. Study the principle of net metering and its role in grid-connected solar PV systems.
2. Identify key components: smart meter, solar panel, inverter, utility grid.
3. Draw the block diagram showing power flow (consumer ↔ grid).
4. Demonstrate data monitoring on a smart energy meter or simulator.
5. Record sample readings of energy consumption vs. energy export.
6. Discuss safety, regulatory guidelines, and energy-saving benefits.

Exemplars and Utility:

1. Demonstration using a smart energy meter connected to a solar PV trainer kit
2. Helps consumers reduce electricity bills by exporting surplus solar power.

Experiment No. 6	**Learn MATLAB software used in Electrical engineering**	**2Hrs**	**CO5**

Objective:

To introduce MATLAB software as a computational and simulation tool, enabling students to perform basic calculations, plotting, and simple circuit/system analysis in electrical engineering.

Associated Tasks:

1. Learn the MATLAB interface, command window, and script editor.
2. Perform basic arithmetic and matrix operations.
3. Write simple scripts for solving electrical equations (Ohm's law, KVL, KCL).
4. Plot graphs of voltage, current, and power vs. time using MATLAB plotting functions.
5. Simulate basic electrical circuits using **Simulink** (resistive circuit, RC/RL response).
6. Save, run, and debug MATLAB programs.
7. Document results and interpret outputs for engineering problems.

Exemplars and Utility:

1. Provides a strong foundation for advanced subjects like power systems, machines, and control engineering.

Experiment No. 7	**Solution of ordinary differential equation using MATLAB.**	**2Hrs**	**CO5**

Objective:

To learn how to solve ordinary differential equations (ODEs) using MATLAB programming and built-in functions, and to apply it to basic electrical engineering problems such as RLC circuits and system responses.

Associated Tasks:

1. Recall the form of a first-order and second-order ODE (e.g., RC charging, RLC oscillations).
2. Learn MATLAB functions for ODE solving (ode45, ode23, etc.).
3. Write a MATLAB function file to represent the given ODE.
4. Use the solver to compute the solution over a defined time interval.
5. Plot the solution (e.g., voltage across capacitor vs. time).
6. Verify results with analytical (manual) solution if possible.
7. Interpret physical meaning of results (charging curve, transient response).

Exemplars and Utility:

1. Helps analyze dynamic behavior of electrical systems (transients in circuits, machine dynamics, and control systems).

Experiment No. 8	Perform arithmetical operation of electrical signals	**2Hrs**	**CO5**

Objective:

To understand and perform basic arithmetical operations (addition, subtraction, multiplication, and scaling) on electrical signals using experimental setups or MATLAB/Simulink, and analyze their results

Associated Tasks:

1. Study the nature of input signals (sinusoidal, square, triangular, etc.).
2. Generate electrical signals using function generator / MATLAB.
3. Perform addition and subtraction of signals using an op-amp adder/subtractor circuit or MATLAB.
4. Perform multiplication (AM modulation demo or multiplier IC) and **scaling** (amplification/attenuation).
5. Observe the resultant signals on CRO/oscilloscope or plot in MATLAB.
6. Compare the output waveforms with theoretical expectations.
7. Record observations and note practical applications.

Exemplars and Utility:

1. Addition of two sine waves of different frequencies to form a composite signal.

Experiment No. 9	Calculation of RMS value of waveform by simulation model.	**2Hrs**	**CO5**

Objective:

To understand and calculate the Root Mean Square (RMS) value of electrical waveforms (sinusoidal, square, triangular) using a simulation model in MATLAB/Simulink or equivalent software.

Associated Tasks:

1. Recall the formula of RMS value:
2. Generate different waveforms (sine) using a function block in the simulation software.
3. Build a simulation model that squares the signal, averages it over one cycle, and takes the square root.
4. Use RMS measurement blocks/tools (e.g., Simulink RMS block).
5. Compare the simulated RMS values with theoretical values
6. Record simulation results in tabular form.
7. Interpret the importance of RMS value in power calculations.

Exemplars and Utility:

1. Essential for AC circuit analysis

Experiment No. 10	Application of 12-0-12 volt center tapped step down transformer.	**2Hrs**	**CO2**

Objective:

To study the working and applications of a 12-0-12 V center-tapped step-down transformer and demonstrate its role in AC to DC power supply circuits

Associated Tasks:

1. Identify all loops and junctions in a given electrical circuit.
2. Draw the construction and circuit symbol of a center-tapped transformer.
3. Connect the transformer with AC mains (under safe conditions).
4. Measure the secondary voltages: 12 V–0 V and 12 V–12 V using a multimeter.
5. Demonstrate its application in a full-wave rectifier circuit.
6. Observe and record the rectified output waveform using a CRO/oscilloscope.
7. Discuss its role in regulated DC power supply design

Exemplars and Utility:

1. Used in regulated DC power supplies for electronic devices.

Strength of CO-PO-PSO Mapping

CO	P01	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	3		2	2	3		2	-	-	3	2	-
CO2	3	3	2	2	3	2		2	2	-	-	3	-	-
CO3	2	2	-	-	2	3	3	-	2	-	2	2	-	-
CO4	2	2	2	-	3	3	-	-	2	-	3	-	3	-
CO5	3	2	2	3	3	-	-	-	2	2	3	3	2	3
Avg.	2.6	2.2	2.2	2.5	2.6	2.5	3	2	2	2	2.6	2.75	2.3	3

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Unit wise Weightage: This course serves as a prerequisite for / maps with the following future courses: Electrical Machines, Power Systems, Power Electronics & Drives, Renewable Energy Systems, Electric Vehicle Technology, Control Systems, and Simulation Tools in Electrical Engineering.

Job Mapping:

Electrical Technician / Wiring Supervisor, Maintenance Engineer, Junior Design/Simulation Engineer.

