Curriculum– R25

B.Tech
in
Mechanical Engineering

Effective for 2025 Admission Batch Onwards

L – Lecture; T- Tutorial; P- Practical
[1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

1st Year - 1st Semester

Sl.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
		A. THEORY			L	T	P	Total	
1	ENGG	Major	ME101	Engineering Mechanics	3	0	0	3	3
2	ENGG	Minor	CS101	Introduction to Artificial Intelligence	2	0	0	2	2
3	SCI	Multidisciplinary	CH101	Engineering Chemistry	2	0	0	2	2
4	SCI	Multidisciplinary	M101	Engineering Mathematics –I	3	0	0	3	3
5	HUM	VAC	HU105	Constitution of India and Professional Ethics	1	0	0	1	1
6	HUM	Ability Enhancement Course	HU103	Design Thinking and Innovation	1	0	0	1	1
		B. PRACTICAL							
1	ENGG	Major	ME191	Workshop and Manufacturing Practices Lab	0	0	3	3	1.5
2	ENGG	Minor	CS192	Artificial Intelligence Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	CH191	Engineering Chemistry Lab	0	0	2	2	1.0
4	ENGG	Skill Enhancement Course	ME192	IDEA LAB Workshop	0	0	3	3	1.5
MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	Mandatory Course	MC181	Induction Program	0	0	0	0	0
		TOTAL CREDIT							**17.5**

*'Mandatory Additional Requirement'(MAR) activities have to be carried out as per university guidelines

1st Year - 2nd Semester

Sl.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
		A. THEORY			L	T	P	Total	
1	ENGG	Major	ME201	Fluid Mechanics	3	0	0	3	3
2	SCI	Multidisciplinary	M201	Engineering Mathematics II	3	0	0	3	3
3	SCI	Multidisciplinary	PH201	Engineering Physics	3	0	0	3	3
4	ENGG	Minor	EE(ME)101	Basic Electrical and Electronics Engineering	3	0	0	3	3
5	HUM	Value Added Course	HU204	Environmental Science	2	0	0	2	2
6	HUM	Value Added Course	HU205	Indian Knowledge System	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	ME291	Fluid Mechanics Lab	0	0	3	3	1.5
2	ENGG	Major	ME292	Engineering Graphics and Computer Aided Design Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	PH291	Engineering Physics Lab	0	0	3	3	1.5
4	ENGG	Minor	EE291	Basic Electrical and Electronics Engineering Lab	0	0	3	3	1.5
5	HUM	Skill Enhancement Course	HU191	Communication and Presentation Skill	0	0	3	3	1.5
C. MANDATORY ACTIVITIES / COURSES									
1	MC	Mandatory Course	MC281	NSS/ Physical Activities / Meditation & Yoga / Photography/ Nature Club	0	0	0	0	0
TOTAL CREDIT									**22.5**
TOTAL FIRST YEAR CREDIT									**40**

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2nd Year - 3rd Semester

Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
		THEORY			L	T	P	Total	
1	ENGG	Major	ME301	Engineering Thermodynamics	3	0	0	3	3
2	ENGG	Major	ME302	Materials Engineering	3	0	0	3	3
3	ENGG	Major	ME302	Strength of Material	3	0	0	3	3
4	ENGG	Major	ME303	Manufacturing Process	3	0	0	3	3
5	ENGG	Minor	M(ME)301	Mathematics III	3	0	0	3	3
6	SCI	Minor	CS(ME)301	Programming for Problem Solving	3	0	0	3	3
		PRACTICAL							
1	ENGG	Major	ME391	Material Testing Lab	0	0	3	3	1.5
2	ENGG	Major	ME392	Manufacturing Process Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	CS(ME)391	Programming for Problem Solving Lab	0	0	3	3	1.5
4	HUM	Ability Enhancement Course	HU(ME)391	Technical Seminar Presentation	0	0	1	1	0.5
		MANDAORY COURSES							
1	Mandatory Course	MC	MC381	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives		0	0	0	0
		TOTAL CREDIT							**23**

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2nd Year – 4th Semester

Sl.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits Points
					L	T	P	Total	
A. THEORY									
1	ENGG	Major	ME401	Applied Thermodynamics	3	0	0	3	3
2	ENGG	Major	ME402	Fluid Machinery	3	0	0	3	3
3	ENGG	Major	ME403	Manufacturing Technology	3	0	0	3	3
4	ENGG	Major	ME404	Kinematics & Dynamics of Machines	3	0	0	3	3
5	ENGG	Minor	CS(ME)401	Data Structure	2	0	0	2	2
B. PRACTICAL									
1	ENGG	Major	ME491	Fluid Mechanics & Fluid Machines Lab	0	0	3	3	1.5
2	ENGG	Major	ME492	Kinematics & Dynamics of Machines Lab	0	0	3	3	1.5
3	ENGG	Major	ME493	Manufacturing Technology Lab	0	0	3	3	1.5
4	ENGG	Major	ME494	Machine Drawing Lab	0	0	3	3	1.5
5	ENGG	Ability Enhancement Course	HU(ME)491	Quantitative Aptitude	1	0	0	1	0.5
C. MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC	MC481	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives		0	0	0	0
		TOTAL CREDIT							**20.5**

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3rd Year 1st Semester

Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
		A. THEORY			L	T	P	Total	
1	ENGG	Major	ME501	Heat Transfer	3	0	0	3	3
2	ENGG	Major	ME502	IC Engine & Hybrid Vehicles	3	0	0	3	3
3	ENGG	Major	ME503A	Refrigeration and Air Conditioning	3	0	0	3	3
			ME503B	Finite Element Analysis					
			ME503C	Metrology & Measurement					
4	ENGG	Minor	EC(ME)501A	Mechatronics Systems	3	0	0	3	3
			EE(ME)501B	Fluid Power control					
			CS(ME)501C	Data Base Management System					
5	ENGG	Minor	EC(ME)502A	Internet of Things	3	0	0	3	3
			EE(ME)502B	Energy Conservation & Management					
			CS(ME)502C	Data Science and Industry 4.0					
B. PRACTICAL									
1	ENGG	Major	ME591	Heat Transfer Lab	0	0	3	3	1.5
2	ENGG	Major	ME592	Thermal Engineering Lab	0	0	3	3	1.5
3	ENGG	Major	ME593A	Refrigeration and Air Conditioning Lab	0	0	3	3	1.5
			ME593B	Finite Element Analysis Lab					
			ME593C	Metrology & Measurement Lab					
4	ENGG	Minor	EC(ME)591A	Mechatronics Systems Lab	0	0	2	2	1
			EE(ME)591B	Fluid Power Control Lab					
			CS(ME)591C	Data Base Management System Lab					
5	ENGG	VAC	ME594	Modeling & Simulation of Mechanical Systems	0	0	1	1	0.5
6	ENGG	Project	ME581	Minor Project	0	0	2	2	1
C. MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC	MC581	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives	0	0	0	0	0
		TOTAL CREDIT							22

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3rd Year 2nd Semester

Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
		A. THEORY			L	T	P	Total	
1	ENGG	Major	ME601	Design of Machine Elements	3	0	0	3	3
2	ENGG	Major	ME602	Power Plant Engineering	3	0	0	3	3
3	ENGG	Major	ME603A	Materials Handling	3	0	0	3	3
			ME603B	Computational Fluid Dynamics					
			ME603C	Tribology					
4	ENGG	Major	ME604A	Renewable Energy System	3	0	0	3	3
			ME604B	Industrial Safety					
			ME604C	Nanotechnology					
5	ENGG	Minor	EC(ME)601A	Robotics & Flexible Automation	3	0	0	3	3
			EE(ME)601B	Electrical Machines					
			CS(ME)601C	Artificial Intelligence & Machine Learning					
6	HU	Multidisciplinary	HU(CS)601	Research Methodology & IPR	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	ME692	Design Lab	0	0	3	3	1.5
3	ENGG	Minor	EC(ME)693A	Robotics Lab	0	0	0	2	1
			EE(ME)693B	Electrical Machines Lab					
			CS(ME)693C	Artificial Intelligence & Machine Learning Lab					
5	ENGG	Internship	ME681	Industrial Training (Min. 2 weeks)	0	0	0	0	1
6	ENGG	Project	ME682	Major Project I	0	0	8	8	4
C. MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	MC	MC581	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives	0	0	0	0	0
		TOTAL CREDIT							23.5

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4th Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	THEORY			L	T	P	Total	
1	Major	ME701	Advanced Manufacturing Technology	3	0	0	3	3
2	Major	ME702	A. Automobile Engineering B. Computer Aided Design C. Turbomachinery	3	0	0	3	3
3	Major	ME703	A. Micro and Nano-Manufacturing B. Maintenance Engineering C. Composite Materials	3	0	0	3	3
4	Major	ME704	Rapid Prototyping	3	0	0	3	3
5	Minor	EC(ME)701A	Introduction to AR/VR	3	0	0	3	3
		EE(ME)701B	Electric Vehicles					
		CS(ME)701C	Cyber Security and Blockchain					
6	Ability Enhancement Course	HU(ME)701	Industrial Engineering & Management	2	0	0	2	2
	PRACTICAL							
1	Major	ME791	Advanced Manufacturing Technology Lab	0	0	2	2	1
2	Major	ME792A	Automobile Engineering Lab	0	0	2	2	1
		ME792B	Computer Aided Design Lab					
		ME792C	Turbomachinery Lab					
3	Ability Enhancement Course	HU(ME)791	Seminar & Group Discussion	0	0	2	2	1
4	Internship	ME781	Rapid Prototyping Lab	0	0	2	2	1
5	Project	ME782	Major Project-II	0	0	8	8	4
	TOTAL CREDIT							25

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4th Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	PRACTICAL			L	T	P	Total	
3	Project	ME881	Grand Viva	0	0	0	8	4
4	Project	ME882	Internship/ Entrepreneurship	0	0	0	8	4
	TOTAL CREDIT							8

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Total Credit:

Semester	Without MOOCS
1st	19.5
2nd	20.5
3rd	23
4th	20.5
5th	22
6th	23.5
7th	25
8th	8
TOTAL	**162**

Curriculum & Detailed Syllabus – R25
For First Year Courses

B.Tech
in
Mechanical Engineering

Effective for 2025 Admission Batch Onwards

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1st Year - 1st Semester

Sl.	Broad Category	Category	Course	Course Title	Hours per week				Credits
		C. THEORY			L	T	P	Total	
1	ENGG	Major	ME101	Engineering Mechanics	3	0	0	3	3
2	ENGG	Minor	CS101	Introduction to Artificial Intelligence	2	0	0	2	2
3	SCI	Multidisciplinary	CH101	Engineering Chemistry	2	0	0	2	2
4	SCI	Multidisciplinary	M101	Engineering Mathematics –I	3	0	0	3	3
5	HUM	VAC	HU105	Constitution of India and Professional Ethics	1	0	0	1	1
6	HUM	Ability Enhancement Course	HU103	Design Thinking and Innovation	1	0	0	1	1
		D. PRACTICAL							
1	ENGG	Major	ME191	Workshop and Manufacturing Practices Lab	0	0	3	3	1.5
2	ENGG	Minor	CS192	Artificial Intelligence Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	CH191	Engineering Chemistry Lab	0	0	2	2	1.0
4	ENGG	Skill Enhancement	ME192	IDEA LAB Workshop	0	0	3	3	1.5
MANDATORY ACTIVITIES / COURSES									
1	Mandatory Course	Mandatory Course	MC181	Induction Program	0	0	0	0	0
		TOTAL CREDIT							**17.5**

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COURSE NAME: ENGINEERING MECHANICS
COURSE CODE: ME101
CONTACTS: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3
Prerequisites: Basic Concept of Physics

Course Objective:
The objective of this course is to teach students how to apply Newtonian physics to relatively simpler real life applications under friction. This course covers statics, dynamics and elementary parts of strength of materials.

Course Outcomes:
CO1: Understand representation of force, moments for drawing free-body diagrams and analyze friction-based systems in static condition.
CO2: Analyze the centroid of an area and calculate the moment of inertia of a section.
CO3: Apply conservation of momentum & energy principle for particle dynamics and rigid body kinetics.
CO4: Understand and apply the concept of virtual work, rigid body dynamics and systems under vibration.

Course Contents:

Module No.	Syllabus	Contact Hrs.
Module 1: Introduction to Engineering Mechanics	Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Vector Mechanics- dot product, cross product, Problems.	**8**
Module 2: Friction:	Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack, Problems.	**4**
Module 3: Basic Structural Analysis	Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams;Frames & Machines, Problems.	**4**
Module 4: Centroid and Centre of Gravity	Distributed Force: Centroid and Centre of Gravity; Centroids of a triangle, circular sector, quadrilateral, etc., Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications, Problems.	**4**
Module 5: Moment of Inertia	Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; , Problems.	**4**

Module 6: Virtual Work and Energy Method	Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium, Problems.	**3**
Module 7: Review of particle dynamics	Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique), Problems	**5**
Module8: Introduction toKinetics of Rigid Bodies	Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation, Problems.	**4**

Text books:

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, –Dynamics, 9th Ed, Tata McGraw Hill
3. R.C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, PearsonPress.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford UniversityPress
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education

Reference books:

1. Reddy Vijaykumar K. and K. Suresh Kumar (2010), Singer's Engineering Mechanics
2. Bansal R.K. (2010), A Text Book of Engineering Mechanics, Laxmi Publications
3. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
4. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

CO – PO/PSO Mapping:

COS	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	2	2	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-
CO3	3	2	3	2	-	-	-	-	-	-	-
CO4	3	3	3	3	-	-	-	-	-	-	-

Course Name	**Introduction to Artificial Intelligence**
Course Code	**CS102**
Contact Hours (Period/week)	**2**
Total Contact Hours	**30**
Credit	**2**

Course Objectives:

The objectives of this course are to enable students to

1. Comprehend the fundamental concepts of Knowledge Representation and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context.
2. Formulate a problem as State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Use the strategies of AI-Heuristics to find acceptable solutions avoiding brute- force techniques.
4. Design AI-Frameworks for Inferencing based on knowledge base.
5. Analyze the effectiveness of AI-Inferencing Model in offering solutions to the respective problem.

Course Outcomes (COs):

After successful completion of this course, students will be able to:

CO1	**Understand and explain** the fundamental concepts of **Knowledge Representation** and Inferencing in Artificial Intelligence and its utilitarian importance in current technological context for further exploration leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem primarily to fit a State-Space Exploration Framework or an Inferencing **Model/Agent** Design Framework within the scope of Artificial Intelligence paradigm.
CO3	**Explore** relevant literature and **apply** the concept of Heuristic Techniques of Artificial Intelligence to **solve** problems.
CO4	**Develop** Inferencing Models for **proposing** solutions to the problems of Artificial Intelligence.
CO5	**Implement** Inferencing Models of Artificial Intelligence through **developing** feasible algorithms and **investigate** their effectiveness by **analyzing** their performances in solving the relevant problems.

Course Contents:

Module 1: Introduction to Artificial Intelligence (3 Lectures)

Why AI • Definition of AI • Goals of AI • History and evolution of AI • Types of AI: Narrow, General, Super • Human vs Artificial Intelligence • Applications of AI in various domains • AI for social good

Module 2: Intelligent Agents and Logic-Based Thinking (8 Lectures)

Intelligent systems • Agents and environments • Decision making using rules and logic • Symbolic AI concepts • Propositional Logic: Knowledge Representation and Inference using Propositional Logic • Predicate Logic: Knowledge Representation, Inference and Answer Extraction using First Order Predicate Logic

Module 3: Overview of AI Branches and Perception (8 Lectures)

Machine learning • Deep learning • Natural language processing • Computer vision • Expert systems • Fuzzy logic • Evolutionary algorithms • Reinforcement learning • Planning and scheduling • Human-AI collaboration

Module 4: **Basics of Machine Learning (6 Lectures)**

What is machine learning • AI vs ML • Types of learning: supervised, unsupervised • Concept of dataset, features, and labels • ML model and prediction flow • Common ML applications

- Introduction to decision trees (concept only) • ML pipeline overview.

Module 5: **Applications and Ethics of AI (5 Lectures)**

AI in robotics and automation • AI-enabled smart applications • Industry 4.0 and intelligent systems • AI in different sectors: healthcare, agriculture, transport, education, etc. • Human- AI teamwork • Basics of AI ethics: bias, fairness, privacy • Career opportunities and future scopes in AI.

Textbook:

Saptarsi Goswami , Amit Kumar Das , Amlan Chakrabarti - **AI for Everyone: A Beginner's Handbook for Artificial Intelligence (AI),** Pearson**.**

Rich, E., Knight, K and Shankar, B. 2009. **Artificial Intelligence**, 3rd edition, Tata McGraw Hill. Russell , S. and Norvig , P. 2015. **Artificial Intelligence - A Modern Approach**, 3rd edition, Prentice Hall.

Reference Books:

Reema Thareja, **Artificial Intelligence**: Beyond Classical AI, Pearson.

Patterson , **Introduction to Artificial Intelligence and Expert Systems,** Pearson.

CO–PO Mapping:

COs	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	2	-	-	-	-	-	-	-	-	3
CO2	2	3	-	-	-	-	-	-	-	-	-
CO3	2	2	3	2	-	-	-	-	-	-	-
CO4	2	2	2	3	-	-	-	-	-	-	2
CO5	2	2	3	3	2	-	-	-	-	-	2

Course Name: ENGINEERING CHEMISTRY
Paper Code: CH 101/CH 201
Total Contact Hours: 24
Credit: 2
Prerequisites: 10+2

COURSE OBJECTIVE

- Understand the basic principles of atomic structures and periodic properties of elements, different engineering materials, advanced polymers.
- Apply the knowledge of free energy, energy storage device and semiconductors to design environment friendly and sustainable devices.
- Apply the concept of corrosion and fuel to improve its efficacy and application for industrial purpose.
- Analyze the organic reaction with the structure of organic molecules by applying the knowledge of different spectroscopic techniques.
- Evaluate the electrical, optical, and structural properties of semiconductors to analyze their potential applications in modern electronic and energy devices

COURSE OUTCOME

CO1. Able to understand the basic principles of atomic structures and periodic properties of elements, different engineering materials, advanced polymers.

CO2. Able to apply the knowledge of free energy, energy storage device and semiconductors to design environment friendly and sustainable devices.

CO3. Able to apply the concept of corrosion and fuel to improve its efficacy and application for industrial purpose.

CO4. Able to analyze the organic reaction with the structure of organic molecules by applying the knowledge of different spectroscopic techniques.

CO5. Able to evaluate the electrical, optical, and structural properties of semiconductors to analyze their potential applications in modern electronic and energy devices.

COURSE CONTENT

Module 1

Quantum Properties of Atoms (4 L)

Schrodinger Wave Equation (time independent – basic principles only), de Broglie Equation, Heisenberg Uncertainty Principle, Quantum Numbers, Effective nuclear charge, Slater's rule, penetration of orbitals, variations of orbital energies in the periodic table, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, oxidation properties.

Chemistry of materials (2L)

Semiconductor-Based Memory Materials (Si & Ge) [Introduction, Properties and role of Si & Ge), Intensive & Extensive semiconductor,

Module II

Chemical Thermodynamics (5L)

1st & 2nd Law of Thermodynamics, Tendency for maximum randomness, Carnot Heat Engine [Derivation], Entropy characteristics, Mathematical explanation & physical significance of Entropy, Entropy change of ideal gas for isothermal reversible process, Gibbs free Energy Function, Standard free Energy, Criterion of spontaneity.

Electricity production through chemical reactions (2L)

Electrochemical Cell, writing of cell notation, free energy and EMF, Criterion of spontaneity in terms of Cell,

Nernst equation (only expression, no derivation) and applications, calculation of EMF of a cell, calculation of single electrode potential, calculation of Kc, calculation of Kc from G^0.

Working principle and applications of Lithium-ion batteries

Module III

Polymers for Engineering Applications (3L)

Polymers and their classifications (based on origin, chemical structure, polymeric structure, tacticity and molecular forces)

Commercially important polymers: Synthesis and applications of Bakelite, nylon 6,6, HDPE & LDPE

Conducting polymers –Types examples and applications.

Biodegradable polymers –definition, example and uses

Industrial Chemistry (3L)

Types of corrosion, Electrochemical theory of corrosion, rusting of iron, comparison of chemical & electrochemical corrosion. [Mechanism excluded]

Factors affecting the rate of corrosion; nature of metal (physical state, purity, position in Galvanic series) & environment.

Corrosion control: Cathodic protection, anodic protection, Inorganic coatings.

Classification of Fuel (LPG, CNG, BIOGAS), Calorific value, Octane number, Cetane number, HCV, LCV. [Definition only]

Module IV

Organic Reactions & synthesis of drugs (3L)

Acidity and basicity comparison of organic compounds(acids, alcohols & amines), Nucleophilic Substitution reaction and Electrophilic Addition reactions, Markonikov's rule, peroxide effect, Synthesis of Paracetamol & Aspirin and uses.(Name reactions are not in syllabus)

Spectroscopy (2L)

Electromagnetic spectrum, Lambert-Beer Law, Finding of λ max value & concentration of the unknown solution, Applications of UV-VIS spectroscopy, Chromophores & Auxochromes. Applications of IR spectroscopy, Fingerprint region

Suggested Text Books

- Chemistry –I, Gourkrishna Das Mohapatro
- A text book of Engineering Chemistry, Dr. Rajshree Khare
- Engineering Chemistry, U. N. Dhar
- Physical Chemistry, P.C. Rakshit

Reference Books

- Engineering Chemistry, Jain & Jain
- Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishna
- Text book of Engineering Chemistry, Jaya Shree Ani reddy

Course Name: Engineering Mathematics – I
Paper Code: M 101
Contact (L: T: P): 3 : 0 : 0
Total Contact Hours: 36
Credit: 3

Prerequisites:
The students to whom this course will be offered must have the understanding of (10+2) standard algebraic operations, coordinate geometry, and elementary calculus concepts including limits, continuity, differentiation, and integration.

Course Objectives:
The objective of this course is to familiarize the prospective engineers with techniques in matrix algebra and calculus. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes (COs): On successful completion of the learning sessions of the course, the learner will be able to:

CO1. Apply linear algebra methods to perform matrix operations, classify matrix structures, solve systems of linear equations, and compute eigenvalues and eigenvectors in engineering contexts.

CO2. Apply differential and integral calculus to evaluate and approximate the behavior of single- variable and multivariable real-valued functions relevant to engineering scenarios.

CO3. Analyze the properties of eigenvalues and eigenvectors to assess matrix diagonalizability and interpret linear transformations using the Cayley-Hamilton theorem in engineering systems.

CO4. Analyze single-variable and multivariable real-valued functions using differential and integral calculus to model and interpret complex behavior in engineering applications.

CO-PO/PSO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	1
CO3	3	3	1	1	-	-	-	-	-	-	2
CO4	3	3	1	1	-	-	-	-	-	-	2
M 101	**3**	**2.5**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1.5**

Weightage Values: Strongly mapped: '3', Moderately mapped: '2', Weakly mapped: '1', Not mapped: '-'.

Course Content:

Module I: Liner Algebra (11L)

Echelon form and normal (canonical) form of a matrix; Inverse and rank of a matrix; Consistency and inconsistency of system of linear equations, Solution of system of linear equations; Eigenvalues and eigenvectors; Diagonalization of matrix, Cayley-Hamilton theorem.

Module II: Single Variable Calculus (5L)

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; Taylor's series.

Module III: Multivariable Calculus (Differentiation) (13L)

Function of several variables; Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function; Jacobian; Maxima and minima of functions of two variables.

Module IV: Multivariable Calculus (Integration) (7L)

Double Integral, Triple Integral; Change of order in multiple integrals; Line Integral, Surface Integral, Volume Integral. Change of variables in multiple integrals.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New age International Publishers.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
5. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
6. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
7. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
8. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
9. Bronson, R., Schaum's Outline of Matrix Operations. 1988.
10. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.

Course Name: ***Constitution of India and Professional Ethics***
Course Code: HU105
Contact: 1:0:0
Total Contact Hours: 12
Credit: 1

Prerequisites:

A basic knowledge (10+2 level) of the Indian Constitution and moral science.

Course Objectives: The objectives of this course are to make the student able to-
O1:understand the salient features of the Indian constitution and form of government.
O2: develop ethical awareness and responsible professional conduct.
O3:understand ethical frameworks, guidelines and recognize ethical dilemmas.
O4:understand professional responsibilities and applications of ethical principles in real-life scenarios.
O5: develop an awareness of the social impact of the profession and act responsibly in the broader community.

Course outcome: After successful completion of this course, students will be able to

CO1	Identify, define and understand the significance of the Constitution of India, its spirit and values and the fundamental rights and duties as a responsible citizen.
CO2	define and discover core ethical concepts, the basic perception of profession, and professional ethics that shape the ethical behavior of an engineer.
CO3	identify, examine and apply codes of engineering ethics, engineers' social responsibilities and industrial standards and ethical dilemmas.
CO4	consider, correlate and appraise ethical leadership and principles in addressing gender issues, concerns of IPR and industrial responsibilities.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**
CO 1	-	-	-	-	-	-	-	2	-	-	2
CO 2	-	-	-	-	-	3	3	2	-	-	2
CO 3	-	-	-	-	-	2	3	2	-	-	2
CO 4	-	-	-	-	-	2	3	3	-	-	2

Course Contents:

Module 1: Introduction to the Constitution of India and Indian Government: (2L)

Preamble : Salient Features, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliament -Powers and Functions –Executive- President - Governor - Council of Ministers.

Module 2: Professional Ethics and Human Values: (3L)
Introduction to Ethical Thinking; what is Ethics, Work ethics; Scope of Professional Ethics, Values and Characteristics, Types of values: Negative and positive values, Ethical values for Professional success.

Module 3: Codes of Professional Ethics, Violation and Safeguards: (4L)
Engineering Ethics, Ethical theories: a brief overview; utilitarianism, deontology, virtue ethics.
Professional Codes, Codes of professional ethics-Moral dilemmas, and moral autonomy-Internal ethics of business: whistle blowing, conflicts of interest, Job discrimination, and Exploitation of Employees; Social and ethical responsibilities of technologists: Responsibilities towards Customers, shareholders, employees – Social Audit.
Case Studies: Bhopal Gas Tragedy, Chernobyl (linking ethics to real-world failures).

Module 4: Business Ethics and Workplace Issues: (3L)

Business ethics, ethical decision-making frameworks - Impact of ethics on business policies and strategies- Characteristics of ethical leaders; fostering integrity in teams; Addressing occupational crime, discrimination, and gender-based issues in workplaces-Intellectual property rights (IPR), Plagiarism and Academic Misconduct.

Text Books:
1.Durga Das Basu. *Introduction to the Constitution of India*. 27th ed. New Delhi: Lexis Nexis, 2024.
2. R.S Naagarazan. *A Textbook on Professional Ethics and Human Values*. New Age International (P) Limited, 2022.
3. N. Subramanian. *Professional Ethics.* New Delhi: Oxford University Press, 2017.
4. A N Tripathi, *Human Values*. New Delhi: New Age Publishers, 2019.
5. S. K. Chakraborty. *Values and Ethics for Organizations: Theory and Practices*. New Delhi: Oxford University Press, 1997.

Reference Books:
1.O. C. Ferrell, John Friaedrich and Linda Ferrell. *Business Ethics: Ethical Decision Making and Cases.* New Delhi: Cengage India, 2024.
2.Charles Fledderman. *Engineering Ethics*. 3rd ed. New Delhi: Pearson Education, 2007.
3.Dinesh G. Harkut and Gajendra R. Bamnote. *Professional Ethics for Engineers*. Chennai: Notion Press, 2023.
4.U.C.Mathur, *Corporate Governance and Business Ethics*: *Text and Cases*. Chennai: Macmillan, 2012.
5. Fernando. A. C., K. P. Muralidheeran and E. K. Satheesh. *Business Ethics – An Indian Perspective*. New Delhi: Pearson Education, 2019.

Course Title	Design Thinking and Innovation	
Course Code	HU 103 / HU203	
(L-T-P)	(2-0-0)	
Class Hours / Week	02	
Total class hours	30	

Course Objective:

The objective of this Course is to provide new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products and services which are useful for a student in preparing for an engineering career.

Course Outcomes (COs): Upon completion of the course, students shall be able to

Sl. No.	Course outcomes	Mappingto POs
1.	Analyze emotional experience and expressions to better understand stakeholders whiledesigning innovative products through group brainstorming sessions.	PO1, PO2, PO4, PO5, PO7, PO8 & PO9
2.	Generate and develop design ideas through different technique	PO1, PO2, PO3, PO4, PO5, PO7, PO8, PO10 & PO11
3.	Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing any innovative products using facility in AICTE IDEA LAB	PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO10 & PO11

CO-PO MAPPING:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	-	2	2	-	2	3	1	-	-
CO2	1	2	3	3	3	-	2	3	-	3	2
CO3	1	3	3	3	3	2	2	3	-	2	2

Prerequisites:

For a course on the Basics of Design Thinking, students should ideally possess basic computer skills, communication abilities, problem-solving aptitude, critical thinking,

introductory knowledge of Sustainable Development Goals, curiosity, and openness to new ideas, as well as basic understanding of mathematics, technology, and manufacturing processes.

However, even if these prerequisites are not satisfied, the faculty will cover them in the first few classes.

