Zeal Education Society's

ZEAL COLLEGE OF ENGINEERING & RESEARCH, PUNE – 41

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

NBA Accredited, NAAC Accredited with A+ Grade, ISO 21001:2018

DEPARTMENT OF MECHANICAL ENGINEERING

Curriculum Structure and Syllabus of

S.Y. B. Tech. – Mechanical Engineering

(With effect from - Academic Year 2026 - 27)
(2025 Pattern)

VISION OF THE INSTITUTE

To be a premier institute in technical education by imparting academic excellence, research, social and entrepreneurial attitude.

MISSION OF THE INSTITUTE

- To achieve academic excellence through innovative teaching and learning process.
- To imbibe the research culture for addressing industry and societal needs.
- To inculcate social attitude through community engagement initiatives.
- To provide conducive environment for building the entrepreneurial skills.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION:

To be recognized as center for quality education in the field of mechanical engineering, integrating top-tier teaching, innovative research, and fostering socially conscious and entrepreneurial engineers.

MISSION:

M1: To impart value-added education by creating an ambiance of academic excellence in teaching-learning processes.
M2: To inculcate research approach through innovation and skill development centers.
M3: To inculcate a strong sense of social responsibility and empathy among the students.
M4: To imbibe the entrepreneur skill amongst the students by strengthening Industry- Institute interaction.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Mechanical Engineering graduates excel in solving industrial challenges, innovating for society, and leveraging core engineering principles for industry advancement.
PEO2: Graduates will apply technical expertise, leadership, and entrepreneurship, to establish ethical organizations to address societal needs and pursue higher studies.
PEO3: Graduates will work effectively as individuals and as team members with high ethical values and motivation for life-long learning for the benefit of society.

PROGRAM OUTCOMES (POs):

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop the solution of complex engineering problems.
PO2: 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: Design creative solutions for 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)

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Identify, formulate and analyze real-life mechanical engineering problems by applying the principles of thermal, design, manufacturing, interdisciplinary and allied engineering.

PSO2: Select and apply appropriate materials, metallurgical processes, measurement techniques, feedback control systems, hydraulic and pneumatic control systems to develop appropriate solutions to mechanical engineering problems.

PSO3: Select and apply appropriate manufacturing technologies and tools, and develop competencies for working in manufacturing and allied industries.

PSO4: Apply acquired knowledge, skills, and hands-on experiences to work professionally in mechanical and related systems.

DEPARTMENT OF MECHANICAL ENGINEERING

LIST OF ABBREVIATIONS

Abbreviation	Description
BSC	Basic Science Course
ESC	Engineering Science Course
PCC	Program Core Course
PEC	Program Elective Course
MDM	Multidisciplinary Minor
OE	Open Elective - Other than a particular program
VSEC	Vocational and Skill Enhancement Course
AEC	Ability Enhancement Course
ENTR	Entrepreneurship
EC	Economics
MC	Management Courses
IKS	Indian Knowledge System
VEC	Value Education Courses
RM	Research Methodology
CEP	Community Engagement Project
FP	Field Project
PROJ	Project
INT	Internship
OJT	On Job Training
CC	Co-curricular Courses
HSSM	Humanities Social Science and Management
ELC	Experiential Learning Course
B. Tech	Bachelor of Technology
L	Lecture
P	Practical
T	Tutorial
H	Hours
CR	Credits
CIE	Continuous Internal Evaluation
ETE	End Term Evaluation
TW	Term Work
OR	Oral
PR	Project

DEPARTMENT OF MECHANICAL ENGINEERING

Second Year B. Tech. – Mechanical Engineering: Semester - III

Course Code	Course Type	Course Name	Teaching Scheme (hrs/Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR/Tut	Total						
25MEPC302	PCC	Mechanics of Solids	4	-	-	4	4	-	4	40	60	-	-	-	100
25MEPC302P	PCC	Mechanics of Solids Lab	-	2	-	2	-	1	1	-	-	-	50	-	50
25MEPC303	PCC	Engineering Thermodynamics	3	-	-	3	3	-	3	40	60	-	-	-	100
25MEPC304	PCC	Engineering Materials and Metallurgy	3	-	-	3	3	-	3	40	60	-	-	-	100
25MEPC304P	PCC	Engineering Materials and Metallurgy Lab	-	2	-	2	-	1	1	-	-	-	-	25	25
25MEMD301	MDM	Engineering Mathematics – III	3	-	-	3	3	-	3	40	60	-	-	-	100
25ALOE301	OE	Open Elective - I[#]	2	-	-	2	2	-	2	-	-	50	-	50	100
25MEVS304	VSEC	Problem Solving Technique – I	-	2	-	2	-	1	1	-	-	25	-	-	25
25MEVS305	VSEC	Python & Generative AI Lab		2		2		1	1	-	-	25	-	-	25
25MECE301	CEP	Project Based Learning	-	2	-	2	-	1	1	-	-	25	-	-	25
25MECC305	CC	Liberal Learning-III	-	2	-	2	-	1	1	-	-	25	-	-	25
25MEIN301	ELC - INT	Internship – I	4 Weeks				-	2	2	-	-	25	-	-	25
Total			**15**	**12**	**-**	**27**	**15**	**8**	**23**	**160**	**240**	**175**	**50**	**75**	**700**

BoS Chairman

PU/PN/Engg./285/2007
ZES's Zeal College of Engineering & Research Narhe, Pune-41

Director
ZES's Zeal College of Engineering & Research Narhe, Pune - 411041.

DEPARTMENT OF MECHANICAL ENGINEERING

Second Year B. Tech. – Mechanical Engineering: Semester - III

# - Select any one course from the given Open Elective Courses		
Course Code	**Course Type**	**Open Elective - I**
25ALOE301A	OEC	Digital Literacy and Applications
25ALOE301B		Environmental Studies
25ALOE301C		Green Energy and Sustainability
25ALOE301D		Basics of Consumer Electronics
25ALOE301E		Renewable Energy Systems

*** Liberal Learning – III: Choose any one from the following:**

Sr. No.	Course Code	Module	Sr. No.	Course Code	Module
1.	25MECC305A	Guitar	6.	25MECC305F	Basketball
2.	25MECC305B	Singing	7.	25MECC305G	Cricket
3.	25MECC305C	Cinematography	8.	25MECC305H	Rifle and Pistol Shooting
4.	25MECC305D	Dance	9.	25MECC305I	Volleyball
5.	25MECC305E	Synthesizer	10.	25MECC305J	Football

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DEPARTMENT OF MECHANICAL ENGINEERING

Second Year B. Tech. – Mechanical Engineering: Semester - IV

Course Code	Course Type	Course Name	Teaching Scheme (hrs/Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR/Tut	Total						
25MEPC405	PCC	Theory of Machines	3	-	-	3	3	-	3	40	60	-	-	-	100
25MEPC405P	PCC	Theory of Machines Lab	-	2	-	2	-	1	1	-	-	-	-	20	20
25MEPC406	PCC	Fluid Mechanics	3	-	-	3	3	-	3	40	60	-	-	-	100
25MEPC407	PCC	Manufacturing Technology – II	3	-	-	3	3	-	3	40	60	-	-	-	100
25MEPC407P	PCC	Manufacturing Technology – II Lab	-	2	-	2	-	1	1	-	-	-	-	20	20
25MEMD402	MDM	Machine Learning & Data Science	2	-	-	2	2	-	2	40	60	-	-	-	100
25MEMD402P	MDM	Machine Learning & Data Science Lab	-	2	-	2	-	1	1	-	-	-	20	-	20
25ALOE402	OE	Open Elective – II[#]	2	-	-	2	2	-	2	-	-	50	-	50	100
25MEMC402	HSSM-MC	Project Management System – I	-	2	-	2	-	1	1	-	-	25	-	-	25
25MEAE402	AEC	Problem Solving Technique – II	-	2	-	2	-	1	1	-	-	25	-	-	25
25MEVS406	VSEC	Solid Modelling and Drafting Lab	-	2	-	2	-	1	1	-	-	20	-	-	20
25MEVS408	VSEC	Fluid Mechanics and Machinery Lab	-	2	-	2	-	1	1	-	-	-	20	-	20
25MECC406	CC	Liberal Learning-IV	-	2	-	2	-	1	1	-	-	25	-	-	25
25MEIN402	ELC - INT	Internship – II	4 Weeks				-	2	2	-	-	25	-	-	25
Total			**13**	**16**	**-**	**29**	**13**	**10**	**23**	**160**	**240**	**170**	**40**	**90**	**700**

BoS Chairman

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Director
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DEPARTMENT OF MECHANICAL ENGINEERING

Second Year B. Tech. – Mechanical Engineering: Semester - IV

# - Select any one course from the given Open Elective Courses		
Course Code	**Course Type**	**Open Elective – II**
ALOE402A	OEC	Cyber Security and Laws
ALOE402B		Sustainability and Climate Change
ALOE402C		Energy Audit and Electrical Safety
ALOE402D		Digital Marketing
ALOE402E		Entrepreneurship and Innovations

*** Liberal Learning – IV: Choose any one from the following:**

Sr. No.	Course Code	Module	Sr. No.	Course Code	Module
1.	25MECC406A	Guitar	6.	25MECC406F	Basketball
2.	25MECC406B	Singing	7.	25MECC406G	Cricket
3.	25MECC406C	Cinematography	8.	25MECC406H	Rifle and Pistol Shooting
4.	25MECC406D	Dance	9.	25MECC406I	Volleyball
5.	25MECC406E	Synthesizer	10.	25MECC406J	Football

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DEPARTMENT OF MECHANICAL ENGINEERING

SYLLABUS

SEMESTER - III

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Mechanics of Solids								**Code:** 25MEPC302	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
04	-	-	04	40	60	-	-	-	100

Prerequisites:

Basic concept of Engineering Mathematics and Engineering Mechanics

Course Objectives:

1. To develop students' ability to analyze and evaluate stresses, strains, shear forces, bending moments, torsion, buckling, and combined loading in mechanical components under different loading conditions.
2. To enable students to apply theories of elasticity, principal stresses, and failure theories for the safe and reliable design of beams, shafts, columns, and other engineering components.

Course Outcomes: After completion of this course, students will be able to -

CO1	Apply the concepts of stress and strain to calculate axial and thermal stresses in homogeneous and composite members
CO2	Analyze shear force and bending moment diagrams for beams under various loading and support conditions.
CO3	Calculate bending and shear stresses, slope, and deflection in beams using analytical methods and experimental observations.
CO4	Analyze torsional stresses in circular shafts and evaluate critical buckling loads in columns using Euler's theory.
CO5	Evaluate principal stresses and planes, Mohr's Circle, and failure theories to assess material safety under complex loading.
CO6	Solve combined loading problems using concepts of shear force, bending moment, stresses, torsion, buckling, principal stresses and failure theories.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Simple Stresses and Strains**: Types of loads and various types of stresses with applications, Unit conversion & dimensions, Hooke's law, Poisson's ratio, Elastic Constants. Interrelation between elastic constants, Stress-strain diagram for ductile, brittle and composite material, factor of safety, Stresses and strains in determinate and indeterminate beam, homogeneous and composite bars under concentrated loads. **Thermal stresses:** in plain and composite members.	10
2.	**Shear Force Diagram and Bending Moment Diagram** : Introduction to SFD, BMD with application, SFD & BMD for statically determinate beam due to concentrated load, uniformly distributed load, couple and combined loading,	07

	Relationship between rate of loading, shear force and bending moment, Concept of zero shear force, Maximum bending moment, point of contra-flexure.	
3.	**Bending Stress in a Beam**: Introduction to bending stress in a beam with application, Theory of Simple bending, assumptions in pure bending, Flexural formula, Moment of inertia of common cross section (Circular, Hollow circular, Rectangular, I & T), Bending stress distribution along the same cross-section. **Shear Stress in a Beam**: Introduction to transverse shear stress on a beam with application, shear stress distribution diagram along the Circular, Hollow circular, Rectangular, I & T cross-section.	09
4.	**Torsion of circular shafts**: Introduction to torsion on a shaft with application, Basic torsion formulae and assumption in torsion theory, Torsion in stepped and composite shafts, Torque transmission on strength and rigidity basis, Torsional Resilience, torsion in thin wall cylinder. **Buckling of columns**: Introduction to buckling of column with its application, Different column conditions and critical, safe load determination by Euler's theory. Limitations of Euler's Theory, Introduction to other theories.	09
5.	**Principal Stresses**: Introduction to principal stresses with application, Transformation of Plane Stress, Principal Stresses and planes (Analytical method and Mohr's Circle), Stresses due to combined Normal and Shear stresses. **Theories of Elastic failure**: Introduction to theories of failure with application, Maximum principal stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal strain theory, Maximum strain energy theory.	09
6.	**Combined loading and stresses** Combined stresses at any cross-section or at any particular point for Industrial and Real life example for the following cases: Combined problem of Normal type of Stresses (Tensile, Compressive and Bending stress), Combined problem of Shear type of stresses (Direct and Torsional Shear stresses), Combined problem of Normal and Shear type of Stresses.	08
	TOTAL	**52**

Text Books:

1. R. K. Bansal, "Strength of Materials", Laxmi Publication
2. S.S. Rattan, "Strength of Material", Tata McGraw Hill Publication Co. Ltd.
3. B.K. Sarkar, "Strength of Material", McGraw Hill New Delhi
4. Singer and Pytel, "Strength of materials", Harper and row Publication
5. R. C. Hibbeler, "Mechanics of Materials", Prentice Hall Publication

Reference Books:

1. Egor. P. Popov, "Introduction to Mechanics of Solids", Prentice Hall Publication
2. G. H. Ryder, "Strength of Materials", Macmillan Publication
3. Beer and Johnston, "Strength of materials", CBS Publication

4. James M. Gere, "Mechanics of Materials", CL Engineering
5. Timoshenko and Young, "Strength of Materials", CBS Publication, Singapore

E-Resources:

1. Prof. S.K. Bhattacharyya, IIT Kharagpur , "NPTEL Web course material" https://drive.google.com/file/d/1N2Eyv9ofPimIT2OSMZeMrSxe68Ulclei/view?usp=sharing

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Mechanics of Solids Lab								**Code:** 25MEPC302P	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	-	50	50

Prerequisites:

Basic concept of Engineering Mathematics and Engineering Mechanics

Course Objectives:

1. To develop students' practical skills in conducting mechanical tests to determine the strength and deformation characteristics of engineering materials and components.
2. To enhance students' analytical skills in evaluating experimental results using laboratory instruments, virtual experiments, and software tools for Strength of Materials applications.

Course Outcomes: After completion of this course, students will be able to -

CO1	Evaluate the mechanical behaviour of engineering materials based on tensile, compressive, shear, bending, and torsion test results.
CO2	Select appropriate experimental or software-based methods for determining and validating the mechanical properties of engineering materials.
CO3	Recommend suitable materials and testing methods for engineering applications based on experimental observations and analysis.

List of Experiments:

1. Tension test for ductile material using extensometer on Universal Testing Machine.
2. Compression test for Brittle material on Universal Testing Machine.
3. To understand the working principle of Strain gauge - Virtual Lab experiment
4. Shear test of ductile material on Universal Testing Machine.
5. Slope & deflection calculation for a simply supported beam with point load at center.
6. Torsion testing for circular bar.
7. Verification of results of any one from experiments no 1-6 using any software tools.
8. Self-learning study practical: Testing (Tensile/Compressive/Shear/Torsion/Bending) of composite material are distributed among the group of 3-5 Students and *groups need to present and also submit the slides/poster on TW file*.

Reference Books:

1. Egor. P. Popov, "Introduction to Mechanics of Solids", Prentice Hall Publication
2. G. H. Ryder, "Strength of Materials", Macmillan Publication
3. Beer and Johnston, "Strength of materials", CBS Publication
4. James M. Gere, "Mechanics of Materials", CL Engineering
5. Timoshenko and Young, "Strength of Materials", CBS Publication, Singapore

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Engineering Thermodynamics								**Code:** 25MEPC303	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Engineering Physics, Fundamentals of Mechanical Engineering.

Course Objectives:

1. To provide students fundamental understanding of basic thermodynamic laws and system behaviour.
2. To enable students to analyze energy interactions in gases, vapors, and various thermodynamic processes.
3. To enable students to evaluate the performance of steam and gas power cycles.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand thermodynamic systems and the First Law of Thermodynamics.
CO2	Interpret the Second Law, entropy, and irreversibility in thermodynamic processes.
CO3	Calculate work, heat, and property changes during ideal gas processes.
CO4	Evaluate properties of pure substances using steam tables and diagrams.
CO5	Explain the Rankine cycle and effect of various parameters on its efficiency.
CO6	Compare various gas power cycles and their efficiency.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Basic Concepts and First Law of Thermodynamics:** Units, Units conversion, Microscopic & Macroscopic point of view, Thermodynamic systems, boundaries, and properties, state, path, process, and cycle, Thermodynamic equilibrium, Quasi-static process, Concepts of work & heat and its sign conventions, Zeroth Law of Thermodynamics, Temperature scales, Measurement of temperature and pressure and its units. Statement of First Law of Thermodynamics, First law applied to closed systems, specific heat, internal energy, enthalpy, First law applied to open systems (steady flow energy equation), Application to nozzles, turbines, compressors, heat exchangers etc.	08
2.	**Second Law of Thermodynamics and Entropy:** Limitations of First Law, Heat engines, refrigerators, heat pumps, Efficiency and COP, Second Law of Thermodynamics - Kelvin-Planck and Clausius statements, It's equivalence, Reversible and irreversible processes, Carnot cycle and Carnot efficiency.	07

	Entropy and its physical significance, T-s and h-s diagrams, Entropy as a property, Clausius inequality, Entropy changes for an Open and Closed System, Entropy - a measure of Disorder.	
3.	**Ideal Gas Processes:** Ideal Gas definition, Gas Laws: Boyle's Law, Charles's Law, Avogadro's Law, Equation of State, Ideal Gas Constant and Universal Gas Constant, Specific Heats and their relationship, Ratio of Specific Heats, Ideal Gas Processes – P-v and T-s Diagrams, Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, and Throttling Processes (Open and Closed Systems), Calculations of Heat Transfer, Work Done, Internal Energy and Enthalpy Changes during various processes.	06
4.	**Properties of Pure Substances:** Steam formation, Steam properties, Phase change processes, P-v, T-s, and h-s diagrams, Use of steam tables and Mollier charts, Dryness fraction and its determination, Various processes with steam as working substance, Steam calorimeters, Real-life application: Steam power plants and water heating systems.	06
5.	**Steam Power Cycles:** Introduction to Steam Power Plant and its main components, Basic Rankine Cycle – processes and representation on P-v , T-s and h-s diagrams, Comparison between Carnot Cycle and Rankine Cycle, Thermal Efficiency of Rankine Cycle, Concept of Relative Efficiency, Effects of operating parameters on cycle performance – influence of Superheating, Boiler Pressure, and Condenser Pressure, Actual Rankine cycle.	07
6.	**Gas Power Cycles:** Basic considerations in the analysis of Power Cycles, Air-Standard assumptions, An overview of reciprocating engines, Otto cycle, Diesel Cycle, and Dual cycle (Simple Numerical), Sterling Cycle, Ericsson Cycle, Lenoir cycle and Atkinson cycle, Brayton Cycle.	05
	TOTAL	**39**

Text Books:

1. Nag P. K., "Engineering Thermodynamics", Tata McGraw-Hill Publisher Co. Ltd.
2. R. K. Rajput, "Engineering Thermodynamics", EVSS Thermo, Laxmi Publications.
3. Domkundwar, Kothandaraman and Domkundwar, "Thermal Engineering", Dhanpat Rai Publishers.
4. M M Rathore, "Thermal Engineering", Tata McGraw-Hill.

Reference Books:

1. Cengel and Boles, "Thermodynamics an Engineering Approach", McGraw Hill
2. Holman J.P, "Thermodynamics", McGraw Hill
3. Steam Tables/Data book.