Program:	**F. Y. B. Tech (IT)**			**Semester:**		**II**	
Course:	**Digital Technology Lab**			**Course Code:**		**R25-IT-VSE-115**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	**02**	**-**	**01**	**-**	**-**	**50**	**-**

Course Description

The Digital Technology Lab provides engineering students with practical exposure to fundamental and emerging areas of digital technologies. The course covers hands-on activities related to computer hardware assembly, networking, operating systems, cloud storage, data analysis, Internet of Things (IoT), virtualization, version control using Git and GitHub, and the application of artificial intelligence tools. It enables students to understand the functioning and integration of various hardware and software components while developing essential technical and analytical skills required for modern digital systems.

Course Relevance:

This course is highly relevant to engineering education as it bridges theoretical knowledge with real-world applications of digital systems. It equips students with multidisciplinary competencies that are essential for careers in information technology, computer engineering, and electronics. By working with contemporary tools and technologies, students develop problem-solving abilities, technical adaptability, and innovation skills aligned with industry 4.0 requirements. The lab serves as a foundation for advanced courses in computer networks, data analytics, IoT, and AI, thereby enhancing employability and professional readiness in the engineering domain.

Prerequisite:

Fundamental knowledge and basics of computer.

Bridge Content

Computer System Components Overview- Recap on hardware components and their functions

Course Objectives:

1. **UNDERSTAND** computer hardware and peripherals with hands-on system assembly and troubleshooting.
2. **LEARN** basic networking concepts, components, configurations, and data communication.
3. **EXPLORE** IoT sensors, OS fundamentals, and virtualization techniques.
4. **GAIN** practical skills in Google Drive, mobile app, Git, GitHub for cloud storage and version control.
5. **PERFORM** data analysis in Excel and apply basic AI tools for content generation.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**IDENTIFY** the functionality and integration of essential computer hardware components and peripheral devices	**2**
CO2	**UNDERSTAND** networking components and network configurations, protocols, and data transmission mechanisms.	**2**
CO3	**IDENTIFY** IoT sensors and **UNDERSTAND** key operating system components along with virtualization techniques	**2**
CO4	**APPLY** basic development tools to build a mobile app and Git, GitHub Repository	**3**
CO5	**DEMONSTRATE** Data analysis using Microsoft Excel, AI Tools and AI Generation	**3**

List of Practical:

Experiment No.1	**Assembling Computer System by identifying and assembling components**	**2 Hrs.**	**CO1**

Objective: To enable students to identify, select, and assemble essential computer hardware components to build a fully functional personal computer system.

Associated Tasks:

1. Students will be provided with various hardware components such as the CPU, RAM, motherboard, power supply, storage devices, and cooling systems.
2. They must correctly identify each component, explain its function, and assemble a fully functional computer.
3. The assembled system will be tested for successful boot-up and basic functionality.

Exemplars and Utility:

1. Identify and describe the functions of CPU, RAM, motherboard, SMPS, HDD/SSD, GPU, etc.
2. Mount the motherboard in the cabinet and connect the power supply.

Experiment No.2	**Installing, Configuring & Demonstrating Functionality of Peripheral Devices**	**2 Hrs**	**CO1**

Objective: To enable students to install, configure, and demonstrate the working of various peripheral devices such as input, output, and storage devices used in a computer system.

Associated Tasks:

1. Students will install, configure peripheral devices: monitors, keyboards, webcam/digital Camera, printers, scanner, speaker, projectors.
2. Students will install and configure external storage devices: Disk Drives, Pen Drives and Memory Cards.
3. They must troubleshoot common connection issues like display resolution issues, install necessary drivers, and verify device functionality using appropriate software tools.

Exemplars and Utility:

1. Install and test printers (inkjet/laser), monitors, speakers, and projectors.
2. Power on the system, listen for POST beeps, and troubleshoot basic errors.

Experiment No.3	**Setting Up a Local Area Network (LAN)**	**2 Hrs.**	**CO2**

Objective: To enable students to design, configure, and implement a **Local Area Network (LAN)** by connecting multiple devices using appropriate hardware, IP addressing, and testing connectivity, thereby demonstrating basic networking concepts and practical skills.

Associated Tasks:

1. Students will set up a basic LAN using Twisted Pair cables and switches.
2. Students will Learn Crimping Process required for LAN Setup
3. Test the LAN using LAN Tester
4. They must configure IP addresses, subnet masks for LAN setup.
5. Test network connectivity using ping and tracert(trace route) commands

Exemplars and Utility:

1. Identify the number of systems, select topology (star, bus), and list required devices (switch, router, cables).
2. Create and test straight-through and crossover Ethernet cables using RJ-45 connectors.

Experiment No.4	**Understanding Network Protocols and Packet Transmission**	**2 Hrs**	**CO2**

Objective: To enable students to understand the structure, function, and behavior of various **network**

protocols and to analyze **packet transmission** processes across layers in a network, including encapsulation, addressing, and routing.

Associated Tasks:

1. Students will use a network analyzer (e.g. Wireshark) to inspect data packet transmission between devices.
2. Fundamentals of TCP/IP(Transmission Control Protocol/Internet Protocol) to data is transmission
3. The lab will involve troubleshooting basic network issues in data transmission

Exemplars and Utility:

1. Use Cisco Packet Tracer to simulate client-server communication (e.g., web browsing, email).
2. Use ping and tracert/traceroute to observe packet journey, round-trip time, and route hops.

Experiment No.5	**Exploring IoT Sensors and Data Collection**	**2 Hrs**	**CO3**

Objective: To introduce students to the functioning of IoT sensors, their interfacing with microcontrollers, and the process of collecting, transmitting, and analyzing sensor data for real-world applications.

Associated Tasks:

1. Students will work with various IoT sensors such as temperature, humidity, motion, and light sensors.
2. Interfacing of sensors with Arduino or Raspberry Pi to collect real-time data.
3. The lab will involve analyzing sensor outputs, visualizing data

Exemplars and Utility:

1. Study and demonstrate basic IoT sensors such as temperature (DHT11), humidity, motion (PIR), light (LDR), gas, etc.
2. Connect sensors to Arduino/Raspberry Pi and collect readings via code.