An awareness of 21st-century skills, including creativity and collaboration, is also beneficial.

These prerequisites aim to provide a foundation, and any gaps in knowledge will be addressed by the instructor early in the course.

SYLLABUS:

Module	Content	Hour
Module 1:	**Basics of Design Thinking:** Definition of Design Thinking, Need for Design Thinking, history of Design Thinking, Concepts & Brainstorming, 2X2 matrix, 6-3-5 method, NABC method;	3
Module 2:	**PROCESS OF DESIGN: Understanding Design thinking** Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping. Stages of Design Thinking Process (explain with examples) – Empathize (Methods of Empathize Phase: Ask 5 Why / 5W+H questions, Stakeholder map, Empathy Map, Peer observation, Trend analysis). Define (Methods of Define Phase: Storytelling, Critical items diagram, Define success). Ideate (Brainstorming, 2X2 matrix, 6-3-5 method, NABC method). Prototype (Types of prototypes - Methods of prototyping - Focused experiments, Exploration map, Minimum Viable Product). Test (Methods of Testing: Feedback capture grid, A/B testing).	6
Module 3:	**Tools for Design Thinking** Real-Time design interaction captures and analysis – Enabling efficient collaboration in digital space– Empathy for design – Collaboration in distributed Design	3
Module 4:	**Design Thinking in IT** Design Thinking to Business Process modelling – Agile in Virtual collaboration environment – Scenariobased Prototyping	2
Module 5:	**Design Thinking For strategic innovations** Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid	3

	prototyping, Strategy and Organization – Business Model	
Module 6:	**Problem Solving & Critical thinking** Introduction to TRIZ, SCAMPER, UI and UX.	2
Module 7:	**Sustainable development goals (SDG)** Integrating and mapping 17 Sustainable development goals (SDG) during designing a product; goods or service. Introduction to 21st Century Skill Set	1
Module 8:	**Case Study & Project Report Submission**	10

Text Books :

1. Karmin Design Thinking by Dr. Bala Ramadurai, Mudranik Technology Private Ltd. ISBN 978-93-5419-0I0-0.
2. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
3. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
4. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011
5. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

Reference Books:

1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.
2. Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).
3. Tim Brown, Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, HarperCollins e-books, 2009.
4. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Toolbox, John Wiley & Sons, 2020.
5. Michael Lewrick, Patrick Link, Larry Leifer, The Design Thinking Playbook, John Wiley & Sons, 2018.
6. Kristin Fontichiaro, Design Thinking, Cherry Lake Publishing, USA, 2015.
7. Walter Brenner, Falk Uebernickel, Design Thinking for Innovation - Research and Practice, Springer Series, 2016.
8. Gavin Ambrose, Paul Harris, Design Thinking, AVA Publishing, 2010.
9. Muhammad MashhoodAlam, Transforming an Idea into Business with Design Thinking, First Edition, Taylor and Francis Group, 2019.
10. S. Balaram, Thinking Design, Sage Publications, 2011.

WEB REFERENCES:

1. https://designthinking.ideo.com/
2. https://thinkibility.com/2018/12/01/engineering-vs-design-thinking/

3. https://www.coursera.org/learn/design-thinking-innovation
4. https://swayam.gov.in/nd1_noc20_mg38/preview
5.www.tutor2u.net/business/presentations/. /productlifecycle/default.html
6. https://docs.oracle.com/cd/E11108_02/otn/pdf/. /E11087_01.pdf
7. www.bizfilings.com › Home › Marketing › Product Developmen
8. https://www.mindtools.com/brainstm.html
9. https://www.quicksprout.com/. /how-to-reverse-engineer-your-competit
10. www.vertabelo.com/blog/documentation/reverse-engineering https://support.microsoft.com/en-us/kb/273814
11. https://support.google.com/docs/answer/179740?hl=en

COURSE NAME: WORKSHOP AND MANUFACTURING PRACTICES LAB

COURSE CODE: ME191

CONTACT: 0:0:3

CREDITS: 1.5

Prerequisite: Physics & Mathematics (10+2 Level)

CO1: Identify and operate various hand tools related to variety of manufacturing operations
CO2: Safely fabricate simple components with their own hands.
CO3: Apply the knowledge of the dimensional accuracies and tolerances applicable for different manufacturing processes.
CO4: Produce small devices of their interest for project or research purpose.

Course Content:

3P

(i) Theoretical discussions:

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods
2. Fitting operations & power tools
3. Carpentry
4. Welding (arc welding & gas welding), brazing
5. Electrical & Electronics
6. Metal casting
7. CNC machining, Additive manufacturing, 3D Printing
8. Plastic moulding & Glass Cutting

(ii) Workshop Practice:
At least 6 modules should be covered

Module 1 - Machine shop **6P**
Typical jobs that may be made in this practice module:
i. To make a pin from a mild steel rod in a lathe.
ii. To make rectangular and vee slot in a block of cast iron or mild steel in a shaping and / ormilling machine.

Module 2 - Fitting shop **6P**
Typical jobs that may be made in this practice module: To make a Gauge from MS plate.

Module 3 – Carpentry Shop **6P**
Typical jobs that may be made in this practice module: To make wooden joints and/or a pattern or like.

Module 4 - Welding & Soldering shop **6P**
Typical jobs that may be made in this practice module:
i. Arc Welding: To join two thick (approx 5mm) MS plates by manual metal arc welding.

ii. Gas Welding: To join two thin mild steel plates or sheets by gas welding.
iii. House wiring, soft Soldering

Module 5 – Smithy & Casting **6P**

Typical jobs that may be made in this practice module:

i. A simple job of making a square rod from a round bar or similar.
ii. One/ two green sand moulds to prepare, and a casting be demonstrated.

Module 6 – Sheet Metal Works **6P**

Typical jobs that may be made in this practice module:

i. At least one sample shape on mild steel plate should be made using CNC Milling / CNC Lathe Machine
ii. At least one sample shape on glass should be made using laser cutting machine.

Examinations could involve the actual fabrication of simple components, utilizing one or more ofthe techniques covered above.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and NirjharRoy S.K., -Elements of Workshop Technology||, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Rao P.N., -Manufacturing Technology||, Vol. I and Vol. II, Tata McGrawHill House, 2017.

Reference Books:

1. Gowri P., Hariharan and A. Suresh Babu, ManufacturingTechnology – I, Pearson Education, 2008.
2. Roy A. Lindberg, -Processes and Materials of Manufacture||, 4th edition, Prentice Hall India, 1998.
3. Kalpakjian S. and Steven S. Schmid, ManufacturingEngineering and Technology, 4th edition, Pearson Education India Edition, 2002.
4. Manufacturing Science by A. Ghosh and A.K. Mallick,Wiley Eastern.
Principles of Metal Cutting/Principles of Machine Tools by G.C. Sen and A. Bhattacharya, New Central Book Agency, Kolkata.

CO-PO/PSO Mapping:

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3		2			2	2		2	2	
CO2	3		2			2	2		2	2	
CO3	3		2			2	2		2	2	
CO4	3		2			2	2		2	2	

Course Name	**Introduction to Artificial Intelligence Lab**
Course Code	**CS192**
Contact Hours (Period/week)	**3L/Week Total Contact Hours: 30**
Credit	**1.5**

Course Objectives:

The objectives of this course are to enable students to

1. Gain foundational knowledge of PROLOG to implement an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing
2. Formulate a problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Framework of Artificial Intelligence.
3. Apply the concepts of Artificial Intelligence to solve a problem by implementing well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
4. Build expert systems offering solutions to the challenging problems of Artificial Intelligence.
5. Implement Artificial Intelligence based ideas as executable PROLOG programs through developing intelligent heuristic strategies

Course Outcomes (COs):

After successful completion of this course, students will be able to:

CO1	**Acquire** foundational knowledge of PROLOG to **implement** an Artificial Intelligent Agent as an executable computer program for Knowledge Representation and Inferencing and **understand** the working principle of the agent and **assess** its utilitarian importance in current technological context leading towards lifelong learning.
CO2	**Identify** and **formulate** an engineering problem by analyzing its characteristics to fit a State-Space Exploration Framework or an Inferencing Agent Formulation Framework of Artificial Intelligence.
CO3	**Explore** relevant literature and **apply** the concepts of Artificial Intelligence to **solve** a problem by **implementing** well-known Artificial Intelligence strategies using proper techniques and tools of PROLOG.
CO4	**Develop** ideas and **propose an** expert system offering solutions to the challenging problems of Artificial Intelligence.
CO5	**Plan and Implement** Artificial Intelligence based ideas as executable PROLOG programs through **developing** intelligent heuristic strategies or expert systems with adequate documentation in a collaborative environment for successfully carrying out projects on Artificial Intelligence Problems and **investigate** their effectiveness by **analyzing** the performances using proper

Course Contents:

Module 1: Introduction to PROLOG Programming along with the IDE and its Basic Components

Assignments for understanding the Basic Components of Knowledge Representation and Inferencing in Artificial Intelligence using PROLOG Programming and its working strategy. Understanding facts, rules, queries, and syntax.

Module 2: Recursive definitions in Prolog
Fibonacci Series, Calculator, Factorial, summation, list length, etc. Using recursive rules.

Module 3: Defining facts and simple queries
Writing a knowledge base for family relationships, basic objects.

Module 4: **Rules and inference in Prolog**
Creating logical rules and testing
inferences.

Module 5: List operations in Prolog

Checking membership, concatenation, reverse, max/min of list.

Module 6: Pattern matching and symbolic reasoning
Simple examples involving pattern recognition (e.g., shape or name matching, Family Tree design)

Module 7: Expert system simulation (Mini project)
Building a mini knowledge-based system (e.g., Animal Classification, Medical diagnosis, etc).

Textbook:
Ivan Bratko, Prolog Programming for Artificial Intelligence, 4th Edition, Addison-Wesley.

CO–PO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO7	PO8	PO9	PO10	PO11
CO1	3	2	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-
CO3	2	2	3	2	-	-	-	-	-	-	-
CO4	2	2	2	3	-	-	-	-	-	-	-
CO5	2	2	3	3	2	2	2	2	2	2	2

Course Name: ENGINEERING CHEMISTRY LAB
Paper Code: CH 191/CH 291
Total Contact Hours: 24
Credit: 2
Prerequisites: 10+2

Course Objective

- **Study the basic principles of pH meter and conductivity meter for different**
- **applications**
- **Analysis of water for its various parameters & its significance in industries**
- **Learn to synthesis Polymeric materials and drugs**
- **Study the various reactions in homogeneous and heterogeneous medium**

Course Outcome

CO1: Able to operate different types of instruments for estimation of small quantities chemicals used in industries and scientific and technical fields.
CO2: Able to analyse and determine the composition and physical property of liquid and solid samples when working as an individual and also as a team member
CO3: Able to analyse different parameters of water considering environmental issues
CO4: Able to synthesize drug and sustainable polymer materials.
CO5: Capable to design innovative experiments applying the fundamentals of modern chemistry

COURSE CONTENT

Any 10 experiments to be conducted preferably a combination of estimation, water quality analysis, instrumental analysis and synthesis

1. To determine strength of given sodium hydroxide solution by titrating against standard oxalic acid solution.
2. Estimation of amount of Fe^{2+} in Mohr's salt using permanganometry.
3. To determine the surface tension of a given liquid at room temperature using stalagmometerby drop number method.
4. To determine the viscosity of a given unknown liquid with respect to water at room temperature, byOstwald's Viscometer.
5. Water quality analysis :
    i. Determination of total, permanent and temporary hardness of sample water by complexometric titration.
    ii. Determination of Cl^- ion of the sample water by Argentometric method
    iii. Determination of alkalinity of the sample water.
    iv. Determination of dissolved oxygen present in a given water sample.
6. Determination of the concentration of the electrolyte through pH measurement.

7. pH- metric titration for determination of strength of a given HCl solution against a standard NaOH solution.
8. Determination of cell constant and conductance of solutions.
9. Conductometric titration for determination of the strength of a given HCl solution by titration against a standard NaOH solution.
10. Determination of Partition Coefficient of acetic acid between two immiscible liquids.
11. Drug design and synthesis
12. Synthesis of polymers (Bakelite) for electrical devices and PCBs.
13. Synthesis of Silver Nanoparticles doped organic thin film for organic transistors.
14. Determination of R_F of any amino acid by thin layer chromatography.
15. Saponification /acid value of any oil.
16. Isolation of graphene from dead dry batteries

Course Code	**:**	**ME192**
Course Title	**:**	**IDEA Lab Workshop**
Number of Credits	**:**	**(L: 0, T: 0, P: 3)**
Credit	**:**	**1.5**

Course Objectives:

1. To learn all the skills associated with the tools and inventory associated with the IDEALab.
2. Learn useful mechanical and electronic fabrication processes.
3. Learn necessary skills to build useful and standalone system/ project with enclosures.
4. Learn necessary skills to create print and electronic documentation for the system/project

Course Contents*:*

Module	Topics	Topics
1	Electronic component familiarization, Understanding electronic system design flow. Schematic design and PCB layoutand Gerber creation usingEagleCAD. Documentation using Doxygen, Google Docs, Overleaf. Version control tools - GIT and GitHub. Basic 2D and 3D designing using CAD tools such as FreeCAD, Sketchup, Prusa Slicer, FlatCAM, Inkspace, OpenBSP and VeriCUT.	Introduction to basic hand tools - Tape measure, combination square, Vernier calliper, hammers, fasteners, wrenches, pliers, saws, tube cutter, chisels, vice and clamps, tapping and threading. Adhesives Introduction to Power tools: Power saws, band saw, jigsaw, angle grinder, belt sander, bench grinder, rotary tools. Various types of drill bits,

2	Familiarisation and use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal and function generator. Logic analyzer and MSO. Bench power supply (with 4-wire output) Circuit prototyping using (a) breadboard, (b) Zero PCB (c) 'Manhattan' style and (d) custom PCB. Single, double and multilayer PCBs. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station. Soldering using a temperature controlled reflow oven. Automated circuit assembly and soldering using pick and place machines.	Mechanical cutting processes - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc. Basic welding and brazing and other joining techniques for assembly. Concept of Lab aboard a Box.
3	Electronic circuit building blocks including common sensors. Arduino and Raspberry Pi programming and use. Digital Input and output. Measuring time and events. PWM. Serial communication. Analog input. Interrupts programming. Power Supply design (Linear and Switching types), Wireless power supply, USB PD, Solar panels, Battery types and charging	3D printing and prototyping technology – 3D printing using FDM, SLS and SLA. Basics of 3D scanning, point cloud data generation for reverseengineering. Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers. Basics of IPR and patents; Accessing and utilizing patent information in IDEA Lab
4	Discussion and implementation of a mini project.	
5	Documentation of the mini project (Report and video).	

Laboratory Activities:

S. No.	**List of Lab activities and experiments**
1.	Schematic and PCB layout design of a suitable circuit, fabrication and testiof the circuit.
2.	Machining of 3D geometry on soft material such as soft wood or modelling
3.	3D scanning of computer mouse geometry surface. 3D printing of scann geometry using FDM or SLA printer.
4.	2D profile cutting of press fit box/casing in acrylic (3 or
5.	2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6.	Familiarity and use of welding equipment.
7.	Familiarity and use of normal and wood lathe.

8.	Embedded programming using Arduino and/or Raspberry Pi.
9.	Design and implementation of a capstone project involving embedded hardwa software and machined or 3D printed enclosure.

Reference Books:

S. No.	Title
1.	AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), Khanna Book Publishing, New Delhi.
2.	All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13:
3.	Simplified Q&A - Data Science with Artificial Intelligence, Machine Learningand Deep Learning, Rajiv Chopra, ISBN: 978-9355380821, Khanna Book Publishing Company, New Delhi.
4.	3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, KhannaBook Publishing Company, New Delhi.
5.	The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
6.	The Total Inventors Manual (Popular Science): Transform Your Idea into aTop-Selling Product. Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978-1681881584.
7.	Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978-9352137374
8.	The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill.Cambridge University Press. ISBN: 9780521809269
9.	Practical Electronics for Inventors. 4th edition. Paul Sherz and SimonMonk. McGraw Hill. ISBN-13: 978-1259587542
10.	Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945,978-9352131952, 978-9352133703
11.	Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C.Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586
12.	Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633
13.	Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13 : 978-1260019193.

14.	Pro GIT. 2nd edition. Scott Chacon and Ben Straub. A press. ISBN-13 :978-1484200773
15.	Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based andOther Technologies, Kluwer, 2004.
16.	Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
17.	Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.

1st Year - 2nd Semester

Sl.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
		A. THEORY			L	T	P	Total	
1	ENGG	Major	ME201	Fluid Mechanics	3	0	0	3	3
2	SCI	Multidisciplinary	M201	Engineering Mathematics II	3	0	0	3	3
3	SCI	Multidisciplinary	PH201	Engineering Physics	3	0	0	3	3
4	ENGG	Minor	EE101	Basic Electrical and Electronics Engineering	3	0	0	3	3
5	HUM	Value Added Course	HU204	Environmental Science	2	0	0	2	2
6	HUM	Value Added Course	HU105	Indian Knowledge System	1	0	0	1	1
B. PRACTICAL									
1	ENGG	Major	ME291	Fluid Mechanics Lab	0	0	3	3	1.5
2	ENGG	Major	ME292	Engineering Graphics and Computer Aided Design Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	PH291	Engineering Physics Lab	0	0	3	3	1.5
4	ENGG	Minor	EE291	Basic Electrical and Electronics Engineering Lab	0	0	3	3	1.5
5	HUM	Skill Enhancement Course	HU191	Communication and Presentation Lab	0	0	3	3	1.5
C. MANDATORY ACTIVITIES / COURSES									
1	MC	Mandatory Course	MC281	NSS/ Physical Activities / Meditation & Yoga / Photography/ Nature Club	0	0	0	0	0
TOTAL CREDIT									**22.5**
TOTAL FIRST YEAR CREDIT									**40**

*'Mandatory Additional Requirement'(MAR) activities have to be carried out as per university guidelines.

COURSE NAME: FLUID MECHANICS
COURSE CODE: ME201
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisite: Physics and Mechanics (10+2 level)

Course Objectives: To introduce and explain fundamentals of Fluid Mechanics which is useful in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics, Heat Transfer, Power Plant etc.

Course Outcomes:

CO1: Recall fluid flow properties and understand hydrostatic forces on surfaces and bodies.

CO2: Analyze kinematics and dynamics of fluid motion for laminar and turbulent flow and apply conservation equations for the flow regimes of practical interest.

CO3: Estimate the losses in flow through pipes and analyze boundary layer theory for a variety of constraints

CO4: Apply the

Course Contents

Module No.	Syllabus	Contact Hrs.
1 Introduction	Introduction to Fluid Mechanics, Fluid types, Fluid Pressure, Manometers, Properties of Fluids, Newton‘s law of viscosity, surface tension	4
2 Analysis of Fluid Motion	Fluid statics: Forces on submerged surfaces; forces or vertical, horizontal, inclined and curved surfaces, Center of pressure. Stability of floating bodies. Flow of fluid and forces around submerged bodies; basic concepts of drag and lift. Fluid kinematics: fluid flow and classifications. Continuity equation in 1D & 3D. Potential flow & Stream function; types of flow lines. Dynamics of fluid: equations of motion; Euler‘s equation; Navier-Stokes equation; Bernoulli‘s equation; Applications of Bernoulli‘s equation.	12
3 Flow through	Flow through circular pipes, Flow between parallel plates, momentum and energy correction factors, Reynold‘s experiment, characteristics of turbulent	12

pipes	flow, velocity distribution in turbulent flow through pipes. Fluid friction in pipes, head loss, Darcy– Weisbach equation; hydraulic grade line and total energy line. Variation of friction factor with wall roughness – Moody's chart. Minor losses in pipes. Definition of Boundary Layer; Basics of Boundary layer separation, Drag force on a flat plate due to boundary layer, Turbulent layer on a flat plate, displacement thickness, momentum thickness.	
4 Measurement of Flow	Orifices, notches and weirs: Basic principle for flow through orifices, rectangular and V-notches, rectangular and trapezoidal weir	4
5 Dimensional Analysis	Dimensions and dimensional homogeneity, Importance and use of dimensional analysis. Buckingham's π theorem with applications. Geometric, Kinematic and Dynamic similarity, Non-dimensional Numbers, Model studies	4

Text Books:

1. Introduction to Fluid Mechanics & Fluid Machines – Som & Biswas, TMH

2. Fluid Mechanics & Machinery – R.K.Bansal, Luxmi Publications.

3. A textbook on Fluid Mechanics and Hydraulic Machines – Sukumar Pati, TMH

4. Fluid Mechanics & Turbo Machines – M.M.Das, PHI, 2010.

Reference Books:

1. Introduction to Fluid Mechanics – Fox & Macdonald, Wiley.

2. Fluid Mechanics – Fundamentals & Applications – Cengel & Cimbala, TMH.

3. Mechanics of Fluid – Bernard Massey, Taylor & Francis

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	2	2	1	-	-	-	-	-	-	-
CO2	3	3	2	2	-	-	-	-	-	-	1
CO3	3	2	2	2	-	-	-	-	-	-	1
CO4	2	2	2	3	-	-	-	-	-	-	1

Course Name: Engineering Mathematics - II
Paper Code: M201
Contact (L: T: P): 3 : 0 : 0
Total Contact Hours: 36
Credit: 3

Prerequisites:
The students to whom this course will be offered must have the understanding of (10+2) standard algebraic operations, and elementary calculus concepts including limits, continuity, differentiation, and integration.

Course Objectives:
The objective of this course is to familiarize the prospective engineers with techniques in ordinary differential equations, Laplace transform and numerical methods. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Course Outcomes (COs): On successful completion of the learning sessions of the course, the learner will be able to:

CO1. Apply analytical methods to solve ordinary differential equations in engineering contexts.
CO2. Apply the properties and inverse of Laplace Transforms to compute improper integrals and determine solutions of linear ordinary differential equations with constant coefficients in engineering scenarios.
CO3. Apply numerical methods to interpolate data, perform numerical integration, and solve ordinary differential equations in engineering applications.
CO4. Analyze the behavior of solutions using analytical and numerical approaches, including Laplace transforms, to assess stability, convergence, and accuracy in engineering contexts.

CO-PO/PSO Mapping:

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11
CO1	3	2	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	1
CO3	3	2	-	-	-	-	-	-	-	-	1
CO4	3	3	1	1	-	-	-	-	-	-	2
M 201	**3**	**2.25**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**1.25**

Weightage Values: Strongly mapped: '3', Moderately mapped: '2', Weakly mapped: '1', Not mapped: '**-**'.

Course Content:

Module I: First Order Ordinary Differential Equations (ODE) (9L)

Solution of first order and first degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation.

Solution of first order and higher degree ODE: solvable for$p$, solvable for y and solvable for $x$and Clairaut's equation.

Module II: Second Order Ordinary Differential Equations (ODE) (8L)

Solution of second order ODE with constant coefficients: Complementary Function and Particular Integral, Method of variation of parameters, Cauchy-Euler equations.

Module III: Laplace Transform (LT) (12L)

Concept of improper integrals; Definition and existence of LT, LT of elementary functions, First and second shifting properties, Change of scale property, LT of $tf(t)$, LT of $^{f(t)}$, LT of derivatives of $f(t)$, LT of integral of $f(t)$, Evaluation of improperintegrals using LT, LT of periodic and step functions, Inverse LT: Definition and its properties,Convolution theorem (statement only) and its application to the evaluation of inverse LT, Solution oflinear ODE with constant coefficients (initial value problem) using LT.

Module IV: Numerical Methods (7L)

Introduction to error analysis, Calculus of finite difference. **Interpolation:** Newton forward and backward interpolation, Lagrange's interpolation. **Numerical integration:** Trapezoidal rule, Simpson's 1/3 Rule. **Numerical solution of ordinary differential equation:** Euler method, Fourth order Runge-Kutta method.

Text Books:

1. Grewal, B.S., Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. Kreyszig, E., Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

Reference Books:

1. Guruprasad, S. A text book of Engineering Mathematics-I, New age International Publishers.
2. Ramana, B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
3. Veerarajan, T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Bali, N.P. and Goyal, M., A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
5. Thomas, G.B. and Finney, R.L., Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
6. Apostol, M., Calculus, Volumes 1 and 2 (2nd Edition), Wiley Eastern, 1980.
7. Kumaresan, S., Linear Algebra - A Geometric approach, Prentice Hall of India, 2000.
8. Poole, D., Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
9. Bronson, R., Schaum's Outline of Matrix Operations. 1988.

10. Piskunov, N., Differential and Integral Calculus, Vol. I & Vol. II, Mir Publishers, 1969.

Course Name: Engineering Physics
Course Code: PH201
Contact: (3:0:0)
Total Contact Hours: 36
Credit: 3

Prerequisites: Knowledge of Physics up to 12th standard.

Course Objective(s):
The objective of the course is to make the students able to –

1. O1: **Provide foundational understanding** of core physical principles such as optics, quantum mechanics, solid-state physics, and statistical mechanics relevant to engineering disciplines.
2. O2: **Develop the ability** to apply theoretical knowledge of physical sciences in interpreting engineering phenomena and solving problems using scientific reasoning and quantitative analysis.
3. O3: **Expose students to the working principles** of modern devices and technologies like lasers, fiber optics, semiconductors, and nanomaterials used in engineering and industrial applications.
4. O4: **Encourage scientific curiosity and innovation** by connecting physical theories with practical tools and techniques in emerging fields like nanotechnology and quantum systems.
5. O5: **Understand the role of physics** in interdisciplinary domains for the advancement of science, technology, and sustainable development through real-life engineering contexts.

Course Outcomes (COs):
After Successful completion of the course, students will be able to

CO1	*Explain* the principles of lasers, fibre optics, and holography and *apply* them in modern optical and communication systems.
CO2	*Identify* different crystal structures and *compute* structural parameters such as Miller indices and packing factors; *distinguish* between metals, semiconductors, and insulators using band theory.
CO3	*Utilize* the principles of quantum theory, wave-particle duality, and Schrödinger equation—to *interpret* fundamental quantum phenomena.
CO4	*Illustrate* the basic concepts of statistical mechanics and e*xamine* their implications on microscopic particle behaviour.
CO5	*Describe* the properties of nanomaterials and display/storage devices and *analyze* their applications in modern technology.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3								2		2			
CO2	3	3							2		2			

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

Course Content:

Module 1: Modern Optics (11L)

1.01- Laser: Concepts of various emission and absorption processes, Einstein A and B coefficients and equations, working principle of laser, metastable state, population inversion, condition necessary for active laser action, optical resonator, illustrations of Ruby laser, He-Ne laser, Semiconductor laser, applications of laser, related numerical problems. 6L

1.02-Fibre Optics-Principle and propagation of light in optical fibers (Step index, Graded index, single and multiple modes) - Numerical aperture and Acceptance angle, Basic concept of losses in optical fiber, related numerical problems. 3L

1.03--Holography Theory of holography (qualitative analysis), viewing of holography, applications. 2L

Module 2: Solid State Physics (5L)

2.01 Crystal Structure: Structure of solids, amorphous and crystalline solids (definition and examples), lattice, basis, unit cell, Fundamental types of lattices **–**Bravais lattice, simple cubic, fcc and bcc lattices, Miller indices and miller planes, co-ordination number and atomic packing factor, Bragg's equation, applications, numerical problems.
3L

2.02 Semiconductor: Physics of semiconductors, electrons and holes, metal, insulator and semiconductor, intrinsic and extrinsic semiconductor, p-n junction. 2L

Module 3: Quantum and Statistical Mechanics (14L)

3.01 Quantum Theory: Inadequacy of classical physics-concept of quantization of energy, particle concept of electromagnetic wave (example: Black body radiation, Photoelectric and Compton Effect: no derivation required), wave particle duality; phase velocity and group velocity; de Broglie hypothesis; Davisson and Germer experiment, related numerical problems.
5L

3.02 Quantum Mechanics 1: Concept of wave function, physical significance of wave function, probability interpretation; normalization of wave functions-Qualitative discussion; uncertainty principle, relevant numerical problems, Introduction of Schrödinger wave equation (only statement). 4L

3.03 Statistical Mechanics

Concept of energy levels and energy states, phase space, microstates, macrostates and thermodynamic probability, MB, BE, FD, statistics (Qualitative discussions)-physical significance, conception of bosons, fermions, classical limits of quantum statistics, Fermi distribution at zero & non-zero temperature, Concept of Fermi level-Qualitative discussion.
5L

Module 4: Physics of Nanomaterials (4L)

Reduction of dimensionality, properties of nanomaterials, Quantum wells (two dimensional), Quantum wires (one dimensional), Quantum dots (zero dimensional); Quantum size effect and Quantum confinement. Carbon allotropes. Application of nanomaterials (CNT, graphene, electronic, environment, medical).

Module 5: Storage and display devices (2L)

Different storage and display devices-Magnetic storage materials, Operation and application of CRT, CRO, LED and OLED.