E-Resources:
1. Prof. V. Bapu, IIT Madras, Engineering Thermodynamics – https://nptel.ac.in/courses/112106310 2. Prof. Aditya Bandopadhyay, IIT Kharagpur, Concepts of Thermodynamics - https://nptel.ac.in/courses/112105266

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Engineering Materials and Metallurgy								**Code:** 25MEPC304	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites: Engineering Physics, Engineering Chemistry, Fundamental in Mechanical Engineering

Course Objectives:

1. To familiarize students with engineering materials, their internal structure, and defects influencing their properties.
2. To equip students with knowledge of mechanical behaviour, testing methods, and failure mechanisms of engineering materials.
3. To enable students to assess phase diagrams, heat treatment, corrosion, modern materials, and material selection criteria for engineering applications.

Course Outcomes: After completion of this course, students will be able to -

CO1	Classify engineering materials based on type and structure.
CO2	Explain mechanical properties and standard testing methods.
CO3	Describe fracture types and true stress-strain behavior.
CO4	Interpret binary phase diagrams and the iron–carbon diagram.
CO5	Explain heat treatment processes and associated diagrams.
CO6	Select suitable materials using properties and Ashby charts.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Fundamentals of Engineering Materials:** Classification of materials: Metals, polymers, ceramics, composites, and smart materials, Structure of solids: Crystal structures (BCC, FCC, HCP), unit cells, Crystallographic directions and planes, Imperfections in crystals: Point, line, and surface defects, Grain structure and grain boundary.	07
2.	**Mechanical Properties and Testing:** Stress-strain behavior; elastic, plastic deformation, Hardness, toughness, ductility, creep, and fatigue. Testing methods: Tensile test, impact test (Izod/Charpy), hardness tests (Brinell, Rockwell, Vickers), Fracture mechanisms: Ductile and brittle fracture	07
3.	**Phase Diagrams and Alloy Systems:** Concept of phases, phase transformation, solidification, Gibb's phase rule, Iron–carbon diagram: Allotropic forms of iron, critical temperatures, Fe–Fe_3C diagram.	07
4.	**Heat Treatment of Steels:** Purpose and types of heat treatment, Annealing, normalizing, hardening, tempering, case hardening, surface hardening, TTT (Time Temperature Transformation) and	06

	CCT (Continuous Cooling Transformation) diagrams, Hardenability and Jominy end-quench test. Corrosion: Types, and prevention techniques on surface**.**	
5.	**Ferrous and Non-Ferrous Alloys:** Properties and applications of plain carbon steels and alloy steels, Cast irons: Types, microstructure, and applications, Non-ferrous materials: Aluminium, copper, magnesium, and their alloys,	06
6.	**Modern Engineering Materials and Applications:** Introduction to composites: Types, manufacturing methods, and applications, Polymers and ceramics: Structure, properties, and applications, Smart materials: Shape memory alloys, piezoelectric materials, biomaterials, Materials selection criteria in design: Ashby's charts and decision-making.	06
	TOTAL	**39**

Text Books:

1. Dr. V. D. Kodgire & S. V. Kodgire, "A Text Book of Material Science & Metallurgy for Engineers", Everest Publication.
2. William D. Callister Jr., "A Text Book of Materials Science and Engineering an Introduction", John Wiley & Sons, Inc.

Reference Books:

1. Raghvan V., "Material Science & Engineering", Prentice Hall of India, New Delhi. 2003 publication.
2. Avner S.H., "Introduction to Physical Metallurgy", Tata McGraw-Hill, 1997 Publishers.
3. Higgins R. A., "Engineering Metallurgy", Viva books Pvt. Ltd. Publishers.

E-Resources:

1. Lecture Series on Materials Science by Prof.SK. Gupta, Department of Applied Mechanics, IIT Delhi. For more details on NPTEL visit http://nptel.iitm.ac.in
2. Lecture Series on Introduction to Materials Science and Engineering, by Prof.Rajesh Prasad, Department of Materials Science and Engineering, IIT Delhi, http://nptel.iitm.ac.in
3. Lecture Series on phase diagrams in materials science and engineering by Prof.Krishanu Biwas, Department of Materials Science and Engineering, IIT Kanpur, http://nptel.iitm.ac.in
4. Lecture Series on Heat Treatment and Surface Hardening - I by Prof. Sandeep Sangal Department of Materials and Metallurgical Engineering IIT Kanpur http://nptel.iitm.ac.in

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Engineering Materials and Metallurgy Lab								**Code:** 25MEPC304P	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	25	-	25

Prerequisites: Engineering Physics, Engineering Chemistry, Fundamental in Mechanical Engineering

Course Objectives:

1. To familiarize students with crystal structures, material preparation, testing, and microscopic examination techniques.
2. To develop students' ability to evaluate mechanical properties, phase transformations, and hardenability through standard laboratory tests.
3. To expose students to industrial practices in material testing, heat treatment, casting, and composite manufacturing.

Course Outcomes: After completion of this course, students will be able to -

CO1	Identify crystal structures, phases, and microstructures of engineering materials.
CO2	Analyze material properties using standard mechanical and metallurgical tests.
CO3	Evaluate suitability of materials and processes based on test results and industrial practices.

List of Experiments/Exercises/Assignment:

(Any 08)

1. Study of crystal structures using models; calculation of Ligancy Number and atomic packing factor.
2. Hardness testing using: Rockwell and Poldi hardness Test.
3. Specimen Preparation for microscopic examination.
4. Demonstration and study of an Optical Metallurgical microscope.
5. Phase diagram plotting; discussion on Fe–Fe_3C curve and microstructure samples.
6. NDT study using the Dye Penetrant test.
7. Microstructure study of steel, cast iron, and non-ferrous alloys using metallurgical microscope.
8. Impact testing using Charpy and Izod methods.
9. Jominy end-quench test for hardenability.
10. Preparation of composite samples using hand lay-up method.
11. Calculation of percentage constituents in phase diagram using Lever rule.
12. Industrial Visit to cover any one of the practice - Foundry or Casting Industry, Heat Treatment Facility, Material Testing Laboratory or NABL Accredited Lab, Composite Manufacturing or Advanced Materials Industry.

Reference Books:

1. Raghvan V., "Material Science & Engineering", Prentice Hall of India, New Delhi. 2003 publication.
2. Avner S.H., "Introduction to Physical Metallurgy", Tata McGraw-Hill, 1997 Publishers.
3. Higgins R. A., "Engineering Metallurgy", Viva books Pvt. Ltd. Publishers.

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Engineering Mathematics – III								**Code:** 25MEMD301	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Differential and Integral calculus, Differential equations of first order and first degree, Fourier series, Elementary concepts of statistics and probability. Vector algebra, Vector Differentiation.

Course Objectives:

1. To familiarize with concepts and techniques in Ordinary & Partial differential equations, Numerical methods, Statistical methods, Probability theory and Vector calculus.
2. To equip with the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power useful in respective disciplines.

Course Outcomes: After completion of this course, students will be able to -

CO1	Solve higher order linear differential equations and also model & analyze mass spring systems.
CO2	Solve algebraic and transcendental equations using numerical methods
CO3	Apply interpolation techniques, perform numerical differentiation and integration and solve ordinary differential equations using appropriate numerical methods.
CO4	Summarize and analyze the data generated by mechanical systems using the fundamental concepts of statistics and probability.
CO5	Perform Vector integration, analyze the vector fields and apply to fluid flow problems
CO6	Solve Partial differential equations such as wave equation, one- and two-dimensional heat flow equations.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Linear Differential Equations and It's Applications:** Linear Differential Equations (LDE) of nth order with constant coefficients, Method of variation of parameters, Cauchy's and Legendre's D.E., Simultaneous DE and Symmetric DE, Applications of differential equations in mass spring systems.	08
2.	**Numerical Methods:** Numerical Solution of Algebraic and Transcendental equations: Bisection, Regula-Falsi, Newton– Raphson Method, Numerical Solutions of System of linear equations: Gauss elimination Method, Gauss-Seidel Method, LU Decomposition method.	06
3.	**Numerical Interpolation and solution of ODE:** Interpolation: Finite Differences, Newton's and Lagrange's Interpolation formulae, Numerical Differentiation.	07

	Numerical Integration: Trapezoidal and Simpson's rules, Solution of Ordinary differential equations (ODE): Euler's, Modified Euler's, Runge-Kutta 4th order methods.	
4.	**Statistics and Probability:** Statistics: Central tendencies, measures of dispersion, correlation and regression Probability, Random variables, Mathematical Expectation, Probability distributions: Binomial, Poisson, Normal, Test of Hypothesis, Chi-Square test.	06
5.	**Vector Integral Calculus:** Line integral, work done, Green's Lemma, Gauss's Divergence theorem and Stokes's theorem.	06
6.	**Partial Differential Equations (PDE) and It's Applications:** Partial Differential Equations (PDE)**,** Solution of PDE by Variation of Parameter, Modeling and solution of Vibrating String, One and Two-dimensional Heat flow problems.	06
	TOTAL	**39**

Text Books:

1. B.S. Grewal, "Higher engineering Mathematics", Khanna publishers, Delhi (40th edition), 2008
2. P. N. Wartikar & J. N. Wartikar, "Applied Mathematics, Volumes I and II", Pune Vidyarthi Griha Prakashan, Pune
3. H. K. Das, "Higher Engineering Mathematics" S. Chand Publication.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley Publications, 2015.
2. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists", 5e, Elsevier Academic Press.
3. B.V. Ramana, "Engineering Mathematics", Tata McGraw-Hill.
4. Wylie C.R., Barrett L.C., "Advanced Engineering Mathematics", McGraw-Hill, Inc.
5. Thomas L. Harman, James Dabney and Norman Richert, "Advanced Engineering Mathematics with MATLAB", 2e, Brooks/Cole, Thomson Learning.

E-Resources:

1. NPTEL Course "Transform Calculus and its appalicatins in differentail Equations" https://onlinecourses.nptel.ac.in/noc22_ma32/preview
2. NPTEL Course "Probability Theory and Application" https://nptel.ac.in/courses/111104079

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OPEN ELECTIVE - I

(Select any one course from the given Open Elective Courses)

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Common to all Programs)								**Semester:** III	
Course: Open Elective – I (Digital Literacy and Applications)								**Code:** 25ALOE301A	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	50	-	100

Prerequisites:

Basic computer knowledge, Familiarity with using internet and mobile devices

Course Objectives:

1. To introduce students to fundamental digital skills and online applications.
2. To enhance understanding of modern information and communication technologies (ICT).
3. To develop practical skills in digital tools, online collaboration, and data management.
4. To promote safe, ethical, and effective use of technology in professional and personal life.

Course Outcomes: After completion of this course, students will able to -

CO1	Demonstrate proficiency in using essential digital tools for everyday tasks.
CO2	Apply safe and secure practices while using the internet and online services.
CO3	Utilize online collaboration platforms for communication and teamwork.
CO4	Develop simple digital content (documents, presentations, basic websites).
CO5	Leverage emerging digital applications for academic, professional, and social needs.
CO6	Create a simple web application and explain emerging technologies in everyday life.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Digital Literacy**: Evolution of Digital Technology – Role of ICT in modern life – Hardware and Software basics – Overview of digital devices (Computers, Smartphones, Tablets) – Operating Systems and Applications.	04
2.	**Internet and Web Fundamentals:** Basics of Internet – Web Browsers – Search Engines – Online Communication Tools (Email, Chat, Video Conferencing) – Netiquette – Cloud Storage and File Sharing.	04
3.	**Digital Tools for Productivity:** Word Processing (MS Word/Google Docs) – Spreadsheet Fundamentals (MS Excel/Google Sheets) – Presentation Tools (PowerPoint/Canva) – Templates and Online Collaboration (Google Workspace, MS Teams).	05
4.	**Cyber Safety and Digital Ethics:** Online Security Threats – Password Management – Safe Browsing – Data Privacy – Cyberbullying – Digital Footprint – Intellectual Property Rights in the digital era.	05

5.	**Social media and Online Applications:** Role of social media in Communication – Online Professional Networking (LinkedIn) – Blogging and Content Sharing Platforms – Basics of Digital Marketing – E-Governance and Online Services (Banking, Payments, Education Portals).	04
6.	**Introduction to Web and Mobile Applications**: Creating a Simple Blog/Portfolio Website (Using WordPress/Wix) – Overview of Mobile Apps for Education and Productivity – Emerging Technologies (Cloud Computing, IoT, AI) in everyday life.	04
	TOTAL	**26**

Text Books:

1. Pradeep K. Sinha, Priti Sinha, "Computer Fundamentals", BPB Publications.
2. Rajaraman, "Fundamentals of Computers", PHI Learning.

Reference Books:

1. Alan Evans, Kendall Martin, Mary Anne Poatsy, "Technology in Action", Pearson Education.
2. Daniel Scott, "Digital Literacy Unpacked", Facet Publishing.

E-Resources:

1. NPTEL: https://nptel.ac.in
2. Digital Literacy Course, Google: https://learndigital.withgoogle.com
3. Microsoft Learn: https://learn.microsoft.com
4. W3Schools Basics: https://www.w3schools.com

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Common to all Programs)									**Semester:** III
Course: Open Elective – I (Environmental Studies)									**Code:** 25ALOE301B
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	50	-	100

Course Objectives:

1. To understand the structure and functions of ecosystems and the importance of biodiversity.
2. To study advanced energy systems and their role in sustainable development.
3. To learn concepts of natural resource management and disaster management through case studies.
4. To understand sources, impacts, and control measures of environmental pollution and waste management.
5. To create awareness about global environmental issues and environmental toxicology.
6. To gain knowledge of environmental assessment, management systems, and pollution control tools.

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

CO1	Understand the structure and functions of major ecosystems and the significance of biodiversity conservation
CO2	Evaluate various advanced energy systems in terms of their merits, demerits, and global applications
CO3	Apply concepts of natural resource management and disaster management using relevant case studies.
CO4	Analyse the sources, impacts, and control measures of environmental pollution and waste management practices.
CO5	Assess global environmental concerns and suggest sustainable solutions for issues like climate change and groundwater depletion.
CO6	Utilize environmental management tools and prepare environmental impact assessments following legislative guidelines.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Ecosystems** (Structure and Function): Forest, Desert, Wetlands, River, Oceanic and Lake. Biodiversity: Types, Value, Hot-spots, Threats and Conservation of biodiversity, Forest Wealth and Deforestation.	05
2.	**Advances in Energy Systems** (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind. Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable mining, case studies, and Carbon Trading.	04

3.	**Environmental Pollution** (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Groundwater Pollution, Noise pollution, Soil Pollution and Air Pollution. **Waste Management & Public Health Aspects**: Bio-medical Wastes, Solid waste, Hazardous wastes, E-wastes, Industrial and Municipal Sludge.	05
4.	**Global Environmental Concerns** (Concept, policies and case-studies): Groundwater depletion/recharging, Climate Change, Acid Rain, Ozone Depletion, Radon and Fluoride problem in drinking water, Resettlement and rehabilitation of people, Environmental Toxicology.	03
5.	**Latest Developments in Environmental Pollution Mitigation Tools** (Concept and applications): G.I.S. & Remote Sensing, Environmental Management Systems, ISO14001, Environmental Stewardship- NGOs.	04
6.	**Environmental Assessment, Management and Legislation** Aims and objectives of Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS). EIA Guidelines, Impact Assessment Methodologies, Procedure for reviewing EIA of developmental project, Life-cycle analysis, cost benefit analysis, Guidelines for Environmental Audit.	05
	TOTAL	**26**

Text Books:

1. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., "Environmental Encyclopedia", Jaico Publications House, 1st edition, 2000.
2. Agarwal, K.C, "Environmental Biology", Nidhi Publishers, 2nd edition, 2008.

Reference Books:

1. Erach Bharucha, "The Biodiversity of India", Mapin Publishing Pvt. Ltd., 1st Edition, 2002.
2. Brendan Gleeson and Nicholas Low (Eds.), "Global Ethics and Environment", Routledge, London, 1999.
3. Peter H. Gleick, "Water in Crisis", Pacific Institute for Studies in Development, Environment & Security, Stockholm Environment Institute, Oxford University Press, 1993.
4. Martha J. Groom, Gary K. Meffe, and Carl Ronald Carroll, "Principles of Conservation Biology", Sinauer Associates, Sunderland, 2006.
5. R. Edward Grumbine and M. K. Pandit, "Threats from India's Himalaya Dams", Science, Vol. 339, pp. 36–37, 2013.
6. Patrick McCully, "Rivers No More: The Environmental Effects of Dams", pp. 29–64, Zed Books, 1996.

E-Resources:

1. NPTEL video lecture on Environmental Impact Assessment
   https://www.youtube.com/watch?v=_iLdyhgFv1U
2. Sustainability Concepts - Innovations and Challenges
   https://www.youtube.com/watch?v=A9PGRnkLubE&list=PLbRMhDVUMngd2-jPdQSk3QNBTf2n7FxXU&index=2
3. Natural Resources Management

https://www.youtube.com/watch?v=vsXv3anIBSU&list=PLwdnzlV3ogoV162m7Q1rCQamsvKWT9D08

4. Biodiversity & conservation
https://www.youtube.com/watch?v=eJBfZGEzUfA&list=PLwdnzlV3ogoV162m7Q1rCQamsvKWT9D08&index=9

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Common to all Programs)								**Semester:** III	
Course: Open Elective – I **(**Green Energy and Sustainability)								**Code:** 25ALOE301C	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	50	-	100

Prerequisites:

Renewable energy, power generation technology

Course Objectives:

1. To study cleaner production and life cycle assessment.
2. To understand green fuels.
3. To learn green technology and green engineering.
4. To learn waste management.
5. To study sustainable technologies.

Course Outcomes: After completion of this course, students will able to -

CO1	Understand green technology principles, green chemistry, and process intensification for sustainable industries.
CO2	Evaluate the benefits, challenges, and environmental impact of green fuels compared to conventional fossil fuels.
CO3	Apply cleaner production principles and life cycle assessment for sustainability.
CO4	Assess waste types, audits, and management strategies with focus on health and environmental impact.
CO5	Explain sustainable technologies considering ecological, economic, and social dimensions.
CO6	Analyze practical challenges, case studies, and laws in implementing green technologies.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Principles of Green Technology and Green Engineering:** Processes and products for green safe and economically acceptable to the society, green chemistry and Process intensification. **Green Industrial Processes:** Pollution statistics from various industries. A greener approach towards all these industries.	05
2.	**Green Fuels:** Definition of Green Fuels, their benefits and challenges, comparison of green fuels with conventional fossil fuels with reference to environmental, economic and social impacts, public policies and market driven initiatives, Biomass energy: Concept of biomass energy utilization, types of biomass.	05
3.	**Cleaner Production:** Definition, Importance, Principles of Cleaner Production and its Benefits, Role of industry, Clean development mechanism, Reuse, Recovery, Recycle, Raw	04

	material substitution- Wealth from waste. Role of CP in Achieving Sustainability, Benefits, Role of Industry, Government and Institutions, Environmental Management, Pollution Prevention and Cleaner Production Awareness Plan, Environmental Statement, Carbon credit, Carbon trading. Introduction to Life Cycle Assessment (LCA) and Elements of LCA.	
4.	**Waste Management:** Waste stream assessment (WSA), Waste generation and composition, Waste characteristics (physical and chemical), Waste audit, Health and Environmental effects (public health and environmental), Comparative assessment of waste generation and Composition of developing and developed nations, a case study results from an Indian city, Handouts on solid waste compositions. E-waste generation.	04
5.	**Sustainable Technology:** Understand the Sustainable Technology, Three principle dimensions: the ecological, the economic and the social dimension, including intergenerational justice; use a systems perspective, to describe sustainability challenges and possibilities for major technical systems and for their transformation to meet sustainability requirements.	04
6	**Challenges and Practical Implementation:** Responsibilities and potentials of companies for action. Green Productivity and emerging technologies. Implementation of the practical applications of Green emerging technologies and sustainable development. Case studies in Green Technology. Green laws compliance.	04
	TOTAL	**26**

Text Books:

1. Matlack A.S., "Introduction to Green Chemistry", Marcel Dekker Publication.
2. Modak P., Visvanathan C. and Parasnis M., "Cleaner Production Audit Environmental System Reviews", Asian Institute of Technology Publication.
3. Anastas P.T. and Warner J.C., "Green Chemistry: Theory and Practice", Oxford University Press.
4. Bishop P. L., "Pollution Prevention: Fundamentals and Practice", McGraw-Hill Publication, Boston.
5. Clark J.H. and Macquarie D.J., "Handbook of Green Chemistry and Technology", Wiley Blackwell Publication.