Experiment No.6	**Exploring Operating System and Virtualization**	**2 Hrs**	**CO3**

Objective: To familiarize students with the **core functions of an Operating System (OS)** and provide practical exposure to **virtualization technologies**, enabling them to install, configure, and manage multiple virtual machines (VMs) using hypervisors.

Associated Tasks:

1. Students will install and configure an operating system (e.g., Windows, Linux) on a computer machine.
2. They should nevigate OS functions: file system management, process handling, command-line operations.
3. Students will use virtualization software (e.g.VirtualBox, VMware) to configure virtual machines (VMs).
4. Running Windows and Linux on the same physical machine using VMware

Exemplars and Utility:

1. Install VirtualBox, VMware Workstation, or Hyper-V on a host system.
2. Demonstrate how to run multiple VMs and enable networking between them (e.g., NAT, bridged).

Experiment No.7	**Android App Development**	**2 Hrs**	**CO4**

Objective: To introduce students to basic Android app development using a visual or text-based development environment, and to help them design, implement, and test a functional calculator app for basic arithmetic operation

Associated Tasks:

1. **Understanding Android App Components** – Activity, UI Layout, Event Listeners.
2. **Designing User Interface (UI):** Using drag-and-drop components in MIT App Inventor or XML in Android Studio.
3. **Implementing Functionality:** Basic arithmetic logic (Add, Subtract, Multiply, Divide).
4. **Testing the App** – Using emulator or real Android device.

Exemplars and Utility:

1. **Interactive UI Development** – Students learn to build clean and responsive user interfaces.
2. **Logical Thinking** – Students apply basic programming logic in a real-world application.

Experiment No.8	**Demonstrating Git and GitHub Repository**	**2 Hrs**	**CO4**

Objective: To equip students with the knowledge and skills to use Git for version control and manage code repositories on GitHub, enabling collaborative software development and project tracking.

Associated Tasks:

1. Introducing version Control System
2. Git Installation on Windows/Linux • Creating GitHub account and GitHub repository
3. Use example command of GitHub
4. Students should able to manage repositories

Exemplars and Utility:

1. Set up Git on a local machine, configure user credentials, and initialize a new repository (git init)
2. Perform git add, git commit, and git status to track file changes and save versions.

Experiment No.9	**Demonstrating data analysis using Microsoft Excel**	**2 Hrs**	**CO5**

Objective: To enable students to perform **basic to intermediate data analysis** using Microsoft Excel tools such as formulas, functions, charts, PivotTables, and data visualization features, supporting informed decision-making.

Associated Tasks:

1. Apply essential formulas like SUM, AVERAGE, IF, VLOOKUP, COUNTIF, CONCATENATE, etc.
2. Create bar charts, pie charts, line graphs, and combo charts for visual representation of data.
3. Apply Goal Seek, Scenario Manager, and Data Tables for forecasting and decision analysis.

Exemplar & Utility:

Useful for creating sales analysis sheets, student result dashboards, inventory trackers, and financial forecasting models, helping students understand real-world data handling, visualization, and decision making using Excel.

Experiment No.10	**Exploring AI Tools and AI Generation**	**2 Hrs**	**CO5**

Objective: To introduce students to modern AI tools and platforms that enable AI-generated content, and to develop the ability to evaluate and apply these tools for creative, analytical, and productivity tasks.

Associated Tasks:

1. Exploring AI Chatbots – Use of ChatGPT and Gemini
2. Creative Designing with Generative AI Tools: DALL-E
3. Automated Report Writing with AI Tools: like ChatGPT /Notion AI / GrammarlyGO

Exemplars and Utility:

1. Generate code, auto-complete functions, and debug using AI assistance in IDEs.
2. Automate data interpretation and generate charts or forecasts with AI help.

Textbooks:

1. Scott Mueller, Upgrading and Repairing PCs, Pearson Education, 22nd Edition.
2. David Wolber, et al., App Inventor 2: Create Your Own Android Apps, O'Reilly, 2nd Edition.
3. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press (VPT), 2015.

Reference Books:

1. Kurose, Ross, Computer Networking: A Top-Down Approach, Pearson, 8th (2021).
2. Internet of Things: Principles and Paradigms – Rajkumar Buyya & Amir Vahid Dastjerdi
3. Operating Systems: Three Easy Pieces – Remzi H. Arpaci-Dusseau & Andrea C. Arpaci-Dusseau

4. Reema Thareja, Computer Fundamentals and Programming in C, Oxford University Press, 2nd (2017)

MOOCs Links and additional reading material:

NPTEL- Android app using Kotlin - Course
https://onlinecourses.swayam2.ac.in/aic20_sp02/preview
NPTEL- Introduction to Computer and Network Performance Analysis using Queuing Systems - Course
https://onlinecourses.nptel.ac.in/noc25_cs126/preview
Tutorials Point : Output Devices PDF -Output Devices in Computers
https://www.tutorialspoint.com/computer_fundamentals/computer_output_devices.htm

Strength of CO-PO-PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	1	-	2	1	-	1	1	-	2	3	3	2
CO2	3	3	2	2	3	1	-	2	1	-	2	3	3	2
CO3	3	2	2	2	2	2	1	1	1	-	3	3	3	2
CO4	2	2	3	2	3	1	2	3	3	2	3	2	2	3
CO5	2	2	2	3	3	3	3	2	2	2	3	3	3	3
Avg	**2.6**	**2.4**	**2**	**2.25**	**2.6**	**1.6**	**2**	**1.8**	**1.6**	**2**	**2.6**	**2.8**	**2.8**	**2.4**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:
This lab is a direct prerequisite for Computer Networks, Operating Systems, and Internet of Things (IoT). It also provides foundational skills for Data Science, Artificial Intelligence, and Software Engineering courses.