Text book:

1. Concepts of Modern Engineering Physics- A. S. Vasudeva. (S. Chand Publishers)
2. Engineering Physics - Rakesh Dogra
3. Introduction to Nanoscience and Nanotechnology, An Indian Adaptation-Charles P. Poole, Jr., Frank J. Owens.
4. Quantum Mechanics – S. N. Ghosal
5. Nanotechnology – K. K. Chattopadhyay

Reference Books:

1. Optics - Ajay Ghatak (TMH)
2. Solid state Physics - S. O. Pillai
3. Quantum mechanics -A.K. Ghatak and S Lokenathan
4. Fundamental of Statistical Mechanics: B. B. Laud
6. Perspective & Concept of Modern Physics—Arthur Beiser

COURSE NAME: BASICS ELECTRICAL AND ELECTRONICS ENGINEERING
COURSE CODE: EE(ME)101
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3
Pre requisite: Knowledge of Physics up to 12th standard.
Course Outcomes (COs):

COs	Statement
CO1	Apply fundamental concepts and circuit laws to solve simple DC electric circuits
CO2	To solve simple ac circuits in steady state
CO3	Impart the knowledge of Basic Electronics Devices and ICs.
CO4	Analyze the simple electronics circuits

Course Content:

MODULE 1: Elementary Concepts of Electric Circuits 6L

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems-Nodal Analysis, Mesh analysis with independent sources only (Steady state)
Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

MODULE 2: Electrical machine 8L

Transformer: Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.
DC Machines: Brief idea on constructional features, classifications, working principle of both motor and generator. Simple problems on Voltage equation.

MODULE 3: Fundamentals of Semiconductor Devices: 6L

Introduction to Semiconductor: Concept of energy band diagram; Comparison among metal, insulator, semiconductor; Semiconductors-classifications and Fermi energy level; Charge neutrality and Mass-Action law in semiconductor; Current flow in semiconductor due to drift & diffusion process; Einstein relation.

MODULE 4: PN Junction Diode: 4L

Principle of operation; V-I characteristics; principle of avalanche & Zener breakdown; Junction resistances and capacitances; V-I characteristics of Zener diode.

MODULE 5: Bipolar Junction Transistors: 4L

PNP and NPN structures; Principle of operation; Current gains in CE, CB and CC

mode; input and output characteristics; Biasing & Stability Analysis-Concept of Fixed Bias, Collector to base Bias & voltage divider bias.

MODULE 6: Introduction to IC: 8L

Integrated Circuit-Basic idea, classifications, advantages, disadvantages; OPAMP(IC741)-Pin configuration and equivalent circuit; Characteristics of OPAMP(IC741); Inverting & Non-Inverting Amplifier; Adder, Subtractor, Differentiator & Integrator Circuit.

Textbooks:

1. A Textbook of Electrical Technology - Volume I (Basic Electrical Engineering) & Volume II (Ac & DC Machines)-B. L Theraja & A.K. Teraja, S. Chad,23rd Edition, 1959
2. D. Chattopadhyay, P.C Rakshit, "Electronics Fundamentals and Applications", New Age International (P) Limited Publishers, Senenth Edition,2006
3. Basic Electrical & Electronics Engineering by J.B. Gupta , S.K. Kataria & Sons,2013
4. Basic Electrical and Electronics Engineering-I by Abhijit Chakrabarti and Sudip Debnath, McGraw Hill, 2015
5. M.S.Sukhija andT.K.Nagsarkar,Basic Electrical and Electronics Engineering, Oxford University Press,2012.
6. DP Kothari and IJ Nagrath,"Basic Electrical & Electronics Engineering", Tata McGraw Hill,2020.

Reference Books

1. DC Kulshreshtha,"Basic Electrical Engineering",TataMcGrawHill,2010.
2. T.K. Nagsarkar, M.S.Sukhija,"BasicElectricalEngineering",OxfordHigherEducation.
3. Hughes,"Electrical and ElectronicTechnology",Pearson Education".
4. Parker and Smith,"Problems in Electrical Engineering",CBS Publishers and Distributors.
5. Anant Agarwal, Jeffrey Lang, Foundations of Analog and Digital Electronic Circuits, Morgan Kaufmann Publishers, 2005.
6. Bernard Grob,Basic Electronics,McGrawHill.
7. Chinmoy Saha, Arindham Halder and Debarati Ganguly, Basic Electronics-Principles and Applications, Cambridge University Press, 2018.

CO-PO Course Articulation Matrix Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	3	3	2	1	-	-	-	-	-	1	-
CO2	3	3	2	1	-	-	-	-	-	1	-
CO3	3	2	2	1	-	-	-	-	-	1	-
CO4	2	3	2	1	-	-	-	-	-	1	-

Course Name: Environmental Science
Course Code: HU204
Contact Hours: L:2 T:0 P:0
Total Contact Hours: 24
Credits: 2
Prerequisites: 10+2
Course Objective(s)

1. 01 Realize the importance of environment and its resources.
2. 02 Apply the fundamental knowledge of science and engineering to assess environmental and health risk.
3. 03 Know about environmental laws and regulations to develop guidelines and procedures for health and safety issues.
4. 04 Solve scientific problem-solving related to air, water, land and noise pollution.

Course Outcome (COs)

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

C01	Able to understand the natural environment and its relationships with human activities
C02	The ability to apply the fundamental knowledge of science and engineering to assess environmental and health risk
C03	Ability to understand environmental laws and regulations to develop guidelines and procedures for health and safety issues
CO4	Acquire skills for scientific problem-solving related to air, water, noise & land pollution.

CO – PO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
1	2	2	3	-	-	2	3	1	-	-	1
2	3	3	3	1	1	2	3	1	-	-	1
3	3	3	3	2	1	2	3	1	-	-	1
4	1	3	3	-	-	2	1	1	-	-	1

Module 1: Resources and Ecosystem (6L)

1. Resources (4L)

Types of resources, Human resource, Population Growth models: Exponential Growth, Logistic growth curve with explanation. Maximum Sustainable Yield [Derivation]
Alternative sources of Energy [Solar energy, tidal energy, geothermal energy, biomass energy]

2. Ecosystem (2L)

Components of ecosystem, types of ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Pond eco system, Food chain, Food web.

Module 2: Environmental Degradation (10L)

1. Air Pollution and its impact on Environment (3L)

Air Pollutants, primary & secondary pollutants, Criteria pollutants, Smog, Photochemical smog and London smog, Greenhouse effect, Global Warming, Acid rain, Ozone Layer Depletion.

2. Water Pollution and its impact on Environment (4L)

Water Pollutants, Oxygen demanding wastes, heavy metals, BOD [Rate equation], COD, Eutrophication, Hardness, Alkalinity, TDS and Chloride, Heavy metal (As, Hg, Pb) poisoning and toxicity. Numerical on BOD, Hardness.

3. Land Pollution and its impact on Environment (1L)

Solid wastes, types of Solid Waste, Municipal Solid wastes, hazardous wastes, bio-medical wastes, E-wastes,

4. Noise Pollution and its impact on Environment (2L)

Types of noise, Noise frequency, Noise pressure, Measurement of noise level and decibel (dB) Noise intensity, Noise Threshold limit, Effect of noise pollution on human health. Numerical on Measurement of noise level and decibel (dB) and Noise Threshold limit.

Module 3 : Environmental Management (6L)

1. Environmental Impact Assessment (1L)

Environmental Auditing, Environmental laws and Protection Acts of India, carbon footprint, Green building practices. *(GRIHA norms)*

2. Pollution Control and Treatment (2L)

Air Pollution controlling devices, Catalytic Converter, Electrostatic Precipitator.
WasteWater Treatment (Surface water treatment &Activated sludge process), Removal of hardness of water (Temporary &Permanent -Permutitprocess).

3. Waste Management (3L)

Solid waste management, Open dumping, Land filling, incineration, composting & Vermicomposting, E-waste management, and Biomedical Waste management.

Module 4 : Disaster Management (2L)

1. **Study of some important disasters (1L)**
   Natural and Man-made disasters, earthquakes, floods drought, landslide, cyclones, volcanic eruptions, tsunami, oil spills, forest fires.
2. **Disaster Management Techniques (1L)**
   Basic principles of disaster management, Disaster Management cycle, Disaster management policy, Awareness generation program

Text Books:

1. Basic Environmental Engineering and Elementary Biology (For MAKAUT), Gourkrishna Dasmohapatra, Vikas Publishing.
2. Basic Environmental Engineering and Elementary Biology, Dr. Monindra Nath Patra & Rahul Kumar Singha, Aryan Publishing House.
3. Textbook of Environmental Studies for Undergraduate Courses, Erach Barucha for UGC, Universities Press

Reference Books:

1. A Text Book of Environmental Studies, Dr. D.K. Asthana & Dr. Meera Asthana, S.Chand Publications.
2. Environmental Science (As per NEP 2020), Subrat Roy, Khanna Publisher

Course Name: Indian Knowledge System
Course Code: HU205
Contact: 1:0:0
Total Contact Hours: 12
Credit: 01

Prerequisites: A basic knowledge (10+2 level) of Indian history, civilization and culture.

Course Objectives: The objective of this course is to make the students able to—
O1: understand the extent and aspects of ancient Indian cultural, philosophical and scientific heritage.

O2: explore the philosophical roots of Indian knowledge, the scientific temper and quest for advanced understanding of the universe and deeper knowledge of the self.

O3: identify and describe the Indian scientific and technological tools, techniques and discoveries and assess their significance and continuing relevance.

O4: develop a liberality and open-mindedness of outlook to foster lifelong learning.

O5: acquire the skills to apply traditional knowledge in their everyday lives.

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

CO1	define, identify, describe and classify the philosophical, literary and socio-religious heritage of ancient India and the core concepts of the Vedic corpus and way of life.
CO 2	discover, enumerate, compare, contrast and categorize the importance of pioneering developments in science and mathematics and evaluate their continuing relevance.
CO 3	analyze, appraise, correlate and describe the ancient Indian heritage in science and technology and examine technological correlations with present-day technological applications.
C0 4	discover, assess and describe traditional knowledge in health care, architecture, agriculture and other sectors and to explore the history of traditional Indian art forms.

CO-PO Mapping:

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

Course Content:

Module-1 An overview of Indian Knowledge System (IKS): (3L)
Importance of Ancient Knowledge - Definition of IKS - Classification framework of IKS - Unique aspects of IKS.
The Vedic corpus: Vedas and Vedangas - Distinctive features of Vedic life.
Indian philosophical systems: Different schools of philosophy (Orthodox and Unorthodox).

Module-2 Salient features of the Indian numeral system: (3L)
Developments in Indian Mathematics in ancient India - Importance of decimal representation - The discovery of zero and its importance - Unique approaches to represent numbers- Contribution of ancient Indian mathematicians
Highlights of Indian Astronomy: Historical development of astronomy in India- key contributions of ancient Indian astronomers.

Module-3 Indian science and technology heritage: (3L)
Metals and metalworking - Mining and ore extraction –Structural engineering and architecture in ancient India: planning, materials, construction and approaches- Dyes and painting; Shipbuilding.

Module-4 Traditional Knowledge in Different Sectors: (3L)
Traditional knowledge and engineering. Traditional Agricultural practices (resources, methods, technical aids); Traditional Medicine and Surgery; History of traditional Art forms and Culture.

Text Books:
1. Amit Jha . *Traditional Knowledge System in India*. New Delhi: Atlantic Publishers, 2024.
2. B. Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana . *Introduction to Indian Knowledge System: Concepts and Applications*. New Delhi: PHI, 2022.
3. Angad Godbole. *Science and Technology in Ancient India*. New Delhi: Biblia Implex, 2023.
4. Pritilakshmi Swain. *Indian Knowledge System*. New Delhi: Redshine Publication, 2024.
5. Vishnudut Purohit. *Fundamentals of Indian Knowledge System*. New Delhi: ABD Publishers, 2024.

Reference Books:
1. A. L. Basham. *The Wonder that was India*. Vol. I. New Delhi: Picador, 2019.
2. Arun Kumar Jha and Seema Sahay ed. *Aspects of Science and Technology in Ancient India.* Oxford and New Delhi: Taylor and Francis, 2023.
3.Kapil Kapoor and Awadhesh Kumar Singh. *Indian Knowledge Systems*. Vols. 1 and 2. New Delhi: D. K. Printworld, 2005.
4. S. N. Sen and K. S. Shukla, *History of Astronomy in India*. New Delhi: Indian National Science Academy, 2nd edition, 2000.
5. Arpit Srivastava. *Indian Knowledge System*. Rewa: AKS University, 2024.

COURSE NAME: FLUID MECHANICS LAB
COURSE CODE: ME291
CONTACT: 0: 0: 3
CREDITS: 1.5
PREREQUISITES: FLUID MECHANICS

Course Objective: To imbibe the practical skills associate with the measurment various important properties of fluids necessary for running hydraulic devices useful in various industries.

Course Outcomes: After successful completion of this course learners will be able to
CO1: Measure the coefficient of discharge for several flow measuring devices to explore the reasons of differences in theoretical calculation and practical measurements.
CO2: Validate conservation and energy equations through experimental investigations**.**
CO3: Determine the Reynolds number of a flowing fluid and evaluate its hydrodynamics.
CO4: Estimate frictional forces applicable in a flow channel to determine major and minor losses.

CO – PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1	2	-	-	3	-	-	-	2	-	2	-
CO2	2	-	-	3	-	-	-	2	-	2	-
CO3	2	-	-	3	-	-	-	2	-	2	-
CO4	2	-	-	3	-	-	-	2	-	2	-

Course Content - List of Experiments:

1. Measurement of Coefficient of Discharge of an Orifice
2. Measurement of Coefficient of Discharge of a Venturimeter
3. To verify the Bernoulli‘s Theorem
4. To find the critical Reynolds number for pipe flow
5. To determine friction factor for a flow through pipe
6. Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe.

COURSE NAME: ENGINEERING GRAPHICS & COMPUTER AIDED DESIGN LAB
COURSE CODE: ME292
CONTACT: 0:0:3
CREDITS: 1.5

Prerequisites: Basic knowledge of geometry

Course Objectives:

The objective of the course is to teach detailed engineering drawing and modeling of a component or system for a given dimension or constraints through ample understanding of engineering views, projections and sections. It will help students to acquire the manual drawing techniques as well as computer aided graphics skills, using modern engineering tools to communicate their design effectively in industries.

Course Outcomes: Upon successful completion of this course, the student will be able to:

CO1: Use common drafting tools with the knowledge of drafting standards
CO2: Understand the concepts of engineering scales, projections, sections.
CO3: Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints
CO4: Produce part models; carry out assembly operation and represent a design project work.

Course Contents:

Basic Engineering Graphics: **3P**

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; SectionalViews; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Module 1: Introduction to Engineering Drawing **6P**

Principles of Engineering Graphics and their significance, Usage of Drawing instruments, lettering, Conic sections including Rectangular Hyperbola (General method only); Cycloid, Epicycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module 2: Orthographic & Isometric Projections **6P**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes on inclined Planes - Auxiliary Planes; Projection of Solids inclined to both the Planes- Auxiliary Views; Isometric Scale, Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice- versa.

Module 3: Sections and Sectional Views of Right Angular Solids **6P**

Drawing sectional views of solids for Prism, Cylinder, Pyramid, Cone and project the true shape ofthe sectioned surface, Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw sectional orthographic views of objects from industry and dwellings (foundation to slab only).

Computer Graphics: **3P**

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modeling; Solid Modeling.

Module 4: Overview of Computer Graphics **3P**

Demonstration of CAD software [The Menu System, Toolbars (Standard, Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), Zooming methods, Select and erase objects].

Module 5: CAD Drawing, Customization, Annotations, layering **6P**

Set up of drawing page including scale settings, ISO and ANSI standards for dimensioning and tolerance; Using various methods to draw straight lines, circles, applying dimensions and annotations to drawings; Setting up and use of Layers, changing line lengths (extend/lengthen); Drawing sectional views of solids; Drawing annotation, CAD modeling of parts and assemblies with animation, Parametric and nonparametric solid, surface and wireframe modeling, Part editing and printing documents.

Module 6: Demonstration of a simple team design project **3P**

Illustrating Geometry and topology of engineered components: creation of engineering models and presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; use of solid-modeling software for creating associative models at the component and assembly levels.

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R, (2014), Engineering Drawing, Charotar PublishingHouse
2. K. Venugopal, Engineering Drawing + AutoCAD, New Age International publishers

Reference Books:

1. Pradeep Jain, Ankita Maheswari, A.P. Gautam, Engineering Graphics & Design, KhannaPublishing House
2. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
3. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.

CO-PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO1			3		2	1		2		1	
CO2			3		2	1		2		1	
CO3			3		3	1		2		2	
CO4			3		3	1		2		2	

Course Name: Engineering Physics Lab
Course Code: PH191/291
Contact: (0:0:3)
Total Contact Hours: 36
Credit: 1.5
Prerequisites: Knowledge of Physics up to 12th standard.

Course Objective(s): The objective of the course is to make the students able to –

1. O1: **Become familiar with scientific instruments and measurement techniques** used to determine various physical parameters of materials and systems.
2. O2: **Reinforce theoretical concepts learned in classroom physics** by performing related practical experiments and observing real-time outcomes.
3. O3: **Develop a systematic and analytical approach** to collecting, organizing, and interpreting experimental data for error analysis and validation of physical laws.
4. O4: **Engage in the experimental validation of physical laws** through laboratory activities involving classical mechanics, optics, electronics, and quantum phenomena.
5. O5: **Encourage innovation and problem-solving abilities** through hands-on investigation of advanced and application-oriented physics experiments, including specially designed extension activities.

Course Outcomes (COs):
After Successful completion of the course, students will be able to

CO1	*Determine* mechanical properties such as Young's modulus and rigidity modulus through hands-on experiments and *analyze* material behaviour under applied forces.
CO2	*Perform* optical experiments including Newton's Rings, laser diffraction, and optical fiber characterization, and *interpret* the results based on wave optics principles.
CO3	*Investigate* quantum effects such as the photoelectric effect and atomic transitions, and *relate* experimental outcomes to basic quantum principles.
CO4	*Study* the performance of semiconductor and electronic devices like solar cells, LEDs, and LCR circuits, and *investigate* their operational characteristics.
CO5	*Conduct* experiments such as Hall Effect, e/m determination, prism dispersion, or optical rotation to *demonstrate* the application of advanced physical principles in practical scenarios.

CO-PO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	3	3						3	2		2			
CO 2	3	3			3			3	2		2			
CO	3				3			3	2		2			

3														
CO 4	3	3			3			3	2		2			
CO 5	3	3			3			3	2		2			

Course Content:

Module 1: General idea about Measurements and Errors (One Mandatory)

a) Error estimation using Slide callipers/ Screw-gauge/travelling microscope for one experiment.

Module 2: Experiments on Classical Physics (Any 4 to be performed from the following experiments)

1. Study of Torsional oscillation of Torsional pendulum & determination of time using various load of the oscillator.
2. Determination of Young's moduli of different materials.
3. Determination of Rigidity moduli of different materials.
4. Determination of wavelength of light by Newton's ring method.
5. Determination of wavelength of light by Laser diffraction method.
6. Optical Fibre-numerical aperture, power loss.

Module 3: Experiments on Quantum Physics (Any 2 to be performed from the following experiments)

7. Determination of Planck's constant using photoelectric cell.
8. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
9. Determination of Stefan's Constant.
10.
    a) Study of characteristics of solar cell (illumination, areal, spectral)
    b) Study of characteristics of solar cell (I-V characteristics, Power-load characteristics, Power-wavelength characteristics)

Module 4: Perform at least one of the following experiments

11. Determination of Q factor using LCR Circuit.
12. Study of I-V characteristics of a LED/LDR.
13. Determination of band gap of a semiconductor.

**In addition, it is recommended that each student should carry out at least one experiment beyond the syllabus/one experiment as Innovative experiment.

Module 5: Probable experiments beyond the syllabus

1. Determination of the specific charge of the electron (e/m) from the path of an electron beam by Thomson method.

2. Determination of Hall co-efficient of a semiconductor and measurement of Magnetoresistance of a given semiconductor3. Study of dispersive power of material of a prism.
3. Determination of thermal conductivity of a bad/good conductor using Lees-Charlton / Searle apparatus.
4. Determination of the angle of optical rotation of a polar solution using polarimeter.
5. Any other experiment related to the theory.

Text book:

1. Practical Physics by Chatterjee & Rakshit (Book & Allied Publisher)
2. Practical Physics by K.G. Mazumder (New Central Publishing) 3. Practical Physics by R. K. Kar (Book & Allied Publisher)

COURSE NAME: BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

COURSE CODE: EE(ME)191

CONTACT: 0:0:3

CREDITS: 1.5

Course Objective: To get students acquainted with the hands on use of basic electrical machineries and electronic experiments useful in various project works.

Course Outcomes:

COs	Statement
CO1	To analyze a given network by applying KVL and KCL.
CO2	To examine the Operation of DC Motor.
CO3	To examine the Operation of Basic Electronics Devices and ICs.
CO4	To design simple electronics circuits.

Course Contents:

List of Experiments: -

1. Familiarization with different passive and active electrical & electronic components.
2. Familiarization with different Electrical & Electronics Instruments.
3. Verification of KVL and KCL.
4. Forward and reversal of DC shunt motor.
5. Speed control of DC shunt motor.
6. Study of the P-N junction diode V-I characteristics (Forward & Reverse Bias).
7. Study of the Characteristics of Zener diode (Forward & Reverse Bias).
8. Study of the Input and Output characteristics of BJT in CE mode.
9. Determination of offset voltage, offset current & bias current of OPAMP(IC741).
10. Determination of CMRR and slew rate of OPAMP(IC741).
11. Determination of inverting and non-inverting gain of OPAMP(IC741).
12. Extramural Experiment.

Textbooks:

1. Handbook of Laboratory Experiments in Electronics Engineering Vol. 1, Author Name: A.M. Zungeru, J.M. Chuma, H.U. Ezea, and M. Mangwala, Publisher -Notion Press Electronic Devices and Circuit Theory by Robert Boylestad Louis Nashelsky,7th Edition, Prentice Hall
2. Experiments Manual for use with Grob's Basic Electronics 12th Edition by Wes Ponick, Publisher-McGraw Hill,2015
3. Laboratory Manual for 'Fundamentals of Electrical & Electronics Engineering': A handbook for Electrical & Electronics Engineering Students by Manoj Patil (Author), Jyoti Kharade (Author), 2020

4. The Art of Electronics, Paul Horowitz, Winfield Hill,Cambridge University Press, 2015.
5. A Handbook of Circuit Math for Technical Engineers, Robert L. Libbey CRC Press, 05-Jun-1991

Reference Books

1. Basic Electrical and Electronics Engineering, Author:S. K. Bhattacharya, Publisher: Pearson Education India,2011
2. Practical Electrical Engineering
3. By Sergey N. Makarov, Reinhold Ludwig, Stephen J. Bitar, Publisher: Springer International Publishing, 2016
4. Electronics Lab Manual (Volume 2) By Navas, K. A. Publisher: PHI Learning Pvt. Ltd. 2018
5. Practical Electronics Handbook, Ian R. Sinclair and John Dunton, Sixth edition 2007, Published by Elsevier Ltd.

CO-PO Course Articulation Matrix Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO 10	PO 11	PO 12
CO1	3	2	3	2	-	2	-	-	2	-	2	3
CO2	3	3	2	3	-	2	-	-	3	-	2	2
CO3	3	2	2	3	-	2	-	-	2	-	3	3
CO4	3	3	2	2	-	2	-	-	3	-	2	3

Course Name: **Communication and Presentation Skill**
Course Code: **HU191**
Contact: (0:0:3)
Total Contact Hours: 36
Credit: 1.5

Pre requisites: Basic knowledge of LSRW skills.

Course Objectives: The objectives of the course are to make the students able to-
O1: acquire interpersonal communication skills of listening comprehension and speaking in academic and professional situations.
O2: understand English pronunciation basics and remedy errors.
O3:operate with ease in reading and writing interface in global professional contexts.
O4:deliver professional presentations before a global audience.
O5:develop confidence as a competent communicator.

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

CO1	Recognize, identify and express advanced skills of Technical Communication in English and Soft Skills through Language Laboratory.
CO2	Understand, categorize, differentiate and infer listening, speaking, reading and writing skills in societal and professional life.
CO3	Analyze, compare and adapt the skills necessary to be a competent interpersonal communicator in academic and global business environments.
CO4	Deconstruct, appraise and critique professional writing documents, models and templates.
CO5	Adapt, negotiate, facilitate and collaborate with communicative competence in presentations and work-specific conclaves and interactions in the professional context.

CO-PO Mapping:

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

Course Contents:

Module 1: Introduction Theories of Communication and Soft Skills
a. Communication and the Cyclic Process of Communication (Theory, benefits and application)
b. Introduction to Workplace Communication (Principles and Practice)
c. Non-Verbal communication and its application
c. Soft Skills Introduction: Soft-Skills Introduction

What is Soft Skills? Significance of Soft-Skills
Soft-Skills Vs. Hard Skills
Components of Soft Skills
Identifying and Exhibiting Soft-Skills (Through classroom activity)

Module 2: Active Listening
a. What is Active Listening?
b. Listening Sub-Skills—Predicting, Clarifying, Inferencing, Evaluating, Note-taking
c.Differences between Listening and Hearing, Critical Listening, Barriers to Active Listening, Improving Listening.
d. Listening in Business Telephony and Practice
Practical (Role plays, case studies)

Module 3: Speaking Skills
a. Effective Public Speaking: Public Speaking, Selecting the topic for public speaking, (Understanding the audience, Organizing the main ideas, Language and Style choice in the speech, delivering the speech, Voice Clarity). Practical (Extempore)
Self Learning Topics: Preparation, Attire, Posture and Delivery techniques

b. Pronunciation Guide—Basics of Sound Scripting, Stress and Intonation
c. Fluency-focused activities—JAM, Conversational Role Plays, Speaking using Picture/Audio
Visual inputs
d. Group Discussion: Principles, Do's and Don'ts and Practice;

Module 4: Writing and Reading Comprehension
a. Reading and Writing a Book Review (classroom activity)
b. Writing a Film Review after watching a short film (classroom activity)
c. Reading Strategies: active reading, note-taking, summarizing, and using visual aids like diagrams and graphs
d. Solving Company-Specific Verbal Aptitude papers.(Synonyms, Antonyms, Error Correction and RC Passages)

Module 5: Presentation Skills
Kinds of Presentation. Presentation techniques, planning the presentation,
Structure of presentation: Preparation, Evidence and Research, Delivering the presentation, handling questions, Time management, Visual aids.

- Self Introduction, Creation of Video Resume`
- Need for expertise in oral presentation.•Assignment on Oral presentation.
- Rules of making micro presentation (power point). Assignment on micro presentation

Text Books:
1. Pushp Lata and Sanjay Kumar. *A Handbook of Group Discussions and Job Interviews*. New Delhi: PHI, 2009.
2. Jo Billingham. *Giving Presentations*. New Delhi: Oxford University Press, 2003.
3. B. Jean Naterop and Rod Revell. *Telephoning in English*. 3rd ed. Cambridge: Cambridge University Press, 2004.

4. Jeyaraj John Sekar. *English Pronunciation Skills: Theory and Praxis*. New Delhi: Authorspress, 2025.
5. Career Launcher. *IELTS Reading: A Step-by-Step Guide*. G. K. Publications. 2028

Reference Books:

1. Ann Baker. *Ship or Sheep? An Intermediate Pronunciation Course*. Cambridge: Cambridge University Press, 2006.
2. Barry Cusack and Sam McCarter. *Improve Your IELTS: Listening and Speaking Skills.* London: Macmillan, 2007.
3. Eric H. Glendinning and Beverly Holmström. *Study Reading.* Cambridge: Cambridge University Press, 2004.
4.Malcolm Goodale. *Professional Presentations*. New Delhi: Cambridge University Press, 2005.
5. Mark Hancock. *English Pronunciation in Use*. Cambridge: Cambridge University Press, 2003.
6. Tony Lynch, *Study Listening*. Cambridge: Cambridge University Press, 2004.
7. J. D. O'Connor. *Better English Pronunciation*. Cambridge: Cambridge University Press, 2005.
8. Peter Roach. *English Phonetics and Phonology: A Practical Course*. Cambridge: Cambridge University Press, 2000.

2nd Year 1st Semester

Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
		THEORY			L	T	P	Total	
1	ENGG	Major	ME301	Engineering Thermodynamics	3	0	0	3	3
2	ENGG	Major	ME302	Materials Engineering	3	0	0	3	3
3	ENGG	Major	ME303	Strength of Material	3	0	0	3	3
4	ENGG	Major	ME304	Manufacturing Process	3	0	0	3	3
5	ENGG	Minor	M(ME)301	Mathematics III	3	0	0	3	3
6	SCI	Minor	CS(ME)301	Programming for Problem Solving	3	0	0	3	3
		PRACTICAL							
1	ENGG	Major	ME391	Material Testing Lab	0	0	3	3	1.5
2	ENGG	Major	ME392	Manufacturing Process Lab	0	0	3	3	1.5
3	SCI	Skill Enhancement Course	CS(ME)391	Programming for Problem Solving Lab	0	0	3	3	1.5
4	HUM	Ability Enhancement Course	HU(ME)391	Technical Seminar Presentation	0	0	1	1	0.5
		MANDAORY COURSES							
1	Mandatory Course	MC	MC381	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives		0	0	0	0
		TOTAL CREDIT							**23**

Detailed Syllabus for 3rd Semester

COURSE NAME: ENGINEERING THERMODYNAMICS
COURSE CODE: ME301
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3

Prerequisites: Physics (10+2 level)

Course Outcomes:

CO1: Learn about the interrelationship of heat and work to draw an energy balance between a system and its surroundings.