Reference Books:

1. Sawyer C.N, McCarty P.L and Parkin G.F., "Chemistry for Environmental Engineering and Science", 5th ed. McGraw-Hill Professional Publication.
2. Paul L Bishop, "Pollution Prevention: Fundamentals and practice", McGraw-Hill International Publication.
3. Das A. K, "Environmental Chemistry with Green Chemistry", Books and Allied (P) Ltd. Publication.
4. V.K. Ahluwalia, "Green Chemistry Environmentally Benign Reactions", springer publication.

5. V.K. Ahluwalia, Ane. "Green Chemistry: Environmentally Benign Reactions", springer publication.
6. Mike Lancaster, "Green Chemistry: An Introductory Text", Royal Society of Chemistry publication.

E-Resources:

1. NPTEL Course on "Energy Resources, Economics and Sustainability", By Prof. Pratham Arora, IIT Roorkee, https://onlinecourses.nptel.ac.in/noc25_hs86/preview
2. NPTEL Course on "Sustainable Energy Technology", By Prof. Sayak Banerjee, IIT Hyderabad. https://onlinecourses.nptel.ac.in/noc23_me138/preview

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Common to all Programs)						**Semester:** III			
Course: Open Elective – I (Basics of Consumer Electronics)						**Code:** 25ALOE301D			
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	50	-	100

Prerequisites:

Basic understanding current, voltage, and electronics components

Course Objectives:

1. Understand principles and components of audio, video, and communication systems.
2. Develop practical skills in installation, operation, and maintenance of electronics.
3. Prepare students for technical roles in electronics service and support industry.

Course Outcomes: After completion of this course, students will able to -

CO1	Understand the working principles and components of basic audio systems and home theatre setups.
CO2	Explain the functioning of modern video display technologies and remote-control operations.
CO3	Identify and describe the types, specifications, and working of projectors and CCTV systems.
CO4	Describe satellite communication principles and DTH system setup and components.
CO5	Explain the construction, working, and common issues in basic household appliances like washing machines, mixers, and induction cooktops.
CO6	Understand the operation and features of kitchen and office equipment such as microwave ovens, printers, and scanners.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Audio Systems**: Introduction to audio systems, Audio amplifier, Microphone, Loudspeaker, Public address system, DJ system: concept and components, Audio as Data and Signal, Digital Audio Processes: Time Compression & Expansion, Block diagram and working of home theatre system	05
2.	**Video Systems and Display Technologies**: Elements of TV communication system, Scanning process and its necessity, Comparison: CRT, LCD, and LED TVs, LCD and LED TV: principles and section-wise working, 3D TV: Basic working principle, IPS panels and features, Interfaces: HDMI, USB, RGB, etc., TV remote control: types, IR code transmission/reception, functions, faults	05
3.	**Projectors and Surveillance Systems:** LCD vs. LED Projectors: differences and specs, Working principle and faults in LED projectors, CCTV Cameras: types and specifications, CCTV setup and components, Digital Video Recorders: types and working	04

4.	**Satellite Communication and DTH Technology**: Basics of satellite communication, Merits, demerits, and applications, Satellite types, orbits, frequency bands, Components of DTH: PDA, LNBC, satellite receiver, dish alignment, Cable types, impedance, MDU design, Set Top Box: block diagram, features, I/O ports, Cable modem termination system, software, CPE	04
5.	**Domestic Appliances – Part I:** Washing Machines: types, parts, block diagrams, timers, motors, Vacuum Cleaner: block diagram, working, features, motors, circuits, Mixer/Grinder: parts, speed control, auto overload protection, Electric Iron & Steam Iron: principle, thermostat, parts, Water Purifiers: RO/UV principles, components, faults, Immersion Heater: working, insulation, Induction Cooktop: principle, tubes, heat sinking, fault identification	04
6.	**Domestic Appliances – Part II and Office Equipment:** Microwave Oven: types, block & wiring diagram, microwave generation, Food Processors: parts and working, Printers: dot matrix, inkjet, laser; advantages, disadvantages, connectivity, Digital Electronic Lock, Xerox Machine, Scanner, Fax Machine	04
	TOTAL	**26**

Text Books:

1. S. P. Bali, "Consumer Electronics", 1st Edition, Paperback, English.
2. B. R. Gupta, "Consumer Electronics", Paperback, English.
3. Dr. J. S. Chitode, "Consumer Electronics – A Conceptual Approach".
4. Douglas Kinney, "A Beginner's Guide to Consumer Electronics Repair: Handbook and Tutorial".
5. Anand, "Consumer Electronics".
6. H. Davidson, "Troubleshooting Consumer Electronics Audio Circuits".

Reference Books:

1. Dennis Roddy, "Satellite Communications", McGraw Hill.
2. R. G. Gupta, "Audio Video Systems – Principles, Maintenance and Troubleshooting", Tata McGraw-Hill.
3. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
4. S. P. Sharma, "Appliance Servicing and Repair Guide", Katson Books

E-Resources:

1. Audio System Engineering (IIT Kharagpur),
   Course page: https://nptel.ac.in/courses/117/105/117105133
2. Satellite Communication & DTH
   NOC: Satellite Communication Systems (IIT Kharagpur)
   Course page: https://archive.nptel.ac.in/courses/117/105/117105131/

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Common to all Programs)									**Semester:** III
Course: Open Elective – I (Renewable Energy Systems)									**Code:** 25ALOE301E
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	50	-	100

Prerequisites:

Fundamentals of Mechanical Engineering, Physics, Thermodynamics

Course Objectives:

1. Discuss the global and national energy scenarios and environmental impacts and sustainability concerns associated with fossil fuel use.
2. Identify and explain the working principles of solar radiation measuring instruments including pyrheliometers, pyranometers, and sunshine recorders.
3. Classify various types of wind-mills and describe their structural components.
4. Introduce biomass as an energy source and describe biomass conversion technologies.
5. Describe the construction, working, and applications of various renewable energy sources.

Course Outcomes: After completion of this course, students will be able to -

CO1	Identify and describe the main types of renewable energy sources and their respective limitations.
CO2	Compare various types of solar collectors based on design and performance.
CO3	Identify and explain factors affecting wind characteristics and wind energy generation.
CO4	Interpret the advantages and limitations of biomass energy in comparison with other renewable sources.
CO5	Apply energy conversion principles to assess the feasibility of alternative energy systems.
CO6	Compare the suitability of renewable energy technologies (like fuel cells) for specific applications.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Renewable Energy:** Environmental consequence of fossil fuel, Limits Of Fossil Fuel, Energy Scenario, Classification of Energy Sources, types of renewable energy sources, limitations.	04
2.	**Solar Energy:** Environmental impacts of solar energy, Solar radiation measurements, Solar constant, Solar Radiation Measuring Instruments (Radiometers): Pyrheliometers, Pyranometers, Sunshine recorder, classification of solar collectors	05
3.	**Wind Energy:** Factors affecting the wind, Classification of Wind-mills, Main Components of a wind-mill, wind speed prediction, Advantages of Fixed and variable speed systems,	04

4.	**Biomass Energy:** Introduction, Biomass Conversion, Types of biogas plants: Floating dome type, Fixed dome type, Biodiesel, Significance of biodiesel	04
5.	**Other Forms of Renewable Energy Sources**: Introduction, hydro energy, geothermal energy, wave & tidal energy, Energy Conversion Principles, Environmental considerations	04
6.	**Applications of Renewable Energy Sources**: Photovoltaic (PV) cell, Solar water heater, Crop And Grain Drying, Space And Water Heating, Solar Energy Applications for Agriculture, Fuel Cell	05
	TOTAL	**26**

Text Books:

1. S. P. Sukhatme and J. K. Nayak, "Solar Energy: Principles of Thermal Collection and Storage", 3rd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
2. J. Twidell and Tony Weir, "Renewable Energy Resources", 2nd Edition, Taylor & Francis, 2006.
3. B. H. Khan, "Non-Conventional Energy Resources", 2nd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2009.
4. Prabir Basu, "Biomass Gasification, Pyrolysis and Torrefaction", Academic Press, Elsevier, 2013.

Reference Books:

1. O. P. Gupta, "Energy Technology", Khanna Book Publishing, New Delhi.
2. V. V. N. Kishore, "Renewable Energy Engineering and Technology: Principles and Practice", Routledge, 1st Edition, 2019.
3. N. Jenkins and J. Ekanayake, "Renewable Energy Engineering", Cambridge University Press, 1st Edition, 2017.
4. G. Boyle, "Renewable Energy", OUP Oxford, 2nd Edition, 2009.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ph44/preview
2. https://nptel.ac.in/courses/103103206
3. https://onlinecourses.swayam2.ac.in/nou22_ge71/preview
4. https://www.coursera.org/specializations/renewable-energy
5. https://www.coursera.org/learn/exploring-renewable-energy
6. https://www.youtube.com/watch?v=VfowJHJz6-s

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Problem Solving Techniques – I								**Code:** 25MEVS304	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Strategic thinking, natural, formal and informal logic, Conceptual clarity, logical reasoning, analytical mind

Course Objectives:

1. To acquire basic knowledge of problem classification, identification, formulation and root cause analysis.
2. To understand the structured way of solving problems with the various right tools and techniques.
3. To understand process of creative problem solving and decision making.

Course Outcomes: After completion of this course, students will be able to -

CO1	Classify problems, able to define the problem statement precisely by analysing its root cause.
CO2	Demonstrate solution of various problems using Fishbone and five why techniques.
CO3	Apply tools to create new ideas using SCAMPER and carry out decision making scientifically.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Fundamentals of Problem Solving:** Problem definitions, Classifications of problems-Simple and complex, structured, semi structured and unstructured problems with real life technical and non-technical examples, problem solving techniques- Root cause Analysis	09
2.	**Tools and techniques of Problem Solving:** Fishbone Diagram (Ishikawa or Cause-and-Effect Diagram), 5 Whys technique, Demonstration of technique through case studies, parametric study of various problem finding in various sectors and its scientific approach (campus, manufacturing firm, environment, highways, students' fraternity, water and air pollution, national security etc.)	08
3.	**Creative Problem Solving and Decision making:** Creativity, types of innovation, blocks of creativity, three components of creativity, Tools for defining existing problems and creation of new ideas, data collection and fact findings, Decision making, its tools, risk analysis, Delphi technique, SCAMPER technique	09
	TOTAL	**26**

Text Books:

1. M.T. Somashekara, "Problem Solving and Programming Concepts", PHI Learning.
2. Dheeraj Sharma, "Problem Solving and Decision Making", McGraw-Hill Education.

Reference Books:
1. Willian Henderson, "Master Critical Thinking, Creative, Logic & Problem solving skills", Peak Publish LLC. 2. Sharma Narender, "Handbook 7 QC tools", Shakehand with Life.
E-Resources:
1. Coursera: "Creative Problem Solving" - https://www.coursera.org/learn/creative-problem-solving. 2. MindTools – "Problem Solving Techniques", https://www.mindtools.com/cx4ems0/problem-solving.

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Python & Generative AI Lab								**Code:** 25MEVS305	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic Mathematics, Basic Computer Literacy.

Course Objectives:

1. To introduce Python programming and data handling for mechanical applications.
2. To develop skills in engineering computation and data visualization.
3. To expose students to generative AI tools for design and simulation tasks.

Course Outcomes: After completion of this course, students will be able to -

CO1	Select suitable Python and OOP techniques for mechanical engineering problems.
CO2	Evaluate data visualization and numerical methods for engineering analysis.
CO3	Recommend suitable AI tools for mechanical design, simulation, and documentation.

List of Experiments:

1. Program for Thermal Unit Conversion and Ideal Gas Law Calculations Using Python
2. Program for Processing Stress-Strain Data and Generating Graphs Using Python
3. Program for Modeling Mechanical Components Using Object-Oriented Programming in Python
4. Program for Implementing User-Defined Functions and Lambda Expressions in Python
5. Program for Manipulating and Processing Strings Using Python
6. Program for Determining Roots of Equations Using Bisection and Newton-Raphson Methods in Python
7. Program for Evaluating Definite Integrals Using Numerical Methods in Python
8. Program for Simulating a Prompt-Response System Using Python
9. Program for Generating Random Mechanical Design Concepts Using Python

Reference Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Green Tea Press, 2015
2. Wes McKinney, "Python for Data Analysis", O'Reilly Media, 2017
3. Andreas C. Müller & Sarah Guido, "Introduction to Machine Learning with Python", O'Reilly Media, 2016
4. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", O'Reilly Media, 2019
5. Steven C. Chapra & Raymond P. Canale, "Numerical Methods for Engineers", McGraw-Hill Education, 2020

E-Resources:

1. Python for Everybody – Dr. Charles Severance (Coursera)- https://www.coursera.org/specializations/python

2. Lambda Functions and String Methods – Geeks for Geeks- https://www.geeksforgeeks.org/python-lambda-anonymous-functions-filter-map-reduce/
3. Numerical Methods with Python – MIT Open Course Ware- https://ocw.mit.edu/courses/mathematics/18-085-computational-science-and-engineering-i-fall-2008/
4. Generative AI Explained – Google Cloud Skills Boost- https://www.cloudskillsboost.google/paths/118
5. AI in Engineering Design – NPTEL Course- https://nptel.ac.in/courses/112/106/112106289/

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Project Based Learning								**Code:** 25MECE301	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Engineering Mechanics, Fundamentals of Mechanical Engineering

Course Objectives:

1. To enable students to apply fundamental mechanical engineering concepts through the design, modeling, fabrication, and testing of simple systems, encouraging practical learning beyond theory.
2. To foster teamwork, innovation, and communication skills by engaging students in solving real-world problems through hands-on mini-projects with structured planning and documentation**.**

Course Outcomes: After completion of this course, students will be able to -

CO1	Apply mechanical engineering principles to design and develop simple mechanical systems addressing practical problems.
CO2	Use modeling, simulation, and fabrication tools to create and test functional prototypes or virtual systems.
CO3	Collaborate effectively in teams to plan, execute, and manage mini-projects with critical thinking and creativity.
CO4	Document and communicate project outcomes through technical reports, presentations, and self/peer evaluations.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	Brainstorming & project theme selection, Formulation of the problem statement, Setting objectives, team roles and timeline, Initial sketches or CAD models	06
2.	Detailed 2D/3D modelling (CAD + calculations if any), Application of engineering fundamentals	07
3.	Prototype fabrication, Testing, Design iteration (if needed)	07
4.	Final project demonstration, Poster or PowerPoint presentation, Report preparation and reflection	06
	TOTAL	**26**

Text Books:

1. Dr. K. Viswanath Allamraju, "Mechanical Engineering through Project Based Learning", Mahi Publication.
2. "Project Based Learning and Implementation", Bhabad International Publication, 2024.

Reference Books:

1. Dr. Sandhya Khedekar & Dr. Deepak Waikar, "Project Based Learning – Engaging in Real-World Challenges".

E-Resources:
1. Proceeding of the International Conference on Transformations in Engineering Education, Editor – R. Natrajan, 2014

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Liberal Learning - III

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** III	
Course: Liberal Learning – III (Guitar)								**Code:** 25MECC305A	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music and Guitar musical instrument.

Course Objectives:

1. To develop advanced guitar techniques, including scales, arpeggios, fingerstyle, and lead guitar skills.
2. To strengthen students' understanding of music theory, chord construction, harmony, improvisation, and melodic phrasing.
3. To enhance ensemble performance, stage confidence, musical communication, and readiness for intermediate-level performances.

Course Outcomes: After completion of this course, students will be able to -

CO1	Perform advanced scales, arpeggios, chord progressions, and fingerstyle techniques with accuracy.
CO2	Apply music theory concepts in lead guitar playing, improvisation, and melodic expression.
CO3	Demonstrate confident solo and ensemble performances with effective musical expression and stage readiness.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Revision of Semester II concepts, Warm-up & Finger Independence	2
2.	Major & Minor Scale Revision (Two Octaves)	2
3.	Pentatonic Scales & Blues Scale	2
4.	Arpeggios and Picking Exercises	2
5.	Chord Construction & Extended Chords (7th, Maj7, m7)	2
6.	Chord Progressions in Different Keys	2
7.	Fingerstyle Techniques – Patterns & Independence	2
8.	Lead Guitar Techniques – Hammer-ons, Pull-offs, Slides	2
9.	Improvisation using Pentatonic Scale	2
10.	Genre-based Playing (Blues, Rock, Pop)	2
11.	Ensemble Playing & Rhythm Coordination	2
12.	Solo Performance Practice & Individual Corrections	2
13.	Mock Performance & Stage Preparation	2
	TOTAL	**26**

Text Books:

1. Hal Leonard Corporation, "Hal Leonard Guitar Method – Complete Edition", Hal Leonard Publications.

2. Mel Bay, "Modern Guitar Method – Grades 1, 2 & 3", Mel Bay Publications.
3. William Leavitt, "A Modern Method for Guitar (Books 1–3)", Berklee Press.
4. Richard Chapman, "The Complete Guitar Manual", DK Publishing.
5. Ralph Denyer, "The Guitar Handbook", Knopf Publishing..

Reference Books:

1. Troy Stetina, "Fretboard Mastery", Hal Leonard Publications.
2. Tom Kolb, "Music Theory for Guitarists", Hal Leonard Publications.
3. Don Latarski, "Practical Theory for Guitar", Alfred Music.
4. Bruce Buckingham, "Scales and Modes for Guitar", Hal Leonard Publications.
5. Mark Phillips and Jon Chappell, "Guitar For Dummies", Wiley Publishing.

E-Resources:

1. **Berklee Online** – Guitar lessons, music theory, ear training, and performance resources. https://online.berklee.edu
2. **Justin Guitar** – Structured guitar lessons from beginner to advanced. https://www.justinguitar.com
3. **Fender Play** – Interactive lessons on chords, scales, techniques, and songs. https://www.fender.com/play
4. **TrueFire** – Professional online guitar courses covering multiple genres and techniques. https://truefire.com
5. **Ultimate Guitar** – Tabs, chord charts, scales, and community resources. https://www.ultimate-guitar.com
6. **MuseScore** – Free music notation software and sheet music library. https://musescore.org
7. **MusicTheory.net** – Interactive music theory lessons and exercises. https://www.musictheory.net
8. **Yamaha Music India** – Educational resources on guitar fundamentals and musicianship. https://in.yamaha.com

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** III	
Course: Liberal Learning – III (Singing)								**Code:** 25MECC305B	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music in singing.

Course Objectives:

1. To develop students' understanding of prescribed ragas and talas through theoretical and practical study.
2. To enhance vocal skills through Alankar practice in Shuddha and Vikrit (Komal) Swaras and different musical forms.
3. To strengthen rhythmic knowledge, musical expression, voice culture, and stage performance skills.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate understanding of prescribed ragas, talas, and Alankars through accurate vocal performance.
CO2	Apply rhythmic patterns such as Bhajani Theka and Jhaptal in prescribed vocal compositions.
CO3	Perform festival songs, ghazals, and vocal compositions with proper pitch, voice control, musical expression, and stage confidence.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Detailed Study of Prescribed Ragas: Raga Bageshree ,Raga Des, Raga Khamaj	6
2.	Study of Prescribed Talas: Bhajani Theka, Jhaptal	4
3.	Basic theory concepts	2
4.	Identification of Raga Characteristics and Tala Structure	2
5.	Festival Songs	2
6.	Gazals	2
7.	Soulful / Light Vocal Songs	2
8.	Interpretation and Presentation of Different Song Styles	2
9.	Practice of Ten Alankars in Shuddha/ Komal swaras	2
10.	Alankars based on the Prescribed Ragas	2
	TOTAL	**26**

Text Books:

1. V. N. Bhatkhande, "Kramik Pustak Malika (Vol. III & IV)", Publications.
2. V. D. Paluskar, "Sangeet Bal Prakash", Publications.