Job Mapping:
Job opportunities that one can get after learning this course:
This course prepares you for entry-level roles like IT Support Specialist, Network Technician, and IoT Trainee Engineer, while building a foundation for careers in Data Analysis, Software Development, and AI Prompt Engineering.

Program:	**F. Y. B. Tech (Mechanical)**			**Semester:**		**II**	
Course:	**Digital Technology Lab**			**Course Code:**		**R25-ME-VSEC-115**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	2	-	1	-	-	50	-

Course Description

This introductory laboratory course is designed for first-year B.Tech Mechanical Engineering students to help them understand the basics of digital manufacturing. The course provides hands-on practice with modern engineering tools and processes such as Solid Modeling, Assembly Design, CNC Programming, 3D Printing, and Digital Manufacturing workflows.

Students will use industry-standard CAD and CAM software to create 3D models of mechanical parts, build assemblies, simulate simple operations, and generate basic CNC codes. They will also fabricate small prototypes using 3D printing.

Course Relevance:

The course highlights key concepts such as geometric reasoning, parametric modeling, toolpath generation, and digital process planning. By linking theory to practice, it builds a strong foundation for higher-level courses in mechanical, manufacturing, and mechatronic engineering, while giving students early exposure to industry-relevant technologies.

Prerequisite:

1. Basic understanding of orthographic projections, isometric representations, and standard dimensioning practices to accurately interpret and create technical drawings.
2. Prior exposure to commonly used machine elements - such as bolts, nuts, shafts, bearings, flanges, and keys is essential for effective modeling, assembly, and functional analysis of mechanical systems.
3. Basic Manufacturing knowledge

Course Objectives:

1. **INTRODUCE** students to Computer-Aided Design (CAD) by creating simple 3D models of mechanical parts and combining them into basic assemblies.
2. **PROVIDE** a basic understanding of CNC (Computer Numerical Control) technology and hands-on practice in writing, editing, and simulating simple CNC programs using standard G-codes and M-codes.
3. **GIVE** students practical experience in 3D printing (Additive Manufacturing) using Fused Deposition Modeling (FDM), including model preparation, slicing, G-code generation, and prototype fabrication.
4. **FAMILIARIZE** students with Digital Manufacturing and Computer-Aided Manufacturing (CAM) tools, highlighting their role in improving accuracy, efficiency, and process planning in modern production systems.

Course Outcomes: After learning the course, students will be able to

CO	**Course Outcome**	**Bloom's Level**
CO1	**CREATE** simple 3D models of mechanical parts and combine them into assemblies using CAD tools.	3
CO2	**WRITE** AND **SIMULATE** basic CNC programs using standard G-codes and M-codes for simple machining operations.	3
CO3	**PREPARE** AND **FABRICATE** small prototypes using FDM-based 3D printing, including model slicing and G-code generation.	3
CO4	**EXPLAIN** AND **DEMONSTRATE** the role of CAM and Digital Manufacturing tools in improving accuracy, efficiency, and process planning.	2

List of Experiments (4 Experiments):

Experiment No.1	**Modelling and Assembly**	**8 Hrs.**	**CO1**

Objective:

To develop the ability to create solid models of basic mechanical components and assemble them using Computer-Aided Design (CAD) tools.

Associated Tasks:

1. 2-D sketching with geometrical and dimensional constraints
2. Solid modeling for simple mechanical components
3. Assembly modeling (Output file as Assembly drawing and detailing) of the parts modeled
4. Using proper assembly constraint conditions and generation of exploded view for assemblies.

Exemplars and Utility:

1. Enhances spatial visualization and geometric reasoning.
2. Builds proficiency in parametric modeling and design intent
3. Prepares students for roles in mechanical design, product development, and manufacturing.
4. Aligns with CAD workflows in tools like SolidWorks, Autodesk Inventor, Creo, and Fusion 360.

Experiment No.2	**Computerized Numerical Control (CNC)**	**8 Hrs.**	**CO2**

Objective:

Students will be able to interpret and generate CNC programs for basic machining tasks, demonstrating proficiency in G-code and M-code syntax and simulation

Associated Tasks:

1. Identify and label key components: control panel, drive system, spindle, tool changer.
2. Write CNC program (Lathe Machine) for basic components using part drawings (2D).
3. Develop a complete CNC program for a stepped shaft or flange

Exemplars and Utility:

1. Builds fluency in CNC programming language.
2. Develops confidence in interpreting and debugging code.
3. Prepares students for roles in CNC operation, process planning, and automation. Can be extended to CAD/CAM workflows and post-processing.

Experiment No.3	**3D Printing Technology**	**6 Hrs.**	**CO3**

Objective:

To design, slice, and fabricate 3D printed components using FDM technology

Associated Tasks:

1. Create 3D Models in CAD Software. Convert CAD models to STL format
2. Import STL into Slicer Software. Generate G-code.
3. Prepare FDM Printer
4. Start the Print. Remove Supports and Clean Print

Exemplars and Utility:

1. Builds understanding of additive manufacturing workflows.
2. Prepares students for roles in prototyping, product design, and manufacturing.

Experiment No.4	**Digital Manufacturing**	**2 Hrs.**	**CO4**

Objective:

Evaluate digital manufacturing workflows and CAM toolpaths to optimize production accuracy, efficiency, and collision avoidance.