CO2: Understand the second law limitation of energy conversion and differentiate realistic and unrealistic thermodynamic systems.

CO3: Carry out Entropy and Exergy analysis of thermal systems to evaluate sustainability ofpractical equipment in industries.

CO4: Evaluate the performance of energy conversion devices using utility thermodynamiccycles.

Course Contents

Module	Syllabus	Contact Hours
1. Fundamentals	System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.	**4**
2. Temperature& First Law of Thermodynamics	Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non- cyclic processes; Concept of total energy E; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.	**4**
3. Pure Substance	Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two-phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.	**7**
4. First Law for Flow Processes	Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law	**5**

5. Second law of Thermodynamics	Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin- Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle;	**5**
6. Entropy andits application	Clausius inequality; Definition of entropy S; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of entropy from steam tables- Principle of increase of entropy; Illustration of processes in TS coordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles. Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.	**7**
7. Thermodynamic cycles	Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle	**4**
	Total Contact Hours	**36**

Text Books:

1. Yunus A. Cengel, Michael A. Boles, 2014, 8th Edition, Thermodynamics: An Engineering Approach, McGraw-Hill Education.
2. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Reference Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons. 2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India 3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons

CO-PO/PSO Mapping:

COs	PO 1	PO 2	PO3	PO4	PO 5	PO6	PO 7	PO8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2	2	2	-	-	-	1	-	-	-	-	1	-	2	-
CO2	3	2	2	1	-	-	2	-	-	-	-	-	-	1	-
CO3	3	3	3	1	-	-	3	-	-	-	-	1	-	3	-
CO4	2	1	2	-	-	-	-	-	-	-	-	-	-	2	-
Avg	2.5	2	2.25	0.5	-	-	1.5	-	-	-	-	0.5	-	2	-

COURSE NAME: MATERIALS ENGINEERING
COURSECODE:ME302
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS:3

CO1: Identify crystal structures for various materials and understand the defects in such structures

CO2: Analyze the effect of heat treatment of mechanical properties of a material
CO3: Understand how to tailor material properties of ferrous and nonferrous alloys
CO4: Learn about advanced materials useful in modern industrial application.

Prerequisite: Engineering Physics and Engineering Chemistry

Course Contents:

Module	Syllabus	Cont. Hrs
1. Crystal Structure	Unit cells, Metallic crystal structures, Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress	6
2. Mechanical Property measurement	Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hook's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell, Vickers and their relation to strength.	7
3. Metals & Alloys	Alloys, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; Iron - Iron- carbide phase diagram, and microstructure analysis of ferrous materials, cast iron, steel.	6
4. Heat treatment	Heat treatment of Steel: Annealing, tempering, normalising and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbonitriding, flame and induction hardening, vacuum and plasma hardening	7
5. Alloying of steel	Properties of stainless steel and tool steels, maraging steels- cast irons; - copper and copper alloys; brass, bronze and cu-nickel; Aluminum and Al -Cu – Mg alloys- Nickel based super alloys and Titanium alloys	5

6. Ceramics and Advanced Materials	Structure, properties and application of ceramics, Composite Types, Types and properties of main composition, Smart Materials, Ferro elastic and Piezoelectric materials, Nano-materials, Biomaterials, Shape memory alloys	**5**
	Total Contact Hours	**36**

Text Books:

1. W. D. Callister,2006, MaterialsScienceandEngineering-AnIntroduction,6th Edition, Wiley India.
2. V. Raghavan, Material Science and Engineering, Prentice Hall of India Private Limited, 1999.
3. Kodgire and Kodgire, 'Material Science and Metallurgy'-Everest Publishing House
4. U. C. Jindal, Engineering Materials and Metallurgy, Pearson,2011.

Reference Books:

1. Kenneth G. Budinski and Michael K. Budinski, Engineering Materials, Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.

CO–PO/PSO Mapping:

COs	PO 2	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2	2	2	2	1	-	-	-	-	-	-	1	-	3	2
CO 2	2	2	3	2	1	-	-	-	-	-	-	2	-	3	2
CO 3	3	3	3	2	1	-	-	-	-	-	-	2	-	2	2
CO 4	2	1	3	2	1	-	-	-	-	-	-	2	-	2	2
Avg	2.25	2	2.75	2	1	-	-	-	-	-	-	1.75	-	2.5	2

COURSE NAME: STRENGTH OF MATERIALS
COURSE CODE: ME303
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3
Prerequisite: Engineering Mechanics

Course Outcomes:

CO1: Recognize various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components

CO2: Evaluate the strains and deformation in materials that will result due to the elastic stresses developed within the materials for simple types of loading.

CO3: Quantify mechanical integrity and failure in materials

CO4: Analyze application of materials with respect to their strength and weakness.

Course Contents:

Module	Syllabus	Contact Hours
1. Deformation in solids	Hooke's law, stress and strain- tension, compression and shear stresses, elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr,s circle	**6**
2. Beams	Beams and types of transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.	8
3. Moment of inertia	Moment of inertia about an axis and polar moment of inertia, Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook, Problems. deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.	**6**
4. Failure Theories	Static failure theories: Ductile and brittle failure mechanisms, Tresca, Von-mises, Maximum normal stress, Mohr-Coulomb and Modified Mohr-Coulomb Theory	**4**
5. Torsion	Torsional stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs	**6**
6. Pressure Vessels	Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure	**6**
	Total Contact Hours	**36**

Text Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi 2005.
4. Strength of Materials, Timoshenko & Young, D. Von Nostrand Company

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2	-	-	-	-		-	2	2	-	-
CO2	3	2	2	2	2	-	-	-	-		-	2	-	-	-
CO3	2	3	3	-	3	-	-	-	-		-	2	2	-	-
CO4	2	2	3	2	2	-	-	-	-		-	2	2	-	-
Avg	2.5	2.5	2.5	2	2.25	-	-	-	-		-	2	2	-	-

COURSENAME: MANUFACTURING PROCESSES
COURSE CODE: ME304
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS:3

Prerequisite: Workshop

Course Outcomes:

CO1: Understand the basics of manufacturing processes and concerned behavior of material properties**.**

CO2: Explain various casting processes for different molding designs and forming techniques for metal works.

CO3: Understand welding methods and analyze solid or liquid state joining

CO4: Analyze the principle of powder metallurgy and its application.

Course Contents:

Module	Syllabus	Contact Hours
1. Casting Process	**Metal Casting**: Casting and Molding: Major Classification, Casting Materials. Sand mould casting: Moulding sands: composition, properties & testing. Design of gating system: sprue, runner, ingate & riser, Estimation of powering time, Foundry equipment, Furnaces Melting, pouring and solidification Type of patterning, use of a core. Different type of sand mould casting: Floor mould casting, Centrifugal casting, Shell mould & CO2 casting, Investment casting. Permanent mould casting: Die casting, types, methods; advantages & applications. Slush casting, principle & use. Casting defects, types, causes & remedy; equipment; Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.	**10**
2. Forming Process	**Metal Forming**: Plastic deformation and yield criteria; Forging: Introduction, definition, classification, hot forging & cold forging, characteristics & applications. Forging material operations, equipment & tools: Smith forging, Drop forging, Pressing or press forging, Forging dies, materials & design. Rolling: Introduction, basic principles, hot rolling & cold rolling, characteristics & applications. Rolling processes & applications, operations, equipment & roll stands. Wire drawing & extrusion: Basic principles & requirements. Classification, methods & applications. Miscellaneous forming processes. load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending).	**10**

3. Joining Process	**Metal Joining**: Different metal welding processes; types of joints. Gas welding: oxy-acetylene flame; gas welding equipment; welding process. Electric arc welding: principle of arc formation; arc welding equipment- AC & DC machine; electrodes. Manual metal arc welding procedure: edge preparation, current & voltage setting, electrode movement; down hand, horizontal & overhead welding. GTAW & GMAW, SAW, FSW: process & application. Resistance welding- spot welding & butt/seam welding. Causes & remedy of welding defects, Testing of welding joints; Destructive testing and NDT methods.	**10**
4. Press-tool Works	**Press tool works**: Basic principles, systems, operations & applications, Shearing, parting, blanking, piercing & notching, Cupping (drawing), Spinning & deep drawing Blanks & forces needed for shearing & drawing operations, Coining & embossing	**3**
5. Powder Metallurgy	**Powder Metallurgy**: Principles of powder metallurgy; production of Metallic Powder; processing methods (mixing and blending, compacting, sintering, secondary operations etc.); Advantages; Designing for P/M; Metal injection Mounding (MIM); applications, advantages and limitations.	**3**
	Total Contact Hours	**36**

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems.
3. 'Material Science and Metallurgy'-Everest Publishing House by Kodgire and Kodgire
4. Degarmo, Black & Kohser, Materials and Processes in Manufacturing
5. Strength of Materials, Timoshenko & Young,

CO – PO/PSO Mapping:

COs	PO 1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	-	2	-	-	-	-	-	-	-	1	-	1	-	1
CO2	3	3	3	2	-	-	-	-	-	-	-	-	2	-	2
CO3	3	2	3	2	-	-	-	-	-	-	-	-	3	-	2
CO4	3	2	3	2	-	-	-	-	-	-	1	-	2	-	3
Avg	3	1.75	2.75	1.5	-	-	-	-	-	-	0.5	-	2	-	2

COURSE NAME: PROGRAMMING FOR PROBLEM SOLVING
COURSE CODE: CS(ME)301
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36 CREDITS: 3
Prerequisites: Number system, Boolean Algebra
Course Outcome:

CO1	Understand and differentiate among different programming languages for problem solving.
CO2	Describe the way of execution and debug programs in C language.
CO3	Define, select, and compare data types, loops, functions to solve mathematical and scientific problem.
CO4	Understand the dynamic behavior of memory by the use of pointers.
CO5	Design and develop modular programs using control structure, selection structure and file.

Course Contents

Module	Syllabus	Cont. Hour
1. Fundamentals of Computer	History of Computer, Generation of Computer, Classification of Computers, Basic structure of Computer System, Primary & Secondary Memory, Processing Unit, Input & Output devices. Number System: basic of Binary, Octal, Decimal and Hexadecimal number systems; Representation and interchanging of number in different number systems. Introduction to complements system, Representation of signed and unsigned numbers in singed magnitude singed 1_s complement system and signed 2_s complement system. Arithmetic– Addition and Subtraction (using1_scomplementand2_scomplement). Representation of Characters-ASCII Code Basics of Compiler, Interpreter and Assembler Problem solving – Basic concept of Algorithm. Representation of algorithm using flow chart and pseudo code. Some basic examples	**9**

2. Introduction to C Programming	Overview of Procedural vs Structural language; History of C Programming Language. Variable and Data Types: The C characterse identifiers and keywords, data type & sizes, variable names, declaration, statements. Operators & Expressions: Arithmetic operators, relational operators, logical operators, increment and decrement operators, bitwise operators, assignment operators, conditional operators, special operators-type conversion, C expressions, precedence and associativity. Input and Output: Standard input and output, formatted output–print f, formatted input scan f.	**5**
3. Branch and Loop	Branching: Concept of Statement and Blocks in C, Simple if, if -else, nested if-else and if-else ladder. Switch Case: break and continue; switch-case, concept of go to and labels Loops - while, for, do while	**5**
4. Program Structures	Function: Basics of Functions, function types, function prototypes, formal and actual parameter, function calling, functions returning values, functions not returning values. Recursion and Recursive Function. Storage Class in C: Storage Class-auto, external, static and register storage class, scope rules and life time of variables C pre-processor: Pre-processing directive and macro, parameterized macro.	**4**
5. Array and Pointer	Arrays: One dimensional arrays, Two-dimensional arrays, Passing an array to a function Pointers: Pointers, Pointer and Array, Pointer and functions. Strings: Character array and string, array of strings, Passing a string to a function, String related functions, Pointer and String. Dynamic memory allocation: Malloc, calloc, realloc and free with example.	**7**
6. Structures, Unions and Enum	Basic of structures, arrays of structures, structures and pointers, bit fields. Basics of union and enum, difference between structure and union.	**3**
7. File in C	Files handling- opening and closing a file in different mode, formatted and unformatted files, Command line arguments, f open, f close, f get c, f put c, f print f, f scan f function	**3**
	Total Contact Hours	**36**

Textbook:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. KanetkarY.-LetusC,BPBPublication,15th Edition

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of

CO–PO/PSO Mapping:

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2	2								**3**	**3**	**3**
CO2	3	2	2	2	2								3	3	3
CO3	3	3	3	2	2								3	3	3
CO4	3	3	3	2	2								3	3	3
CO5	3	3	3	2	2								3	3	3

COURSE NAME: MATERIALS TESTING LABORATORY
COURSE CODE: ME391
CONTACT: 0:0:3
CREDITS: 1.5
Prerequisites: Engineering Mechanics and Engineering Materials.

Course Outcomes:

CO1: Acquire experimentation skills in the field of material testing.

CO2: Apply the knowledge to analyze a material failure and determine the failure inducing agent/s.

CO3: Apply the knowledge of testing methods in related areas.

CO4: Understand how to improve structure/behavior of materials for various industrial applications.

List of experiments:

At least six experiments need to be conducted.

1. Uniaxial tension test on mild steel rod
2. Torsion test on mild steel rod
3. Impact test on a metallic specimen
4. Brinell and Rockwell hardness tests on metallic specimen
5. Bending deflection test on beams
6. Strain measurement using Rosette strain gauge
7. Microscopic examination of heat-treated and untreated metallic samples
8. Demonstration of Fatigue Test
9. Strut test (Column buckling experiment)
10. Determination of moment of inertia of rotating bodies

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	-	-	-	-	-	-	2	3	2	2
CO 2	2	2	2	-	-	-	-	-	-	-	-	2	2	2	2
CO 3	2	3	2	-	-	-	2	-	-	-	-	2	2	2	2
CO 4	3	3	3	-	-	-	2	-	-	-	-	2	2	2	2
Avg	2.5	2.5	2.25	-	-	-	2	-	-	-	-	2	2.25	2	2

COURSE NAME: MANUFACTURING PROCESS LAB
COURSE CODE: ME392
CONTACTS: 0: 0: 3
CREDIT: 1.5
Prerequisite: Manufacturing Process
Course Outcome:
CO1: Learn about patterns and casting of metals
CO2: Practice forming techniques and modern improvements for sophisticated metal works.
CO3: Apply the knowledge of welding technology and they can perform arc and gas welding to join the material.
CO3: Appreciate the role of powder metallurgy component in various field

List of Experiments

Experiment No	Name of the Experiment
1.	To determine the percentage of clay content in dry sand
2.	To determine the grain fineness number of dry and clay free sand
3.	To determination the compressive strength, splitting strength and shearing strength of green sand by Pendulum Type Universal Strength Testing Machine
4.	To determine the permeability number of greensands, Core sand and Raw sand.
5.	Mould preparation and casting of metals after preparation of suitable moulds
6.	Study of post casting operation like fettling, cleaning, deburring and polishing
7.	Practicing smithy or forging of carbon steels and testing for its property changes
8.	To generate plastic curve of a given metal strip at room temperature and at recrystallization temperature during rolling. Observe the changes in metal characteristic after rolling
9.	To generate plastic curve of a given metal strip at room temperature and at recrystallization temperature during rolling. Observe the changes in metal characteristic after rolling
10.	Laboratory experiments in Fabrication processes to observe effects of varying process parameters in GMAW and SMAW and Testing for Joint defects.
11.	Mechanical Press Working: Blanking & Piercing operation and study of simple, compound and progressive press tool. Hydraulic Press: Deep drawing and extrusion operation.
12.	To Study Various Characteristics of given metal powders and Evaluate Green Density as well as Strength Characteristics (hardness) of Cold-compacted and sintered (Conventional) powder

CO-PO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	-	-	-	-	-	-	-	-	2	3	2	2
CO 2	2	2	2	-	-	-	-	-	-	-	-	2	2	2	2
CO 3	2	3	2	-	-	-	2	-	-	-	-	2	2	2	2
CO 4	3	3	3	-	-	-	2	-	-	-	-	2	2	2	2
Avg	2.5	2.5	2.25	-	-	-	2	-	-	-	-	2	2.25	2	2

COURSENAME: PROGRAMMING FOR PROBLEM SOLVING LAB
COURSE CODE: CS(ME)391
CONTACT: 0:0:3
CREDITS: 1.5
Prerequisites: Number system, Boolean Algebra
Course Outcomes (COs):
After completion of the course students would be able to,
CO1: Understand and propose appropriate command or function in the running system or developing program for engineering and mathematical problems depending on the platform used even in a changed environment leading to their lifelong learning.
CO2: Identify and propose appropriate data type, arithmetic operators, input/output functions and also conditional statements in designing effective programs to solve complex engineering problem using modern tools.
CO3: Design and develop effective programs for engineering and mathematical problems using iterative statements as well as recursive functions using modular programming approach possibly as a team maintaining proper ethics of collaboration.
CO4: Explain and organize data in arrays, strings and structures and manipulate them through programs and also define pointers of different types and use them in defining self-referential structures and also to construct and use files for reading and writing to and from leading to solution of engineering and mathematical problem**.**
CO5: Prepare laboratory reports on interpretation of experimental results and analyse it for validating the same maintaining proper ethics of collaboration.

Course Content:

Module-1: Familiarization with some basic commands of DOS and Linux. File handling and Directory structures, file permissions, creating and editing simple C program in different editor and IDE, compilation and execution of C program. Introduction to Code block.

Module-2: Problem based on

a) Basic data types
b) Different arithmetic operators.
c) Print f( ) and scan f( ) functions.

Module-3: Problem based on conditional statements using

a) if-else statements
b) different relational operators
c) different logical operators

Module-4: Problem based on

a) **for** loop
b) **while** loop
c) **do-while** loop

Module-5: Problem based on

a) How to write a menu driven program using **switch-case** statement
b) How to write a function and passing values to a function
c) How to write a **recursive function.**

Module-6: Problem based on

a) How to use **array (both I-Dand2-D).**
b) How to pass an **array** to a **function.**

Module-7: Problem based on manipulation of strings in different way.

Module-8: Problem based on

a) How to handle compound variables in

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. Kanetkar Y.- Letus C, BPB Publication,15th Edition

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hallof India
2. K R Venugopal & S R Prasad – MASTERING C, TMH, 2nd Edition

CO-PO/PSO Mapping:

CO PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3								3	3	3
CO2	3	3	2	3	3								3	3	3
CO3	3	3	3	3	3								3	3	3
CO4	3	3	3	3	3								3	3	3
CO5	3	3	3	3	3								3	3	3

COURSENAME: TECHNICAL SEMINAR PRESENTATION
COURSE CODE: HU(ME)391
CONTACT: 0:0:1
CREDITS: 0.5
Prerequisites: Basic (10+2) level of knowledge of English grammar, vocabulary reading and writing skills.

Course Outcomes (COs):
After completion of the course students would be able to,

Course Content:

Module- 1:
Verbal and Non-verbal communication:
Definition, Relevance and Effective Usage, :Components of Verbal Communication: Written and Oral Communication, Components of Non-verbal Communication: Kinesics, Proxemics, Chronemics, Haptics Paralanguage , Barriers to Effective Communication

Module- 2:
Social Communication Essentials and Cross-Cultural Communication
Communication in Society and the Workplace, Greetings, Courtesies and Socially Useful Language , Cultural Contexts: High Context and Low Context Cultures , Understanding Cultural Nuances and Stereotyping
Achieving Culturally Neutral Communication in Speech and Writing, Preparing the Minutes of a Meeting (MOM)

Module- 3:
Technical Report Writing
Nature and Function of Reports, Types of Reports , Researching for a Business Report, Format, Language and Style, Report Documentation.

Module- 4:
Group Discussions
The students are made to understand the difference between the language of conversation and group discussion. Strategies of such discussions are to be taught to them. It is also helpful to use videocassettes produced by the U.G.C. on topics like group-discussion. Afterwards the class is divided into groups and the students have to discuss on given topics on current socio-economic-political-educational importance.

Module- 5:
Interview sessions :
students are taught the do's and don'ts of facing a successful interview. They then have to face rigorous practices of mock-interviews. There would be simulations of real life interview sessions where students have to face an interview panel.

Module- 6:
Presentations:
The secrets of an effective presentation are taught to the students. Then each and every student has to make lab presentations with the help of the overhead projector/ using power point presentation and other audio-

visual aids in the laboratory. They also have to face the question answer sessions at the end of their presentation.

Text Books &Reference Books:

1. Meenakshi Raman and Sangeetha Sharma. Technical Communication. 3rd edition. NewDelhi: Oxford University Press, 2015.
2. Mark Ibbotson. Cambridge English for Engineering. Cambridge: Cambridge UniversityPress, 2008.

Reference Book

1. Mark Ibbotson. Professional English in Use: Engineering. Cambridge: Cambridge UP,2009.
2. Lesikar et al. Business Communication: Connecting in a Digital World. New Delhi: TataMcGraw-Hill, 2014.
3. John Seeley. Writing Reports. Oxford: Oxford University Press, 2002.
4. Judith Leigh. CVs and JobApplications. Oxford: Oxford University Press, 2002.
5. Judith Leigh. Organizing and Participating in Meetings. Oxford: Oxford University Press,2002.
6. Michael Swan. Practical English Usage. Oxford: OUP, 1980.
7. Pickett, Laster and Staples. Technical English: Writing, Reading & Speaking. 8th ed. London: Longman, 2001.
8. Diana Booher. E-writing: 21st Century Tools for Effective Communication

2nd Year 2nd Semester

Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
		THEORY			L	T	P	Total	
1	ENGG	Major	ME401	Applied Thermodynamics	3	0	0	3	3
2	ENGG	Major	ME402	Fluid Machinery	3	0	0	3	3
3	ENGG	Major	ME403	Manufacturing Technology	3	0	0	3	3
4	ENGG	Major	ME404	Kinematics and Dynamics of Machines	3	0	0	3	3
5	ENGG	Minor	CS(ME)405	Data Structure	2	0	0	2	2
		PRACTICAL							
1	ENGG	Major	ME491	Fluid Machinery Lab	0	0	3	3	1.5
2	ENGG	Major	ME492	Kinematics and Dynamics of Machines Lab	0	0	3	3	1.5
3	ENGG	Major	ME493	Manufacturing Technology Lab	0	0	3	3	1.5
4	ENGG	Major	ME494	Machine Drawing Lab	0	0	3	3	1.5
5	ENGG	Ability Enhancement Course	HU(ME)491	Quantitative Aptitude	1	0	0	1	0.5
		MANDATORY ACCTIVITIES/ COURSES							
1	Mandatory Course	MC	MC 481	NSS/NCC/Physical Activities/ Meditation & Yoga/ Club Activities/ Environmental Protection Initiatives	0	0	0	0	0
		TOTAL CREDIT							20.5

* “Mandatory Additional Requirement” (MAR) activities have to be carried out as per university guidelines.

Detailed Syllabus for 2nd Year 2nd Semester

COURSE NAME: APPLIED THERMODYNAMICS
COURSE CODE: ME401
CONTACT: 3:0:0
TOTAL CONTACT HOURS:36
CREDITS:3
Prerequisite: Engineering Thermodynamics

Course Outcomes:

CO1: Get a good understanding of various practical power cycles and heat pump cycles.

CO2: Analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers.

CO3: Understand phenomena occurring in high-speed compressible flows and study the functioning and application of compressors.

CO4: Learn the concepts, types and working principles and define their different types of efficiencies

Course Contents

Module	Syllabus	Cont. Hour
1. Fuels and Combustion Analysis	Introduction to solid, liquid and gaseous fuels – Stoichiometry, exhaust gas analysis - First law analysis of combustion reactions Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and composition calculations using free energy	**6**
2. Vapor Based Cycles	Vapor power cycles, Rankine cycle with superheat, reheat and regeneration, exergy analysis. Supercritical and ultra-supercritical Rankine cycle - Vapor compression refrigeration cycles, refrigerants and their properties	**8**
3. Gas Based Cycles	Gas power cycles, Air standard Otto, Diesel and Dual cycles – Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles	**8**
4. Psychrometry	Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	**4**
5. Reciprocating Compressors	Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.	**5**
6. Nozzle and Diffuser	Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- Flow of steam and refrigerant through nozzle, super-saturation, compressible flow in diffusers, efficiency of nozzle and diffuser	**5**
	Total Contact Hours	**36**

Text Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G.J., 2003,6thEdition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Nag, P. K,1995, Engineering Thermodynamics, Tata McGraw-HillPublishing Co. Ltd

Reference Books

1. Jones, J. B. and Duggan,R. E., 1996,EngineeringThermodynamics,Prentice-HallofIndia
2. Moran, M. J.and Shapiro, H. N.,1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons

CO–PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	2	2	2	-	-	2	-	-	-	-	2	3	-	-
CO 2	2	2	2	3	-	-	2	-	-	-	-	2	2	-	-
CO 3	3	3	2	3	-	-	2	-	-	-	-	2	2	-	-
CO 4	2	3	2	2	-	-	2	-	-	-	-	2	2	-	-
Avg	2.5	2.5	2	2.5	-	-	2	-	-	-	-	2	1.75	-	-

COURSE NAME: FLUID MACHINERY
COURSE CODE: ME402
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3
Prerequisite: Fluid Mechanics
Course Outcomes: At the end of the course the students will be able to

CO1: Discuss the characteristics of centrifugal pump and reciprocating pumps
CO2: Calculate forces and work done by a jet on fixed or moving plate and curved plates
CO3: Analyze the working of turbines and select the type of turbine for an application.
CO4: Evaluate hydraulic machines and select the suitable one for a specific application

Course Contents:

Module	Syllabus	Cont. Hrs
1. Impact of Jets and Jet Propulsions	Euler's fundamental equation, Force exerted by a liquid jet on a stationary flat plate, force exerted by a liquid jet on a stationary curved vane, force exerted by a liquid jet on a hinged plate, force exerted by a liquid jet on moving flat plates, force exerted by a liquid jet on moving curved vane, jet propulsion.	**4**
2. Hydraulic Turbines	Essential element of a hydroelectric power plant; head and efficiencies of hydraulic turbines; classifications of hydraulic turbines, Pelton turbine, reaction turbine, Francis's turbine, Kaplan turbine; draft tube; cavitation in hydraulic machines; dimensional analysis and similarity laws for rotodynamic machines; specific speed of hydraulic turbines; unit quantities of hydraulic turbines; characteristic curves of hydraulic turbines; governing of Pelton wheel and turbines.	**8**
3. Centrifugal Pump	Components of a centrifugal pump, working principle,work done by impeller, different heads in a pumping system, different efficiencies, characteristics, minimum speed for starting a centrifugal pump, multistage centrifugal pumps, specific speed, model testing, cavitation & separation, net positive suction head	**8**
4. Positive Displacement Pump:	Components of a reciprocating pump, working principle, types of reciprocating pumps, discharge and power requirement, slip and coefficient of discharge, variation of velocity and acceleration in the suction and delivery pipes due to acceleration of the piston, frictional head on suction and delivery pipes, indicator diagram, air vessels. Comparison of centrifugal and reciprocating pumps, Performance characteristics.	**8**

5. Miscellaneous Hydraulic Machines:	Hydraulic press, hydraulic accumulator, hydraulic intensifier, hydraulic ram, hydraulic lift, hydraulic crane, hydraulic coupling, hydraulic torque converter, hydraulic actuators, hydraulic valves, air lift pump, jet pump.	**8**
	Total Contact Hours	**36**

Text Books:

1. A textbook on Fluid Mechanics and Hydraulic Machines – Sukumar Pati, TMH
2. Fluid Mechanics & Machinery – R. K. Bansal, Luxmi Publications.
3. Introduction to Fluid Mechanics & Fluid Machines – Som Biswas, Chakraborty, TMH.
4. Fluid Mechanic s & Turbo Machines – M.M. Das, PHI, 2010.
5. Fluid Mechanics and Fluid Power Engineering by D S Kumar, S K Kataria & Sons

Reference Books:

1. Fluid Mechanics & Machinery – C. Ratnam, A.V. Kothapalli, I.K. International Publishing House Ltd, 2010.
2. Fluid Mechanics & Machinery – C.S.P Ojha, R. Berndtsson, P.N. Chandramouli, OUP.
3. Introduction to Fluid Mechanics – Fox & Macdonald, Wiley.
4. Fluid Mechanics – Fundamentals & Applications – Cengel & Cimbala, TMH.

CO – PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	1	-	1	3	-	2	-	-	-	2	3	-
CO2	3	3	2	2	-	1	1	-	1	-	-	-	2	2	-
CO3	2	2	2	2	-	1	2	-	3	-	-	-	2	3	-
CO4	2	3	2	-	1	1	1	-	1	-	-	-	2	2	-
Avg	2.5	2.5	2.25	1.25	0.25	1	1.75	-	1.75	-	-	-	2	2.5	-

COURSE NAME: MANUFACTURING TECHNOLOGY
COURSE CODE: ME403
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3

Prerequisite: Manufacturing Processes, Materials Engineering.