Reference Books:

1. V. N. Bhatkhande, "Hindustani Sangeet Paddhati (Vol. I–IV)", Publications.
2. Ashok Da. Ranade, "Hindustani Music: Tradition in Transition", Publications.

3. S. N. Ratanjankar, "Abhinav Geet Manjari", Publications.
E-Resources:
1. Sangeet Natak Akademi - All India Radio (Akashvani) 2. SwarGanga Music Foundation 3. YouTube – Sangeet Natak Akademi Channel 4. Digital Tanpura and Tabla Applications (e.g., iTanpura, Riyaz, NaadSadhana)

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** III	
Course: Liberal Learning – III (Cinematography)								**Code:** 25MECC305C	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

A basic understanding of film theory, Camera operation, Lighting techniques and visual storytelling is essential for cinematography.

Course Objectives:

1. To identify and operate camera equipment while understanding camera functions and exposure settings.
2. To develop skills in composition, framing, perspective, and lighting techniques.
3. To create visual stories through different photography genres and creative image-making.
4. To apply basic photo editing and post-processing techniques using editing software.

Course Outcomes: After completion of this course, students will be able to -

CO1	Operate cameras and apply appropriate settings, exposure, and lighting techniques to capture quality photographs.
CO2	Compose visually appealing photographs using principles of composition, design, and creative framing.
CO3	Capture photographs across different genres such as portrait, landscape, product, event, and wildlife photography.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Introduction to Videography	2
2.	Basics of Video Camera operations	2
3.	Techniques for steady shooting (Tripod, Gimble)	2
4.	Basics shot types (Wide, Medium, Close-up)	2
5.	Basics shot types (Wide, Medium, Close-up)	2
6.	Camera Movement (Pan, Tilt, Roll)	2
7.	Practical	2
8.	Composition Technique - Focus and Depth of field	2
9.	Natural vs artificial lighting	2
10.	Practical	2
11.	Filming Techniques	2
12.	Audio Recording	2
13.	Practical Session	2
	TOTAL	**26**

Text Books:

1. Peterson, B., "Understanding Exposure – Theory + Fundamentals", Amphoto Books.

2. Kelby, S., "The Digital Photography Book – Practical + Shooting", Rocky Nook.
Reference Books:
1. Langford, M., "Langford's Basic Photography – Technical Concepts", Focal Press. 2. Freeman, M., "The Photographer's Eye – Composition, Visual Balance, Framing, Perspective", Ilex Press.
E-Resources:
1. https://www.youtube.com/watch?v=xKRh4PI-BKg 2. https://www.youtube.com/@StudioBinder/videos

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** III	
Course: Liberal Learning – III (Dance)								**Code:** 25MECC305D	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Good stamina, flexibility and familiarity with simple rhythmic patterns and beats.

Course Objectives:

1. To strengthen students' technical proficiency through advanced Adavus, Jathis, and rhythmic patterns.
2. To develop expressive skills (Abhinaya) by interpreting simple classical compositions.
3. To enhance coordination, balance, posture, and stage presence through regular practical training.
4. To introduce students to intermediate Bharatanatyam repertoire such as Jatiswaram and improve performance skills.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate dance techniques with precision, balance, posture, and rhythmic accuracy.
CO2	Apply musicality, synchronization, expression, and storytelling in solo and group performances.
CO3	Create dance combinations using choreography principles with confidence, creativity, and stage presence.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Introduction to forms and previous year revision	2
2.	Choreography on song/ composition	6
3.	Application and introduction to emotions for better understanding of movements	4
4.	Rhythm and rhythmic movements	6
5.	Introduction to different forms other than the teaching format	2
6.	Insights to choreographies and partner motions in folk forms	4
7.	Mock performance training and presentation with costumes	2
	TOTAL	**26**

Text Books:

1. Bharata Muni, "Natya Shastra", translated by Manomohan Ghosh, Asiatic Society, Kolkata.
2. Nandikeshvara, "Abhinaya Darpana", translated by Manomohan Ghosh.
3. Balasaraswati, T., "Bharatanatyam", Madras Music Academy.
4. Krishna Iyer, E., "Bharatanatyam", Ganesh & Co., Chennai.

Reference Books:

1. Kothari, Sunil, "Bharatanatyam", Marg Publications, Mumbai.
2. Vatsyayan, Kapila, "Classical Indian Dance in Literature and the Arts", Sangeet Natak Akademi.

3. Subramaniam, Padma, "Bharata's Art: Then and Now", Bharata Ilango Foundation.
4. Vatsyayan, Kapila, "Indian Classical Dance", Publications Division, Government of India.
5. Srinivasan, Priya, "Sweating Saris: Indian Dance as Transnational Labor", Temple University Press.
6. Sangeet Natak Akademi, "Bharatanatyam – A Reader", Sangeet Natak Akademi, New Delhi.

E-Resources:

1. https://youtu.be/XONKu803dAk?si=LkLbNKPUvKpfZJkF
2. https://youtu.be/D0Ow529EHSo?si=upTtBpNp1lODzHMq
3. https://youtu.be/JDfYT3Ax7mE?si=Q9VYWj95cnLikw2V
4. https://youtu.be/GcZJMiHds3U?si=AXAMwJ37YuDEVbTF
5. https://youtu.be/2j9KmG25l8g?si=zH9rKV-VY7RPirgD

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** III	
Course: Liberal Learning – III (Synthesizer/Keyboard)								**Code:** 25MECC305E	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music and Keyboard musical instrument.

Course Objectives:

1. To strengthen students' understanding and practical application of major/minor scales, chords, chord progressions, and inversions.
2. To develop skills in Western Staff Notation, accompaniment techniques, melody integration, and left-hand coordination.
3. To enhance technical proficiency, musical expression, rhythmic accuracy, ensemble coordination, and stage confidence.

Course Outcomes:

CO1	Apply scales, chords, chord progressions, and inversions in keyboard performance.
CO2	Perform musical compositions using Indian and Western Staff Notation with suitable accompaniment techniques.
CO3	Demonstrate technical proficiency, musical interpretation, ensemble coordination, and stage confidence.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Revision of all Major Scales	2
2.	Revision of all Minor Scales (Natural, Harmonic & Melodic)	2
3.	Revision of Major and Minor Chords,	2
4.	Revision of Chord Progression, Family chords, Chords Inversion	2
5.	Playing Simple Songs with Indian Notation	2
6.	Introduction to Staff Notation	2
7.	Understanding the Difference between Indian and Western Staff Notation	2
8.	Reading and Playing Simple Melodies from Staff Notation	2
9.	Playing Songs using Both Indian and Staff Notation	2
10.	Fundamentals of Keyboard Accompaniment	2
11.	Accompaniment using Major and Minor Chords	2
12.	Accompaniment with Scales and Simple Songs	2
13.	Group Performance	2
	TOTAL	**26**

Text Books:

1. Aaron, M., "Michael Aaron Piano Course – Grade 2", Alfred Music.

2. Thompson, J., "John Thompson's Modern Course for the Piano – Second Grade", Willis Music.
3. Hanon, C. L., "The Virtuoso Pianist in Sixty Exercises", G. Schirmer.
4. Agay, D., "Learning to Play Piano – Book 2", Yorktown Press.

Reference Books:

1. Thompson, J., "Modern Course for the Piano", Willis Music.
2. Aaron, M., "Piano Course", Alfred Music.
3. Hanon, C. L., "The Virtuoso Pianist", G. Schirmer.
4. Harrison, M., "Contemporary Music Theory", Hal Leonard.
5. ABRSM, "Music Theory in Practice (Grades 1–5)", Associated Board of the Royal Schools of Music.

E-Resources:

1. https://www.youtube.com/watch?v=5nA245TZvBY
2. https://www.youtube.com/watch?v=h4YGP7GyZNU&list=PLUPHIkAcHm-SvoAmFIkec2STxRdvJnYYF

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** III	
Course: Liberal Learning – III (Basketball)								**Code:** 25MECC305F	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop fundamental basketball skills, physical fitness, teamwork, and understanding of rules and strategies to enable effective participation and performance in the game.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate basic basketball skills such as dribbling, passing, shooting, and defensive fundamentals effectively.
CO2	Apply offensive and defensive strategies, including transition play, during gameplay and scrimmages.
CO3	Understand and implement basketball game rules and referee gestures accurately in practical situations.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Fundamentals Skill Review:** Refresh all core basketball skills. Perform all basic techniques confidently.	2
2.	**Skill Circuit:** Practice all basic skills in rotation. Improve overall basketball fundamentals.	2
3.	**Small Group Practice:** Apply skills in partner and group activities. Work effectively with teammates.	2
4.	**Player Stance & Footwork:** Improve movement and body balance. Apply proper stance during movement.	2
5.	**Passing Under Movement:** Practice passing while changing positions. Execute accurate passes while moving.	2
6.	**Dribbling Around Cones:** Improve control through obstacle drills. Maintain dribbling control in different directions.	2
7.	**Assessment- V**	2
8.	**Shooting Practice:** Practice shooting from different spots. Improve shooting accuracy.	2
9.	**Rebounding Drills:** Practice timing and ball recovery. Perform effective rebounding.	2
10.	**Individual Defense:** Practice defensive movement in simple drills. Apply defensive techniques effectively.	2
11.	**Body Technique:** Improve body positioning and balance. Demonstrate better body	2

	control.	
12.	**Combined Fundamental Drills:** Integrate all basketball skills. Execute skills smoothly in sequence, Practice skills with a partner. Improve teamwork and communication	2
14.	**Assessment – VI**	2
	TOTAL	**26**

Text Books:

1. FIBA, "Official Basketball Rules", International Basketball Federation (FIBA)
2. Dr. James Naismith, "Basketball: Its Origin & Development",
3. John R. Wooden, "Practical Modern Basketball", Allyn & Bacon

Reference Books:

1. James Naismith – Basketball: Its Origin and Development – University of Nebraska Press.
2. Jerry V. Krause & Don Meyer – Basketball Skills & Drills – Human Kinetics

E-Resources:

1. Rules of Basketball : How to Play Basketball : Basketball Rules for Beginners
2. How To Dribble A Basketball For Beginners! Basketball Basics for Kids Basketball Training
3. How To Shoot A Basketball For Beginners! Basketball Basics [SECRETS]
4. Basketball: Rebounding

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** III	
Course: Liberal Learning – III (Cricket)								**Code:** 25MECC305G	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop basic cricket skills. Fitness, teamwork, and knowledge of rules and strategies for effective game performance.

Course Outcomes: After completion of this course, students will be able to -

CO1	Analyze batting, bowling, fielding, and match strategies across T20, ODI, and Test cricket formats.
CO2	Apply tactical decision-making, leadership, field placements, and performance analysis during competitive matches.
CO3	Demonstrate effective cricket performance by integrating sports psychology, nutrition, injury prevention, and technology in match situations.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Batting Strategies:** Build innings in different formats	2
2.	**Bowling Plans:** Field settings and tactical bowling	2
3.	**Captaincy & Leadership:** Decision-making and leadership	2
4.	**Match Strategy:** Powerplay, middle overs, death overs	2
5.	**T20 Cricket Strategies:** Aggressive tactics	2
6.	**ODI Cricket Strategies / Test Cricket Strategies:** Rotation of strike and partnerships / Patience and long-form tactics	2
7.	**Assessment – V**	2
8.	**Advanced Field Placements:** Offensive and defensive setups	2
9.	**Sports Psychology:** Confidence and concentration	2
10.	**Nutrition for Cricketers:** Performance nutrition	2
11.	**Injury Prevention & Recovery:** Basic sports medicine	2
12.	**Technology in Cricket:** DRS, Hawk-Eye, performance analysis	2
14.	**Assessment – VI**	2
	TOTAL	**26**

Text Books:

1. Sanjay Manjrekar, "Cricket Fundamentals", Orient BlackSwan
2. Ravi Shastri, "Winning Cricket: Skills and Strategies", Notion Press
3. R. Sridhar, "Coaching Beyond", Rupa Publications India

Reference Books:
1. Rob Eastaway, "Cricket Explained: From Grubbers to Googlies", St. Martin's Griffin 2. Surendra Shrivastava, "Cricket – Khel Aur Niyam", Prabhat Prakashan
E-Resources:
1. Sports and Performance Nutrition, IIT Madras, https://onlinecourses.nptel.ac.in/noc24_hs82/ 2. How to Play Cricket 3. Cricket rules explained in 2 minutes 4. Every Cricket Shot Explained in 21 Minutes

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)						**Semester:** III			
Course: Liberal Learning – III (Rifle and Pistol Shooting)						**Code:** 25MECC305H			
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop safe shooting skills, accuracy concentration, and proper shooting techniques in students. It also aims to build discipline, confidence and prepare shooters for competitive events.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain safe rifle handling, range discipline, equipment, and match procedures.
CO2	Demonstrate proper shooting techniques, physical coordination, and shooting posture.
CO3	Apply mental focus, concentration, and scientific principles to improve shooting performance.
CO4	Demonstrate sportsmanship, discipline, and overall proficiency in competitive shooting.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Recoil Management:** How to avoid recoil	2
2.	**Loading and Unloading Procedures: P**rocedure to load a gun.	2
3.	**Malfunction Identification and Clearance:** What is malfunction and its solutions	2
4.	**PGun Cleaning and Maintenance:** Process to open a gun and clean it	2
5.	**Ammunition Types and Selection:** Selecting a perfect ammunition from different ammunition companies	2
6.	**Environmental Effects on Shooting:** Effect on a shot of environment	2
7.	**Assessment – V**	2
8.	**Scoring Systems:** How to read score.	2
9.	**Competition Rules:** Explaining the rules and commands	2
10.	**Match Preparation:** Physical and mental preparation of a shooter for match	2
11.	**Mental Conditioning and Concentration:** Making a shooter mentally strong and increasing concentration process	2
12.	**Time-Controlled Shooting:** Procedure to fire a shot in given time	2
13.	**Assessment – VI**	2
	TOTAL	**26**

Text Books:

1. International Shooting Sport Federation (ISSF), "ISSF Official Statutes, Rules and Regulations", International Shooting Sport Federation (ISSF)
2. National Rifle Association (NRA), "The NRA Guide to the Basics of Pistol Shooting", National Rifle Association of America

3. National Rifle Association (NRA), "The NRA Guide to the Basics of Rifle Shooting", National Rifle Association of America

Reference Books:

1. National Rifle Association (NRA), "The Fundamentals of Rifle Marksmanship", National Rifle Association of America
2. International Shooting Sport Federation (ISSF), "ISSF Official Statutes, Rules and Regulations", International Shooting Sport Federation (ISSF)
3. National Rifle Association (NRA), "The NRA Guide to the Basics of Pistol Shooting", National Rifle Association of America
4. National Rifle Association (NRA), "The NRA Guide to the Basics of Rifle Shooting", National Rifle Association of America

E-Resources:

1. Introduction to Exercise Physiology & Sports Performance, IIT Madras, https://nptel.ac.in/courses/109106406
2. Open Sight Air Rifle Shooting Sports For Beginners. @TheGunzoneNetwork - YouTube
3. Basics of the Standing Position | Sauer Academy
4. The Ideal Air Rifle Shooter with Abhinav Bindra [IND]

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** III	
Course: Liberal Learning – III (Volleyball)								**Code:** 25MECC305I	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To equip participants with the essential skills and knowledge of volleyball, enabling them to perform fundamental techniques, understand basic rules, and participate in basic gameplay scenarios confidently.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain safe rifle handling, range discipline, equipment, and match procedures.
CO2	Demonstrate proper shooting techniques, physical coordination, and shooting posture.
CO3	Apply concentration, mental focus, and scientific principles to improve shooting performance.
CO4	Demonstrate discipline, sportsmanship, and overall proficiency in competitive shooting.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Double Blocking Technique:** Introduction to double blocking, stance and ready position, footwork for lateral movement, timing the jump with the attacker, hand positioning over the net, coordination between middle and wing blocker, drills on blocking angles and recovery.	2
2.	**Advance Digging:** Advanced defensive posture, digging against hard-driven spikes, rolling and diving techniques, pancake save, anticipation and reading the attacker, transition from defense to offense, reaction drills**.**	2
3.	**Advance Setting:** Jump setting, back setting, quick setting, setting accuracy under pressure, decision-making, communication with hitters, setter movement and transition drills.	2
4.	**Cross Court And Line Spiking:** Approach mechanics, body positioning, wrist action, cross-court attack, line attack, shot placement, attacking against blockers, controlled hitting drills**.**	2
5.	**Advanced Blocking:** Single, double and triple blocking strategies, reading setter intentions, block coverage, penetration over the net, transition after blocking, tactical blocking drills.	2
6.	**Libero Skills:** Role and responsibilities of the libero, serve receive, defensive positioning, emergency setting, court communication, floor defense techniques, specialized libero drills.	2
7.	**Assessment – V**	2

8.	**Offensive Systems (5-1):** Introduction to the 5–1 offensive system, player rotations, setter responsibilities, transition from defense to offense, positional responsibilities, team coordination.	2
9.	**Offensive Combinations:** Quick attacks, tandem attack, slide attack, combination plays, synchronization between setter and attackers, offensive communication and execution drills.	2
10.	**Team Defensive System:** Perimeter defense, rotational defense, block-defense coordination, defensive coverage, court positioning, communication, transition to counterattack.	2
11.	**Tactical Serving:** Float serve and jump serve placement, serving strategies against different formations, targeting weak receivers, serving under pressure, tactical decision-making.	2
12.	**Competitive Match Practice:** Full competitive matches following official rules, tactical implementation, referee signals, teamwork, leadership, sportsmanship, and post-match performance evaluation.	2
13.	**Assessment – VI**	2
	TOTAL	**26**

Text Books:

1. Fédération Internationale de Volleyball (FIVB), "Official Volleyball Rules", FIVB Publications
2. Bonnie Kenny & Cindy Gregory, "Volleyball: Steps to Success", Human Kinetics
3. Anita Bean, "The Complete Guide to Sports Nutrition", Bloomsbury Sport
4. Ian Jeffreys, "The Warm-Up", Human Kinetics

Reference Books:

1. Pete Waite, "Aggressive Volleyball", Human Kinetics
2. Bob Bertucci, "Volleyball Drill Book", Human Kinetics

E-Resources:

1. Volleyball Rules : How to Play Volleyball : The Rules of Volleyball EXPLAINED!
2. 6 Basic Skills in Volleyball - YouTube
3. Everything You Need to Know About the Game of Volleyball - YouTube

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)							**Semester:** III		
Course: Liberal Learning – III (Football)							**Code:** 25MECC305J		
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To enhance football players' technical skills, tactical understanding, physical fitness, teamwork, and sportsmanship, fostering a comprehensive understanding and appreciation of the game.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain attacking, defensive, formation, and set-piece principles in football.
CO2	Apply possession, counter-attacking, and transition strategies in match situations.
CO3	Analyze performance using psychology, nutrition, injury management, and technology.
CO4	Demonstrate teamwork, decision-making, and tactical skills during matches.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Principles of Attack:** Understand and apply the principles of attack, including creating space, supporting teammates, progressing the ball, and creating goal-scoring opportunities.	2
2.	**Principles of Defense**: Understand and apply the principles of defense, including pressure, cover, balance, marking, and communication to effectively prevent opponents from scoring.	2
3.	**Team Formations:** Understand and apply different team formations to improve player positioning, tactical organization, and overall team performance.	2
4.	**Transition Play:** Understand and apply effective transition play by quickly switching between attacking and defensive phases to maintain team advantage.	2
5.	**Possession-Based Football:** Develop possession-based football skills by improving ball retention, passing accuracy, movement, and decision-making to control the game effectively.	2
6.	**Counter-Attacking Football:** Understand and apply counter-attacking principles by transitioning quickly from defense to attack through speed, movement, and effective decision-making.	2
7.	**Assessment-V**	2
8.	**Set-Piece Organization**: Understand and apply set-piece organization by developing effective attacking and defensive strategies for free kicks, corners, and restarts.	2

9.	**Sports Psychology**: Develop mental skills such as confidence, focus, motivation, resilience, and decision-making to enhance football performance and overall sporting attitude.	2
10.	**Injury Management**: Understand basic injury management practices, including prevention, immediate care, recovery strategies, and safe return-to-play procedures for football players.	
11.	**Technology in Football:** Understand the role of technology in football by exploring tools for performance analysis, player development, match decisions, and injury prevention.	2
12.	**Full Match Analysis:** Analyze full match performance by evaluating tactics, player decisions, team organization, strengths, and areas for improvement.	2
13.	**Assessment-VI**	2
	TOTAL	**26**

Text Books:

1. Fédération Internationale de Football Association (FIFA), "Laws of the Game", FIFA
2. International Football Association Board (IFAB), "Laws of the Game", IFAB

Reference Books:

1. Charles Hughes, "The Winning Formula in Soccer", Meyer & Meyer Sport
2. Fédération Internationale de Football Association (FIFA), "Laws of the Game", FIFA
3. International Football Association Board (IFAB), "Laws of the Game", IFAB

E-Resources:

1. Udemy – Soccer Courses - https://www.udemy.com/topic/soccer/
2. Beginner's guide to football | Football for dummies
3. Every position in soccer explained
4. Rules Of Soccer : How to play Soccer : Soccer Rules for Beginners

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Program: B. Tech. (Mechanical Engineering)								**Semester:** III	
Course: Internship – I								**Code:** 25MEIN301	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
4 Weeks			02	-	-	25	-	-	25

Preamble:

Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.