Associated Tasks:

1. Identify stages: CAD → CAM → Simulation → CNC → Post-processing

2. Simulate Toolpaths in CAM Software. Use simulation to detect tool-part, tool-fixture, and tool-machine collisions.

Exemplars and Utility:

1. Prepares students for roles in process engineering, CAM programming, and digital manufacturing
2. Enhances understanding of CAM logic and CNC safety

Textbooks:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 53rd Edition, ISBN: 978-9380358963
2. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw-Hill, ISBN: 978-0070265103.
3. P. N. Rao, Computer Aided Manufacturing. Tata McGraw-Hill, ISBN: 978-0070583733,
4. M. P. Groover, Fundamentals of Modern Manufacturing, Wiley India, ISBN: 978-8126547371

Reference Books:

1. P. Radhakrishnan, S. Subramanyan, and V. Raju, CAD/CAM/CIM, New Age International, 4th Edition, ISBN: 978-8122439809
2. T. K. Kundra, P. N. Rao, and N. K. Tewari, Numerical Control and Computer-Aided Manufacturing, Tata McGraw-Hill, ISBN: 978-0074516218
3. C. K. Chua, K. F. Leong, and C. S. Lim, Rapid Prototyping: Principles and Applications, Tata McGraw-Hill India Edition, ISBN: 978-8120348288.
4. Serope Kalpakjian and Steven Schmid, Manufacturing Engineering and Technology, Pearson India, ISBN: 978-9332549814.
5. M. Adithan, Computer Aided Manufacturing, PHI Learning, ISBN: 978-8120347496.

MOOCs Links and additional reading material:

1. Fundamentals of Additive Manufacturing Technologies By Prof. Sajan Kapil, IIT Guwahati: https://nptel.ac.in/courses/112103306
2. The Future of Manufacturing Business: Role of Additive Manufacturing, By Prof. R. K. Amit, Prof. U. Chandrasekhar, IIT Madras: https://onlinecourses.nptel.ac.in/noc20_mg70/preview
3. Computer Integrated Manufacturing, BY Prof. J. Ramkumar Prof. Amandeep Singh IIT Kanpur: https://onlinecourses.nptel.ac.in/noc22_me10/preview
4. Computer Aided Design and Manufacturing, By Prof. Anoop Chawla, Prof. P.V. Madhusudan Rao IIT Delhi: nptel.ac.in/courses/112102101

Strength of CO-PO mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2	1	-	1	1	1	1	2	-	3
CO2	3	2	2	1	2	1	-	1	1	1	1	-	-	3
CO3	2	3	2	1	3	1	-	1	1	1	1	2	-	3
CO4	2	3	2	1	3	1	-	1	1	1	1	2	-	3
Avg.	**2**	**2**	**2**	**1**	**3**	**1**	**-**	**1**	**1**	**1**	**1**	**2**	**-**	**3**

Note: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:
Machine Design, Computer Aided Manufacturing, Advanced Manufacturing Processes

Job Mapping:

Job opportunities that one can get after learning this course:

1. Technical Assistant / Technician Trainee: Basic machine operations, CAD drawing support, Workshop/lab assistant roles
2. Manufacturing/Production Helper: Roles in small manufacturing firms, Machine shop assistant, Assembly line work
3. Apprenticeships / Internships: Many industries offer ITI-level apprenticeships for candidates with basic technical knowledge, PSU apprentice schemes under the National Apprenticeship Promotion Scheme (NAPS)
4. Field Technician: Jobs in installation and maintenance of machinery,
5. Customer Service Support (Technical): Call center support for mechanical tools or software, Sales assistant in hardware/tool shops.

Program:	**F. Y. B. Tech**	**Semester:**	**II**
Course:	**Cocurricular Course- II** **Creative Arts & Design**	**Course Code:**	**R25-SH-CC-117.1**

Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	25	-

Course Description. This course provides students with advanced techniques in visual and textile arts, paper crafts, clay modelling , and eco-friendly creative practices. It emphasizes hands-on learning, creative expression, and sustainability. Students will learn to plan, execute, and present individual and group projects, culminating in exhibitions that reflect both skill development and aesthetic understanding.

Course Relevance

Arts & Craft enhances creativity, fine motor skills, and aesthetic appreciation. It fosters innovative thinking and promotes environmentally conscious practices. This course is relevant for students pursuing careers in design, teaching, fine arts, and sustainable crafts, while also nurturing cultural and personal expression.

Course Objectives

1. Develop advanced skills in drawing, painting, and mixed media.
2. Create decorative and functional art using paper, textiles, clay, and recycled materials.
3. Apply design principles, color theory, and texture in practical projects.
4. Plan, execute, and present individual and collaborative creative projects.
5. Promote sustainable practices through eco-friendly art and craft.

CO	**Course Outcome**	**Bloom's Level**
CO1	Demonstrate proficiency in advanced drawing and painting techniques.	**3**
CO2	Construct complex paper crafts and textile-based art pieces.	**3**
CO3	Produce clay and sculptural works with proper finishing and design aesthetics.	**3**
CO4	Integrate sustainable materials into creative projects.	**3**
CO5	Organize and present art projects effectively in an exhibition setting	**3**

Course Contents

Unit 1	**Advanced Drawing & Painting Techniques**	**4 Hrs.**	**CO1**

- Perspective drawing (one-point, two-point)
- Light & shadow, advanced shading technique
- Color mixing, harmonies & contrasts (complementary, analogous, triadic)
- Brushwork: wet-on-wet, dry-brush, glazing, impasto
- Mixed media painting: combining drawing, water-based paints, inks, and collage elements

Unit 2	**Paper Craft, Origami & Decorative Paper Art**	**4 Hrs.**	**CO2**

- Complex origami models: modular origami, tessellations
- Paper cutting and layering: silhouette art, kirigami
- Decorative paper items: pop-up cards, 3D paper sculptures, paper quilling