Course Outcomes: After successful completion of this course, the learner will be able to:

CO1: Understand the cutting tool geometry, mechanism and mechanics of machining, cutting temperature and application of cutting fluids, tool life and tool materials.
CO2: Understand the basic operations and kinematic structure of machine tools needed for manufacturing.
CO3: Explore and use the knowledge of the assembly of different components in practical projects
CO4: Apply the optimization methods in manufacturing

Course Contents:

Module	Syllabus	Cont. Hrs
1. Machining Principles	Machining: Basic principle, definition and requirements. Cutting Tools: Geometry of single point and multi point tools in ASA, ORS and NRS systems, Conversion of tool angles. Mechanism and Mechanics of machining: Chip formation in various cutting and determination of various force components. Cutting temperature and cutting fluids. Tool Life: Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials.	**12**
2. Machine Tools	Introduction, Purpose of use, definition and general features of machine tools. Generatrix and Directrix and tool–work motions in different operations of conventional machine tools. Major components and their functions for shaping, planning and slotting machines; drilling and milling machines; and lathe. Kinematic structure of conventional machine tools; preferred numbers, gear ratio and gear box design. Alignment test of machine tools	**10**
3. Mechanical Assembly	Manufacturing and assembly, alignment and testing methods, tolerance analysis, process planning, selective assembly, Material handling and devices	**4**
4. Optimization	Linear programming, objective function and constraints, graphical method, Simplex algorithms, transportation assignment, Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling; Production planning& control: Forecasting models, aggregate production planning, materials requirement planning.	**10**
	Total Contact Hours	**36**

Text Books:

1. A. B. Chattopadhyay, Machining and Machine Tools, Wiley India (P) Ltd., New Delhi.
2. G. Kuppuswamy, Principles of Metal Cutting, University Press, Hyderabad.
3. Stephenson &Agapion, Metal Cutting Theory and Practice, Taylor and Francis, NY.
4. G.C. Sen and A. Bhattacharyya, Principles of Machine Tools, New Central Book Agency (P)Ltd., Kolkata.

CO–PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	2			2	-	2		-		3		2
CO2	3	2	2	2			2	-	2		-		2		2
CO3	3	3	2	2			2	-	2		-		3		2
CO4	3	2	-	-			-	-	3		2		3		2

COURSE NAME: KINEMATICS & DYNAMICS OF MACHINES
CODE: ME 404
CONTACT: 3:0:0
TOTAL CONTACTHOURS: 36
CREDITS: 3
Prerequisite: Physics

Course Outcomes:

CO1: Understand the kinematics and rigid- body dynamics of kinematically driven machine components
CO2: Understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
CO3: Design and analyses cam and gear based mechanisms to generate specified output motion
CO4: Explore the mechanism of bearings and understand vibration-based systems

Course Contents:

Module	Syllabus	ContactHrs
1– Mechanisms	Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof_s law, Kinematic inversions of four bar chain and slider crank chains Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms	6
2– Velocity& Acceleration	Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation	**8**
3– Cam Drive	Classification of cams and followers- Terminology and definitions- Displacement diagrams, Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers	**6**

4- Gear Drive	Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.	**6**
5- Friction & Bearings	Introduction to Bearing, Classification; Sliding contact bearing & Rolling Contact bearing, Lubrication in different bearing material, 'Balancing' in Mechanical components, Gyroscope.	**6**
6 - Vibration	Natural and Transverse vibration, Free and forced Vibration, Damping, Torsional vibration	**4**
Total Hours (36 L)		

Text Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East West Pvt. Ltd,New Delhi, 1988.

Reference Books:

1. Cleghorn W.L., Mechanisms of Machines, Oxford University Press, 2005.
2. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata Mc Graw Hill, 2009.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	2	1	2	-	-
CO3	2	2	2	-	2	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	3	2	2	-	3

COURSE NAME: DATA STRUCTURE
COURSE CODE: CS(ME)405
CONTACT: 2:0:0
TOTAL CONTACT HOURS: 24
CREDITS: 2

Prerequisite: C language

Course outcomes:
CO1: For a given algorithm student will able to analyze the algorithms to determine the time and computation complexity and justify the correctness.
CO2: For a given Search problem (Linear Search and Binary Search) student will able to implement it.
CO3: For a given problem of Stacks, Queues and linked list student will able to implement it and analyze the same to determine the time and computation complexity.
CO4: Students will able to write algorithms and practice programming in C++.

Course contents:

Module	Syllabus	Contact Hours
I – Introduction	Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.	**5**
II – Stacks and Queues	ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks:Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each types of Queues: Algorithms and their analysis.	**5**
III – Linked Lists and Trees	Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Treeoperations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.	**8**

IV– Sorting and Hashing	Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, HeapSort; Performance and Comparison among all the methods, Hashing.	**4**
V – C++	Object oriented Programming using C++	**2**
	Total Contact Hours	**24**

Text Book:

1. ―Fundamentals of Data Structures‖, Illustrated Edition by Ellis Horowitz, Sartaj Sahni, Computer Science Press.

Reference books:

1. Algorithms, Data Structures, and Problem Solving with C++‖, Illustrated Edition by Mark Allen
Weiss, Addison-Wesley Publishing Company
2. ―How to Solve it by Computer‖, 2nd Impression by R.G. Dromey, Pearson Education

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	1	1	-	-	-	-	-	-	1	1	1	-	-	-
CO2	1	1	-	-	-	-	-	-	-	1	1	-	-	1	-
CO3	1	1	-	-	-	-	-	-	-	1	1	1	2	-	2
CO4	2	1	1	2	-	-	-	-	-	1	2	-	2	1	-

COURSE NAME: FLUID MECHANICS & FLUID MACHINES LAB
COURSE CODE: ME 491
CONTACT: 0: 0: 3
CREDITS: 1.5
PREREQUISITES: FLUID MECHANICS & MACHINARY
Course outcome:

CO1: Develop a hands-on grasp of fluid behavior principles through experiments, covering pressure, velocity, and flow dynamics.

CO2: Gain expertise in using instruments like manometers, pitot tubes, and viscometers for accurate fluid parameter measurement and data interpretation.

CO3: Acquire skills to assess pump, turbine, and hydraulic system performance, analyzing efficiency, head, and power characteristics.

CO4: Learn experimental design, execution, and reporting techniques, cultivating the ability to present findings systematically and conclusively.

List of Experiments:

1. Determination of the performance characteristics of a centrifugal pump
2. Determination of the performance characteristics of a Pelton Wheel
3. Determination of the performance characteristics of a Francis Turbine.
4. Determination of the performance characteristics of a Kaplan Turbine
5. Impact of jet on vanes
6. Performance Characteristics of a single stage Centrifugal Pump
7. Determination of Discharge over of Triangular / Rectangular/Trapezoidal Notch.
8. Study of flow through a horizontal contraction in a rectangular channel.
9. Determination of coefficient of discharge for given rectangular notch.
10. Study of Cavitation phenomenon in Centrifugal Pump,
11. Measurement of Performance of Centrifugal Pump with Series and Parallel Connection

COURSE NAME: KINEMATICS AND DYNAMICS OF MACHINES LAB
COURSE CODE: ME 492
CONTACT: 0:0:3
CREDITS: 1.5
Prerequisite: Kinematics & Theory of Machines.

Course Outcomes:

CO1: Understand the kinematics and rigid- body dynamics of kinematically driven machine components
CO2: Understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
CO3: Design and analyse cam and gear basedmechanisms to generate specified output motion
CO4: Explore the mechanism of bearings and understand vibration-based systems

List of Experiment:

1. Velocity ratios of simple, compound, epicyclic and differential gear trains
2. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms
3. Study of Cam & follower motion.
4. Determination of natural frequency and damping coefficient for a Single DOF Spring- mass-damper system
5. Determination of torsional natural frequency of single and double rotor systems- undamped and Damped natural frequencies
6. Static and dynamic balancing of rotating masses;
7. Balancing of reciprocating masses;
8. Experiments on working of governor, operation and analysis.
9. Experiments on working of gyroscope, operation and analysis.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	3	1	-	-	-	-	-	-	2	1	2	-	-
CO3	2	2	2	-	2	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	3	2	2	-	3

COURSENAME: MANUFACTURING TECHNOLOGY LAB
COURSECODE: ME493
CONTACTS: 0: 0: 3
CREDITS: 1.5

Prerequisite: Manufacturing Technology

CO1: Develop proficiency in operating machining tools, mastering techniques for precise material removal and dimensional accuracy.
CO2: Gain hands-on experience in using a variety of machine tools, understanding their functions, capabilities, and applications in production processes**.**
CO3: Learn principles of efficient assembly, including component alignment, joining methods, and quality verification for producing functional products.
CO4: Acquire the ability to analyze manufacturing processes, identify areas for improvement, and propose solutions for enhanced product quality and production efficiency.

List of Experiments

At least 6 (six) of the following experiments/ assignments to be conducted

1. Taper turning and external thread cutting using lathe
2. Contour milling using vertical milling machine
3. Spur gear cutting in milling machine
4. Measurement of cutting forces in Milling/ Turning process
5. Measurement of surface roughness in turning under different conditions
6. Observation of chip forms and measurement of thrust and torque in Drilling under different speed – feed combinations.
7. Study of chip formation (type, color & thickness) in turning mild steel and evaluation of role of variation of cutting velocity and feed on chip reduction coefficient /cutting ratio and shear angle
8. Measurement of tool – wear and evaluation of tool life in turning mild steel by HSS or carbide tool
9. Bore diameter measurement using micrometer and telescopic gauge
10. Carrying out alignment test of a machine tool.

CO-PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	3	2	-	-	2	-	1	-	3	-	2	-	2
CO2	3	3	2	2	-	-	2	-	-	-	3	-	2	-	2
CO3	3	2	2	2	-	-	2	-	-	-	3	-	2	-	2
CO4	3	3	2	2	-	-	2	-	1	-	3	-	2	-	2

Avrg.	2.75	2.5	2.25	2	-	-		-		-	3	-	2	-	2

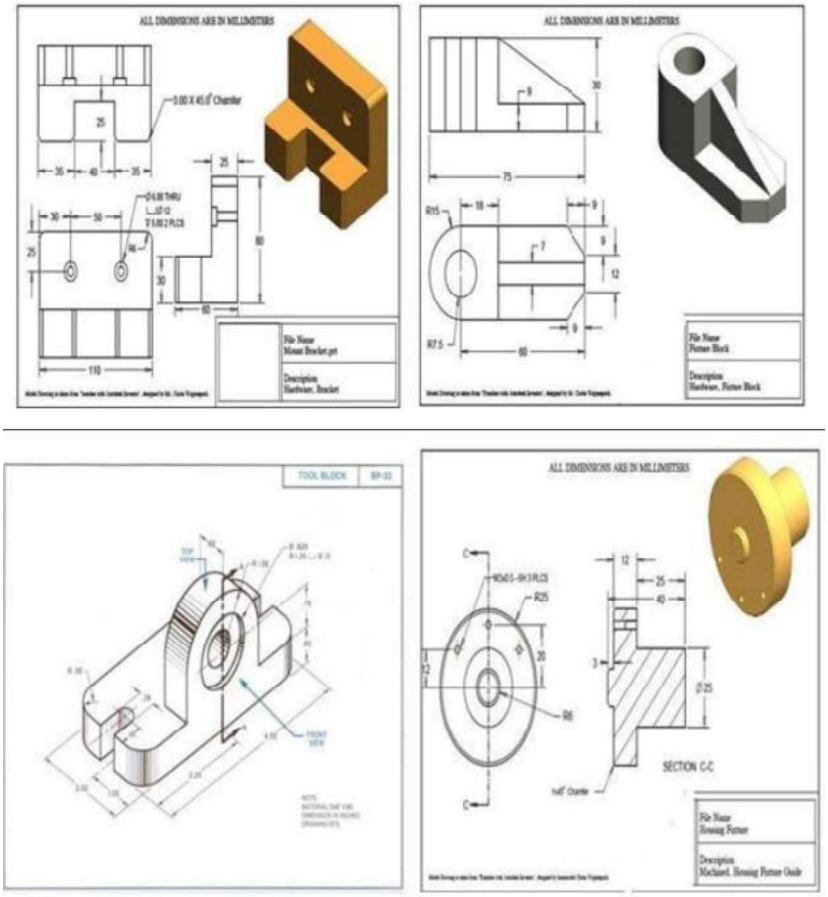
Course Name: Machine Drawing
Course Code: ME494
Contact: 0:0:3
Credits: 1.5
Prerequisite: Basic knowledge of Machine elements, engineering drawing/drafting

Course Outcomes:

CO1: Gain knowledge about the isometric views of a given three-dimensional object/part.
CO2: Understand and draw the orthogonal projection of a solid body and assemble drawing usingpart drawings.
CO3: Learn and practice 3D modeling of machine parts using AutoCAD / SOLIDWORKS /CATIA
CO4: Draft the shape and structure of different types of screws, keys and Couplings

List of Experiments

1. Schematic product symbols for standard components in welding and pipe joints
2. Joints 2 Orthographic projections of machine elements, different sectional views- full, auxiliary sections, Isometric projection of components (Manual and CAD).
3. Assembly and detailed drawings of a mechanical assembly (Manual Drafting) a) Plummer block b) Tool head of a shaping machine c) Tailstock of a lathe d) Welded pipe joints indicating work parts before welding
4. Basic 3D modeling practice of simple machine elements using AutoCAD or SolidWorks (At least 10, samples given)



Text Books:

1. Text Book on Engineering Drawing, Narayana/Kannaia H, Scitech
2. Mechanical Engineering Drawing and Design, S. Pal and M. Bhattacharyya
3. Machine Drawing by N.D. Bhatt
4. Machine Drawing by P.S. Gill
5. Engineering Drawing and Graphics + AutoCAD by K. Venugopal, New Age International Pub.
6. Engineering Drawing with an Introduction to AutoCAD by D.A. Jolhe, Tata-McGraw-Hill Co.
7. Introduction to Solid Modeling Using SolidWorks 2008, Joseph C. Musto and William E.Howard
8. SOLIDWORKS 2016 Basic Tools, Paul Tran.

5.

CO-PO/PSO Mapping:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO 1	1	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO 2	1	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO 3	1	3	2	-	-	-	-	-	-	-	-	-	1	-	1
CO 4	2	2	1	-	-	-	-	-	-	-	-	-	1	-	1
Avg	1.25	2.25	1.75	-	-	-	-	-	-	-	-	-	1.25	-	0.75

Curriculum– R25

B.Tech
in
Mechanical Engineering

Effective for 2025 Admission Batch Onwards

L – Lecture; T- Tutorial; P- Practical
[1L=1Cr, 1T=1Cr, 1P =0.5 Cr]

3rd Year 1st Semester

Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
		A. THEORY			L	T	P	Total	
1	ENGG	Major	ME501	Heat Transfer	3	0	0	3	3
2	ENGG	Major	ME502	IC Engine & Hybrid Vehicles	3	0	0	3	3
3	ENGG	Major	ME503A	Refrigeration and Air Conditioning	3	0	0	3	3
			ME503B	Finite Element Analysis					
			ME503C	Metrology & Measurement					
4	ENGG	Minor	EC(ME)501A	Mechatronics Systems	3	0	0	3	3
			EE(ME)501B	Fluid Power control					
			CS(ME)501C	Data Base Management System					
5	ENGG	Minor	EC(ME)502A	Internet of Things	3	0	0	3	3
			EE(ME)502B	Energy Conservation & Management					
			CS(ME)502C	Data Science and Industry 4.0					
B. PRACTICAL									
1	ENGG	Major	ME591	Heat Transfer Lab	0	0	3	3	1.5
2	ENGG	Major	ME592	Thermal Engineering Lab	0	0	3	3	1.5
3	ENGG	Major	ME593A	Refrigeration and Air Conditioning Lab	0	0	3	3	1.5
			ME593B	Finite Element Analysis Lab					
			ME593C	Metrology & Measurement Lab					
4	ENGG	Minor	EC(ME)591A	Mechatronics Systems Lab	0	0	2	2	1
			EE(ME)591B	Fluid Power Control Lab					
			CS(ME)591C	Data Base Management System Lab					
5	ENGG	VAC	ME594	Modeling & Simulation of Mechanical Systems	0	0	1	1	0.5
6	ENGG	Project	ME581	Minor Project	0	0	2	2	1
C.MANDATORYACTIVITIES/COURSES									
1	Mandatory Course	MC	MC581	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives	0	0	0	0	0
		TOTAL CREDIT							22

*'Mandatory Additional Requirement'(MAR) activities have to be carried out as per university guidelines.

COURSE NAME: HEAT TRANSFER
COURSE CODE: ME 501
CONTACT: 3:0:0
TOTAL CONTACT
HOURS: 36CREDITS: 3
Prerequisite: Thermodynamics, Fluid mechanics.
Course Outcomes:
CO1: Understand the basic laws & constraints of heat transfer to analyze problems involving steady state or transient heat conduction in simple geometries.
CO2: Survey the analytical solutions of free and forced convection problems to apply in modern research sectors of heat and mass transfer.
CO3: Evaluate the radiation heat transfer between black body and gray body surfaces and obtain numerical solutions of combined mode heat transfer problems in practice.
CO4: Analyze the effectiveness of several type of heat exchanger and develop skills for industrial design solutions regarding boiling and condensation.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Conduction	Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer- approximate solution to unsteady conduction heat transfer by the use of Heissler charts	**10**
2 Convection	Heat convection, basic equations, boundary layers- Forced convection, external and internal flows-Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer-Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.	**9**
3 Radiation	Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann‘s law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method	**7**
4 Heat Exchangers	Types of heat exchangers, Analysis and design of heatexchangers using both LMTD and ε-NTU methods.	**5**

5 Boiling & Condensation	Boiling and Condensation heat transfer, Pool boiling curve.	**3**
6 Mass Transfer	Introduction to mass transfer, Similarity between heat and mass transfer.	**2**

Text Books:

1. P.K. Nag, Heat & Mass Transfer, TMH.
2. Yunus A Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002

Reference Books:

1. S.K. Som, Introduction to Heat Transfer, PHI.
2. Kreith, Principles of Heat Transfer, Cengage learning.
3. O.P. Single, Heat & Mass Transfer, Macmillan India.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	3	-	1	1	-	-	-	2	1	3	2	-
CO2	3	3	2	3	-	1	1	-	-	-	1	2	3	2	-
CO3	2	2	1	2	-	1	1	-	-	-	1	1	3	2	-
CO4	3	2	2	3	-	2	2	-	-	-	2	2	3	2	2

COURSENAME: INTERNAL COMBUSTION ENGINE AND HYBRID VEHICLES

COURSE CODE: ME502
CONTACT: 3:0:0
TOTAL CONTACTHOURS: 36
CREDITS:3

Prerequisite: Applied Thermodynamics, Fluid mechanics.

Course Outcomes:

CO1: Get the knowledge of engine nomenclature, performance parameters and characteristics of different fuels to differentiate several types of I C engine designs.

CO2: Understand several losses in an engine Understand several losses in an engine to predict performance and fuel economy trends with good accuracy,

CO3: Identify modern injection systems, cooling & lubrication systems and supercharging to optimize the thermal efficiency and emission standards.

CO4: Explore new generation hybrid engines and basics of electric vehicles to acquire modern industry standards.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Engine Fundamentals	Classification and working of basic engine types: 2-stroke & 4-stroke Engines, SI & CI Engines, Engine Nomenclature, Performance parameters; Measurement of speed, torque, fuel consumption, IHP, BHP and FHP, SFC, thermal efficiency,	**5**
2 Fuel Air Cycle & Actual Cycle	Review of Air Standard Cycles, Fuel-Air cycles: Assumptions, Effect of specific heat & Dissociation, Performance analysis of fuel air cycle. Actual cycles: Assumptions, Heat Loss, Time loss and Blowdown loss, Optimum spark advance	**6**
3 Fuels & Combustion	Fuels: classification and desirable characteristics, HCV and LCV, Rating of fuels, Alternative fuels. Combustion of fuels in S.I and C.I engines, Parameters influencing combustion, Detonation and knocking in S.I. and C.I. engines and their preventions, Types of combustion chambers, Analysis of combustion product	**7**
4 Fuel Mixing, Injection and Ignition Systems	Fuel-Air mixing in SI Engines, Analysis of a simple carburetor, Disadvantages. Fuel injection systems: Working principle, Injection pumps and nozzles, electronic fuel injection system, MPFI systems, Ignition systems: ignition timing and spark advance, firing order.	**8**
5 Engine Cooling, Scavenging & Supercharging	Cooling and Lubrication: Properties of lubricating oil, Air and liquid cooling. Scavenging: ideal and actual, scavenging pumps, Supercharging and Turbo charging	**5**

6 Electric vehicles and Hybrid Engines	History, Components and General Layout of Electric vehicle (EV), EV classification, Comparison with IC Engine, Advantages and disadvantages of EV, Components and General Layout of Hybrid EV, Comparison with EV, Advantages and disadvantages of Hybrid EV.	5
Total Hours (36L)		

Text Books:

1. V. Ganesan, Internal Combustion Engines, The McGraw-Hill Companies.
2. M.L. Mathur and R.P. Sharma, A course in Internal Combustion Engines, Dhanpat Rai & Sons.
3. H.N. Gupta, Fundamentals of Internal Combustion Engines, PHI Learning Private Ltd.
4. Electric vehicle technology explained, James Larminie and John Lowry, Wiley.
5. Introduction to Hybrid vehicle system Modeling and control, Wei Liu, Wiley.

Reference Books:

6. S.K. Som, Introduction to Heat Transfer, PHI.
7. Kreith, Principles of Heat Transfer, Cengage learning.
8. O.P. Single, Heat & Mass Transfer, Macmillan India.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	-	1	1	-	-	1	2	2	2	3	2
CO2	2	1	3	2	-	2	2	1	-	1	2	2	2	2	2
CO3	3	3	3	3	2	1	1	-	-	1	3	3	2	2	2
CO4	2	1	2	2	3	3	3	1	-	1	2	3	2	3	2

COURSE NAME: REFRIGERATION & AIR CONDITIONING
COURSE CODE: ME503A
CONTACT: 3:0:0
TOTAL CONTACT HOURS:36
CREDITS:3

Prerequisite: Applied Thermodynamics

Course Outcomes:

CO1: Explain different types of Refrigeration cycles and its applications in multi compressor and multi evaporator systems.
CO2: Evaluate the selection and design of different components of Refrigeration systems
CO3: Interpret the knowledge of psychometric processes and air conditioning systems.
CO4: Design the air-conditioning system for a given conditions including refrigerating equipment as well as ducting systems.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Refrigerants	Classification of refrigeration systems, Refrigerants and their mixtures: properties and characteristics; Ozone depletion and globalwarming issues	**3**
2 VCRS	Advanced Vapor compression cycles Compressors, Condensers, Expansion devices and Evaporators-Performance matching of components of refrigeration systems	**8**
3 VARS	Vapour Absorption Refrigeration System, Advanced sorption refrigeration systems and their components, Lithium bromide - waterSystem; Aqua-ammonia systems.	**6**
4 ARS	Air Refrigeration System (ARS): Bell-Coleman refrigerator. COP determination, actual air refrigeration cycle.	**4**
4 Air Conditioning	Review of Psychrometry and Air-conditioning processes- Comfort air conditioning and Cooling load calculations - Applications of ACsystems	**10**
5 Application & Duct Design	Concept of enthalpy potential - Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils, Duct Sizing & Design	**6**
Total Hours (36 L)		

Text Books:

1. Stocker & Jones, Refrigeration and Air Conditioning, McGraw Hill.
2. P. L. Ballaney, Refrigeration and Air Conditioning.

Reference Books:

3. R. C. Arora, Refrigeration and Air Conditioning, TMH.
4. Arora and Domkundwar, Refrigeration and Air Conditioning, Dhanpat Rai Publication.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	3	3	2	1	-	1	1	-	-	1	1	-	-	-	-
CO 2	2	-	2	-	-	1	3	1	-	1	2	1	2	-	3
CO 3	2	2	2	-	-	-	-	-	-	1	1	-	2	-	2
CO 4	3	1	3	1	-	1	2	-	-	1	2	2	2	-	3

COURSE NAME: FINITE ELEMENT ANALYSIS

COURSE CODE: ME503B

CONTACT: 3:0:0

TOTAL CONTACTHOURS: 36
CREDIT:

PREREQUISITE: MATHEMATICS III.

Course Outcomes:

CO1: Understand the fundamental theory of the FEA method.
CO2: Develop the ability to generate the governing FE equations for systems governed by partial differential equations.
CO3: Apply the basic finite element methods for structural applications using truss, beam, frame, and plane elements.
CO4: Analyze the FE method and compare the results with FEA package like ANSYS.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Historical background, Relevance of FEM to design problems, Application to the continuum– Discretization, Matrix approach, Matrix algebra– Gaussian elimination, Governing equations for continuum, Classical Techniques in FEM, Weighted residual	8

	method, Ritz method, Galerkin method.	
2.	One dimensional problems: Finite element modeling– Coordinates and shape functions, Potential energy approach– Element matrices and vectors, Assembly for global equations, Boundary conditions, Higher order elements- Shapes functions, Applications to axial loadings of rods– Extension to plane trusses, Bending of beams– Finite element formulation of stiffness matrix and load vectors, Assembly to Global equations, boundary conditions, Solutions and Post processing, Example Problems.	8
3.	Two dimensional problems– scalar variable problems: Finite element modeling– CST element, Element equations, Load vectors and boundary conditions, Assembly, Application to heat transfer, Examples.	4
4.	Two dimensional problems– vector variable problems: Vector Variable problems, Elasticity equations– Plane Stress, Plane Strain and Axisymmetric problems, Formulation, element matrices, Assembly, boundary conditions and solutions. Examples	8
5.	Isoparametric elements for two dimensional problems: Natural coordinates, Iso parametric elements, Four node quadrilateral element, Shape functions, Element stiffness matrix and force vector, Numerical integration, Stiffness integration, Displacement and Stress calculations, Examples.	6
6.	Computer implementation: Pre-processor, Processor, Post-processor. Discussion about finite element packages.	2
Total		**36**

Text Books:

1. David Hutton, Fundamentals of Finite element Analysis, 2st Edition
2. C.S. Krishnamoorthy, Finite Element Analysis, TMH.

Reference books.

1. J. Bathe, Finite Element Procedures, Prentice Hall.
2. O.C. Zienkiewicz, R.L. Taylor, J.Z. Zhu, The Finite Element Method: Its Basis and Fundamentals, Elsevier.
3. J.N. Reddy, An Introduction to the Finite Element Method, McGraw-Hill.

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	2	2	3	-	-	1	-	-	-	3	3	-	-
CO2	2	3	-	3	2	-	-	1	-	-	-	2	3	-	-
CO3	3	3	-	2	2	-	-	1	-	-	-	2	3	-	-
CO4	-	-	-	1	2	-	-	1	-	-	-	2	3	-	2

COURSE NAME: METROLOGY AND MEASUREMENT

COURSE CODE: ME503C

CONTACT: 3:0:0

TOTAL CONTACTHOURS:
36CREDIT: 3

Prerequisite: Knowledge of basic science upto 12th

Course Outcomes: Upon successful completion of this course, students will be able to
CO1: Obtain knowledge about different instruments used to measure pressure, temperature, flow, level of liquids and data acquisition etc.
CO2: Elucidate the construction and working of various industrial devices used to measure pressure, sound and flow
CO3: Explicate the construction and working of various industrial devices used to measure temperature, level, vibration, viscosity and humidity
CO4: Ability to analyze, formulate and select suitable sensor for the given industrial applications

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: Definition and importance of Metrology Measurement; Methods of measurements – direct, indirect, comparison, substitution, transposition, deflection and null measurement; Errors in measurement – absolute, relative, parallax, alignment, loading, dynamic and calibration error; Units of measurements – SI base and derived units, SIprefixes of units.	3
2.A	Linear Metrology: Vernier scale; construction and use of Vernier calliper,Vernier height and depth gauge, micrometer; slip gauge.	3
2.B	Angular Metrology: Constructional features and use of protractor, Vernierbevel protractor, angle gauges, sine bar and slip gauges.	2
2.C	Measurements of : (i) Level using spirit-level; (ii) Flatness using straight edge, interferrometry (Newton‘s rings) and surface plate; Parallelism, cylindricity and concentricity using dial indicator.	3
3.	Interchangeability of components; concept of limits, tolerances and fits; Hole basis and shaft basis system of fits; Go and No Go limit gauges; plug, ring, snap, thread, radius and filler gauges.	5
4.	Definition, use and essential features of Comparators; working principle and application of (i) dial gauge, (ii) Cook optical comparator, (iii) back pressure Bourdon gauge pneumatic comparator, (iv) optical comparator- profile projector.	4

5.	Measuring Instruments: Functional elements of an instrument – sensing, conversion & manipulation, data transmission and presentation element; Characteristics – accuracy, precision, repeatability, sensitivity, reproducibility, linearity, threshold, calibration, response, dynamic or measurement error; Transducers – definition, primary and secondary, active and passive.	5
6.	Measurement of Surface Finish: Definition; Terminologies – geometrical surface, effective surface, surface roughness, roughness (primary texture), waviness (secondary texture), form, lay, sampling length; Numerical evaluation of surface roughness: peak-to-valley height (Rmax), centre line average (CLA, Ra), average depth (Rm), smoothness value (G); Principleof operation of a Talysurf.	4
7.	Principle of operation of a few measuring instruments: displacement by LVDT; force by strain – gauge load cell and piezoelectric load cell; pressure by Bourdon – tube gauge; temperature by liquid-in-glass thermometer, thermocouples, optical pyrometer; liquid velocity by pitot tube; water flow by orifice meter.	7
Total 36L		

Text Book

1. E.O. Doebelin and D.N. Manik, Measurement Systems– Application and Design, TMH
2. R. Rajendra, Principles of Engineering Metrology, Jaico Pub. House.