Course Objectives:

1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry.
2. Learn to implement the technical knowledge in real industrial situations.

Course Outcomes: After completion of this course, students will be able to -

CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.

Internship Requirements

1. **Internship Duration:** It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 4 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW).
2. **Internship Opportunities:** Students can explore various opportunities for internships at:
    a. Industries
    b. Research labs or organizations
    c. Collegiate clubs
    d. In-house research projects
    e. Online internships
3. **Support and Assistance:** Students can seek assistance for securing internships from:
    a. The Training and Placement cell, along with departmental coordinators
    b. Department or institute faculty members
    c. Personal contacts
    d. Directly connecting with industries or organizations
4. **Request Letter:** Once an industry, research organization, or collegiate club is identified, students must obtain a request letter from the concerned department or placement office. This letter, in the

standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.

5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.

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SYLLABUS

SEMESTER - IV

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Theory of Machines								**Code:** 25MEPC405	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Engineering Mechanics, Engineering Drawing and Kinematics, Fundamental concepts of Physics and Mathematics

Course Objectives:

1. To familiarize students with fundamental concepts of mechanisms, degrees of freedom, inversions, and steering mechanisms.
2. To develop students' ability to analyze motion and dynamic forces in mechanisms using analytical and graphical methods.
3. To equip students with knowledge of gear trains, speed and torque transmission, and gyroscopic effects in mechanical systems.
4. To enable students to design cam profiles and evaluate follower motion for mechanical automation applications.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand mechanisms, inversions, and steering gear mechanism
CO2	Analyze motion in mechanisms using analytical and graphical methods.
CO3	Apply dynamic force analysis to reciprocating engine mechanisms and calculate crankshaft torque.
CO4	Understand gear theory and analyze speed and torque in various gear train systems.
CO5	Analyze the gyroscopic effect for the stabilization of ships, airplanes, and four-wheeler vehicles
CO6	Design cam profiles based on specified follower motions.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Fundamentals of Mechanisms:** Review of Basics of mechanism, machine, degree of freedom, Kutzbach criterion, Grubler's criterion, Grashoff's law, Inversion of four bar chain, Slider crank and double slider crank Mechanisms, Equivalent Mechanisms. Steering Gear Mechanism, Condition for correct steering, Davis and Ackermann Steering Gear Mechanism. Hooke's Joint and Double Hooke's Joints.	07
2.	**Kinematic Analysis of Mechanisms:** Analytical Methods, Displacement, velocity and acceleration analysis mechanisms by Relative Velocity and Acceleration Method, Instantaneous Centre of Velocity method, Coriolis component of Acceleration	07

3.	**Dynamics of Reciprocating Mechanisms:** Dynamic Force Analysis of Reciprocating Engines, Inertia Forces in Slider-Crank Mechanism, Two-Mass Statically and Dynamically Equivalent System, Correction Couple, Turning Moment (T–θ) Diagram, Crankshaft Torque, Fluctuation of Energy and Flywheel Applications	07
4.	**Gears:** Gear: Classification, Terminology, law of gearing, Involute and cycloidal tooth profile, path of contact, arc of contact, sliding velocity, Interference and undercutting, Minimum number of teeth to avoid interference, Force Analysis Helical and Spiral Gears: Terminology, Geometrical Relationships, virtual number of teeth for helical gears **Gear Trains:** Gear Train: Types and its application, Speed and Torque Analysis of Gear Trains	06
5.	**Gyroscope:** Introduction, Precessional angular motion, Gyroscopic couple, Effect of gyroscopic couple on an airplane, Effect of gyroscopic couple on a naval ship during steering, pitching and rolling, Stability of a Four Wheel drive moving in a curved path, Stability of a two-wheel vehicle taking a turn, Effect of gyroscopic couple on a disc fixed rigidly at a certain angle to a rotating shaft.	06
6.	**Cams and Followers:** Cams & Followers: Introduction, Classification of Followers and Cams, Terminology of Cam, Displacement and Cam Profile diagram for the Different Follower and Motion of follower, Cam jump Phenomenon, Application in Automated Systems.	06
	TOTAL	**39**

Text Books:

1. S. S. Rattan, "Theory of Machines", Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Bevan T, "Theory of Machines", Third Edition, Longman Publication
3. G. Ambekar, "Mechanism and Machine Theory", PHI
4. J. J. Uicker, G. R. Pennock, J. E. Shigley, "Theory of Machines and Mechanisms", Fifth Edition, International Student Edition, Oxford
5. Khurmi, R. S. and Gupta, J. K., "Theory of Machines", S. Chand Publishing, 2005.

Reference Books:

1. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd.
2. Sadhu Singh, "Theory of Machines", Pearson
3. Dr. V. P. Singh, "Theory of Machine", Dhanpatrai and Sons
4. R. L. Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi
5. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI

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E-Resources:
1. Kinematics of Machines, Prof. Ashok K Mallik, IIT Kanpur https://nptel.ac.in/courses/112104121/ 2. Theory Of Mechanisms, IIT Madras, Prof. Sujatha Srinivasan https://nptel.ac.in/courses/112106270 3. Mechanism and Robot Kinematics, Prof. Anirvan Das Gupta, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc20_me53/preview

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Theory of Machines								**Code:** 25MEPC405P	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	20	-	20

Prerequisites:

Engineering Mechanics, Engineering Drawing and Kinematics, Fundamental concepts of Physics and Mathematics

Course Objectives:

1. To develop students' skills in modeling and analyzing mechanisms, gear trains, cams, governors, and gyroscopic systems.
2. To enhance students' ability to apply graphical, analytical, and software-based methods for mechanism analysis and design.
3. To familiarize students with virtual labs, engineering software, and practical applications of mechanisms.

Course Outcomes: After completion of this course, students will be able to -

CO1	Analyze the kinematics and dynamics of mechanisms, gear trains, cams, governors, and gyroscopic systems.
CO2	Apply graphical, analytical methods for mechanism analysis and design.
CO3	Evaluate mechanism performance using experimental, virtual laboratory, and computational techniques.

List of Experiments:

For Laboratory Conduction The student shall complete the following activity as a Term Work:

Practical (Experiments 1 to 5 are compulsory. Perform any one from Experiments 6 and 7)

1. Creation and Presentation of a Model of a Real-Life Mechanism with Kinematic Analysis, and Design of a Simple Planar Mechanism Using 3D Modelling Software
2. Speed and torque analysis of Epicyclic gear train to determine holding torque.
3. To study and verify cam jump phenomenon
4. To determine the effect of active gyroscopic couple on a spinning disc and verify the gyroscopic effect
5. Study of the Working Principles and Applications of Governors
6. To study manufacturing of gear using gear generation with rack as a cutter and to generate an involute profile.
7. To study the Gear Boxes and its Types, Gearboxes Used in EV, CVT, AMT, DCT

Assignments using Drawing Aids

Do following graphical assignments on Half Imperial drawing sheet:

1. Velocity and acceleration analysis using relative velocity and acceleration method.
2. Velocity analysis using the ICR method.
3. To draw cam profile for combination of various follower motion with radial and off-set cam.

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Assignment Using Software (Perform any One)

1. Kinematic Analysis of Simple Mechanisms using Analytical Methods and Comparison with Computer Programming Results.
2. To do computer programming (using software/programming languages like C, Python, Scilab, Matlab etc.) for Kinematic Analysis of Hooke's joint Mechanism using Analytical Method.

Assignments using Virtual Laboratory:

Perform any One Virtual lab Experiments and Submit the Report.

1. Mechanics-of-Machines Lab (All Experiments), http://mm-nitk.vlabs.ac.in/index.html
2. Mechanisms and Robotics - Oldham Coupling Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html
3. Mechanisms and Robotics - Quick Return Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html
4. Mechanisms and Robotics - CAM Follower Mechanism, http://vlabs.iitkgp.ernet.in/mr/index.html

Reference Books:

1. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd.
2. Sadhu Singh, "Theory of Machines", Pearson
3. Dr. V. P. Singh, "Theory of Machine", Dhanpatrai and Sons
4. R. L. Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi
5. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Fluid Mechanics								**Code:** 25MEPC406	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Engineering Mathematics , Engineering Mechanics, Fundamentals of Mechanical Engineering, Engineering Thermodynamics

Course Objectives:

1. To introduce fundamental fluid properties and principles of fluid statics, including pressure and buoyancy.
2. To explain fluid kinematics and dynamics, covering flow classification and key governing equations.
3. To describe viscous and turbulent flow behavior and the effects on internal flows.
4. To teach flow characteristics and energy losses in pipes and open channels using practical methods.
5. To present control volume concepts and dimensional analysis for fluid flow modelling and experimentation.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain fluid properties and apply fluid statics principles to calculate pressure forces on submerged bodies.
CO2	Describe fluid motion using flow visualization and apply the continuity equation for steady incompressible flow.
CO3	Apply Bernoulli's equation and understand its limitations; interpret fundamental fluid dynamics principles including Navier-Stokes and CFD basics.
CO4	Analyze laminar and turbulent flow behavior in pipes and channels; understand boundary layer development and velocity distribution.
CO5	Evaluate major and minor losses in pipe systems and analyze open channel flow.
CO6	Apply control volume approach and Reynolds Transport Theorem to conservation laws; perform dimensional analysis and assess model-prototype similarity.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Fluid Properties and Fluid Statics:** Definition and classification of fluids, fluid properties, Pascal's Law, hydrostatic pressure distribution, buoyancy and Archimedes' Principle, applications of fluid statics forces on submerged bodies, center of pressure and total pressure.	07

2.	**Fluid Kinematics:** Flow visualization techniques, Description of fluid motion, Continuity equation- derivation and applications in steady incompressible flow, Fluid Acceleration	07
3.	**Fluid Dynamics:** Continuity equation in differential form, assumptions, Bernoulli's equation from differential momentum analysis, applications of Bernoulli's equation, limitations of Bernoulli's equation due to viscous effects and compressibility, Introduction to : notches and weirs, Navier–Stokes equation, CFD	07
4.	**Viscous and Turbulent Flows:** Laminar flow through circular pipe, between plates, Shear stress and velocity distribution. Boundary layer theory: thicknesses, separation, and control. Turbulent flow: characteristics, Reynolds experiment, velocity profiles.	06
5.	**Flow in Pipes and Open Channels:** Major and minor losses, Pipe network analysis, Friction factor and Moody chart, Open channel flow: types and regimes. Chezy's and Manning's equations, specific energy, critical depth, hydraulic jump (intro).	06
6.	**Control Volume and Dimensional Analysis:** Control volume concept; Reynolds Transport Theorem. Conservation of mass, momentum, and energy. Applications: pipe bends, nozzles, vanes. Dimensional analysis, Dimensionless numbers, Similitude and model testing	06
	TOTAL	**39**

Text Books:

1. Dr. P.N. Modi and Dr. S.M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House.
2. Cengel & Cimbla, "Fluid Mechanics",TATA McGraw-Hill
3. Russell C. Hibbeler, "Fluid Mechanics", Pearson Publication.

Reference Books:

1. White, "Fluid Mechanics", McGraw Hill Publication
2. Murlidhar, "Advanced Fluid Engineering", Narosa Publication.
3. G.S.Sawhney, "Fundamentals of fluid mechanics", I.K. International Publishing House Pvt. Limited, New-Delhi, 2008 New York.
4. Robert W. Fox, Alan T. McDonald, John W. Mitchell, Fox and McDonald's, "Introduction to Fluid Mechanics", 10th Edition, JOHN WILEY & SONS, INC.

E-Resources:

1. Fluid Mechanics, Prof. Subashisa Dutta, IIT Guwahati, https://onlinecourses.nptel.ac.in/noc25_ce107/preview
2. Fundamental of Fluid Mechanics, Dr. Ishtiyaq Ahmad and Dr. Vikrant Dongre, https://onlinecourses.swayam2.ac.in/nou25_me12/preview

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Manufacturing Technology – II								**Code:** 25MEPC407	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Fundamentals of Mechanical Engineering, Material Science & Metallurgy, Manufacturing Technology-I

Course Objectives: After completion of this course, students will be able to -

1. Concepts related to metal cutting, tool shapes, chip formation, machining forces, tool wear, surface finish, and machinability.
2. Details of machines used in shaping, turning, milling, drilling, grinding, and gear cutting, along with their parts and functions.
3. Basics of jigs and fixtures, their purpose in manufacturing, design principles, and types used for different machining processes.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain chip formation, tool nomenclature, tool wear, and machinability.
CO2	Describe construction, working, and operations of lathe machines.
CO3	Identify operations, tools, and gear manufacturing processes.
CO4	Classify grinding processes and describe broaching machines.
CO5	Explain jig and fixture concepts with degrees of freedom and 3-2-1 principle.
CO6	Identify jig and fixture types and explain their functional elements.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Theory of Metal Cutting:** Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools– nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.	07
2.	**Turning Machines:** Centre lathe, constructional features, specification, operations - taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout - automatic lathes: semi-automatic - single spindle : Swiss type, automatic screw type - multi spindle	06
3.	**Shaper, Milling and Gear Cutting Machines:** Shaper - Types of operations. Drilling, reaming, boring, Tapping, Milling operations – types of milling cutter. Gear cutting - forming and generation principle and construction of gear milling, Hobbing and gear shaping processes –finishing of gears.	06

4.	**Abrasive Process and Broaching:** Abrasive processes: grinding wheel — specifications and selection, types of grinding process– cylindrical grinding, surface grinding, Centre less grinding and internal grinding- Typical applications — concepts of surface integrity, broaching machines: broach construction — push, pull, surface and continuous broaching machines	06
5.	**Overview of Jigs and Fixtures:** Overview of their significance and roles in manufacturing for improving productivity, precision, and repeatability. Explanation of degrees of freedom and the 3-2-1 location principle. Design guidelines for developing efficient jigs and fixtures, including functional and structural considerations. Key advantages in machining and assembly operations. **Fixtures:** Definition and functional elements. Principles of location, clamping, and setting elements. Overview of fixture types for different applications: turning, welding, milling, assembly, and inspection.	07
6.	**Jigs:** Definition and function. Core elements and types of jigs. Guidelines for effective location, clamping, and guiding methods. Study of various jig designs: channel, template, plate, angle plate, turnover, box, and latch-type jigs.	07
	TOTAL	**39**

Text Books:

1. P.N. Rao, "Manufacturing Technology – II", Tata McGraw Hill.
2. R.K. Jain, "Production Technology", Khanna Publishers.
3. Amitabha Ghosh and Ashok Kumar Mallik, "Manufacturing Science", East-West Press.
4. S.K. Hajara Choudhary et al., "Elements of Workshop Technology, Volume II: Machine Tools", Media Promoters and Publishers Pvt. Ltd.

Reference Books:

1. G.C. Sen and A. Bhattacharya, "Metal Cutting and Machine Tools", Wiley Eastern.
2. Phillip F. Ostwald and Jairo Munoz, "Manufacturing Processes and Systems", Wiley.
3. O.P. Khanna, "Manufacturing Technology", Dhanpat Rai & Sons.
4. V.K. Jain, "Advanced Machining Processes", Allied Publishers.

E-Resources:

1. **Unit 1: NPTEL Course:** *Manufacturing Technology – I* by Prof. Amitabha Ghosh Manufacturing Process Technology I & II - Course
2. **Unit 2 to 6 : NPTEL Course:** *Manufacturing Technology – II* by Prof. Amitabha Ghosh Manufacturing Process Technology I & II - Course

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Manufacturing Technology – II Lab								**Code:** 25MEPC407P	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	20	-	20

Prerequisites:

Fundamentals of Mechanical Engineering, Material Science & Metallurgy, Manufacturing Technology-I

Course Objectives: After completion of this course, students will be able to -

1. To develop students' skills in designing and preparing cutting tools, jigs, fixtures, and machined components.
2. To enhance students' ability to apply machining, milling, turning, threading, tapping, and welding techniques in manufacturing applications.
3. To familiarize students with tool life, machinability, and production methods through practical exercises and case studies.

Course Outcomes: After completion of this course, students will be able to -

CO1	Select suitable cutting tools, jigs, fixtures, and machining methods for given manufacturing requirements.
CO2	Determine appropriate machining parameters and operations for producing specified components.
CO3	Evaluate machinability and tool life to make appropriate manufacturing decisions.

List of Experiments/Exercises/Assignment: (Any Six)

1. Design of Single point cutting Tool.
2. Preparation of cutting edges of single point cutting tool (Use of tool grinder).
3. Compound job involving taper turning and threading operation.
4. Manufacturing of spur gear using milling machine.
5. Design of welding fixture for given component configuration.
6. Design of Jig as per given component drawing.
7. Production of tapped hole on compound job (as per Sr. no. 3).
8. Case study on machinability aspects (Use of Taylor Life Equation).

Reference Books:

1. G.C. Sen and A. Bhattacharya, "Metal Cutting and Machine Tools", Wiley Eastern.
2. Phillip F. Ostwald and Jairo Munoz, "Manufacturing Processes and Systems", Wiley.
3. O.P. Khanna, "Manufacturing Technology", Dhanpat Rai & Sons.
4. V.K. Jain, "Advanced Machining Processes", Allied Publishers.