• Designing decorative wall panels, journal covers, gift packaging			
Unit 3	**Textile & Fabric Art – Intermediate**	**4 Hrs.**	**CO3**
• Tie-dye: spirals, mandalas, shibori patterns • Block printing: designing blocks, multiple colour prints • Fabric painting: resist techniques, stenciling • Embroidery: chain stitch, satin stitch, French knots; combining with painting • Upcycling fabric: bags, wall hangings, soft furnishings from textile waste			
Unit 4	**Clay, Modeling & Pottery – Intermediate**	**4 Hrs.**	**CO4**
• Hand-building: slab, coil, pinch-and-combine methods • Sculpting: figurative modeling, relief work • Wheel-throwing introduction or using molds • Surface decoration: glazing, under-painting, texture tools • Functional pottery: bowls, cups, planters; decorative sculptures			
Unit 5	**Recycled & Eco-Friendly Craft – Advanced Projects**	**4 Hrs.**	**CO5**
• Using sustainable materials: cardboard, plastic bottles, fabrics, newspaper/magazines • Concept-to-creation: eco-themed craft items • Collaborative large-scale installations or community projects • Reflection on environmental impact: documenting process and materials			

Strength of CO-PO Mapping											
CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	1	1	3	1	-	-	-	-	-	1	-
CO2	1	-	3	1	-	-	1	-	-	-	-
CO3	1	-	3	2	-	-	-	-	-	-	-
CO4	1	-	2	-	-	-	3	-	-	-	-
CO5	-	-	2	-	-	-	-	-	3	3	2
Average	**1.0**	**1.0**	**2.6**	**1.3**	**-**	**-**	**2.0**	**-**	**3.0**	**2.0**	**2.0**

Program:	**F. Y. B. Tech**			**Semester:**		**II**	
Course:	**Cocurricular Course- II Wellness & Lifestyle Education**			**Course Code:**		**R25-SH-CC-117.2**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	25	-

Course Description

This course builds on the foundational concepts introduced in Semester 1 by deepening students' understanding of nutrition across life-stages, application of physical fitness, mental health and social wellness, preventive lifestyle practices, and wellness programmes and interventions. Students will learn both theoretical frameworks and practical strategies to design, implement and evaluate wellness in personal, community and institutional settings.

Course Relevance

In today's fast-paced world, there is an increased burden of lifestyle diseases, mental health challenges, sedentary living and nutritional imbalances. This course is relevant because it equips students with the knowledge and skills needed to maintain and promote wellness across all life stages — infancy to elderly — and in diverse contexts (school, workplace, community). It helps them become informed individuals who can both manage their own well-being and contribute to the wellness of others.

Course Objectives

1. Understand nutrition requirements and challenges across the life cycle, from infancy to elderly.
2. Design and implement personalised fitness programmes incorporating aerobic, strength, flexibility and functional fitness components.
3. Apply advanced stress-management, mindfulness, and social-emotional wellness techniques to enhance mental health and resilience.
4. Recognise, prevent and manage lifestyle risks, addictions, sleep disorders and safety issues; practise first aid and create safe living environments.
5. Explore and implement wellness programmes such as yoga, meditation, and technology-assisted wellness in educational, workplace and community settings.

CO	**Course Outcome**	**Bloom's Level**
CO1	Analyse the nutritional needs at various life stages (infancy, childhood, adolescence, adulthood, elderly) and identify public-health nutrition challenges such as malnutrition, over-nutrition and micronutrient deficiencies.	**3**
CO2	Develop and evaluate personal fitness programmes appropriate for different age groups and special populations (pregnant women, elderly) including assessment, planning and monitoring.	**3**
CO3	Apply strategies for mental and social wellbeing including mindfulness, relaxation, breathing techniques, positive psychology, digital-wellbeing and resilience building.	**3**
CO4	Demonstrate preventive-health practices including sleep hygiene, addiction avoidance, screening, first aid, safe living environments and ergonomics in daily/academic/work settings.	**3**
CO5	Design and implement wellness practices and programmes (yoga, meditation, wellness campaigns, use of technology/wearables) in workplace, educational or community contexts.	**3**

Course Contents			
Unit 1	**Advanced Nutrition & Life Stages**	**4 Hrs.**	**CO1**
• Nutrition through the life-cycle: infancy, childhood, adolescence, adulthood, elderly • Maternal & prenatal nutrition; infant feeding (breast vs formula); complementary feeding • Nutritional needs & challenges in ageing (eg. sarcopenia, bone health) • Public-health nutrition issues: under-nutrition, over-nutrition, micronutrient deficiencies			
Unit 2	**Application of Physical Fitness & Exercise**	**4 Hrs.**	**CO2**
• Designing personal fitness programmes: assessment, planning (aerobic, strength, flexibility, functional) • Exercises for different age-groups and special populations (pregnant, elderly) • Injury prevention, posture correction, ergonomics in daily/academic/office life • Monitoring fitness progress: body composition, VO_2 max, strength tests			
Unit 3	**Mental Health, Well-being & Social Dimensions**	**4 Hrs.**	**CO3**
• Deep stress-management: mindfulness, relaxation, breathing techniques, cognitive strategies • Mental health across life-stages; coping with transitions (college, work); building resilience • Social & emotional wellness: relationships, peer-pressure, digital/social-media impact • Work/education-life balance; positive psychology; self-care strategies			
Unit 4	**Preventive Health, Lifestyle & Safety**	**4 Hrs.**	**CO4**
• Sleep hygiene, circadian rhythms, shift-work challenges • Addictions & lifestyle risks: tobacco, alcohol, substance use, screen time • Preventive practices: screenings, vaccinations, lifestyle-disease prevention (diabetes, hypertension, metabolic syndrome) • First aid advanced topics: basic CPR, disaster-preparedness, safety in environment (home, campus, workplace			
Unit 5	**Wellness Practices & Programmes**	**4 Hrs.**	**CO5**
• Yoga, meditation, pranayama: history, philosophy, advanced practices • Wellness in workplace/educational settings: designing & implementing wellness programmes • Community wellness initiatives: peer-education, health-promotion campaigns • Technology & wellness: apps, wearable fitness-trackers, e-wellness platform			

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	–	2	–	–	2	–	–	–	–
CO2	2	–	3	2	–	2	–	–	1	–	–
CO3	–	–	–	–	–	3	–	–	1	2	–
CO4	–	–	–	–	–	3	2	–	–	2	–
CO5	2	–	2	–	1	2	–	–	2	2	2
Average	**2.33**	**3.00**	**2.33**	**2.00**	**1.00**	**2.50**	**2.00**	**–**	**1.33**	**2.00**	**2.00**

Program:	**F. Y. B. Tech**			**Semester:**		**II**	
Course:	**Cocurricular Course-** II **Adventure Sports: Management, Safety and Career**			**Course Code:**		**R25-SH-CC-117.3**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	25	-

Course Description: To provide students with an overview of the booming adventure sports industry in Maharashtra and India, equipping them with the basic knowledge and and awareness of professional opportunities within the sector.