Reference Book

1. Beckwith, Lienhard and Marangoni, Mechanical Measurements, Pearson.
2. Bewoor and Kulkarni, Metrology & Measurement, TMH.
3. R.K. Jain, Metrology, Khanna Publication, New Delhi.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	-	2	1	-	2	2	-	2	-	-	2	-	3
CO2	2	1	2	-	-	1	2	1	1	1	-	-	-	3	-
CO3	3	2	-	2	1	-	2	2	-	1	-	-	3	-	-
CO4	3	-	2	-	-	2	-	3	-	2	-	-	-	2	-

COURSE NAME: MECHATRONICS SYSTEM

COURSE CODE: EC(ME)501A

CONTACT: 3:0:0

TOTAL CONTACTHOURS:36

CREDIT: 3

Prerequisite: Fluid Mechanics, Basic Electronics.

Course Outcomes

CO1: Describe Mechatronics systems and have an overview of the types of actuators.
CO2: Distinguish between various sensors, transducers, actuators and their applications.
CO3: Understand the basic concept of microprocessor.
CO4: Interpret various signal conditioning units, amplifiers, logic gates and their role in Programmable logic controllers.

Course Contents:

Modul e No.	Syllabus	Contact Hrs.
1.	Introduction to Mechatronics: Definition, Mechatronics in design and manufacturing, Comparison between Traditional and Mechatronic approach; Concurrent engineering.	**3**
2.	Review of fundamentals of electronics, Logic gates and their operations, Signal processing devices, Data conversion devices, Input and output devices. Sensors and Transducers, Actuators, Limit switches, Relays.	**6**
3.	Control Systems: Open loop and closed loop control, block diagrams,transfer functions, Laplace transforms.	**3**
4.	Electrical Drives: Stepper motors, servo drives.	**2**
5.	Mechanical Drives: Different mechanisms, Ball screws, Linear motionbearings, Transfer systems.	**3**
6.	Pneumatic and Hydraulic Drives: Elements of pneumatic and hydraulic drives, comparison between them.Design of pneumatic and hydraulic circuits, symbolic representations of such circuits indicating different valves, actuators, etc.	**4**
7.	Basics of 8085 microprocessor, programmable register architecture, buses, memory mapping, clock pulse and data transfer operations, and simple assembly and mnemonic programming on 8085 microprocessor.	**5**
8.	Use of On-Off, PI and PID controllers to control different drives, Programming in PLC controller using Ladder diagram.	**4**
9.	Mathematical modeling of physical systems, such as spring-mass vibration system, linear and rotary motion and its Laplace Transform.	**2**
10.	Basics of time domain analysis, Introduction to discrete-time systems andZ-transform.	**2**

11.	Introduction to Mechatronic systems, such as automatic brake, doorclosing and opening, robot, CNCmachine, AGV, etc.	**2**
Total Lectures		36 L

Text Book

1. N.P. Mahalik, Mechatronics, Tata McGraw Hill Publication
2. W. Bolton, Mechatronics, Pearson Education

Reference Book

1. Smaili and F. Arnold, Mechatronics, Oxford University Press, Indian Edition
2. M.D. Singh and J.G. Joshi, Mechatronics, Prentice Hall of India Pvt. Ltd.
3. K.K. AppuuKuttan, Mechatronics, Oxford University Press, New Delhi

CO-PO/PSO MAPPING:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	1	-	-	-	-	-	-	1	1	1	2
CO2	3	1	2	-	2	-	1	-	-	-	1	2	2	1	1
CO3	2	-	1	-	2	-	-	-	-	-	-	2	3	2	2
CO4	3	2	2	-	3	-	1	-	-	-	3	2	3	2	1

COURSE NAME: FLUID POWER CONTROL

COURSE CODE: EE(ME)501B

CONTACT: 3:0:0

TOTAL CONTACT HOURS: 36CREDITS: 3

Prerequisite: Fluid Mechanics, Basic Electronics.

Course Outcomes:
CO1: Understand the working principle of hydraulic and pneumatic systems.
CO2: Analyze the performance of pumps and actuators used in control devices.
CO3: Apply hydraulic valves in different industrial application.
CO4: Design and evaluate fluid powered control circuits and express through proper drawing.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	**Introduction:** Introduction to Fluid power; Hydraulic power generation and transmission. Applications and advantages; Components of a hydraulic and pneumatic system. Desired properties of a hydraulic fluid; advantage of mineral oil over water; definition of terms like pressure, head, force, density, specific gravity, kinematic and absolute viscosity, compressibility and incompressibility, Pascal's law; analysis of simple hydraulic jack, Mechanical advantage; continuity equation; hydraulic power of a cylinder.	6
2	**Hydraulic pumps, accumulators and intensifiers:** Classification of pumps, pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump selection factors, problems on pumps. Accumulators: Types, selection/design procedure, applications of accumulators. Types of Intensifiers, Pressure switches/sensor, Temperature switches/sensor, Level sensor.	6
3	**Actuators:** Classification cylinder and hydraulic motors, Hydraulic cylinders, single and double acting cylinder, mounting arrangements, cushioning, special types of cylinders, problems on cylinders. Construction and working of rotary actuators such as gear, vane, piston motors, and Hydraulic Motor. Theoretical torque, power, flow rate, and hydraulic motor performance; numerical problems. Symbolic representation of hydraulic actuators. Application of cylinder through mechanical linkages; force, velocity and Power from a cylinder.	7
4	**Components and hydraulic circuit design Components** Classification of control valves, Directional Control Valves- symbolic representation, sliding spool, solenoid and pilot operated DCV, shuttle valve, and check valves. Pressure control valves – types, direct operated types and pilot operated types. Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation. Hydraulic Circuit Design: Control of single and Double -acting hydraulic cylinder, hydraulic cylinder sequencing circuits, cylinder synchronizing circuit using different methods, hydraulic circuit for force multiplication; speed control of hydraulic cylinder- metering in, metering out and bleed off circuits. Pilot pressure operated circuits. Hydraulic circuit examples with accumulator	7

5	**Pneumatic control circuits:** Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders – supply air throttling and exhaust air throttling. Signal Processing Elements: Use of Logic gates – OR and AND gates in pneumatic applications. Practical examples involving the use of logic gates. Multi- Cylinder Application: Coordinated and sequential motion control, motion and control diagrams. Signal elimination methods, Cascading method principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves).	**6**
6	**Electro- Pneumatic Control**Principles – signal input and output, pilot assisted solenoid control of directional control valves, use of relay and contactors. Control circuitry for simple signal cylinder application. Give an overview of control systems associated with Electro hydraulic and pneumatic applications.	**4**
Total		**36 L**

Text Books:

1. Anthony Esposito, Fluid Power with applications, Prentice Hall international, 1997.
2. Ahmed Abu Hanieh, Fluid Power Control: Hydraulics and pneumatics, CambridgeInternational Science Publishing.

Reference Book:

1. Andrew Parr, Hydraulics and pneumatics, Jaico Publishing House, 2003.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	-	-	-	-	-	1	1	-	-	1	-
CO2	2	-	1	2	1	-	-	1	-	1	2	1	2	2	1
CO3	2	2	2	1	1	1	-	-	-	1	1	1	-	1	1
CO4	2	1	2	2	1	1	-	1	-	1	2	3	2	2	-

COURSE NAME: DATABASE MANAGEMENT SYSTEM

COURSE CODE: CS(ME) 501C

CONTACT: 3:0:0

TOTAL CONTACT HOURS: 36

CREDITS: 3

Prerequisites:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcome(s): On completion of the course students will be able to
CO1: Understand the database management system and database language
CO2: Understand and apply the SQL queries related to management of data and transaction processing.
CO3: Explain about query processing techniques involved in query optimization
CO4: Understand PL/SQL programming, the concept of Cursor Management, Error Handling, Package and Triggers
CO5: Design and build the commercial database systems.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Introduction	Concept & Overview of DBMS, Data Models, Database Languages, Database Administrator, Database Users, Three Schema architecture of DBMS.	**3**
2 Entity-Relationship and Relational Database Model	Basic concepts, Design Issues, Mapping Constraints, Keys, Entity- Relationship Diagram, Weak Entity Sets, Extended E-R features, case study on E-R Model. Structure of relational Databases, Relational Algebra, Relational Calculus, Extended Relational Algebra Operations, Views, Modifications Of the Database.	**9**
3 SQL and Integrity Constraints	Concept of DDL, DML, DCL. Basic Structure, Set operations, Aggregate Functions, Null Values, Domain Constraints, Referential Integrity Constraints, assertions, views, Nested Subqueries, Database security application development using SQL, Stored procedures and triggers.	**6**
4 Relational Database Design	Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Decomposition, Boyce-Codd Normal Form, 3NF, Normalization using multi-valued dependencies, 4NF, 5NF , Case Study	**6**

5 Internals of RDBMS	Physical data structures, Query optimization: join algorithm, statistics and cost bas optimization. Transaction processing, Concurrency control and Recovery Management: transaction model properties, state serializability, lock base protocols; two phase locking, Dead Lock handling	**6**
6 File Organization & Index Structures	File & Record Concept, Placing file records on Disk, Fixed and Variable sized Records, Types of Single-Level Index (primary, secondary, clustering), Multilevel Indexes	**6**
Total Hours (36 L)		

Text Books:

1. Henry F. Korth and Silberschatz Abraham, ―Database System Concepts‖, Mc.Graw Hill.
2. Elmasri Ramez and Novathe Shamkant, ―Fundamentals of Database Systems‖, Benjamin Cummings

Publishing. Company.

Reference Books:

1. Jain: Advanced Database Management System CyberTech
2. Date C. J., ―Introduction to Database Management‖, Vol. I, II, III, Addison Wesley.
3. ―Fundamentals of Database Systems‖, Ramez Elmasri, Shamkant B.Navathe, Addison Wesley Publishing Edition
4. Gray Jim and Reuter Address, ―Transaction Processing : Concepts and Techniques‖, Moragan Kauffman Publishers.
5. Ullman JD., ―Principles of Database Systems‖, Galgottia Publication.

CO- PO/PSO Mapping

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

COURSE NAME: INTERNET OF THINGS
COURSE CODE: EC(ME)502A
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36L
CREDIT: 3

Prerequisites: Fundamental knowledge in computer networking and wireless sensor network.

Course Outcome:
CO1: To understand the concepts of Internet of Things.
CO2: To analyse basic protocols in wireless sensor network.
CO3: To design IoT applications in different domain and be able to analyse their performance.
CO4: To implement basic IoT applications on embedded platform.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1 Fundamental of IoT	The Internet of Things, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Design challenges, Development challenges, Security challenges, Other challenges.	**7**
2 IoT and M2M	A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	**7**
3 Wireless Sensor Network	Network and Communication aspects, Wireless medium access issues, MAC protocol, routing protocols, Sensor deployment and Node discovery, Data aggregation and	**6**
4 IoT Architecture	Introduction, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.	**7**

5 IoT Applications for Value Creations	Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, Real-time monitoring and control of processes - Deploying smart machines, smart sensors, and smart controllers with proprietary communication and internet technologies, Maximize safety, security and reliability through high precision automation and control, Advanced Metering Infrastructure (AMI), Smart Inverters, Remote control operation of energy consuming devices.	**5**
6 IoT Privacy, Security and Governance	Introduction, Overview of Governance, Privacy and Security Issues, Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in smart cities, Security.	**4**
Total Hours (36 L)		

Text Books:

1. Vijay Madisetti and Arshdeep Bahga, ―Internet of Things (A Hands-on-Approach)‖, 1st Edition, VPT, 2014.
2. Francis daCosta, ―Rethinking the Internet of Things: A Scalable Approach to Connecting Everything‖, 1st Edition, Apress Publications, 2013.

Reference Books:

1. Cuno Pfister, Getting Started with the Internet of Things, O‟ Reilly Media, 2011, ISBN: 978-1-4493-9357-1
2. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice‖.

CO-PO MAPPING:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	3	-	-	-	-	-	1	2	-	2	-
CO2	2	3	3	3	3	-	3	3	-	-	1	2	3	-	-
CO3	1	-	-	-	-	2	2	2	3	3	1	2	-	-	2
CO4	1	3	2	2	2	-	-	2	2	2	-	2	-	3	-

COURSE NAME: ENERGY CONSERVATION & MANAGEMENT

COURSE CODE: EE(ME)502B

CONTACT: 3:0:0

TOTAL CONTACT HOURS: 36

CREDIT: 3

Prerequisite: Engineering Thermodynamics, Power Plant Engineering

Course Outcomes: On successful completion of the course, the learner will be able to
CO1: Obtain knowledge about energy conservation policy, regulations and business practices
CO2: Design to improve the thermal efficiency by designing suitable systems for heat recovery and co-generation
CO3: Analyze the energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure
CO4: Evaluate the cost- benefit analysis of various investment alternatives for meeting the energy needs of the organization

Course Contents

Module No.	Syllabus	Contact Hrs.
1	The Energy Resources; Finite & Renewable Sources	4
2	The Need for Energy Conservation- estimation of Finite fuel resource; Hubbert‘s model for oil reserve	3
3	Waste Heat Recovery; Waste Heat Exchangers; Commercial Waste Heat Recovery Devices- Recuperators, Regenerative Heat Exchangers, Heat Pipes	3
4	Industrial Energy Conservation- Industrial Insulations; Case Studies for HVAC, Air Compressor, Mechanical Handling & Other Systems, Study of energy efficient methods	8
5	Energy Management & Audit: Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel and energy substitution, energy audit instruments and metering	8
6	Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing -ESCO concept	6
7	Energy and environment, air pollution, climate change: United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM),	4

Text Books:

1. Energy Management- Murphy WR, G Mckay- Butterworth Heinmann, 2007

2. Energy Mangement, Audit & Conservation-De Barun, Vrinda Publications, Delhi, 2007

3. Eastop& Croft- Energy Efficiency, Longman, 1990

4. Turner- Energy management Handbook, 2nd Ed., Fairmont Press, 1993

CO-PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	-	2	1		2	3	-	2	1	2	2	2	1
CO2	3	2	2	-		1	2	1	1	1	1	2	1	3	1
CO3	2	3	-	2	1		2	2	1	1	1	2	2	2	2
CO4	3	1	2	-		2		3	-	2	1	2	1	2	3

COURSE NAME: DATA SCIENCE AND INDUSTRY 4.0

COURSE CODE: CS(ME)502C

CONTACT: 3:0:0

TOTAL CONTACT HOURS: 36

CREDIT: 3

Prerequisite: Probability, Matrix operations, Basic programming

Course Outcomes: Upon successful completion of this course, students will be able to achieve:

1. Advanced Data Analysis skills
2. Create AI/ML solutions for various business problems.
3. Build and deploy production grade AI/ML applications.
4. Apply AI/ML methods, techniques and tools immediate.

Course Contents

Module No.	Syllabus	Contact Hrs.
1	Introduction to Data Science: Concept of Data Science, Traits of Big data, Web Scraping, Analysis vs Reporting	3
2	Introduction to Programming Tools for Data Science: 2.1 Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK 2.2 Visualizing Data: Bar Charts, Line Charts, Scatter plots 2.3 Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the	5

	Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction	
3	Machine Learning: Overview of Machine learning concepts– Over fitting and train/test splits, Types of Machine learning– Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression- model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms- Naïve Bayes, KNearest Neighbors, logistic regression, support vector machines (SVM), decision trees, and random forest, Classification Errors, Analysis of Time Series- Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks- Learning and Generalization, Overview of Deep Learning	12
4	Introduction to Industry 4.0, Definition of Industry 4.0 What is it all about and why do we have to change industrial production Videos from Bosch, Siemens, ABB, Automotive Industry (VW, Audi, Mercedes), Developments in USA, Europe, China and other countries, Comparison of Industry 4.0 Factory and today's Factory The 10 most important things that will change with Industry 4.0, Difference between conventional automation and Industry 4.0	5
5	Basic principles and technologies of a Smart Factory, Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Big Data, Cyber-Physical Systems, Value chains in manufacturing companies, Customization of products, Digital Twins, Cloud Computing / Cloud Manufacturing, Security issues within Industry 4.0 networks	5
6	The smart workpiece, The intelligent work piece as basic functionality in implementing Industry 4.0, What is an intelligent workpiece? How to make a workpiece intelligent? Work piece tagging, QR codes and RFID, Communication between work piece and environment. Multi-agent systems in production. Applications for smart work pieces (examples of existing or future applications in the field of manufacturing)	6

Text Books

1. J. Grus, Data Science from Scratch: First Principles with Python, O'Reilly Media, 2019.

2. A. Géron, Hands-On Machine Learning with Scikit- Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems, 1st Edition, O'Reilly Media, 2017.

3. V.K. Jain, Data Sciences and Analytics, Khanna Publishing House, New Delhi, 2019.

4. V.K. Jain, Big Data and Hadoop, Khanna Publishing House, New Delhi, 2017.

5. J. Jose, Machine Learning, Khanna Publishing House, New Delhi, 2020.

6. R. Chopra, Machine Learning, Khanna Publishing House, New Delhi, 2020.

7. Jean-Claude André, Industry 4.0, Wiley-ISTE.

CO-PO/PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	1	-	-	3	1	-	-	2	1	1	2	-	1
CO2	2	1	-	-	-	3	1	-	2	1	2	2	1	-	1
CO3	2	-	-	1	-	3	-	-	1	1	2	2	2	-	1
CO4	1	-	1	-	-	3	-	-	-	2	1	2	2	-	1

Practical

COURSE NAME: HEAT TRANSFER LAB

COURSE CODE: ME591

CONTACT: 0: 0: 3

CREDITS: 1.5

Prerequisite: Heat Transfer.

Course Outcomes:

CO1: Evaluate the problems involving steady state conduction in simple geometries.

CO2: Determine the convective heat transfer for free and forced convection related problems.

CO3: Differentiate radiation capabilities of black and grey surfaces by practical observation

CO4: Analyze the effectiveness of heat exchanger and develop skills for industrial design solutions.

Course Outcomes:

List of Experiments:

1. Determination of the thermal conductivity and specific heat of given objects
2. Determination of the thermal conductivity of insulating materials
3. Determine the overall heat transfer coefficient of the composite wall
4. Determination of thermal conductivity of liquid.
5. Determination of the convective heat transfer coefficient for flow over a heated plate
6. Determination of the average theoretical and experimental value of heat transfer coefficient for forced convection.
7. Determination of the emissivity of a given sample.
8. Determination of the Stefan Boltzmann constant for radiation heat transfer.

9. Determination of the effectiveness of a shell and tube heat exchanger.

10. Determination of the LMTD, effectiveness of parallel and counter flow heat exchanger.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	1	-	-	-	-	-	2	1	3	2	-	1	-
CO2	2	-	3	-	-		1	-	2	2	3	2	-	2	2
CO3	2	-	1	-	-	1		-	2	1	3	2	-	1	-
CO4	2	-	1	1	-	-	-	-	2	2	3	2	-	2	3

COURSE NAME: THERMAL ENGINEERING LAB
COURSE CODE: ME592
CONTACTS: 0: 0: 3
CREDITS: 1.5

Prerequisite: Applied Thermodynamics, Internal Combustion Engine

Course Outcomes:

CO1: Understand the practical operation of 2 stroke and 4 stroke I.C engines using valve timing diagram

CO2: Analyze the performance of multi cylinder engines with the variation of various performances like load and speed.

CO3: Determine the quality of Engine fuels by analyzing its calorific value.

CO4: Analyze the constituents of combustion products for emission characteristics related to public safety.

Course Contents:

Experiment No.	Description
1	Study of cut models of Two stroke and four stroke Petrol and Diesel Engines.
2	Study of valve timing diagram of Petrol & Diesel Engine.
3	Determination of flash point and fire point of sample oil.
4	Determination of calorific value of a fuel by Bomb calorimeter.
5	Performance Test of a Diesel Engine using Mechanical and Electrical dynamometer.
6	Morse Test on multi cylinder petrol engine by electrical break dynamometer.
7	Study of Boiler Cut Models
8	Determination of work input and efficiency of an air compressor

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	2	-	-	-	-	-	2	1	3	2	2	2	-
CO2	2	-	3	2	-	1	-	-	3	1	3	2	2	2	-
CO3	-	-	2	-	-	2	2	-	3	1	3	3	2	2	-
CO4	-	3	2	-	-	2	3	2	3	1	3	3	2	2	-

COURSE NAME: REFRIGERATION & AIR CONDITIONING LAB
COURSE CODE: ME593A
CONTACTS: 0: 0: 3
CREDITS: 1.5

Prerequisite: Applied Thermodynamics, Refrigeration & Air Conditioning.

Course Outcomes: On successful completion of the course, the learner will be able to,

CO1. Demonstrate a domestic refrigerator and identify its important components.

CO 2. Analyze the performance parameters of a vapor compression-based refrigeration system

CO 3. Observe the components of a basic air conditioning setup and operate it to analyze its performance index.

CO 4. Recognize the components of a thermoelectric refrigeration setup and measure its coefficient of performance useful in future project applications.

List of Experiments

1. Study of a Domestic Refrigerator.
2. Study of a room (window type) Air Conditioner.
3. Study of a room (split type) Air Conditioner.
4. Determination of C.O.P of a vapour compression refrigeration system.
5. Experiment in an Air Conditioning Test Unit; Determination of bypass factor and plotting of the cooling – dehumidification process on a psychometric chart.
6. Performance test of thermoelectric refrigeration system

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	-	-	-	1	-	-	3	2	3	2	-	-	2
CO2	1	-	2	-	-	-	-	-	3	2	3	3	1	1	2
CO3	1	-	2	-	1	1	1	-	3	2	3	2	1	1	2
CO4	1	-	1	-	1	-	2	-	2	2	3	3	2	-	3

.

COURSE NAME: FINITE ELEMENT ANALYSIS LAB

COURSE CODE: ME593 B

CONTACTS: 0: 0: 3

CREDITS: 1.5

Prerequisite: Mathematics I & II

Course Outcomes: Upon successful completion of this course, students will be able to

1) Understand the fundamental theory of the FEA.
2) Generate the governing FE equations for systems governed by partial differential equations.
3) Use the finite element methods for structural applications using truss, beam frame, and plane elements.
4) Analyze the FE method and compare result with FEA package like-ANSYS.

Course Contents:

1. Introduction to software employed in modelling and analyzing of structural problems.
2. Ten (10) relevant problems shall be modelled and analyzed using ABAQUS software.

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	2	2	-	-	-	1	1	2	3	1	2	-	-
CO2	2	3	-	3	2	-	-	1	2	2	3	1	2	2	-
CO3	3	3	2	2	2	-	-	1	1	2	3	3	-	3	-
CO4	-	-	3	1	3	-	-	1	2	2	3	3	2	-	2

COURSE NAME: METROLOGY & MEASUREMENT LAB

COURSE CODE: ME593C

CONTACTS: 0:0:3

CREDITS: 1.5

Prerequisite: Metrology & Measurement Theory, Physics.

Course Outcomes: Upon successful completion of this course, students will be able to

CO1: Obtain knowledge about different instruments used to measure pressure, temperature, flow, level of liquids and data acquisition etc.
CO2: Elucidate the construction and working of various industrial devices used to measure pressure, sound and flow
CO3: Explicate the construction and working of various industrial devices used to measure temperature, level, vibration, viscosity and humidity
CO4: Ability to analyze, formulate and select suitable sensor for the given industrial applications

Course Contents: List of Experiments

1. Taking measurements using following instruments :

   (i) Vernier height & depth gauge, (ii) Dial micrometer, (iii) Thread gauge, (iv) Radius gauge, (v) Fillergauge, (vi) Slip gauge.

2. Measurement of angle of a component using :

   (i) Vernier bevel protractor, (ii) angle gauges , (iii) Sine-bar and slip gauges.

3. Checking / measuring parallelism, cylindricity and concentricity of components using dial indicator.
4. Measurement of a specific dimension for a lot of components, and prepare a histogram from the dataobtained.
5. Measurement of surface finish by a Talysurf instrument.
6. Measurement of micro feature of a product (eg. Thread of a bolt or saw etc.) in a profile projector.
7. Determine natural cooling characteristics of a heated object by using a thermocouple.
8. Measurement of air velocity across an air duct using anemometer.
9. Fixing a strain gauge on a cantilevered flat section of steel. Then calibration of it as a forcedynamometer using a Wheatstone bridge and loading arrangement.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	1	2	-	2	1	-	2	2	-	2	-	-	2	-	3
CO 2	2	1	2	-	-	1	2	1	1	1	-	-	-	3	-
CO 3	3	2	-	2	1	-	2	2	-	1	-	-	3	-	-
CO 4	3	-	2	-	-	2	-	3	-	2	-	-	-	2	-

COURSE NAME: FLUID POWER CONTROL LAB

COURSE CODE: EE(ME)591B

CONTACTS: 0: 0: 2
CREDITS: 1

Prerequisite: Fluid Power Control.

Course Outcomes:
CO1: Demonstrate the devices such as pumps, compressor, valves, actuators and sensors etc.
CO2: Differentiate hydraulic and pneumatic circuits.
CO3: Apply fluid control valves in different industrial application.
CO4: Design and evaluate fluid powered control circuits and express through proper drawing.

List of Experiments:

Experiment No.	Description
1	Study of Basic hydraulic circuits for the working of single and double acting cylinder, hydraulic pump and hydraulic motor.
2	To Study of Basic pneumatic circuits for the working of single and double acting cylinder, Compressor.
3	To Study of control valve (PCV, DCV, FCV) in a circuit for the working of single and double acting cylinder in a hydraulic and pneumatic system.
4	To Studies of Circuits for the Use of different direction control valves and valve actuation in single and double acting cylinder, and multi actuation circuit.
5	To Study and perform of Speed control circuits. Different Metering methods Inlet & outlet flow control (meter-in& meter-out circuit).
6	To Study Hydraulic or Pneumatic Sequencing circuit with magnetic sensor with Clamp, Direction Control Valves (Manual/External/Solenoid Operated), Flow Control Valves, Roller Lever Valve, Rapid Release Valve.
7	To perform AND & OR logic gate for a double acting cylinder using two cylinders by manual control.
8	To operate Two double acting cylinders, (Sequence of operation A+B+A-B-) using manual control & electrohydraulic control.
9	Study of circuit with cam operated pilot valves operating a pilot operated 4way direction control Valve or proximity/ limit switches, solenoid operated 4way direction control valve for Auto reversing circuit.

CO – PO/PSO Mapping:

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

COURSE NAME: DATABASE MANAGEMENT SYSTEM LAB

COURSE CODE: CS(ME)591C

CONTACT: 0:0:2

CREDITS: 1

Prerequisite:

1. Logic of programming language
2. Basic concepts of data structure and algorithms

Course Outcome(s): On completion of the course students will be able to
CO1: Understand the database management system and database language

CO2: Understand and apply the SQL queries related to management of data and transaction processing.
CO3: Explain about query processing techniques involved in query optimization
CO4: Understand PL/SQL programming, the concept of Cursor Management, Error Handling, Package and Triggers
CO5: Design and build the commercial database systems.

Course Contents:
Module 1 Conceptual Designing using ER Diagrams (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)
Module 2 Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, Represent attributes as columns, identifying keys) and apply the normalization techniques.
Module 3 Creation of Tables using SQL- Overview of using SQL tool, Data types in SQL, Creating Tables
(along with Primary and Foreign keys), Altering Tables and Dropping Tables
Module 4 Practicing DML commands- Insert, Select, Update, Delete
Module 5 Practicing Queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, CONSTRAINTS etc., Practicing Sub queries (Nested, Correlated) and Joins (Inner, Outer and Equi).
Module 6 Practice Queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING, VIEWS Creation and Dropping, Practicing on Triggers - creation of trigger, Insertion using trigger, Deletion using trigger, Updating using trigger
Module 7 Procedures- Creation of Stored Procedures, Execution of Procedure, and Modification of Procedure, PL/SQL, Cursors- Declaring Cursor, Opening Cursor, Fetching the data, closing the cursor.

CO- PO/PSO Mapping

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

COURSE NAME: MODELING & SIMULATION OF MECHANICAL SYSTEMS

COURSE CODE: ME594

CONTACT HOUR: 0:0:1
CREDITS: 0.5

Prerequisite: Engineering Drawing, Mathematics

Course Contents:

Module	Syllabus	Contact Hrs.
Module 1 Introduction	Introduction to CAE, CAD. Role of CAD in Mechanical Engineering, Design process, software tools for CAD,geometric modelling.	2
Module 2 Transformations in Geometric Modeling	Introduction, Translation, Scaling, Reflection, Rotation in 2D and 3D. Homogeneous representation of transformation, Concatenation of transformations. Computer-Aided assembly of rigid bodies, applications of transformations in design and analysis of mechanisms, etc.	4
Module 7 Solids in Geometric Modeling for Design	Solid entities, Boolean operations, Topological aspects, Invariants. Write-frame modeling, B-rep of Solid Modelling, CSG approach of solid modelling. Popular modeling methods in CAD softwares. Data Exchange Formats and CAD Applications:	6

TEXT BOOK:

1. Michael E. Mortenson, Geometric Modelling, Tata McGraw Hill, 2013.
2. A. Saxena and B. Sahay, Computer-Aided Engineering Design, Anamaya Publishers, NewDelhi, 2005.