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Machine Learning & Data Science								**Code:** 25MEMD402	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	03	40	60	-	-	-	100

Prerequisites:

Engineering Mathematics, Basic Programming

Course Objectives:

1. An understanding of Machine Learning and Data Science concepts within the context of Mechanical Engineering applications.
2. Knowledge of methods for preprocessing, analyzing, and modeling datasets relevant to mechanical systems.
3. Awareness of the use of Machine Learning techniques in predictive maintenance, fault detection, and optimization tasks in mechanical engineering.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain data science and machine learning fundamentals from a mechanical engineering perspective.
CO2	Extract and Select meaningful features from mechanical data.
CO3	Apply supervised and unsupervised learning techniques to mechanical problems.
CO4	Understand , Build, tune, and validate ML models for engineering applications.
CO5	Explain key ideas of reinforcement learning and its algorithms.
CO6	Apply deep learning and computer vision for mechanical inspection and prediction tasks.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Basic Concepts of Data and Machine Learning:** **Introduction to Data Science (DS)**-History, Definition and Scope of DS, DS Workflow, Applications in Mechanical Engineering, **Data Types and Pre-processing** -Data Types, Data Quality and Pre-processing. **Machine Learning-** History**,** ML definition, Types of ML, Mechanical Engineering Applications	04
2.	**Feature Extraction and Selection:** **Feature Extraction** Time-domain statistical features (mean, standard deviation, RMS, kurtosis, skewness), Principal Component Analysis (PCA), nonlinear dynamic features (entropy, fractal dimension), **Feature Selection -** Filter methods , wrapper methods (exhaustive search, greedy forward and backward, best-fit), embedded methods (decision tree using entropy/information gain -Numerical)	05

3.	**Supervised Learning:** **Classification:** Decision Trees (ID3-IG), Random Forest, Naive Bayes, Support Vector Machine (SVM), K-Nearest Neighbour (KNN), Logistic Regression (Numerical example on decision trees).**Regression:** Linear regression. **Unsupervised Learning-Clustering:** k-means, selecting number of clusters, mechanical applications like fault pattern analysis and grouping material properties. (Simple Numerical)	05
4.	**ML Modelling and Evaluation:** **Problem identification:** Classification, clustering, regression, ranking, Steps in ML modelling from data pre-processing to deployment; bootstrap sampling, grid search CV, randomized search CV, k-fold cross-validation. **Model evaluation:** accuracy, precision, recall, true/false positives; understanding confusion matrix.	04
5.	**Reinforcement Learning:** Definition and key features of reinforcement learning (RL), Exploration vs Exploitation Trade-off **Types:** Value-based, policy-based, model-based; positive vs negative reinforcement. **Models:** Bellman optimality principle, Markov decision process, Q-learning, SARSA.	04
6.	**Deep Learning and ML Ethics:** **Deep Learning**: Neuron cell model, feedforward and backpropagation Artificial Neural Networks (ANNs), Convolutional Neural Networks (CNNs), activation functions, model training and overfitting **ML Ethics -** Bias and Fairness, Privacy and Data Protection, ML for Sustainability and Environmental Impact	04
	TOTAL	**26**

Text Books:

1. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow", O'Reilly Media, 2019
2. Mohri, Rostamizdeh, Talwalkar, "Foundations of Machine Learning", MIT Press, 2018
3. Alberto Boschetti & Luca Massaron, "Python Data Science Essentials", Packt Publishing, 2016.
4. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2017.
2. Solanki, Kumar, Nayyar, "Emerging Trends and Applications of Machine Learning", IGI Global, 2018
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
4. Rajeev Ranjan, "Machine Learning for Mechanical Engineers", McGraw-Hill, 2021.

5. S. Rajasekaran, G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI Learning, 2017.

E-Resources:

1. Scikit-learn documentation - https://scikit-learn.org
2. TensorFlow tutorials - https://www.tensorflow.org/tutorials
3. Kaggle datasets and notebooks - https://www.kaggle.com
4. Analyticsvidhya - https://www.analyticsvidhya.com

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)									**Semester:** IV
Course: Machine Learning & Data Science Lab									**Code:** 25MEMD402P
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	-	20	20

Prerequisites:

Engineering Mathematics, Basic Programming

Course Objectives:

1. To familiarize students with data acquisition, preprocessing, exploratory analysis, and feature extraction techniques for engineering datasets.
2. To strengthen students' capability to implement and assess classification, regression, and predictive machine learning models.
3. To expose students to machine learning applications in predictive maintenance, manufacturing cost estimation, tool wear prediction, and HVAC energy optimization.

Course Outcomes: After completion of this course, students will be able to -

CO1	Analyze engineering datasets using exploratory data analysis and feature extraction techniques.
CO2	Develop and evaluate classification and regression models for mechanical engineering applications.
CO3	Select suitable machine learning techniques for predictive maintenance, cost estimation, tool wear prediction, and HVAC energy optimization.

List of Experiments :

Guidelines for Practical's Conduction

The student shall complete the following activity as a Practical's. Students need to apply the computational algorithms using suitable software / programming language.

1. To acquire the data set and to extract features from given data set and establish training data.
2. To perform Exploratory Data Analysis on dataset.
3. To develop classification model and evaluate its performance (any one classifier).
4. To develop regression model and evaluate its performance (any one algorithm).
5. To apply a machine learning algorithm for predictive maintenance.
6. To build a model that estimates manufacturing cost based on process parameters.
7. To predict tool wear in CNC machining using sensor data and machine.
8. To optimize energy, use in HVAC systems using regression and clustering.

Reference Books:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2017.
2. Solanki, Kumar, Nayyar, "Emerging Trends and Applications of Machine Learning", IGI Global, 2018
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016.
4. Rajeev Ranjan, "Machine Learning for Mechanical Engineers", McGraw-Hill, 2021.

5. S. Rajasekaran, G. A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI Learning, 2017.

E-Resources:

5. Scikit-learn documentation - https://scikit-learn.org
6. TensorFlow tutorials - https://www.tensorflow.org/tutorials
7. Kaggle datasets and notebooks - https://www.kaggle.com
8. Analyticsvidhya - https://www.analyticsvidhya.com

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OPEN ELECTIVE - II

(Select any one course from the given Open Elective Courses)

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Common to all Programs)								**Semester:** IV	
Course: Open Elective – II (Cyber Security & Laws)								**Code:** 25ALOE402A	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	50	-	100

Prerequisites:

Foundational knowledge in computer science, networking.

Course Objectives:

1. To introduce the cyber world and cyber law in general.
2. To enhance the understanding of problems arising out of online transactions and provoke them to find solutions.
3. To know the technologies that stand behind certain cyber rimes.
4. To identify and analyze statutory, regulatory, constitutional, and organizational laws that affect the information technology professional.

Course Outcomes: After completion of this course, students will able to -

CO1	Illustrate and discuss the basic concepts of cyber security, Devices.
CO2	Understand the aspects related to personal data privacy and security.
CO3	Understand the main components of cyber security plan.
CO4	Understand about the type and nature of cyber-crimes.
CO5	Articulate the well-known cyber-attack incidents, explain the attack scenarios, and explain mitigation techniques.
CO6	Explain the difference between Systems Cyber Security, Network Cyber Security, and Cryptography, Crypto-Protocols, etc.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Cyber Security:** Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security.	04
2.	**Digital Devices Security, Tools and Technologies for Cyber Security:** End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third-party software, Device security policy, Cyber Security best practices, Significance of host firewall, Wi-Fi security, Configuration of basic security policy and permissions.	04

3.	**Cyber security Management, Compliance and Governance:** Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.	05
4.	**Cybercrimes:** Targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach Cybersquatting, Pharming, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft Cyber Police stations, Crime reporting procedure, Case studies	05
5.	**Cybercrime**: Illustrations, Examples and Mini cases, Real-life examples, Mini Cases-Social Engineering Attacks, Illustration of financial frauds in cyber domain, Digital Signature- Related Crime scenarios, Digital forensics case Illustrations, Online scams**.**	04
6.	**Cyber law:** Cybercrime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cybercrime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IOT, Block chain, Dark net and social media, Cyber Laws of other countries.	04
	TOTAL	**26**

Text Books:

1. Michael E. Whitman, Herbert J. Mattord, (2018), "Principles of Information Security", 6th edition, Cenage Learning, N. Delhi.
2. Chris Reed & John Angel, "Computer Law", OUP, New York, (2007).
3. Prasad R.S., "Cyber Crime an Introduction".
4. Ed. Kumar Krishna, "Cyber Laws".

Reference Books:

1. Angus M. Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, 2008.
2. Sushma Arora, Raman Arora, "Cyber Crimes & Laws", 4th Edition 2021, Publisher: Taxmann,
3. N S Nappinai, "Technology Laws Decoded", 1st Edition, Publisher: Lexis Nexis.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
3. https://onlinecourses.nptel.ac.in/noc25_cs116/preview

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Common to all Programs)									**Semester:** IV
Course: Open Elective – II (Sustainability and Climate Change)									**Code:** 25ALOE402B
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	50	-	100

Prerequisites:

Students should have knowledge about current environmental issues, various types of pollution and the concept of sustainable development.

Course Objectives:

1. To introduce the fundamental concepts and definitions of sustainability
2. To equip students with knowledge of sustainable construction solutions.
3. To develop an understanding of the Earth's climate system, assess the impacts of climate change, and evaluate the vulnerabilities of natural systems.

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

CO1	Explain the principles, challenges, global agreements, and legislations related to sustainable development and environmental protection.
CO2	Apply green materials, energy-water efficiency strategies, and green building rating systems to develop sustainable infrastructure solutions.
CO3	Analyze the earth's climate system, human influences, and observed trends to understand the fundamentals of climate change.
CO4	Evaluate the causes, impacts, and physical evidence of climate change at global and regional scales.
CO5	Assess the sectoral impacts of climate change on natural systems, infrastructure, and human health.
CO6	Recommend mitigation strategies and policy measures through international frameworks and technological interventions to address climate change.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Sustainable Development:** Definitions & Dimensions: sustainability, Brundtland Report, triple bottom line (economic, social, environmental), Global & Local Environmental Challenges: resource depletion, climate change, pollution, Agenda 21, CDM, Paris/Kyoto Protocols, Clean Development Mechanism, Environmental Legislation & Standards: ISO 14000 series, Indian Water & Air Acts.	05

2.	**Sustainable Solutions:** Green Materials & Techniques: low-VOC paints, agro-waste bricks, bamboo, ferro-cement, stabilized soil blocks. Energy & Water Efficiency: passive design, renewable/solar/wind energy, rainwater harvesting, EIA in construction. Green Building Systems: LEED, GRIHA, ECBC, BREEAM rating frameworks for sustainable infrastructure.	05
3.	**Climate & Climate Change Fundamentals:** Earth's Climate System: Atmosphere structure, energy balance, greenhouse effect, climate zones, monsoons, El Niño/La Niña Human Influence: Greenhouse gas emissions, global warming trends, carbon cycle, RCP/SSP scenarios, Indian climate observations	04
4.	**Climate Change Impact:** Climate Change Impact: Temperature shifts, sea-level rise, extreme weather, glacier melt, urban heat islands, Natural vs. anthropogenic causes; Milankovitch cycles, anthropogenic emissions. Physical evidence: rising global temperatures, melting glaciers, sea-level rise, extreme weather trends in India and globally.	04
5.	**Impacts on Natural System:** Sectoral impacts: agriculture, water resources, infrastructure, coastal zones, urban systems including heat islands, flooding, human health	04
6.	**Mitigation & Policy Measures:** International policy processes: UNFCCC, IPCC, Kyoto/Montreal Protocols, CDM & carbon trading Technological and engineering mitigation: renewable energy, CCS, reflective surfaces (cool roofs), bioengineering (e.g., slope stabilization)	04
	TOTAL	**26**

Text Books:

1. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science", Pearson Education.
2. D. N. Murty, "Sustainable Development", Himalaya Publishing House.
3. Peter P. Rogers, Kazi F. Jalal, and John A. Boyd, "An Introduction to Sustainable Development", Routledge, Earthscan Series.
4. N. H. Ravindranath and Jayant Sathaye, "Climate Change and Developing Countries", Springer.

Reference Books:

1. K. S. Jagadish et al., "Alternative Building Materials & Technologies", New Age International Publishers.
2. P. T. Anastas and J. B. Zimmerman, "Principles of Green Engineering", Oxford University Press.
3. David T. Allen and David R. Shonnard, "Sustainability Engineering: Concepts, Design & Case Studies", Pearson Education.
4. S. Kumar Dash, "Climate Change – An Indian Perspective", Cambridge University Press, 2007.

5. John M. Wallace and Peter V. Hobbs, "Atmospheric Science: An Introductory Survey", Elsevier Academic Press, 2006.
6. IPCC Assessments, Intergovernmental Panel on Climate Change (IPCC), as referenced in Anna University syllabus.

E-Resources:

1. UNEP (United Nations Environment Programme) https://www.unep.org/resources
2. IPCC (Intergovernmental Panel on Climate Change) Reports https://www.ipcc.ch/reports/
3. edX - Sustainability Courses https://www.edx.org/learn/sustainability
4. Coursera - Climate Change Courses https://www.coursera.org/courses?query=climate%20change
5. NASA Global Climate Change: Vital Signs of the Planet https://climate.nasa.gov/
6. World Bank Open Knowledge Repository https://openknowledge.worldbank.org/
7. UC Berkeley Environmental Courses (Search for PDFs) https://nature.berkeley.edu/classes/
8. MIT Open Courseware - Environmental Topics https://ocw.mit.edu/courses/find-by-topic/#cat=environment

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Common to all Programs)								**Semester:** IV	
Course: Open Elective – II (Energy Audit and Electrical Safety)								**Code:** 25ALOE402C	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**PR**	**OR**	**Total**
02	-	-	02	-	-	50	50	-	100

Prerequisites:

Concept of power & energy in three phase & single phase, Various electrical equipment & specifications

Course Objectives:

1. To Study the importance of energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities
4. Understand the key terms and definitions related to electrical safety.
5. Learn about preliminary preparations and preconditions necessary before starting installation work.

Course Outcomes: After completion of this course, students will able to -

CO1	Illustrate present state of energy security and its importance.
CO2	Identify and describe the basic principles and methodologies adopted in energy audit of utility.
CO3	Illustrate and analyze the Financial Analysis Techniques.
CO4	Evaluating the performance of some common thermal installations and list the energy saving opportunities.
CO5	Demonstrate awareness of the scope and significance of electrical safety in reducing risk and ensuring safe practices in electrical systems.
CO6	Identify and a**ssess** the potential risks and hazards associated with the installation process of electrical equipment.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Energy Scenario:** Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, Energy Conservation Act-2001 and its features, Re-structuring of the energy supply sector, energy strategy for the future, air pollution, climate change, Electricity Act, 2003.	05
2.	**Energy Management & Audit:** Definition, need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy	05

	use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments, Facility as an energy system, Energy analysis and the Sankey Diagram, Organizing - location of energy management, top management support, managerial function, roles and responsibilities of energy manager, force field analysis, Energy policies and its purpose.	
3.	**Financial Management:** Investment-need, appraisal and criteria, financial analysis techniques-simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of ESCOs, Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques -energy consumption, production, cumulative sum of difference (CUSUM).	04
4.	**Energy Efficiency in Electrical Utilities:** Electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors, energy conservation opportunities in Fans, Blower, Pumps, Lighting System.	04
5.	**Introduction to Electrical Safety, Shocks And Their Prevention:** Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, principles of electrical safety, Primary and secondary electrical shocks, causes of electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns in residential buildings and shops.	04
6.	**Safety During Installation of Plant and Equipment:** Introduction, preliminary preparations, preconditions for start of installation work, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines.	04
	TOTAL	**26**

Text Books:

1. Energy Audit and Management, Volume-I, IECC Press.
2. W.R. Murphy, G. McKay Butter worth," Energy management", Elsevier/bsp Books Pvt. Ltd., 2003.
3. Gupta B. R.: Generation of Electrical Energy, Eurasia Publishing House Pvt. Ltd., New Delhi, 2001
4. Prasanna Chandra, "Financial management", Tata McGraw Hill, 10th Edition, 2019.

5. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.
6. Pradeep Chaturvedi, "Energy Management Policy, Planning & Utilization", Concept Publishing.

Reference Books:

1. Albert Thumann, P.E., C.E.M. William J. Younger, "Handbook of Energy Audits", River Publishers,
2. Paul O'Callaghan, "Energy management", McGraw-Hill Education, 1992.
3. CB Smith, "Energy Management Principles", Pergamon Press, New York.
4. W. C. Turner, "Energy Management Hand Book". John Wiley and sons.

E-Resources:

1. NPTEL course on Basic Principles of Energy Management & Energy Audit, By Dr. R. N. Patel & Dr. Akhilesh Kumar Tiwari, Chhattisgarh Swami Vivekanand Technical University, Bhilai.
   Basic Principles of Energy Management & Energy Audit - Course
2. NPTEL course on Building Energy Systems and Auditing, By Prof. Shankha Pratim Bhattacharya, IIT Kharagpur.
   Building Energy Systems and Auditing - Course

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Common to all Programs)								**Semester:** IV	
Course: Open Elective – II (Digital Marketing)								**Code:** 25ALOE402D	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	50	-	100

Prerequisites:

Fundamentals of Business, Digital Tools

Course Objectives:

1. To understand digital marketing & process of website design.
2. To identify the keywords for a website & understand the SEO.
3. To Study the various Digital Marketing Tools.
4. To learn the use of social media websites for Digital Marketing.
5. To be Conversant with Linked In platform.
6. To know the recent trends in Digital Marketing.

Course Outcomes: After completion of this course, students will able to -

CO1	Design websites using free tools like wordpress and explore it for digital marketing.
CO2	Apply various keywords for a website & to perform SEO.
CO3	Understand the various SEM Tools and implement the Digital Marketing Tools.
CO4	Illustrate the use of Facebook, Instagram and YouTube for Digital Marketing in real life.
CO5	Use Linked in platform for various campaigning.
CO6	Understand the importance of recent trends in digital marketing.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Digital Marketing Planning and Structure:** Importance of Digital Marketing, Digital Marketing Vs. Traditional Marketing, Inbound vs Outbound Marketing, Understanding Demographics. WWW, Buying a Domain, Core Objective of Website and Flow, One Page Website, Strategic Design of Products & Services Page, Strategic Design of Landing Page, Segmentation & Targeting and Positioning to Digital Marketing, Portfolio, Gallery and Contact Designing Wordpress Website.	04
2.	**Search Engine Optimization (SEO):** Fundamentals; Keywords and SEO Content Plan; SEO & Business Objectives; Writing SEO Content; On-site & off-site SEO; Optimize Organic Search Ranking, Website SEO Auditing. Introduction to Web Analytics	04

3.	**Search Engine Marketing:** Importance of Adwords, Google Ad Types, PPC Cost Formula, Ad Page Rank, Billing and Payments, Adwords User Interface, Keyword Planner, Creating Ad Campaigns, Creating Text Ads, Creating Ad Groups, Search Engine Marketing (SEM) Tools, Bidding Strategy for CPC. Case Studies. Conversion Tracking Code, Designing Image Ads, Creating Video Ads, Youtube Video Promotion	05
4.	**Social Media Marketing (SMM) Part 1:** **B to C Perspective, B to B Perspective:** Introduction; Major Social Media Platforms for Marketing; Developing Data-driven Audience & Campaign Insights; Social Media for Business. **Facebook & Instagram Marketing:** Understanding of Facebook Marketing, Types of Facebook Advertising, Creating first ad on Facebook, Setting Campaign and optimization, Facebook Power Editor, Facebook Video Marketing, Facebook App & Shopping Marketing. **Youtube Marketing:** YouTube Account Setup (Create a business account with a personal account), YouTube Monetization, YouTube Ads, YouTube Analytics.	05
5.	**Social Media Marketing (SMM) Part 2:** **LinkedIn Advertising:** How to use Linkedin Professionally, Types of LinkedIn Advertising, LinkedIn New feed Advertising, LinkedIn Message Pitching, Traffic and Leads Generation, Billing and Report. **Email Marketing:** Email Software and Tools, Importing Email Lists, Planning Email Campaign, Email Templates and Designs, Sending HTML Email Campaigns, Web Forms Lead Importing, Integrating Landing Page Forms, Campaign Reports and Insights, Segmentation Strategy, Responder Tracker.	04
6.	**Upcoming Trends in Digital Marketing:** Podcast, OTT Platforms, Mob-Ad, No Click Searches, Google Verified Listing, Voice Search, Visual Search, Online Reviews, Automated and Smart Bidding, Chatbots, Affiliate Marketing.	04
	TOTAL	**26**

Text Books :

1. Cory Rabazinsky, "Google-Ad words for Beginners: A Do-It-Yourself Guide to PPC Advertising".
2. Ian Brodie, "Email Persuasion: Captivate and Engage Your Audience, Build Authority and Generate More Sales With Email Marketing".
3. Jan Zimmerman and Deborah, "Social Media Marketing All-In-One for Dummies".
4. Dave Chaffey, Fiona Ellis-Chadwick, Kevin Johnston, Richard Mayer, "Internet Marketing", Pearson Education.
5. Oliver J Rich, "Digital Marketing".
6. Gerry T. Warner and Joe Wilson Schaefer "Online Marketing".