Course Relevance: This course introduces students to the rapidly growing adventure sports industry in Maharashtra and India, helping them understand its scope and professional possibilities. It builds foundational awareness of careers, entrepreneurship, and safety practices within the sector. By connecting students with real-world opportunities, the course encourages skill development, informed career choices, and active participation in the adventure tourism ecosystem.

Course Objectives:

1. To understand the scope and dynamics of the Adventure Sports industry.
2. To understand risk management protocols specific to adventure setups.
3. To explore career pathways such as guiding, adventure park management etc.
4. To gain hands-on experience in adventure activities like Rappelling, Zip lines and Valley Crossing.

CO	**Course Outcome**	**Bloom's Level**
CO1	Analyze the scope and terminology of the Adventure Sports industry.	**4**
CO2	Assess risks and apply safety protocols in adventure setups	**3**
CO3	Identify various career opportunities in the adventure sector.	**2**
CO4	Demonstrate the correct usage of PPE and execute activities like Zip- lining and Jumaring.	**3**

Course Contents

Unit 1	**Overview of Adventure Sports & Topography**	**4 Hrs.**	**CO1**

Definitions: Adventure Sports and allied activities.
Terrain Analysis: Understanding topography suited for land, water, and air sports specific to Sahyadris and Maharashtra.
Legal Framework: Basic liability and regulations in Indian Adventure Tourism.

Unit 2	**Risk Management and Emergency Response**	**4 Hrs.**	**CO2**

- Risk Assessment Matrix: Identifying probability and severity.
- Emergency Action Plans (EAP) for adventure parks and outdoors.
- Basic Life Support (BLS) context in adventure sports scenarios.

Unit 3	**Career Opportunities in Adventure Sports**	**6 Hrs.**	**CO3**
• Roles: Adventure Guide, Instructor, Course Setter, Camp Manager. • Entrepreneurship: Starting an Adventure Park or Trekking Company. • Allied Careers: Adventure photography, Equipment • manufacturing/retail, Rescue specialist.			
Unit 4	**Personal Protective Equipment (PPE) Standards**	**8 Hrs.**	**CO4**
• Standards: UIAA, CE, and EN norms for equipment. • PPE selection: Helmets, full-body harnesses, ropes, belay devices and pulleys. • Care and Inspection of gear.			
Unit 5	**Technical Activities Execution**	**8 Hrs.**	**CO4**
• Rope Access Activities: Setup and execution of Rappelling. • Aerial Activities: Mechanics and safety of Zip Lines and Valley Crossing. • Ascending: Jumaring techniques for rescue and access.			

Strength of CO-PO mapping											
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	1	-	1	-	-	-	1	1	1	-
CO2	2	2	-	2	2	-	1	1	1	1	-
CO3	1	-	-	-	-	-	1	-	-	1	1
CO4	-	1	2	2	2	-	1	1	1	1	1
Avg.	**2**	**2**	**2**	**2**	**2**	**-**	**1**	**1**	**1**	**1**	**1**

Program:	**F. Y. B. Tech**			**Semester:**		**II**	
Course:	**Cocurricular Course-** II **Fire and Safety**			**Course Code:**		**R25-SH-CC-117.4**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	25	-

Course Description. This course provides comprehensive training in fire safety, emergency response, and occupational safety practices. It combines theoretical knowledge with hands-on practical exercises to equip learners with skills to prevent, manage, and respond to fire hazards in residential, commercial, and industrial environments.

Course Relevance

Fire accidents can cause significant loss of life and property. This course is relevant for:

- Workplace safety officers
- Industrial personnel
- Facility managers
- Individuals interested in fire safety awareness
- It addresses regulatory compliance, equips learners with emergency preparedness skills, and ensures adherence to national fire safety standards.

Course Objectives: After learning the course, the student will

1. Understand the fundamentals of fire and its hazards.
2. Identify fire risks and implement preventive measures.
3. Operate fire-fighting equipment and conduct fire drills safely.
4. Respond effectively to fire emergencies and provide first aid.
5. Comply with fire safety laws, regulations, and reporting procedures.

CO	**Course Outcome**	**Bloom's Level**
CO1	Identify and explain fundamental concepts of fire safety, including fire behaviour, fire classification, and basic fire science terminology.	**3**
CO2	Recognize fire hazards and apply preventive measures to reduce risks in residential, commercial, and industrial environments.	**3**
CO3	Demonstrate the correct selection and operation of fire extinguishers and suppression equipment using standard procedures.	**3**
CO4	Execute safe and effective emergency response actions, including evacuation planning, fire drill participation, and rescue techniques.	**3**
CO5	Administer basic first aid for fire-related injuries and use essential safety gear and breathing apparatus during rescue situations.	**3**

Course Contents			
Unit 1	**Introduction to Fire Safety**	**4 Hrs.**	**CO1**

- Understanding fire: definition, causes, and effects
- Fire triangle (fuel, oxygen, heat) and fire behaviour
- Classification of fires (Class A, B, C, D, etc.)