Reference Book

1. Rogers, David F., An introduction to NURBS: with historical perspective, Morgan KaufmannPublishers, USA, 2001.
2. David F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, TMH, 2008.

COURSE NAME: Minor Project
COURSE CODE: ME581
CONTACT HOUR: 0:0:2
CREDITS: 1
Prerequisite: Fundamentals of Mechanical Engineering.

Course Contents:
i) literature review on topic of interest.
ii) Finding research Gaps
iii) Attempt to solve problems towards filling the research gaps.

3rd Year 2nd Semester

Sl. No.	Broad Category	Category	Course Code	Course Title	Hours per week				Credits
		A. THEORY			L	T	P	Total	
1	ENGG	Major	ME601	Design of Machine Elements	3	0	0	3	3
2	ENGG	Major	ME602	Power Plant Engineering	3	0	0	3	3
3	ENGG	Major	ME603A	Materials Handling	3	0	0	3	3
			ME603B	Computational Fluid Dynamics					
			ME603C	Tribology					
			ME603D	Quality Control and 6 Sigma					
4	ENGG	Major	ME604A	Renewable Energy System	3	0	0	3	3
			ME604B	Industrial Safety					
			ME604C	Nanotechnology					
5	ENGG	Minor	EC(ME)601A	Robotics & Flexible Automation	3	0	0	3	3
			EE(ME)601B	Electrical Machines					
			CS(ME)601C	Artificial Intelligence & Machine Learning					
6	HU	Multidisciplinary	HU(CS)601	Research Methodology & IPR	1	0	0	1	1
		B. PRACTICAL							
1	ENGG	Major	ME692	Design Lab	0	0	3	3	1.5
3	ENGG	Minor	EC(ME)693A	Robotics Lab	0	0	0	2	1
			EE(ME)693B	Electrical Machines Lab					
			CS(ME)693C	Artificial Intelligence & Machine Learning Lab					
5	ENGG	Internship	ME681	Industrial Training (Min. 2 weeks)	0	0	0	0	1
6	ENGG	Project	ME682	Major Project I	0	0	8	8	4
		C. MANDATORYACTIVITIES/COURSES							
1	Mandatory Course	MC	MC581	NSS/NCC/ Physical Activities / Meditation & Yoga / Club Activities/Environmental Protection Initiatives	0	0	0	0	0
		TOTAL CREDIT							23.5

*'Mandatory Additional Requirement'(MAR) activities have to be carried out as per university guidelines.

COURSE NAME: DESIGN OF MACHINE ELEMENTS
COURSE CODE: ME 601
CONTACT: 3:0:0
TOTAL
CONTACT
HOURS: 36
CREDITS: 3
Prerequisite: Rigid body Mechanics, Strength of Materials, Theory of Machine.
Course Outcomes:
C01: Understand the use of codes, standards for designing.
CO1: Able to prevent failure under static and fluctuating load.
C03: Able to analyze the different kind of stresses, which generates due to the loading in different mechanical element.
CO2: Able to design different mechanical elements

Course Content

Module No.	Syllabus	Contact Hrs.
1.Fundamentals of design of machine elements	Theory of failures to prevent static failure; Design consideration under cyclic stresses; S-N Curve; Endurance limit; Design for Infinite cycle and finite cycles under cyclic loading; Uses of Stress concentrationfactor(k_t); Notch sensitivity; Theoretical stress concentration factor; Gerber line, Soderberg line, Goodman Line, Modified Goodman Line.	7
2.Design of Shaft and Bearings	Design of shafts under static and fatigue loadings, Design of shaft using ASME code, Analysis and design of sliding and rolling contact bearings	6
3. Design of transmission elements	Spur, helical, bevel and worm gears; static & dynamic load calculation,belt and chain drives	7
4. Design of springs	Helical compression, tension, torsional and leaf springs	4
5. Design of joints	Threaded fasteners, pre-loaded bolts and welded joints,	6
6. Design of Clutch and Brakes	Analysis of clutches and brakes	6
Total Lectures: 36L		

Text Books:

1. V. B. Bhandari, Design of Machine Elements, TMH.
2. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.

Reference Book

3. Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and

Practice, Macmillan, 1992

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	2	-	1	-	-	-	1	1	1	1	3	3	2
CO2	2	3	3	2	-	-	-	-	-	-	-	-	2	2	2
CO3	1	3	3	3	-	-	1	-	-	-	-	-	2	3	2
CO4	2	3	3	3	2	1	-	1	-	1	2	2	2	2	2

COURSE NAME: POWER PLANT ENGINEERING
COURSE CODE: ME 602
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3
Prerequisite: Applied Thermodynamics

Course Outcomes:

CO1: Explore minute details of all components of coal-based power plant including steam generation,fuel and ash handling equipment.
CO2: Understand the principle of steam and gas-based turbines to analyze their performance for a variety of design conditions.
CO3: Describe brief functionalities of Nuclear, Hydel and other renewable energy-based power plants.
CO4: Evaluate plant performance with the knowledge of plant economics.

Course Contents:

Module	Syllabus	Contact Hrs
1 Thermal Power Plant	Coal based thermal power plants, Coal properties, Combustion analysis, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers & Cooling Towers, Steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, Losses in boilers, boilers efficiency binary cycles and cogeneration systems.	**10**
2 Steam Turbine & Condensing Systems	Steam turbine- Major classification, Nozzles types and efficiency, Impulse turbine - velocity diagram, work done and blade efficiency. Pressure compounding and velocity compounding of steam turbine. Impulse reaction turbine - Velocity diagram, degree of reaction and Parsons turbine. Governing in Steam turbine. Condenser and Cooling Towers	**8**
4 Gas Turbine and Combined Cycle	Diesel Power Plant, Gas turbine and combined cycle power plants, components of gas turbine power plants, combined cycle power plants, Brayton Cycle – Analysis & Optimization. Integrated Gasifierbased Combined Cycle (IGCC) systems.	**5**

5 Nuclear Power Plants	Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor, Pressurized Water Reactor, CANDU Pressurized Heavy Water Reactor, Fast Breeder Reactors, Gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.	**5**
6 Hydel and Renewable Energy plants	Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems.	**4**
7 Plant Economics	Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including wastedisposal options for coal and nuclear plants	**4**
TOTAL		**36L**

Text Books:

1. P.K. Nag, –Power plant Engineering,‖ Tata McGraw Hill.
2. Arora and Domkundwar, ―A course in Power Plant Engineering‖ Dhanpat Rai & Sons.

Reference Book:

3. M. M. EI- Wakil, –Power plant technology,‖ Tata McGraw - Hill.

CO– PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	2	3	2	1	-	-	3	2	2	2	3
CO2	2	2	3	1	3	1	2	1	1	1	2	3	3	2	2
CO3	2	1	2	1	3	1	2	1	-	1	1	2	2	2	2
CO4	3	3	3	2	2	1	1	2	1	1	2	3	3	2	3

COURSE NAME: MATERIALS HANDLING

COURSE CODE: ME603A

CONTACT: 3:0:0

TOTAL CONTACT HOURS: 36

CREDIT: 3

Prerequisite: Manufacturing Technology, Kinematics & Dynamics of Machines.

Course Outcomes:

CO1: Understand the importance of material handling and plant layout.
CO2: Study the design procedures of various material handling equipment & component.
CO3: Analyze the variety of load & selection of material handling system based on application through general analysis procedure.
CO4: Apply the fundamentals of load lifting, automation and auxiliary equipment in material handling with proper design consideration.

Course Contents

Module No.	Syllabus	Contact Hrs.
1	Introduction: Elements of Material Handling System-Importance, Terminology, Objectives and benefits of better Material Handling; Principles and features of Material Handling System; Interrelationships between material handling and plant layout, physical facilities and other organizational functions; Classification of Material Handling Equipment.	4
2	Study of Systems & Material Handling Equipment: Objectives of storage; Bulk material handling; Gravity flow of solids through slides and chutes; Storage in bins and hoppers; Belt conveyors Bucketelevators; Screw conveyors; Vibratory Conveyors; Cabin conveyors; Mobile racks, etc. Auxiliary Equipment: Descriptive specification and use of – (i) Slide and trough gates, (ii) belt, screw and vibratory feeders, (iii) positioners like elevating platform, ramps, universal vice; (v) ball table	10
3	Selection of Material Handling Equipment: Factors affecting for selection; Material Handling Equation; Choice of Material Handling Equipment; General analysis Procedures; Basic Analytical techniques; The unit load concept; Selection of suitable types of systems for applications; Activity cost data and economic analysis for design of components of Material Handling Systems; functions and parameters affecting service; packing and storage of materials	8
4	Hoisting Equipment: Advantage of using steel wire rope	10

	over chain; constructional features of wire ropes; Rope drum design; Pulley system-simple vs. multiple pulley; Load handling attachments: hooks, grabs, tongs, grab bucket; Arrangement of hook suspension with cross piece and pulleys (sheaves); Use and constructional features of (i) hand operated trolley hoist, (ii) winch; (iii) bucket elevator, (iv) Jib crane, (v) overhead traveling crane and (vi) wharf crane; Level luffing system of a wharf crane; Utility of truck mounted and crawler crane. Safety precautions.	
5	Robotic Handling: Materials handling at workplace; Major components of a robot; Applications of robotic handling.	4

Text Books:

1. S. Ray, Introduction to Materials Handling, New Age Int. Pub.

2. T. K. Ray, Mechanical Handling of Materials, Asian Books Pvt. Ltd.

3. T.H. Allegri, Materials Handling: Principles and Practices, CBS Publishers and istributors.

4. J.A. Apple, Material Handling System Design, John Wiley & Sons

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	1	1	-	2	2	2	-	1	1	1	-	2
CO2	3	2	1	-	-	1	-	1	-	-	1	2	2	-	1
CO3	3	2	3	2	1	2	1	1	-	-	1	2	1	-	1
CO4	3	1	3	2	1	2	1	1	1	-	1	3	2	-	2

COURSE NAME: COMPUTATIONAL FLUID DYNAMICS
COURSE CODE: ME603B
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDITS: 3
Prerequisite: Fluid mechanics, Thermodynamics, Heat Transfer

Course Outcomes:

CO1. To create numerical modeling and its role in the field of fluid flow
CO2. To use the various discretization methods, solution procedures and
CO3. To solve turbulence modeling flow and heat transfer problems.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1. Introduction	Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behavior ofPDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.	7
6. Finite difference andfinite volume methods for diffusion	Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – Finite volume formulation for steady state One, Two and Three - dimensional diffusion problems –Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations – Use of Finite Difference and Finite Volume methods.	6
3.Finite volume method for convection diffusion	Steady one-dimensional convection and diffusion – Central, upwind differencing schemes properties of discretization schemes – Conservativeness,	6
4.Flow field analysis	Finite volume methods -Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections	5
5.Turbulence models and mesh generation	Important features of turbulent flow, Vorticity transport equation, Statistical representation of turbulent flows: Homogeneous turbulence and isotropic turbulence, General Properties of turbulent quantities, Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models	6
Total Hours		**36 L**

TEXT BOOKS:

1. ProdipNiyogi, Chakrabarty, S.K., Laha, M.K. "Introduction to Computational FluidDynamics", Pearson Education, 2005.
2. Versteeg, H.K., and Malalasekera, W., "An Introduction to Computational Fluid Dynamics:The finite volume Method", Pearson Education Ltd.Second Edition – 2007.

REFERENCES:

1. Anil W. Date, "Introduction to Computational Fluid Dynamics", Cambridge UniversityPress, 2005.
2. Patankar, S.V. "Numerical Heat Transfer and Fluid Flow", Hemisphere PublishingCorporation, 2004.
3. Chung, T.J., "Computational Fluid Dynamics", Cambridge University, Press, 2002.
4. Ghoshdastidar P.S., "Heat Transfer", Oxford University Press, 2005

5. Muralidhar, K., and Sundararajan, T., "Computational Fluid Flow and Heat Transfer",Narosa Publishing House, New Delhi, 1995.
6. S.V.Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill.
7. T. J. Chung, Computational Fluid Dynamics, Cambridge University Press.
8. John D.Anderson Jr, Computational Fluid Dynamics, McGraw Hill Book Company.

CO – PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	1	-	-	1	2	1	1	**2**	2	1	2
CO2	3	2	3	1	1	-	1	2	-	1	-	**3**	2	2	3
CO3	3	3	3	3	1	1	-	1	-	1	-	**2**	2	1	2
CO4	3	2	2	2	1	-	-	1	2	1	1	**3**	2	2	3

COURSE NAME: TRIBOLOGY

COURSE CODE: ME 603C

CONTACT: 3:0:0

CONTACT HOURS: 36

CREDIT: 3

Prerequisites: Machine Design

Course Outcomes: On successful completion of the course, the learner will be able to

CO1: Become familiar with mathematical tools used to analyze Tribological processes.

CO2: Have awareness of Tribological issues in the design of machine components, such as rolling element bearings, journal bearings, thrust bearings, seals, and braking systems.

CO3: Become familiar with common anti-friction and anti-wear components.

CO4: Design a Tribological system for optimal performance.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction: History, Industrial Importance. Engineering Surfaces: Properties and Measurement: Measurement Methods, Surface Profilometry, Statistical Description of Roughness.	4
2.	Surface Contact: Hertz contact theory, Greenwood-Williamson model, Elastic-plastic contact. Adhesion: Basic Models, Factors influencing Adhesion.	5
3.	Friction: Measurement Methods, Origin of Friction, Friction Theories – adhesion and ploughing, Mechanisms, Friction of Metals, Non-metallic Materials.	4
5.	Surface Engineering: Surface Treatments: Microstructural and Thermochemical Treatments, Surface Coatings: Hard Facing, Vapour Deposition Processes: PVD, CVD, PECVD etc.	5

6.	Lubrication: Basic Equations for Fluid Film Lubrication. Hydrodynamic lubrication -Thrust and Journal bearings, Squeeze Film Bearings, Hydrostatic lubrication, Gas-Lubrication. Lubrication of rolling element bearings. Boundary lubrication – metal working lubrication, solid film lubrication. Hygiene of lubricants.	8
7.	Nanotribology: Measurement Tools: Surface Force Apparatus, Scanning Tunneling Microscope, Atomic / Friction Force Microscope.	4

Text Books:

1. P. Sahoo, Engineering Tribology, Prentice Hall-India, New Delhi, 2009.
2. B. Bhushan, Introduction to Tribology, Wiley, 2002.
3. G W Stachowiak and A W Batchelor, Engineering Tribology, Butterworth-Heinemann,2005.
4. S.K. Basu, S.N. Sengupta, B.B. Ahuja, Fundamentals of Tribology, Prentice Hall-India, 2005.
5. B C Majumdar, Introduction to Tribology of Bearings, S Chand & Co, 2012.

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	-	-	-	-	-	1	-	1	-	2	-
CO2	2	1	1	1	-	-	-	-	-	1	-	2	3	-	-
CO3	3	2	1	2	-	-	-	-	-	1	-	1	-	2	-
CO4	2	1	2	1	-	-	-	-	-	1	-	2	-	2	3

COURSE NAME: RENEWABLE ENERGY SYSTEM

COURSE CODE: ME604A

CONTACT: 3:0:0

TOTAL CONTACT HOURS: 36

CREDIT: 3

Prerequisite: Thermodynamics, Power Plant Engineering

Course Outcomes: On successful completion of the course, the learner will be able to
CO1. Create awareness among students about renewable sources of energy and application of renewable technologies in different areas of country.
CO2. Understand the working principle of various renewable energy technologies and systems like solar, wind, tidal and geothermal resources.

CO3. Explain the knowledge of Storage technologies from renewable energy sources.
CO4. Recognize the need and application of alternative biofuels in the field of power production.

Course Contents

Module No.	Syllabus	Contact Hrs.
1	Principles of Renewable Energy: The history and future of energy scenario, Sustainable Development and role of renewable energy, Scientific Principles of renewable energy. Review of principles: thermodynamics, fluid dynamics and heat transfer	4
2	Solar radiation: (i) Sun-Earth geometry (ii) Extra-terrestrial Solar Radiation (iii) Measurement and estimation of solar radiation. Photovoltaic Generation: (i) Photon absorption at Silicon p-n junction (ii) Solar Cell (iii) Application and Systems. Designing a solar system and its implementation	8
3	Solar Water Heating: (i) Flat Plate Collectors: Heat Transfer analysis, Testing (ii) Evacuated Tube Collectors. Applications: (i) Air heaters (ii) Water Desalination (iii) Space Cooling (iv) Solar Concentrators (v) Solar ponds. Designing a solar heating system and its implementation.	7
4	Wind Power: Wind Turbine types & Principles, Calculation of Power production from Wind mills, Betz Criteria	4
5	Wave Power & tidal Power: Basic Concepts of Wave Power, Tidal Basins, Determination of energy conversion. Ocean Thermal Energy Conversion.	5
6	Geothermal Energy: Location and Extraction, Petrothermal systems, Geothermal energy based vapor power cycles	4
7	Biomass & Bio fuels: (i) Use of Biomass (ii) Classification & Use of Bio fuels. Energy Storage, Pumped Hydro Systems	4

Text Books:

1. Renewable Energy – G. Boyle, 2nd edition, OUP, 2010.
2. Renewable Energy Resources- Twidell, J & Weir, T, 2ndedition, Taylor & Francis, 2006.
3. Non-Conventional Energy Resources- B.H. Khan, T M H, 2010.
4. Non-Conventional Energy Sources- G.D. Rai, Khanna Publishers.

CO-PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	2	-	2	3	-	-	-	-	3	1	1	1

CO2	2	-	2	-	-	2	3	-	-	-	-	2	2	1	1
CO3	2	-	1	-	-	2	3	-	-	-	-	2	1	1	2
CO4	-	-	-	-	-	2	3	-	-	-	-	3	2	1	2

COURSE NAME: INDUSTRIAL SAFETY

COURSE CODE: ME604B

CONTACT: 3:0:0

TOTAL CONTACT HOURS: 36

CREDIT: 3

Prerequisite: Strength of Material, Machine Design, Measurement and Instrumentation

Course Outcomes: Upon successful completion of this course, students will be able to achieve:
CO1. Primary knowledge of industrial and occupational safety and accident prevention
CO2. Understand occupational health and safety rules and regulations.
CO3. Analyze the safety management issues along with accident compensation acts.
CO4. Manage real life problems in the industries related to accident prevention and safety.

Course Contents

Module No.	Syllabus	Contact Hrs.
1	Development of industrial safety, Developments in Occupational Health, Occupational Safety and Health in India	3
2	Accidents and their prevention Theory of accident, Anatomy of an accident, How Accidents are Caused , Cost of Accidents, Principles of Accident Prevention, Techniques of Accident Prevention, Safe Work Environment, Housekeeping, Job Safety Analysis, Investigation of Accidents, Ergonomics, Personal Protective Equipment, Promotion of Health and Safety, Basic Safety Programming	6
3	Fire hazard Types of fire, Fire Hazards, Fire Explosion, fire prevention, Means of Escape in Case of Fire Inspection Safety Supervision Safety, Responsibility Safety Inspection, Fire prevention authorities, Rules Safety Training Safety Appraisal Safety Communication Safety Audit	5
4	Occupational health and safety Occupational Health, Occupational Health Services in Places of Employment, Occupational Physician, Occupational Health in	6

	Developing Countries, Occupational Safety, Occupational Safety in Developing Countries, Promoting Occupational Health and Safety, Work Related Diseases, Occupational Health Hazards Recognition of Hazards, Industrial Hygiene, Occupational Diseases, basics of OHSAS 18001	
5	SAFETY, HEALTH AND ENVIRONMENT (SHE) EDUCATION AND TRAINING, SHE: elements of training cycle, Assessment of needs. Techniques of training, design and development of training program. Training methods and strategies types of training. Evaluation and review of training programs,Competence building technique (CBT), concept for training, safety as a on-line function. Role of multi-media communication, Applications of computers. Relevance of WTO regarding safety, health and Environment	8
6	Health and safety management Basics of Safety management, Role of safety supervisor, planning for safety, Safety Policies, Safety Promotion, Safety Committee, safety education & training, Health and Safety Process, Measuring Safety, Risk Management and Loss Control	4
7	Accident compensation Brief introduction to different acts - The Dangerous Machines (Regulations) Act, 1983, The Employers' Liability Act, 1938 The (Indian), Fatal Accidents Act, 1855 The Public Liability Insurance Act, 1991, The Workmen's Compensation Act, 1923, The Employees' State Insurance Act, 1948, Role of National Safety Council, International labour office	4

Text Books:

1. Safety management Systems, A. Waring, (Chapman & Hall,1996)

2. Environmental Health & Safety Management – A Guide to Compliance, N.P. Cheremisinoff, M.L. Graffia, (Noyes Publin 2003)

3. Safety at Work, J. Ridley & J. Channing (5th. Edn.), (Butterworth & Heinemann, 2001)

4. Occupational Health & Hygiene, J.Stranks, (Pitman Publn., 1995)

5. Safety management: Strategy & Practice, R. Pybuss, (Butterworth & Heinemann, 1997)

6. Essentials of Safety management, H.L. Kalia, A. Singh, S. Ravishankar & S.V. Kamat, (Himalaya Publishing House, 2002)

7. Industrial Health & Safety Management, A.M. Sarma, (Himalaya Publishing House, 2002)

CO-PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	1	-	-	3	2	-	-	-	1	1	2	-	-
CO2	2	-	-	-	-	3	2	-	-	-	2	2	1	-	1
CO3	2	-	-	-	-	3	2	-	-	-	2	2	2	-	-
CO4	1	-	1	-	-	3	2	-	-	-	1	2	1	-	1

COURSE NAME: NANOTECHNOLOGY

COURSE CODE: ME604C

CONTACT: 3:0:0

TOTAL CONTACT HOURS: 36

CREDIT: 3

Prerequisite: Material science

Course Outcomes: Upon successful completion of this course, students will be able to
CO1: Identify 0D, 1D, 2D and 3D nanomaterials.
CO2: Gain knowledge the optical and mechanical properties
CO3: Interpret the magnetic and electrical properties.
CO4: Illustrate the use of nanomaterials for different applications

Course Contents

Module No.	Syllabus	Contact Hrs.
1	Introduction of nanomaterials and nanotechnologies, influence of nano over micro/macro, Comparison of nanotechnology with micromanufacturing, Features of nanostructures, Background of nanostructures, Techniques of synthesis of nanomaterials, Tools of the nanoscience, Applications of nanomaterials and technologies.	7
2	Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure, One dimensional, Two dimensional and Three dimensional nanostructured materials, Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties	7
3	Mechanical properties of materials, theories relevant to mechanical properties, techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials.	7
4	Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials,	8

	classification of magnetic phenomena.	
5	Nano thin films, nanocomposites, new application of nanoparticles in manufacturing of bearings, cutting tools, cutting fluids, medical science, soil science, membrane-based application, polymer based application.	7

Text Books:

1. Mick Wilson, Kamali Kannargare, Geoff Smith, ―Nano technology: Basic Science and Emerging technologies‖, Overseas Press, 2005.

2. Charles P. Poole, Frank J. Owens, ―Introduction to Nanotechnology‖, Wiley Interscience, 2008.

3. Mark A. Ratner, Daniel Ratner, ―Nanotechnology: A gentle introduction to the next Big Idea‖, Prentice Hall P7R:1st Edition, 2002.

CO-PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	2	-	3	1	-	1	2	-	2	-	2	2	-	-
CO2	2	1	2	-	-	1	2	1	1	1	-	2	1	-	1
CO3	2	3	-	2	1	-	3	2	-	2	-	2	2	-	-
CO4	1	-	2	-	-	2	-	2	-	2	-	2	1	-	1

COURSE NAME: ELECTRICAL MACHINES

COURSE CODE: EE(ME)601B
COURSE CREDIT: 3:0:0
CONTACT HOURS: 36 L
CREDIT: 3
Prerequisite: Basic electrical engineering
Course Outcome

CO1: Formulate and then analyze the working of any electrical machine under loaded and unloaded conditions.

CO2: Understand and explain the principle of operation and performance of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.

CO3: Analyze the response of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.

CO4: Troubleshoot the operation of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.

CO5: Analyze given require specification of electrical machine and select a suitable measuring instrument for a given application.

Course Content

Module No.	Syllabus	Contact Hrs
1 DC Machines	EMF generated in the armature, OCC and Voltage build-up in d.c. generator - concept of critical resistance & critical speed. External Characteristics. Armature reaction - function of Interpoles & Compensating windings. Commutation process, Concept of back e.m.f. - Speed & Torque equation of d.c. motor, Speed control of DC motor, Losses and Efficiency, Application of d.c. Machine	**9**
2 3-Phase Induction machine	Construction of 3-phase induction motor. Production of rotating magnetic field (concept only) - Working principle of 3-phase induction motor. Concept of synchronous speed & slip. Phasor diagram (at no-load & running condition). Equivalent circuit - No-load and Blocked rotor test. Torque equation. Torque-slip characteristic. Power flow in 3-phase induction motor (Numerical). Speed control & Braking of Induction motor. Starting methods of 3-phase induction motor – DOL, Auto-transformer & Star-Delta starter. Industrial application of 3-phase Induction motor	**10**
3 Synchronous Machines	Construction & Types of synchronous machines. Method of excitation system. Working principle of synchronous machines - generator & motor modes. Armature reaction at different power factor - concept of synchronous reactance.	**10**
	Theory of salient pole machine, Two reaction theory Voltage regulation by synchronous impedance method (with Numerical). Synchronous machine connected to infinite bus, Synchronization of two or more alternators and an alternator with infinite bus. Load sharing between them. Principle of operation of synchronous motor- its starting techniques - Damper winding & Hunting. ‗V' Curves – Synchronous condenser.	
4 Fractional Kilowatt motors	Single phase Induction motor: Construction, Double revolving field theory. Starting methods, Speed - torque characteristics & Application Principle of operation & Application of Stepper motors Principle of operation of Welding Transformer	**7**
	Total	**36L**

Text Books:

1. P.S. Bhimra, Electrical Machinery, Khanna Publishers.
2. D.P. Kothari & I.J Nagrath, Electric machines, Tata Mc Graw-Hill Publishing Company Limited.

Reference Books:

1. Bhag S. Guru and H.R. Hiziroglu, Electric Machinery & Transformers, Oxford

University press.
2. R.K. Srivastava, Electrical Machines, Cengage Learning.
3. Alexander S Langsdorf, Theory of Alternating Current Machinery, Tata Mc Graw Hill.
4. M.G. Say, The performance and Design of Alternating Current Machines, CBS Publishers &Distributors.
5. Irving L Koskow, Electric Machinery & transformer, Prentice Hall India.

CO-PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	1	1	-	-	-	-	-	1	-	-	1	1	2
CO2	2	2	2	2	-	-	-	-	-	1	-	1	2	1	1
CO3	2	2	1	2	-	-	-	-	-	1	-	1	3	2	2
CO4	2	-	1	1	-	-	-	-	-	-	-	1	3	2	1
CO5	2	2	1	2	-	-	-	-	-	1	-	1	3	2	2

COURSE NAME: ARTIFICIAL INTELLIGENCE & MACHINE LEARNING
COURSE CODE: CS(ME)601C
CONTACT HOURS: 36L
CREDIT: 3
Prerequisite: Probability, Matrix operations, Basic programming

Course Outcomes: Upon successful completion of this course, students will be able to achieve:
1. Advanced Data Analysis skills
2. Create AI/ML solutions for various business problems.
3. Build and deploy production grade AI/ML applications.
4. Apply AI/ML methods, techniques and tools immediate.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1.	Introduction to Data Science and AI & ML, Essentials (Tutorial) Programming, Statistical Analysis Initial Data Analysis	6
2.	Data Acquisition, Data Pre-processing and Preparation, Data Quality and Transformation, Handling Text Data, Principles of Big Data	6
3.	Data Visualization, Sampling and Estimation, Inferential Statistics, LinearRegression, Multiple Linear Regression, Non-Linear Regression	6
4.	AI: Application areas; AI Basics (Divide and Conquer, Greedy, Branch and Bound, Gradient Descent); NN basics (Perceptron and MLP, FFN, Back propagation) Convolution Neural Networks: Image classification; Text classification; Image classification and hyper-parameter tuning; Emerging NN architectures	6

5.	Recurrent Neural Networks: Building recurrent NN; Long Short-Term Memory; Time Series Forecasting;	6
6.	Deep Learning: Auto-encoders and unsupervised learning; Stacked auto-encoders and semi-supervised learning; Regularization - Dropout andBatch normalization	6
Total 36 L		

Text Books:

1) Artificial Intelligence A Modern Approach Stuart J. Russell and Peter Norvig.
2)ARTIFICIAL INTELLIGENCE, Third Edition, E. Rich, K. Knight, SB Nair, Tata Mc Grawhill

CO-PO/PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	1	-	-	3	1	-	-	2	1	1	2	-	1
CO2	2	1	-	-	-	3	1	-	2	1	2	2	1	-	1
CO3	2	-	-	1	-	3	-	-	1	1	2	2	2	-	1
CO4	1	-	1	-	-	3	-	-	-	2	1	2	2	-	1

Practical

COURSE NAME: DESIGN LAB
COURSE CODE: ME692
CONTACTS: 0:0:3
CREDITS: 1.5
Prerequisite: Theory of machines, Dynamics of Machine Theory, Strength of Material, Design ofMachine element.