Reference Books:
1. Prof. Seema Gupta, "Digital Marketing", Mcgraw Hill Publications. 2. Judy Strauss, Adel Ansary, Raymond Frost, Prentice Hall, "E- Marketing". 3. Dr. Andy Williams,"WordPress for Beginners 2020: A Visual Step-by-Step Guide to Mastering WordPress". 4. Cecilia Figueroa, "Introduction To Digital Marketing 101", BPB Publications. 5. The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns by Ian Dodson, Wiley; 1st edition (2016). 6. Digital Marketing For Dummies by Ryan Deiss and Russ Henneberry, For Dummies
E-Resources:
1. Digital Tools Certification- By Google. Link of the Course: https://skillshop.exceedlms.com/student/catalog 2. Swayam Certification course on, "Digital Marketing", by Dr. Tejindarpal Singh Panjab University Chandigarh. Link of the Course: https://swayam.gov.in/nd2_ugc19_hs26/preview

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Robotics & Automation Engineering)									**Semester:** IV
Course: Open Elective – II (Entrepreneurship and Innovations)									**Code:** 25ALOE402E
Teaching Scheme				**Evaluation Scheme**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	50	-	100

Prerequisites:

Professional Development, Quality Management System

Course Objectives:

1. To learn the students various aspects of innovation and methods of fostering Innovation
2. To appreciate the importance of embarking on self-employment and has developed the confidence and personal skills for the same.
3. To start a small business enterprise by liaising with different stake holders.
4. To effectively manage small business enterprise.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand the key concepts of innovation
CO2	Identify and analyze opportunities for innovation
CO3	Recognize the potential and value of self-employment
CO4	Develop a viable business plan for a small enterprise
CO5	Apply financial principles to plan and structure engineering and automation projects effectively
CO6	Apply fundamental principles of management

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Innovation:** Creativity, Invention and innovation, Types of Innovation, Relevance of Technology for Innovation, The Indian innovations and opportunities, Promoting and managing innovation, Innovators and Imitators, Patents, Trademarks, Intellectual Property, Exploring, Executing, Leveraging and renewing innovation, Enhancing Innovation Potential & Formulating strategies for Innovation	04
2.	**Strategy for Commercializing Innovation:** Innovation Process, Risks and barriers for introducing products and services, selecting a Strategy, setting up the Investment and establishing organisation, Evaluating the Costs and impact of the Project	04
3.	**Entrepreneurship:** Definition. Growth of industries in developing countries; role of industries in the national economy; characteristics; demand based and resources based ancillaries and sub-control types. Government policies, stages in starting an industry, types (family business/start-ups etc.), Sources of finance	04

4.	**Project Identification and Accountancy:** Assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, Accountancy: Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, preparation of financial reports, accounts and stores studies.	04
5.	**Project Planning and Control:** The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital expenditure and operations. Control of financial flows, control and communication.	05
6	**Laws:** Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state agencies which render assistance to small scale industries.	05
	TOTAL	**26**

Text Books:

1. Rabindra N. Kanungo, "Entrepreneurship and Innovation", Sage Publications, New Delhi, 1998.
2. Donald F. Kuratko, "Entrepreneurship – Theory, Process and Practice", 9th Edition, Cengage Learning, 2014.
3. Peter F. Drucker, "Innovation and Entrepreneurship", Butterworth-Heinemann.

Reference Books:

1. Robin Lowe and Sue Marriott, "Enterprise: Entrepreneurship and Innovation – Concepts, Contexts and Commercialization", Butterworth-Heinemann.
2. S. S. Khanka, "Entrepreneurial Development", S. Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
3. Joseph L. Massie, "Essentials of Management", Prentice Hall of India.

E-Resources:

1. https://ocw.mit.edu/collections/entrepreneurship/
2. https://onlinecourses.nptel.ac.in/

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Project Management System – I								**Code:** 25MEMC402	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

This course demands attributes like Positive outlook, Teamwork, effective communication, emotional intelligence, computer literacy, people skill, professional attributes, good leader.

Course Objectives:

1. To curate project, its types, classification and characteristics of project
2. To understand various project selection models to select project and check feasibility of it for success.
3. To understand project life cycle analysis, significance of each stage

Course Outcomes: After completion of this course, students will be able to -

CO1	Aware with lifecycle models of project management.
CO2	Know roles and responsibilities of project manager and apply technique of project selection
CO3	Understand project life cycle analysis and implement it to real life projects.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to project management:** Project attributes, types of projects, project classification, characterizers of project, Trends in project managements, SMART project, project, program and portfolio fundamental differences with real world examples, project selection models.	8
2.	**Project Selection Models:** Net present value, weighted scoring model, internal rate of return, analytical hierarchy process, project manager, project manager office, project manager attributes, organization structure of project organization, leadership ethics, management style, leadership competencies.	8
3.	**Project Initiation:** Project life cycle analysis, significance of each stage. Stakeholder types, their role and analysis, commitment assessment matrix, Resolving conflicts, negotiation, human factors in project management, Introduction to Agile project management Project management in real world.	10
	TOTAL	**26**

Text Books:

1. Gary Richard Son, Brad Jackson, "Project Management Theory & Practice" CRC Press.
2. Arun Kanda, "Project Management: A Lifecycle Approach", PHI.

3. John M. Nicholas, Herman Steyn, "Project Management for business engineering and technology", Elsevier.

Reference Books:

1. Goel, B. B., "Project Management: Principles and Techniques", Deep & Deep Publications Pvt. Ltd.
2. Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", Project Management Institute.

E-Resources:

1. Dr. Nimisha Singh, "Introduction to Project Management: Principles & Practices", NPTEL Course - https://onlinecourses.swayam2.ac.in/imb25_mg167/preview
2. Prof. Raghu Nandan Sengupta, "Project Management", NPTEL Course - https://onlinecourses.nptel.ac.in/noc25_mg78/preview
3. Project management for beginners by Ramesh Kumar https://youtu.be/gnkjcRDQkw0?list=PLLy_2iUCG87CBuNhvti0h6W54ZmqrSDMJ

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Problem Solving Techniques – II								**Code:** 25MEAE402	
Teaching Scheme (Hr/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Problem Solving Techniques-I, Strategic thinking, natural, formal and informal logic, Conceptual clarity, logical reasoning, analytical mind.

Course Objectives:

1. To acquire basic knowledge creative problem solving.
2. To understand the Skills and attitudes requirements for critical thinking.
3. To understand process of creative problem solving and design thinking

Course Outcomes: After completion of this course, students will be able to -

CO1	Apply concepts of critical thinking to complex problems of real world.
CO2	Apply skills and develop attitude of positivity and openness to undertake problem
CO3	Demonstrate ideation tools, diagram and maps for intricate problem solving

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Critical Thinking and Problem Solving:** Knowledge: fundamentals of logics, cognitive biases, advanced problem-solving techniques. Linking Critical Thinking and Cognitive Biases, the art of asking questions, problem framing, problem setting, Classification of methods of Problem Solving, Method for Problem Solving.	08
2.	**Skills and attitudes requirements for critical thinking:** Skills: identify own cognitive biases, identify biases in other, ability to apply a structured method to solve problems. Attitudes: metacognition, positivity with respect to problems Use Scenarios, Solving Contradictions, Combination, Crossover, brainstorming 3-6-5, 9 quadrants, Functional Brainstorming, TRIZ, The power of critical thinking: Effective reasoning about ordinary and extraordinary claims.	08
3.	**Design Thinking:** The Basis for Design Thinking, The Design Thinking Team, Design Thinking Workshops and Meetings, Listening and Empathizing Techniques Design Thinking Frameworks, Ideation tools, Use of Diagrams and Maps in Design Thinking – Empathy map. Affinity diagram, mind map, journey map Brief introduction of story telling.	10
	TOTAL	**26**

Text Books:
1. B. Mahadevan, "Operations Management: Theory and Practice", Pearson Education India. 2. L.M. Prasad, "Principles and Practices of Management", Sultan Chand & Sons. 3. Goudar, Amitkumar, "The Secrets of Design Thinking Mindset: More Tools and Techniques to Enhance Your Design Thinking Skill", Notion Press. 4. Agarwal, Anuja, "Design Thinking: A Framework for Applying Design Thinking in Problem Solving", 1st Edition, BPB Publications.
Reference Books:
1. Henderson, William, "Master Critical Thinking, Creative, Logic & Problem-Solving Skills", Peak Publish LLC. 2. Sharma, Narender, "Handbook of 7 QC Tools", Shakehand with Life.
E-Resources:
1. Coursera: "Effective Problem-Solving and Decision-Making" - https://www.coursera.org/learn/problem-solving 2. Design thinking by NPTEL Link - nptel.ac.in/courses/110106124

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)								**Semester:** IV	
Course: Solid Modelling and Drafting Lab								**Code:** 25MEVS406	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	-	20	20

Prerequisites:

Engineering Graphics, Solid Mechanics, Engineering Materials and Metallurgy

Course Objectives:

1. Introduce the fundamentals of solid modelling and CAD with a focus on industry applications.
2. Develop skills in 2D sketching, part modelling, and assembly creation using CAD tools.
3. Impart knowledge of modelling concepts, including geometry, topology, surface and sheet metal design.
4. Familiarize students with standard drawing practices, GD&T, and IS/BIS dimensioning standards.

Course Outcomes: After completion of this course, students will be able to -

CO1	Apply CAD tools and constraints to create 2D sketches and 3D models of mechanical components.
CO2	Select appropriate constraints and surface features to develop complete 3D assemblies and models.
CO3	Generate detailed engineering drawings with appropriate dimensions and GD&T symbols.

List of Experiments :

The student shall complete the following Practical in laboratory using suitable CAD modelling.

Total 08 of the following practical must be performed.

During Oral, the Student shall be evaluated based on the completion of Practical, Assignments, Presentations

1. Introduces the basics of Computer-Aided Design (CAD) software used for 2D drafting and 3D modeling.
2. Simple sketching of any 5 objects by using the above mentioned commands.
3. Creating any 2 simple machine parts by using 3D modeling software and calculation of mass properties by applying suitable material.
4. Creating assembly of model consisting of minimum 5 parts
5. Generation of 3D model by using surface parameters (Such as product casing design, automotive body panel design etc.)
6. Generation of Simple 3D model by using Sheet metal
7. Study and reading of Industrial Drawings to understand standard industrial practices viz. Dimensioning, GD&T, and Surface finish, welding symbols, etc.
8. Generating views from 3D parts and assemblies, Exploded views, Bill of Materials (BOM), GD&T symbols, dimensioning.

Reference Books:
1. Lee Kunwoo, (1999), "Principles of CAD/CAM/CAE Systems", Pearson/Addison-Wesley. 2. Bordegoni Monica and Rizzi Caterina, (2011), "Innovation in Product Design: From CAD to Virtual Prototyping", Springer. 3. Vukašinovic Nikola and Duhovnik Jože, (2019), "Advanced CAD Modeling: Explicit, Parametric, Free-Form CAD and Re-engineering", Springer.
E-Resources:
1. A NPTEL Course on "Design Practice – II", Prof. Shantanu Bhattacharya https://onlinecourses.nptel.ac.in/noc25_me157/preview 2. A Udemy Course on "Geometric Dimensioning & Tolerancing" https://www.udemy.com/topic/geometric-dimensioning-and-tolerancing-gdt/

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)									**Semester:** IV
Course: Fluid Mechanics and Machinery Lab									**Code:** 25MEPC408
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	-	20	20

Prerequisites:

Engineering Mathematics , Engineering Mechanics, Fundamental of Mechanical Engineering, Engineering Thermodynamics

Course Objectives:

1. To demonstrate and analyze fluid flow behavior and pressure measurement in practical systems.
2. To evaluate performance characteristics of hydraulic turbines and pumps through experiments.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain the working principles of flow measuring devices and hydraulic machinery.
CO2	Conduct experiments to measure pressure, flow rate, and losses in pipes.
CO3	Analyze flow regimes, head losses, and verify Bernoulli's principle using appropriate apparatus.
CO4	Evaluate the performance of turbines and pumps under different operating conditions.

Guidelines for Laboratory Conduction

The student shall complete the following activity as a Term Work

Total 08 of the following practical must be performed.

During Oral, the Student shall be evaluated based on the completion of Practical, Assignments, Presentations and Detailed Industrial Visit Report.

1. Study of Various Pressure Measuring Devices
2. Calibration of Orifice meter/ Venturimeter.
3. Determination of Reynolds number and flow visualization of laminar and turbulent flow using Reynolds apparatus.
4. Verification of Modified Bernoulli's Theorem.
5. Determination of minor losses through metal/non-metal pipes.
6. Determination of major losses through metal/non-metal pipes.
7. Trail on Pelton turbine
8. Trial on Francis Turbine
9. Trial on Centrifugal pump
10. Industrial Visit to pumping station/Hydro power plant.

Reference Books:

1. Dr. P.N. Modi and Dr. S.M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House.
2. Cengel & Cimbla, "Fluid Mechanics",TATA McGraw-Hill
3. Russell C. Hibbeler, "Fluid Mechanics", Pearson Publication.
4. White, "Fluid Mechanics", McGraw Hill Publication

5. Murlidhar, "Advanced Fluid Engineering", Narosa Publication.
6. G.S.Sawhney, "Fundamentals of Fluid Mechanics", I.K. International Publishing House Pvt. Limited, New-Delhi, 2008 New York.
7. Robert W. Fox, Alan T. McDonald, John W. Mitchell, Fox and McDonald's, "Introduction to Fluid Mechanics", 10th Edition, JOHN WILEY & SONS, INC.

E-Resources:

1. Applied Mechanics - Fluid Mechanics Laboratory, IIT Madras, https://nptel.ac.in/courses/112106311

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Liberal Learning - IV

DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Guitar)								**Code:** 25MECC406A	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music and Guitar musical instrument.

Course Objectives:

1. To develop advanced technical proficiency, musical interpretation, and performance skills through complex repertoire.
2. To enhance creativity, improvisation, composition, and theoretical understanding across multiple musical genres.
3. To strengthen ensemble leadership, stage performance, and professional musicianship for advanced musical pursuits.

Course Outcomes: After completion of this course, students will be able to -

CO1	Perform advanced guitar repertoire with technical accuracy, musical expression, and stylistic interpretation.
CO2	Apply advanced harmony, rhythm, improvisation, composition, and performance techniques across different musical genres.
CO3	Demonstrate ensemble leadership, collaboration, stage etiquette, and professional musicianship.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Revision of Semester III Concepts	2
2.	Advanced Chord Voicings & Inversions	2
3.	Modal Scales & Advanced Scale Applications	2
4.	Improvisation over Chord Progressions	2
5.	Advanced Fingerstyle & Hybrid Picking	2
6.	Guitar Solo Techniques – Bends, Vibrato, Legato	2
7.	Song Arrangement & Musical Interpretation	2
8.	Introduction to Composition & Melody Writing	2
9.	Ensemble Rehearsal & Musical Communication	2
10.	Genre-based Performance (Jazz, Rock, Blues, Contemporary)	2
11.	Stage Performance Techniques & Performance Psychology	2
12.	Mock Recital & Individual Feedback	2
13.	Final Rehearsal & Performance Preparation	2
	TOTAL	**26**

Text Books:

1. Hal Leonard Corporation, "Hal Leonard Guitar Method – Complete Edition", Hal Leonard Publications.

2. Mel Bay, "Modern Guitar Method – Grade 1, 2 & 3", Mel Bay Publications.
3. Leavitt, W., "A Modern Method for Guitar (Books 1–3)", Berklee Press.
4. Stetina, T., "Fretboard Mastery", Hal Leonard Publications.
5. Kolb, T., "Music Theory for Guitarists", Hal Leonard Publications.

Reference Books:

1. Chapman, R., "The Complete Guitar Manual", DK Publishing.
2. Latarski, D., "Practical Theory for Guitar", Alfred Music.
3. Denyer, R., "The Guitar Handbook", Knopf Publishing.
4. Buckingham, B., "Scales and Modes for Guitar", Hal Leonard Publications.

E-Resources:

1. Berklee Online – Guitar lessons, music theory, ear training, and performance resources. https://online.berklee.edu
2. JustinGuitar – Structured guitar lessons from beginner to advanced. https://www.justinguitar.com
3. Fender Play – Interactive lessons on chords, scales, techniques, and songs. https://www.fender.com/play
4. TrueFire – Professional online guitar courses covering multiple genres and techniques. https://truefire.com
5. Ultimate Guitar – Tabs, chord charts, scales, and community resources. https://www.ultimate-guitar.com
6. MuseScore – Free music notation software and sheet music library. https://musescore.org
7. MusicTheory.net – Interactive music theory lessons and exercises. https://www.musictheory.net
8. Yamaha Music India – Educational resources on guitar fundamentals and musicianship. https://in.yamaha.com

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Singing)								**Code:** 25MECC406B	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music in singing.

Course Objectives:

1. To develop voice modulation, singing, and expression techniques across different musical genres.
2. To familiarize students with microphone handling, studio setup, microphone placement, and recording practices.
3. To enhance students' recording and stage performance skills through practical application of raga, tala, rasa, and presentation techniques.

Course Outcomes: After completion of this course, students will be able to -

CO1	Apply voice modulation, pitch control, and singing techniques in various styles.
CO2	Perform Khayal, Semi-Classical, and Folk compositions with musical expression.
CO3	Demonstrate microphone handling, recording skills, and stage presentation.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Voice range development and voice modulation, Pitch control and tonal accuracy	4
2.	Voice culture for studio singing	4
3.	Singing techniques in different genres: Light Music, Film Songs, Ghazals, Lavani etc., Expression according to song style	4
4.	Vilambit Khayal, Drut Khayal	4
5.	Semi-Classical Music, Folk Music	2
6.	Performance practice, Stage presentation skills	2
7.	Knowledge of Raga and Tala, Rasa and Musical Expression	2
8.	Studio setup, Microphone handling techniques, Microphone placement, Recording techniques, Recording practice	4
	TOTAL	**26**

Text Books:

1. Bhatkhande, V. N., "Kramik Pustak Malika (Vol. III & IV)", Hindustani Music Publications.
2. Paluskar, V. D., "Sangeet Bal Prakash", Gandharva Mahavidyalaya Mandal.

Reference Books:

1. Bhatkhande, V. N., "Hindustani Sangeet Paddhati (Vol. I–IV)", Sangeet Karyalaya.
2. Ranade, A. D., "Hindustani Music: Tradition in Transition", Promilla & Co. Publishers.
3. Ratanjankar, S. N., "Abhinav Geet Manjari", Sangeet Karyalaya.

E-Resources:
1. Sangeet Natak Akademi 2. All India Radio (Akashvani) 3. SwarGanga Music Foundation 4. YouTube – Sangeet Natak Akademi Channel 5. Digital Tanpura and Tabla Applications (e.g., iTanpura, Riyaz, NaadSadhana)

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)						**Semester:** IV			
Course: Liberal Learning – IV (Cinematography)						**Code:** 25MECC406C			
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

A basic understanding of film theory, Camera operation, Lighting techniques and visual storytelling is essential for cinematography.

Course Objectives:

1. To develop proficiency in camera operation, exposure settings, and photographic composition.
2. To apply lighting techniques and visual storytelling principles across different photography genres.
3. To develop basic image editing and post-processing skills using appropriate software.
4. To enhance creative, technical, and professional skills for effective photography practice.

Course Outcomes: After completion of this course, students will be able to -

CO1	Operate cameras confidently and use various camera settings effectively.
CO2	Apply exposure principles by controlling aperture, shutter speed, and ISO to capture quality images.
CO3	Compose visually appealing photographs using principles of composition and design.
CO4	Utilize natural and artificial lighting techniques to enhance photographic results.
CO5	Capture photographs in different genres such as portrait, landscape, product, event, and wildlife photography.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Revision Session Of Sem III	2
2.	Storyboarding and planning	2
3.	Short film Screening	2
4.	Short Film Project (Camera-Phone)	2
5.	Short Film Project	2
6.	Short Film Project	2
7.	Short Film Project	2
8.	Short Film Project	2
9.	Short Film Project	2
10.	Short Film Project Submission	2
11.	Introduction Video Editing	2
12.	Basic Knowledge of Editing Tools	2
13.	Basics Timeline, Color Correction, Transition, Effects	2
	TOTAL	**26**

Text Books:

1. Peterson, B., "Understanding Exposure – Theory + Fundamentals", Amphoto Books.
2. Kelby, S., "The Digital Photography Book – Practical + Shooting", Rocky Nook.