- Basic fire science terminology

Unit 2	Fire Prevention Techniques	4 Hrs.	CO2

- Hazard identification and risk analysis (residential, commercial, industrial)
- Good housekeeping practices and safe storage of combustible materials
- Electrical fire precautions and chemical fire hazards
- Fire safety signage, escape routes, emergency lighting

Unit 3	Fire Extinguishing Methods & Equipment	4 Hrs.	CO3

- Types and classifications of fire extinguishers (water, foam, CO_2, dry-powder, etc.)
- Fire hoses, hydrants, sprinkler systems, wet/dry risers
- PASS technique (Pull, Aim, Squeeze, Sweep) for extinguisher operation
- Inspection, maintenance, and servicing of fire safety equipment

Unit 4	Emergency Response & Evacuation Procedures	4 Hrs.	CO4

- Fire alarm and detection systems
- Evacuation planning: exit routes, assembly points, role of fire warden
- Planning and execution of fire drills
- Rescue operations: ladders, ropes, and safe evacuation techniques

Unit 5	First Aid & Rescue Basics	4 Hrs.	CO5

- First response to burns, smoke inhalation, and fire-related injuries
- CPR (Cardio-pulmonary Resuscitation) and basic life-saving techniques
- Use of breathing apparatus and protective clothing
- Safe handling of rescue tools and equipment

Strength of CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	1	–	–	–	1	–	–	–	–	–
CO2	2	2	1	–	–	2	2	–	–	–	–
CO3	1	–	3	1	–	–	–	–	–	–	–
CO4	2	1	2	2	–	1	1	–	–	1	–
CO5	2	–	1	1	–	2	1	–	–	1	1
Avg.	**1.8**	**1.3**	**1.8**	**1.3**	**-**	**1.5**	**1.3**	**-**	**-**	**1**	**1**

Program:	**F. Y. B. Tech**			**Semester:**		**II**	
Course:	**Cocurricular Course-** II **Self Defence**			**Course Code:**		**R25-SH-CC-117.5**	
Teaching Scheme (Hrs./Week)				**Examination Scheme**			
Lecture	**Practical**	**Tutorial**	**Credit**	**CCE**	**ESE**	**TW**	**PR**
-	02	-	01	-	-	25	-

Course Description - This course provides students with practical, easy-to-learn self-defense skills focused on awareness, prevention, and effective physical techniques. Through a combination of instruction, drills, and scenario-based practice, participants will learn how to recognize potential threats, set personal boundaries, and respond confidently under stress. The curriculum emphasizes real-world safety, empowering students to use verbal de-escalation, strategic movement, and simple, high-percentage techniques to escape common grabs, holds, and attacks. Ground defense, striking fundamentals, and safe use of reasonable force are taught in a controlled, supportive environment. By the end of the course, students will have the knowledge and capability to enhance their personal safety and make informed decisions in challenging situations.

Course Relevance

In an increasingly unpredictable world, personal safety skills are essential for individuals of all ages and backgrounds. This course equips students with practical tools to recognize danger early, avoid risky situations, and respond effectively if confronted with aggression. Beyond physical techniques, learners gain valuable life skills—such as situational awareness, boundary-setting, stress management, and confident communication—that carry over into everyday interactions. The course supports personal empowerment, enhances physical and mental resilience, and fosters a proactive mindset toward safety. Whether for personal development, professional requirements, or general preparedness, the knowledge gained in this course is directly applicable to real-life environments such as schools, workplaces, public spaces, and daily routines.

Course Objectives:

1. **Demonstrate situational awareness** and identify potential safety risks in everyday environments.
2. **Apply verbal de-escalation and boundary-setting skills** to reduce or prevent conflict before physical action becomes necessary.
3. **Use basic self-defense techniques**—including striking, movement, and escape skills—in a controlled and safe manner.
4. **Execute defensive responses** to common grabs, holds, and attempts at restraint using simple, effective, and lawful methods.
5. **Perform basic ground-defense movements** to protect themselves and create opportunities to escape.

CO	**Course Outcome**	**Bloom's Level**
CO1	Identify potential safety risks and environmental hazards using situational awareness.	**2**
CO2	Explain the principles of de-escalation, boundary-setting, and personal safety strategies.	**2**
CO3	Demonstrate basic self-defense movements such as stance, footwork, and protective positioning	**3**
CO4	Apply simple, safe escape techniques against common non-dangerous grabs and holds in a controlled environment.	**3**
CO5	Analyze real-world scenarios to determine appropriate safety responses, including disengagement options.	**4**

Course Contents			
Unit 1	**Awareness & Prevention**	**4 Hrs.**	**CO1**

- Situational awareness
- Risk recognition
- Boundary setting & assertive communication
- De-escalation tools

Unit 2	**Foundations of Movement**	**4 Hrs.**	**CO2**

- Defensive stance
- Footwork (step, pivot, retreat)
- Guarding and covering
- Basic balance and posture

Unit 3	**Safe Striking Fundamentals**	**4 Hrs.**	**CO3**

- Palm strikes
- Hammer-fist motions
- Elbow and knee mechanics
- Low defensive kicks

Unit 4	**Escape & Ground Defense Techniques**	**4 Hrs.**	**CO4**

Escape Techniques

- Wrist-grab releases
- Clothing-grab responses
- Bear-hug escape principles
- Choke defense basics (safety-based)

Ground Defense

- Falling safely
- Shrimping, bridging
- Using legs defensively
- Technical stand-up

Unit 5	**Scenario Integration & Application**	**4 Hrs.**	**CO5**

- Environment-based scenarios
- Communication + movement + escape
- Managing adrenaline and stress
- Final review and practice

Strength of CO-PO Mapping

CO No.	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	-	-	-	-	1	-	1	-	-	-
CO2	1	-	-	-	-	2	-	1	-	1	-
CO3	-	-	2	-	-	-	-	1	1	-	-
CO4	-	-	3	-	-	-	-	1	1	-	-
CO5	1	-	2	2	-	1	1	2	-	1	-
Avg.	**1**	**-**	**2.33**	**2**	**-**	**1.33**	**1**	**1.2**	**1**	**1**	**-**