Reference Books:

1. Langford, M., "Langford's Basic Photography – Technical Concepts", Focal Press.
2. Freeman, M., "The Photographer's Eye – Composition, Visual Balance, Framing, Perspective", Ilex Press.

E-Resources:

1. https://youtu.be/V7z7BAZdt2M?si=to4yQ46zEKRbxKOm
2. https://youtu.be/WXdAX0No2hM?si=GZu_mJsmyJ7NGnAU

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)						**Semester:** IV			
Course: Liberal Learning – IV (Dance)						**Code:** 25MECC406D			
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Good stamina, flexibility and familiarity with simple rhythmic patterns and beats.

Course Objectives:

1. To develop advanced dance techniques with precision, coordination, balance, flexibility, and rhythmic control.
2. To enhance expressive skills, musicality, stage presence, and overall performance quality.
3. To develop creativity and choreography skills through individual and group dance compositions.
4. To integrate technique, rhythm, expression, synchronization, and stagecraft in complete performances.
5. To develop leadership, teamwork, discipline, confidence, and professional performance skills through rehearsals, competitions, and cultural events.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate advanced dance techniques with precision, coordination, flexibility, balance, and rhythmic control.
CO2	Apply musicality, expression, synchronization, creativity, and stage presence in individual and group performances.
CO3	Create and present dance compositions using advanced choreography, formations, transitions, and stagecraft.
CO4	Plan, rehearse, and perform polished dance presentations for cultural events, competitions, and advanced training.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Revision of prior semester & Warm-up	2
2.	Introduction formatted story telling through dance	2
3.	Learning the First Half of the Composition ,	2
4.	Completion of Composition with Rhythm and introduction to live music dancing format	2
5.	Theme-Based Choreography – Planning and Concept Development	2
6.	Production introduction and choreography completion	2
7.	Lights and stage formative knowledge	2
	TOTAL	**26**

Text Books:

1. Bharata Muni, "Natya Shastra", translated by Manomohan Ghosh, Asiatic Society, Kolkata.
2. Nandikeshvara, "Abhinaya Darpana", translated by Manomohan Ghosh.

3. Balasaraswati, T., "Dance", Madras Music Academy.
4. Krishna Iyer, E., "Dance", Ganesh & Co., Chennai.

Reference Books:

1. Kothari, Sunil, "Dance", Marg Publications, Mumbai.
2. Vatsyayan, Kapila, "Dance: Indian Dance in Literature and the Arts", Sangeet Natak Akademi.
3. Payne, Helen, "Creative Dance and Movement in Groupwork", Routledge, 2021.

E-Resources:

1. https://youtu.be/VTrGVHvWfPA?si=AvKTenB7bpx302R6
2. https://youtu.be/pG0NmQDKspc?si=AEfhbRAEs9OjNErp
3. https://youtu.be/eg-3ybiL6UI?si=AOj0NuGXDupxD2Mt

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Synthesizer/Keyboard)								**Code:** 25MECC406E	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music and Keyboard musical instrument.

Course Objectives:

1. To strengthen understanding of fundamental keyboard concepts and techniques.
2. To develop proficiency in major and minor scales and arpeggios through practical exercises.
3. To enhance accompaniment, improvisation, and jamming skills through practical performance.
4. To develop listening skills, musical creativity, and ensemble performance techniques.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate improved technical proficiency through advanced practice of Major and Minor Scales.
CO2	Perform musical pieces based on Minor Scales with proper fingering, expression and dynamics.
CO3	Apply arpeggio patterns effectively in chord progressions and keyboard performance.
CO4	Demonstrate accompaniment, improvisation and jamming skills in solo and group performances.
CO5	Develop listening ability, rhythmic accuracy and musical confidence through ear training and ensemble practice.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	Revision of all Major Scales	2
2.	Revision of all Minor Scales (Natural, Harmonic & Melodic)	2
3.	Revision of Major and Minor Chords,	2
4.	Revision of Chord Progression, Family chords, Chords Inversion	2
5.	Playing Simple Songs with Indian Notation	2
6.	Introduction to Staff Notation	2
7.	Understanding the Difference between Indian and Western Staff	2
8.	Reading and Playing Simple Melodies from Staff Notation	2
9.	Playing Songs using Both Indian and Staff Notation	2
10.	Fundamentals of Keyboard Accompaniment	2
11.	Accompaniment using Major and Minor Chords	2
12.	Accompaniment with Scales and Simple Songs	2
13.	Group Performance	2
	TOTAL	**26**

Text Books:
1. Aaron, M., "Michael Aaron Piano Course – Grade 2", Alfred Music. 2. Thompson, J., "John Thompson's Modern Course for the Piano – Second Grade", Willis Music. 3. Hanon, C. L., "The Virtuoso Pianist in Sixty Exercises", G. Schirmer. 4. Agay, D., "Learning to Play Piano – Book 2", Yorktown Press.
Reference Books:
1. Thompson, J., "Modern Course for the Piano", Willis Music. 2. Aaron, M., "Piano Course", Alfred Music. 3. Harrison, M., "Contemporary Music Theory", Hal Leonard. 4. Hanon, C. L., "The Virtuoso Pianist", G. Schirmer. 5. ABRSM, "Music Theory in Practice (Grades 1–5)", Associated Board of the Royal Schools of Music.
E-Resources:
1. https://youtu.be/2mPS-2guHVo?si=8X_4KKezIdrMejLH 2. https://youtu.be/tEtukfFv3Wk?si=2iJ8wdD0dfjWauPb

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Basketball)								**Code:** 25MECC406F	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop fundamental basketball skills, physical fitness, teamwork, and understanding of rules and strategies to enable effective participation and performance in the game.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate fundamental basketball skills including passing, dribbling, shooting, and rebounding.
CO2	Apply proper footwork, body control, and individual defensive techniques during play.
CO3	Integrate fundamental skills effectively through drills, small-sided games, and practice matches.
CO4	Demonstrate teamwork, coordination, confidence, and consistency in basketball performance.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Complete Skill Revision:** Review all basketball fundamentals. Recall and perform all basic skills.	2
2.	**Passing & Receiving Practice:** Improve passing speed and accuracy. Demonstrate efficient passing skills.	2
3.	**Dribbling:** Enhance control and confidence. Maintain effective dribbling during movement.	2
4.	**Shooting:** Continue improving shooting technique. Achieve better shooting consistency.	2
5.	**Rebounding:** Reinforce rebounding fundamentals. Secure rebounds confidently.	2
6.	**Individual Defense:** Improve defensive positioning. Apply correct defensive techniques.	2
7.	**Assessment – VII**	2
8.	**Body Technique and Footwork:** Reinforce movement and balance. Demonstrate efficient basketball footwork.	2
9.	**Skill Integration:** Combine all fundamental skills. Execute basketball movements smoothly.	2
10.	**Partner Skill:** Develop teamwork through drills. Improve coordination with teammates.	2
11.	**Small Sided Games:** Apply skills in simple match situations. Use basketball fundamentals during gameplay.	2

12.	**Practice Match:** Reinforce practical learning. Participate confidently in basketball games.	2
13.	**Assessment - VIII**	2
	TOTAL	**26**

Text Books:

1. FIBA, "Official Basketball Rules", International Basketball Federation (FIBA)
2. Dr. James Naismith, "Basketball: Its Origin & Development"
3. John R. Wooden, "Practical Modern Basketball", Allyn & Bacon

Reference Books:

1. James Naismith – Basketball: Its Origin and Development – University of Nebraska Press.
2. Jerry V. Krause & Don Meyer – Basketball Skills & Drills – Human Kinetics

E-Resources:

1. Rules of Basketball : How to Play Basketball : Basketball Rules for Beginners
2. How To Dribble A Basketball For Beginners! Basketball Basics for Kids Basketball Training
3. How To Shoot A Basketball For Beginners! Basketball Basics [SECRETS]
4. Basketball: Rebounding

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** II	
Course: Liberal Learning – II (Cricket)								**Code:** 25MECC406G	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop basic cricket skills. Fitness, teamwork, and knowledge of rules and strategies for effective game performance.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate basic batting, bowling, and fielding skills with consistency.
CO2	Apply learned cricket skills, coordination, and decision-making during match situations.
CO3	Demonstrate basic umpiring knowledge, fair play, teamwork, and sportsmanship.
CO4	Demonstrate overall cricket proficiency through practice and competitive matches.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Revision of Batting Skills:** Strengthen all basic batting techniques.	2
2.	**Revision of Bowling:** Improve consistency and control in bowling.	2
3.	**Revision of Fielding Skills:** Enhance catching, throwing, and ground fielding.	2
4.	**Combined Skill Practice:** Practice batting, bowling, and fielding together.	2
5.	**Net Practice:** Improve performance through focused practice.	2
6.	**Team Coordination:** Develop communication during play.	2
7.	**Assessment - VII**	2
8.	**Match Awareness Practice Match I:** Understand basic match situations / Apply all learned skills in a game.	2
9.	**Practice Match II:** Improve decision-making during play.	2
10.	**Practice Match III:** Build confidence through match experience.	2
11.	**Basic Umpiring:** Learn simple umpiring signals and decisions.	2
12.	**Fair Play & Sportsmanship:** Understand discipline and ethics in cricket.	2
13.	**Assessment - VIII**	2
	TOTAL	**26**

Text Books:

1. Sridhar, R., "Coaching Beyond", Rupa Publications India.

Reference Books:
1. Eastaway, R., "Cricket Explained: From Grubbers to Googlies", St. Martin's Griffin.
E-Resources:
1. How to Play Cricket 2. Cricket rules explained in 2 minutes 3. Every Cricket Shot Explained in 21 Minutes

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)						**Semester:** IV			
Course: Liberal Learning – IV (Rifle and Pistol Shooting)						**Code:** 25MECC406H			
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop safe shooting skills, accuracy, concentration, and proper shooting techniques in students.
2. To build discipline, confidence and prepare shooters for competitive events.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain safe rifle handling, range discipline, equipment, and match procedures.
CO2	Demonstrate proper shooting techniques, coordination, and posture.
CO3	Apply mental focus and scientific principles to improve shooting performance.
CO4	Demonstrate discipline, sportsmanship, and overall shooting proficiency.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Shot calling:** Shot calling is the ability to mentally identify the exact location of the shot.	2
2.	**Maintain training diary:** To maintain notes given by coach	2
3.	**Pressure handling:** To handle pressure during match, shooters get tensed during match due to crowd or pressure about the performance	2
4.	**Full qualification matches:** Qualifying test match	2
5.	**Final match:** Final match between the qualified shooters	2
6.	**Dry firing test:** To do the whole process of firing the shot but the gun is not loaded	2
7.	**Assessment –VII**	2
8.	**Advanced Accuracy Drills:** It is a structured training exercise designed to improve precision, consistency, shot execution and mental control.	2
9.	**Mock Competition I:** It is a simulated shooting match conducted under actual competition conditions –match no.- **1**	2
10.	**Mock Competition II:** It is a simulated shooting match conducted under actual competition conditions –match no.- **2**	2
11.	**Equipment Inspection and Adjustment:** Learn to adjust the weapon according to the shooter	2
12.	**Ethics and sportsmanship:** It refers to the moral principles ,values, and respectful behavior that guide shooters during training and competition	2
13.	**Assessment – VIII**	2
	TOTAL	**26**

Text Books:
1. International Shooting Sport Federation (ISSF), "ISSF Official Statutes, Rules and Regulations", International Shooting Sport Federation (ISSF) 2. National Rifle Association (NRA), "The NRA Guide to the Basics of Pistol Shooting", National Rifle Association of America 3. National Rifle Association (NRA), "The NRA Guide to the Basics of Rifle Shooting", National Rifle Association of America
Reference Books:
1. National Rifle Association (NRA), "The Fundamentals of Rifle Marksmanship", National Rifle Association of America 2. International Shooting Sport Federation (ISSF), "ISSF Official Statutes, Rules and Regulations", International Shooting Sport Federation (ISSF) 3. National Rifle Association (NRA), "The NRA Guide to the Basics of Pistol Shooting", National Rifle Association of America 4. National Rifle Association (NRA), "The NRA Guide to the Basics of Rifle Shooting", National Rifle Association of America
E-Resources:
1. Introduction to Exercise Physiology & Sports Performance, IIT Madras, https://nptel.ac.in/courses/109106406 2. Open Sight Air Rifle Shooting Sports For Beginners. @TheGunzoneNetwork - YouTube 3. Basics of the Standing Position | Sauer Academy 4. The Ideal Air Rifle Shooter with Abhinav Bindra [IND]

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Volleyball)								**Code:** 25MECC406I	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To equip participants with the essential skills and knowledge of volleyball, enabling them to perform fundamental techniques, understand basic rules, and participate in basic gameplay scenarios confidently.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain the official rules, referee signals, and scoring procedures of volleyball.
CO2	Demonstrate advanced volleyball skills, fitness components, and position-specific techniques.
CO3	Apply offensive, defensive, and tactical strategies effectively during competitive play.
CO4	Demonstrate proficiency in officiating, teamwork, sportsmanship, and overall match performance.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Official Volleyball Rules:** History and development of volleyball rules, Court dimensions and equipment specifications, Team composition and player positions, Rotation and substitution rules, Scoring system (Rally Point System), Faults, violations, and penalties, Service order and match regulations.	2
2.	**Referee Signals:** Duties of the first and second referee, Official hand signals for all game situations, Line judge signals, Communication between officials, Practical demonstration of referee signals.	2
3.	**Score Sheet And Match Procedures:** Components of the official score sheet, Recording player line-ups and substitutions, Recording time-outs, sanctions, and scores, Match protocol before, during, and after play, Practical score sheet filling	2
4.	**Physical Conditioning:** Volleyball-specific warm-up exercises, Strength development for upper and lower body, Core stability exercises, Endurance training, Cool-down and recovery methods.	2
5.	**Speed And Agility And Plyometric:** Sprint drills , Agility ladder exercises, Cone drills , Jump training (plyometrics) , Explosive movement drills for volleyball	2
6.	**Flexibility And Injury Prevention:** Dynamic and static stretching, Mobility exercises, Common volleyball injuries, Injury prevention techniques, Recovery and rehabilitation basics	2
7.	**Assessment - VII**	2

8.	**Position-Specific Training:** Setter responsibilities and drills, Outside hitter techniques, Middle blocker skills, Opposite hitter training, Libero defensive techniques, Position-based game practice.	2
9.	**Complex Offensive System:5**–1 offensive system, 6–2 offensive system, Quick attack combinations, Setter-hitter coordination, Transition offense, Team offensive strategies.	2
10.	**Complex Defensive System:** Block defence system, Perimeter defense, Rotation defense, Backcourt positioning, Defensive communication, Transition from defense to attack.	2
11.	**Tournament Practice:** League and knockout match formats, Tournament scheduling, Team strategy under competition conditions, Match officiating practice, Sportsmanship and fair play.	2
12.	**Comprehensive Skill Revision:** Revision of all technical skills, Tactical system review, Fitness drills, Match-based practice, Error correction and performance improvement	2
13.	**Assessment - VIII**	2
	TOTAL	**26**

Text Books:

1. Fédération Internationale de Volleyball (FIVB), "Official Volleyball Rules", FIVB Publications
2. Bonnie Kenny & Cindy Gregory, "Volleyball: Steps to Success", Human Kinetics
3. Anita Bean, "The Complete Guide to Sports Nutrition", Bloomsbury Sport
4. Ian Jeffreys, "The Warm-Up", Human Kinetics

Reference Books:

1. Pete Waite, "Aggressive Volleyball", Human Kinetics
2. Bob Bertucci, "Volleyball Drill Book", Human Kinetics

E-Resources:

1. Volleyball Rules : How to Play Volleyball : The Rules of Volleyball EXPLAINED!
2. 6 Basic Skills in Volleyball - YouTube
3. Everything You Need to Know About the Game of Volleyball - YouTube

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech (Mechanical Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Football)								**Code:** 25MECC406J	
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To enhance football players' technical skills, tactical understanding, physical fitness, teamwork, and sportsmanship, fostering a comprehensive understanding and appreciation of the game.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate advanced football skills, position-specific techniques, and physical conditioning.
CO2	Apply leadership, coaching, refereeing, and talent identification skills in football.
CO3	Analyze match statistics, player performance, and team effectiveness using appropriate methods.
CO4	Demonstrate teamwork, fair play, ethics, and overall football proficiency in competitive matches.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Advanced Technical Drills:** Develop advanced football techniques through challenging drills that improve skill execution, speed, accuracy, and game adaptability.	2
2.	**Position-Specific Training:** Understand and apply position-specific skills, roles, and responsibilities to enhance individual performance within the team structure.	2
3.	**Leadership & Captaincy:** Develop leadership qualities, communication skills, and decision-making abilities to effectively guide and motivate teammates.	2
4.	**Football Coaching Methods:** Understand and apply effective coaching methods, session planning, and teaching approaches to improve player development.	2
5.	**Talent Identification:** Understand the principles of talent identification by evaluating technical, physical, tactical, and psychological attributes of players.	2
6.	**Strength & Conditioning:** Develop football-specific strength, endurance, speed, agility, and conditioning to improve athletic performance and reduce injury risk.	2
7.	**Assessment-VII**	2
8.	**Refereeing & Match Officiating:** Understand the laws of the game and develop basic refereeing skills for fair and effective match officiating.	2
9.	**Match Statistics & Performance Analysis:** Analyze match statistics and performance data to evaluate player contributions, team effectiveness, and areas for improvement.	2
10.	**Fair Play & Professional Ethics:** Understand the importance of fair play, respect, discipline, teamwork, and ethical behavior in football.	2

11.	**Tournament Practical:** Apply technical, tactical, physical, and teamwork skills in a competitive tournament environment.	2
12.	**Final Competitive Match:** Demonstrate overall football development by applying skills, tactics, teamwork, and sportsmanship in a competitive match setting.	2
13.	**Assessment-VIII**	2
	TOTAL	**26**

Text Books:

1. Fédération Internationale de Football Association (FIFA), "Laws of the Game", FIFA.
2. International Football Association Board (IFAB), "Laws of the Game", IFAB.

Reference Books:

1. Hughes, C., "The Winning Formula in Soccer", Meyer & Meyer Sport.
2. Fédération Internationale de Football Association (FIFA), "Laws of the Game", FIFA.
3. International Football Association Board (IFAB), "Laws of the Game", IFAB

E-Resources:

1. Beginner's guide to football | Football for dummies
2. Every position in soccer explained
3. Rules Of Soccer : How to play Soccer : Soccer Rules for Beginners

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DEPARTMENT OF MECHANICAL ENGINEERING

Program: B. Tech. (Mechanical Engineering)									**Semester:** IV
Course: Internship – II									**Code:** 25MEIN402
Teaching Scheme (Hrs/week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	-	-	02	-	-	25	-	-	25

Preamble:

Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.

Course Objectives:

1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry.
2. Learn to implement the technical knowledge in real industrial situations.

Course Outcomes: After completion of this course, students will be able to -

CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.

Internship Requirements

1. **Internship Duration:** It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 3 to 5 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW).
2. **Internship Opportunities:** Students can explore various opportunities for internships at:
    a. Industries
    b. Research labs or organizations
    c. Collegiate clubs
    d. In-house research projects
    e. Online internships
3. **Support and Assistance:** Students can seek assistance for securing internships from:
    a. The Training and Placement cell, along with departmental coordinators
    b. Department or institute faculty members
    c. Personal contacts
    d. Directly connecting with industries or organizations
4. **Request Letter:** Once an industry, research organization, or collegiate club is identified, students must obtain a request letter from the concerned department or placement office. This letter, in the

standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.

5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.

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