Course Outcomes: After taking this course the students should be able to:

1. Identify different mechanical elements and the uses of those elements.
2. Analyze existing mechanical elements under static as well as dynamic loading.
3. Determine the endurance limit of rotating beam specimen, stress concentration factors by FEA
4. Design a mechanical element by using standards, codes

List of Experiments

1. Study of different mechanical elements e.g Gear, Clutch, Brake, Bearing, Shaft, Spline,Coupling, Keys
2. Determination of Endurance Limit for a rotating beam specimen by using fatigue testingmachine.
3. Introduction to CAE, FEA
4. Measurement of stress at a desired point on a deformed body e.g beam under

static loading byusing strain gauge.

5. Estimation of stress at point on a deformed body e.g beam under static loading by using CAEtool and comparison with the experimental result obtained through Exp. No. 4
6. Determination of Stress concentration factors for different types of discontinuities in mechanicalelement by FEA using CAE tool.

Course Articulation Matrix:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	-	3	2	1	-	-	-	-	3	2	3	2	1	1	2
CO2	-	1	2	-	-	-	-	-	3	2	3	3	2	1	1
CO3	-	1	3	-	1	-	-	-	2	2	3	2	3	2	2
CO4	-	1	3	-	-	-	-	-	2	2	3	3	3	2	1

COURSE NAME: ROBOTICS LAB

COURSE CODE: EC(ME)693A

CONTACTS: 0: 0: 2
CREDITS:1
Prerequisite: Basic of robotics and electronics

Course Outcomes:
CO1: Describe the configuration of a robotic system from its motion.
CO2: Analyze the control of robotic systems with the help of programs.
CO3: Apply different operation in robot.
CO4: Evaluate different application in industry.

List of Experiments:

Experiment No.	Description
1	Introduction to robot configuration
2	Demonstration of robot with 2 DOF, 3 DOF, 4 DOF
3	Study and selection of Gripper.
4	Programming exercise of robots for Pick and Place activity.
5	Color based pick and place operation using vision system
6	Few case studies of robot applications in industry

CO – PO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	2	-	2	-	-	-	-	2	2	2	1	1	2
CO2	2	-	1	-	1	-	-	1	-	2	2	3	2	1	1
CO3	2	1	3	-	1	1	-	-	-	2	3	2	3	2	2
CO4	2	1	2	-	1	-	-	1	-	2	3	3	3	2	1

COURSE NAME: ELECTRICAL MACHINES LAB
COURSE CODE: EE(ME)693B
CONTACT: 0:0:2
CREDITS: 1

Prerequisite: Electrical Machines Theory

Course Outcome: On completion of the course students will be able to
1. Formulate and then analyze the working of any electrical machine under loaded and unloaded conditions.
2. Analyze the response of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.
3. Troubleshoot the operation of DC machine, Three Phase Induction Motor, Synchronous Machine and Fractional kW Motors.

Course Content:

At least 8 (eight) of the following experiments to be conducted.

1. Study of the characteristics of a separately excited d.c. generator.
2. Plot the O.C.C. of a d.c. generator & find the critical resistance.
3. Perform load test of d.c. shunt motor to determine efficiency and study the differentcharacteristics of d.c. shunt motor.
4. Perform load test of d.c. series motor to determine efficiency and study the differentcharacteristics of d.c. series motor.
5. Determine the efficiency of a D.C. motor by Swinburn‘s test.
6. Study different type of starting of 3 phase induction motor & their comparison.
7. Perform No-load test and Blocked-rotor test on 3-phase induction motor & draw the equivalentcircuit from the two tests.
8. Study of performance of three phase squirrel- cage Induction motor – determination of Iron-loss,friction & windage loss.
9. Study the effect of capacitor on the starting and running condition of a single-phase inductionmotor.
10. Perform the load test on 3-phase induction motor and to study the performance characteristicsof the motor.
11. Plot V-curve & inverted V-curve of the synchronous motor.

CO-PO/PSO Mapping

CO Codes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	2	-	1	1	-	-	-	-	-	1	3	3	-	1	-
CO2	2	2	2	2	-	-	-	-	-	1	2	2	2	-	1
CO3	2	2	1	2	-	-	-	-	-	1	3	2	1	1	2

COURSE NAME: ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB
COURSE CODE: CS(ME)693C
CONTACT:0:0:2
CREDIT: 1
Prerequisite: Probability, Matrix operations, Basic programming

Course Outcomes: Upon successful completion of this course, students will be able to achieve:
1. advanced Data Analysis skills
2. Create AI/ML solutions for various business problems.
3. Build and deploy production grade AI/ML applications.
4. Apply AI/ML methods, techniques and tools immediate.

Course Contents:
1. Logic programming with Prolog: To specify relationships among objects and properties of objects, problem solving.
2. Introduction to Python Programming: Learn the different libraries - NumPy, Pandas, SciPy, Matplotlib, Scikit Learn.
3. Supervised Learning: Linear Regression predicts a real-valued output based on an input value, Logistic regression- the notion of classification, the cost function for logistic regression, and the application of logistic regression, KNN- classification.
4. Bagging Algorithm:Decision Tree,different ensemble techniques like bagging, boosting, stacking and voting, Random Forest- bagging, Attribute bagging and voting for class selection.
5. Boosting Algorithms: AdaBoost, Stochastic Gradient Boosting, Voting Ensemble.
6. Deployment of Machine Learning Models: simple Web API.

CO-PO/PSO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	1	-	1	-	-	3	1	-	-	2	1	1	2	-	1
CO2	2	1	-	-	-	3	1	-	2	1	2	2	1	-	1
CO3	2	-	-	1	-	3	-	-	1	1	2	2	2	-	1
CO4	1	-	1	-	-	3	-	-	-	2	1	2	2	-	1

COURSE NAME: INDUSTRIAL TRAINING
COURSE CODE: ME681
CREDIT: 1
Course contents: (Minimum 2 weeks training)
Collective Data from 3rd to 6th Semester (Summer/Winter Training during Semester Break & Internship should be done after 5th Semester or 6th Semester). All related certificates to be collected by the training/internship coordinator(s).

COURSE NAME: MINOR PROJECT I
COURSE CODE: ME682
CONTACT:0:0:8
CREDIT: 4
Course contents:
It is intended to start the project work in the semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The students in a group of 4 to 6 works on a topic are to be approved by the head of the department under the guidance of a faculty member. The students prepare a comprehensive project report after completing the work to the satisfaction of the supervisor to be submitted at the end of the semester. The project work is evaluated based on oral presentation and the project report may jointly by examiners constituted by the Head of the Department.

4th Year 1st Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	THEORY			L	T	P	Total	
1	Major	ME701	Advanced Manufacturing Technology	3	0	0	3	3
2	Major	ME702	A. Automobile Engineering B. Computer Aided Design C. Turbomachinery	3	0	0	3	3
3	Major	ME703	A. Micro and Nano-Manufacturing B. Maintenance Engineering C. Composite Materials	3	0	0	3	3
4	Major	ME704	Rapid Prototyping	3	0	0	3	3
5	Minor	EC(ME)701A	Introduction to AR/VR	3	0	0	3	3
		EE(ME)701B	Electric Vehicles					
		CS(ME)701C	Cyber Security and Blockchain					
6	Ability Enhancement Course	HU(ME)701	Industrial Engineering & Management	2	0	0	2	2
	PRACTICAL							
1	Major	ME791	Advanced Manufacturing Technology Lab	0	0	2	2	1
2	Major	ME792A	Automobile Engineering Lab	0	0	2	2	1
		ME792B	Computer Aided Design Lab					
		ME792C	Turbomachinery Lab					
3	Ability Enhancement Course	HU(ME)791	Seminar & Group Discussion	0	0	2	2	1
4	Internship	ME781	Rapid Prototyping Lab	0	0	2	2	1
5	Project	ME782	Major Project-II	0	0	8	8	4
	TOTAL CREDIT							25

*'Mandatory Additional Requirement'(MAR) activities have to be carried out as per university guidelines.

COURSE NAME: ADVANCED MANUFACTURING TECHNOLOGY

COURSE CODE: ME701

CONTACTS: 3:0:0

TOTAL CONTACT HOURS: 36

CREDITS: 3

Prerequisites: Concept of Manufacturing Process.

Course Objective:
Introduce manufacturing systems and automation, emphasizing the integration of machines, tools, and control systems for efficient production. Develop a comprehensive understanding of NC and CNC systems, focusing on programming, operations, and the role of computer control in enhancing machining accuracy and repeatability. Expose students to non-traditional manufacturing processes, such as EDM, ECM, LBM, and USM, with an emphasis on their principles, applications, and comparative advantages in machining complex and hard-to-machine materials. Provide insights into 3D printing technologies, highlighting their role in product development, design validation, and customization in modern manufacturing environments.

Course Outcomes:
CO1: Learn the basics of automation and its application in flexible manufacturing systems.
CO2: Understand the principle of CNC machines and learn their programming language.
CO3: Evaluate the process parameters involved in machining process and analyze their effect on surface finish achieved in various nonconventional processes.
CO4: Get an overview of rapid prototyping and use of 3D printing.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	Introduction to Advanced Manufacturing Technology Manufacturing Systems and Automation: Job shop, Flow lines, Transfer lines, Project shop, Continuous processes, Cellular manufacturing system, Flexible Manufacturing System. Automation: (i) degree of automation and their justified application in different levels of production (ii) benefits and draw backs of employing automation (iii) examples of conventional non-automatic, semi-automatic and automatic machine tools extent of automation in transfer machines Integrated Manufacturing System: Steps involved in implementation, forming the linked-cell factory, Introduction to Robotics for its implementation in manufacturing	**10**

2	Basic systems of NC and CNC machines: coordinate system, control –open loop and closed loop, dimensioning – absolute and incremental CNC machine tools; structure and working principle machining centre (MC) – characteristics and applications. Control of tool – work travel, point – to –point and contouring, interpolation – linear and circular Part programming for NC, CNC and MC systems, Codes used, sequential steps, examples; part programming for machining in CNC lathes, drilling machines and milling, Computer aided part programming, advantages, programming languages, statements in APT, examples.	**8**
3	Non Traditional Manufacturing -Advantages, classification, characteristics Abrasive Jet Machining (AJM): principle, material removal rate Water Jet Machining, Applications, Advantages and limitations. Ultrasonic Machining (USM): Working principle, Influence of Process parameters, Applications. Plasma Arc Machining- principle, applications. Chemical Machining-Blanking, Design factors, advantages and disadvantages. Electro-Chemical Machining, Applications. Electrical Discharge Machining (EDM), Wire-cut EDM: working principle, Dielectric fluid, Die sinking EDM, Advantages & Disadvantages. Electron Beam Machining Principle and Applications. High energy density welding processes like, LBW, EBW, PAW, etc. Laser Beam Machining (LBM): Characteristics of Ruby laser, Carbon Dioxide laser, Welding Heat treating, cladding. Hybrid Machining	**12**
4	Rapid Prototyping- Overview of Rapid Prototyping, Basic Process- CAD Model Creation, Conversion to STL format, Slice the STL File, Layer by layer construction, Clean and finish. Principles, systems, relative advantages and applications of the common RP methods; • stereo lithography (SLG) • selective laser sintering (SLS) • fused deposition modeling (FDM) • laminated objects manufacturing (LOM) • 3-D Inkjet Printing	**6**

Text Books:

1. Fundamentals of Modern Manufacturing by Mikeel P. Grover– 3E Wiley

2. Automation, Production systems and CIM – M.P. Groover, Prentice Hall

3. Non-conventional machining – P.K. Mishra, Narosa

4. Manufacturing science – Ghosh &Mullick, EWP

References Books:

5. Rapid prototyping – A. Ghosh, EW Press
6. Non-traditional Manufacturing Processes by Gary F. Benedict– Marcel Dekker
7. Micromachining of Engineering Material by Mc Geogh, J.A. – Marcel Dekker
8. Advanced Machining Process, Non-traditional and Hybrid Machining Processes by Hassan Abdel- Gawad El- Hofy – McGraw Hill, Mechanical Engineering Science.

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3		2		2		3				1	2	2		
CO2	3	2	2		2		2				2	2		3	
CO3	2	1	1		2		2				1	1			3
CO4	2	2	2		3		2				2	2		2	3

COURSE NAME: AUTOMOBILE ENGINEERING
COURSE CODE: ME 702A
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3
Prerequisite: Thermodynamics, Kinematics & Theory of Machines.

Course Objectives:
Introduce the basic structure, classification, and layout of automobiles, covering various subsystems such as powertrain, chassis, suspension, and braking. Familiarize students with the transmission systems, steering mechanisms, and vehicle dynamics that influence ride comfort, handling, and safety. Enable students to analyze automotive performance, efficiency, and environmental impact through appropriate testing and diagnostic tools.

Course Outcomes:
CO1**:** Understand the basic layout of an automobile.
CO2: Explain the operation of engine cooling, lubrication, ignition, electrical and air conditioning systems.
CO3: Analyze the principles of transmission, suspension, steering and braking systems.
CO4: Study latest developments in automobiles.

Course Contents:

Module No.	Syllabus	Contact Hrs.
1	Introduction: History & Development of Automobile. Various sub system of Automobile. Prime Mover: Engine for Two–Wheeler & Three-Wheeled vehicles, Engine for passenger cars, commercial and other vehicle, Fuel system for carbureted engine, MPFI engine and Diesel engine, Lubrication and cooling system.	**6**
2	Transmission System: Devis steering & Ackerman steering system. Rack & pinion, cam & lever, worm & sector system. Flywheel & clutch. Gearbox sliding and constant mesh type, Automatic Transmission, Universal joint, Propeller shaft. Construction & function of differential, Different types of front & rear axles. Wheel quality, assembly, types of wheels, wheel rims. Construction of tyres and tyre specifications.	**12**
3	Suspension System Conventional and independent suspension system, application. Automotive Restraints: Seat belt, automatic seat belt tightened system, collapsible steering column and air bags.	**6**
4	Brake System: Disc & drum brake, Hydraulic brake, Parking brake, Stopping distance.	**4**
5	Electrical Systems: Battery, generator, Ignition system, Starting system, lighting & signaling.	**4**
6	Power Requirement: Various resistances such as air resistance, gradient resistance, rolling resistance.	**4**

	Tractive effort. Torque- Speed curve. Horse power calculation.	

Text Books:

1. Michael E. Mortenson, Geometric Modelling, Tata McGraw Hill, 2013. 2. A. Saxena and B. Sahay, Computer-Aided Engineering Design, Anamaya Publishers, New Delhi, 2005.
3. Rogers, David F., An introduction to NURBS: with historical perspective, Morgan Kaufmann Publishers, USA, 2001. 4. David F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, TMH, 2008.

CO– PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	1	2	-	2	2	2	1	1	2	1	-	2
CO2	3	2	1	-	2	1	-	1	-	1	1	2	2	-	2
CO3	3	2	3	2	3	2	1	1	-	1	1	2	1	-	2
CO4	3	1	3	2	3	2	1	1	1	1	1	3	2	-	2

COURSE NAME: COMPUTER AIDED DESIGN
COURSE CODE: ME702B
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3
Prerequisite: Engineering Drawing, Mathematics

Course Objective:
Introduce the fundamental principles and applications of computer-aided design in the engineering design process. Enable students to create 2D drawings and develop 3D solid models using industry-standard CAD software. Familiarize students with geometric modeling techniques, parametric design, and assembly modelling.

Course Outcome:
CO1. Apply geometric transformations and projection methods in CAD.
CO2. Develop geometric models to represent curves.
CO3. Develop surface models for engineering design.
CO4. Model engineering components using solid modelling techniques for design.

Course Contents

Module No.	Syllabus	Contact Hrs.
Module 1 Introduction	Introduction to CAE, CAD. Role of CAD in Mechanical Engineering, Design process, software tools for CAD, geometric modelling.	**3**
Module 2 Transformations in Geometric Modeling	Introduction, Translation, Scaling, Reflection, Rotation in 2D and 3D. Homogeneous representation of transformation, Concatenation of transformations. Computer-Aided assembly of rigid bodies, applications of transformations in design and analysis of mechanisms, etc. Implementation of the transformations using computer codes.	**5**
Module 3 Projections	Projective geometry, transformation matrices for Perspective, Axonometric projections, Orthographic and Oblique projections. Implementation of the projection formulations using computer codes	**6**
Module 4Introduction to Geometric Modeling for Design	Introduction to CAGD, CAD input devices, CAD output devices, CAD Software, Display Visualization Aids, and Requirements of Modelling	**4**
Module 5Curves in Geometric Modeling for Design	Differential geometry of curves, Analytic Curves, PC curve, Ferguson‘s Cubic Curve, Composite Ferguson, Curve Trimming and Blending. Bezier segments Bernstein polynomials, Composite Bezier. B-spline basis functions, Properties of basic functions, NURBS. Conversion of one form of curve to other. Implementation of the all the curve models using computer codes in an interactive manner	**7**

Module 6Surfaces in Geometric Modeling for Design	Surfaces entities (planar, surface of revolution, lofted etc.). Free-form surface models (Hermite, Bezier, B- spline surface). Boundary interpolating surfaces (Coon's). Implementation of the all the surface models using computer codes.	**6**
Module 7Solids in Geometric Modeling for Design	Solid entities, Boolean operations, Topological aspects, Invariants. Write-frame modeling, B-rep of Solid Modelling, CSG approach of solid modelling. Popular modeling methods in CAD softwares. Data Exchange Formats and CAD Applications:	**5**

Text Books:

1. Michael E. Mortenson, Geometric Modelling, Tata McGraw Hill, 2013. 2. A. Saxena and B. Sahay, Computer-Aided Engineering Design, Anamaya Publishers, New Delhi, 2005.

3. Rogers, David F., An introduction to NURBS: with historical perspective, Morgan Kaufmann Publishers, USA, 2001. 4. David F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, TMH, 2008.

CO– PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	1	3	1	2	-	2	2	2	1	1	2	1	-	2
CO2	3	2	1	-	2	1	-	1	-	1	1	2	2	-	2
CO3	3	2	3	2	3	2	1	1	-	1	1	2	1	-	2
CO4	3	1	3	2	3	2	1	1	1	1	1	3	2	-	2

COURSE NAME: TURBOMACHINERY
COURSE CODE: ME702C
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisite: Fluid Mechanics and Fluid machinery.

Course Objectives:
Introduce the fundamental concepts of energy transfer in turbomachines, including the classification and operational characteristics of compressors, turbines, and pumps. Develop the ability to apply fluid mechanics and thermodynamics principles to analyze the performance and efficiency of different types of turbomachinery. Familiarize students with velocity diagrams, work input/output, and flow characteristics for axial and radial flow machines. Explore the design parameters and performance curves of turbomachines under various operating conditions**.**

Course Outcomes:
CO1: Get Basic knowledge about rotary machines, nozzle, diffuser etc.
CO2: Understand about the calculation of efficiency, power etc. of steam turbines and hydraulic turbine.
CO3: Evaluate of efficiency, power required etc. of pumps and compressor
CO4: Design of various incompressible and compressible flow machines.

Course Contents

Module No.	Syllabus	ContactHrs.
1	Introduction: Classification: Incompressible and compressible flow machines; Radial, axial and mixed flow machines; Turbines vs pumps, fans and compressors. Applications: Water supply, ventilation, power generation, propulsion.	**4**
2	Incompressible- Flow Machines: Euler Head Equation Hydraulic Turbines: Headrace, penstock, nozzle, runner, draft tube and tail race; Gross head and net head; Velocity diagrams for impulse and reaction turbines; Discharge, head, power and efficiencies. Pumps: Reservoir, foot valve, suction line, pump, delivery line and overhead tank; Static head and losses; Velocity diagrams; Discharge, head, power and efficiencies.	**10**
3	Compressible-Flow Machines: Static and stagnation states; Isentropic and adiabatic expansion and compression processes; Nozzle, diffuser and rows of stationary and moving blades; Efficiencies.	**9**
4	Dimensional Analysis: Similarity laws, Volume-flow, mass-flow head and power coefficients, Specific speed and machine selection; Pressure ratio, enthalpy ratio, Reynolds number, Mach number; Surge and choking.	**5**
5	Testing and Performance Analysis: Measurement devices; affinity laws and unit quantities. Set up and operating	**8**

	characteristics of pumps, turbines; fans and turbo-compressors. Cavitation– cause of cavitation and definition of Thoma's cavitation parameter.	

Text Books:

1. S.M. Yahya, Turbine, Compressors and Fans.
2. J. Lal, Hydraulic Machines.
3. S.K. Som, G. Biswas and S. Chakraborty, Introduction to Fluid Mechanics & Fluid Machines, TMH.
4. M.M. Das, Fluid Mechanics & Turbo Machines, PHI, 2010.
5. R.K. Bansal, Fluid Mechanics & Machinery, Luxmi Publications.

References:

6. C. Ratnam, A.V. Kothapalli, Fluid Mechanics & Machinery, I.K. International Publishing House Ltd, 2010.
7. C.S.P. Ojha, R. Berndtsson, P.N. Chandramouli, Fluid Mechanics & Machinery, Oxford University Press.
8. Gupta, Fluid Mechanics and Hydraulic Machines, Pearson Publication.
9. A.T. Sayers, Hydraulic and Compressible Flow Turbomachines.
10. R.K. Bansal, Fluid Mechanics and Hydraulic Machines.

CO – PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	2	1	-	-	-	1	3	2		
CO2	3	2	-	-	-	-	-	-	1	-	1	3		2	
CO3	3	2	-	-	-	-	-	-	2	-	1	3		1	3
CO4	3	3	3	3	1	2	1	-	1	-	2	3	2		2

COURSE NAME: MICRO AND NANO MANUFACTURING
COURSE CODE: ME801A
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisite: Traditional and Advanced Micromachining Processes

Course Outcome:
The course objectives of Micro and Nano Manufacturing are to provide students with a comprehensive understanding of the principles, technologies, and challenges associated with manufacturing at micro and nano scales. The course aims to introduce the fundamental differences between conventional manufacturing and micro/nano fabrication techniques, highlighting the significance of size effects, precision, and material behavior at these scales. Students will learn about various micro- and nano-manufacturing processes such as lithography, micro-milling, nano-imprinting, laser-based techniques, and chemical etching. The course also emphasizes the role of cleanroom environments, metrology, and instrumentation required for micro/nano fabrication and inspection. Additionally, it aims to develop the students' ability to select appropriate materials and processes for specific applications in fields such as electronics, biomedical devices, MEMS, and nanotechnology-enabled systems.

Course Outcome:
CO1.Understand different techniques for the synthesis and characterization of nanomaterials.
CO2. Design and analyze methods and tools for micro and nano-manufacturing.
CO3. Select micro and nano-manufacturing methods and identify key variables to improve quality of MEMS.
CO4. Choose appropriate industrially viable process, equipment and tools for a specific product.

Course Contents

Module No.	Syllabus	Contact Hrs.
1	Introduction: Importance of Nano-technology, Emergence of Nanotechnology, Bottom-up and Top-down approaches, challenges in Nanotechnology, Scaling Laws/Sizing effects.	**4**
2	Nano-materials Synthesis and Processing: Methods for creating Nanostructures; Processes for producing ultrafine powders- Mechanical grinding; Wet Chemical Synthesis of nanomaterials- sol-gel process, Liquid solid reactions; Gas Phase synthesis of nano-materials Furnace, Flame assisted ultrasonic spray pyrolysis; Gas Condensation Processing (GPC), Chemical Vapour Condensation (CVC)- Cold Plasma Methods, Laser ablation, Vapour – liquid –solid growth,	**10**

	particle precipitation aided CVD, summary of Gas Condensation Processing (GPC).	
3	Structural Characterization: X-ray diffraction, Small angle X-ray Scattering, Optical Microscope and their description, Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, Scanning Tunneling Microscopy (STM), Atomic force Microscopy (AFM).	**7**
4	Micro fabrication Techniques: Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate Bonding, MEMS Fabrication Techniques, Bulk Micromachining, Surface Micromachining, High- Aspect-Ratio Micromachining	**7**
5	Nanofabrication Techniques: E-Beam and Nano-Imprint Fabrication, Epitaxy and Strain Engineering, Scanned, Probe Techniques, Self-Assembly and Template Manufacturing.	**5**
6	MEMS devices and applications: Pressure sensor, Inertial sensor, Optical MEMS and RFMEMS, Micro-actuators for dual-stage servo systems.	**3**

Text Books:

1.Micromanufacturing, V. K. Jain (Ed.), CRC press, 2012.
2.Micromanufacturing & Nanotechnology, N. P. Mahalik, Springer.
3.Microfacbrication & Nanomanufacturing, Mark J. Jackson, CRC press.
4.Introduction to Micromachining, V. K. Jain (Ed.), Narosa publisher, 2010.

CO-PO/PSO Mapping:

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

COURSE NAME: MAINTENANCE ENGINEERING
COURSE CODE: ME801B
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisite: Strength of Material, Machine Design, Measurement and Instrumentation

Course Objectives:
The course are to equip students with the knowledge and skills necessary to effectively manage, plan, and execute maintenance activities in engineering systems and industrial operations. The course aims to introduce the fundamental concepts of maintenance, its types—such as preventive, predictive, and breakdown maintenance—and the role of maintenance in improving equipment reliability, safety, and productivity. Students will learn techniques for failure analysis, root cause diagnosis, and condition monitoring using tools such as vibration analysis, thermography, and oil analysis. The course also focuses on the economics of maintenance, reliability-centered maintenance (RCM), and the use of maintenance planning and scheduling strategies to minimize downtime and lifecycle costs.

Course Outcomes:
CO1: Get basic knowledge about types and procedure of maintenance, instruments and tools.
CO2: Understand organizational and economic structure of maintenance.
CO3: Evaluate of performance of tools associated with maintenance and lubrication.
CO4: Design maintenance tools for various applications like bearings, drives, pumps, piping etc.

Course Contents

Module No.	Syllabus	Contact Hrs.
1	Introduction: Definitions of repair and maintenance; Importance of maintenance; Different maintenance systems- breakdown, preventive, planned; predictive maintenance through condition monitoring; Maintainability, failure pattern, availability of equipment / systems, design for maintainability. Total Productive Maintenance (TPM): definition, objective & methodology; Implementation of TPM; Lean maintenance; Overall equipment effectiveness (OEE)	**8**
2	Organizational structures for maintenance: Objective; Maintenance functions and activities; Organizational requirements; Types of maintenance organizations, Manpower planning; Engineering stores & inventory management.	**4**
3	Economic Aspect of Maintenance: Life cycle costing; Maintenance cost & its impact; Maintenance budget; Cost control; Maintenance auditProcedure, tools, planning, reports.	**4**

4	Function and use of Maintenance Equipment, Instruments & Tools: Facilities like NDT, painting, coating and cladding, Gas cutting and welding, crack detection, vibration monitor, balancing equipment, compressor, basic machine tools, lubricators and lubricants, chain pulley block, Tools like different types of wrenches, torque wrench, pipe wrench, plier, screw driver, dimension measuring instruments, feeler gauge, scraper, fitting shop tools, spirit level, hand grinder & drill, screw jack, etc.	**6**
5	Lubrication: Purpose & importance; Type of lubricants, Properties of lubricants; Types of lubrication and their typical applications, lubrication devices, centralized lubrication system; Gasket, packing and seals	**6**
6	Repair & Maintenance Procedures: Repair of cracks, threads, worn shafts, keyways, bush bearing, damaged gear tooth. Assembly and dismantling of antifriction bearing; Maintenance of bearing, clutches, coupling, brakes, Alignment of shafts, belt and chain drives, gear drives, centrifugal pump, pipe and pipe fittings, electrical wiring, isolators and main switches, small induction motors; Steps for installation of a machine.	**8**

Text Books:

1. Mishra and Pathak, Maintenance Engineering and Management, PHI
2. Srivastava, Maintenance Engineering and Management, S. Chand & Company Ltd., New Delhi.
3. K. Venkataraman, Maintenance Engineering and Management, PHI

CO-PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	1							1	1	2			3
CO2	2	2	1	1					1	1	2	3	2	1	
CO3	1	2	2	1	2				2	1	1	3		2	3
CO4	1	3	3	2	1	2	1		1	1	2	3			3

COURSE NAME: COMPOSITE MATERIALS
COURSE CODE: ME801C
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisite: Engineering Materials

Course Objectives:
The course objectives of Composite Materials are to provide students with a fundamental understanding of the behavior, properties, and applications of composite materials used in engineering. The course aims to introduce the basic concepts of composite materials, including their classification, constituents (matrix and reinforcement), and the advantages they offer over conventional materials. Students will learn about the manufacturing processes of various types of composites such as polymer matrix composites (PMC), metal matrix composites (MMC), and ceramic matrix composites (CMC). Emphasis is placed on understanding the mechanical behavior of composites, including stress-strain relationships, failure mechanisms, and the influence of fiber orientation and volume fraction on performance. The course also covers micromechanics and macromechanics analysis, testing methods, and standards for characterizing composite materials.

Course Outcomes:
CO1: Know the structure and basic properties of composite and nano-composite materials.
CO2: Explore and understand the several methods of composite fabrication.
CO3: Predict the characteristics and performance of composite materials.
CO4: Apply varying composite materials in automotive, aerospace and other applications**.**

Course Contents

Module No.	Syllabus	Contact Hrs.
1	Introduction to composites: Definition and applications of composite materials, Fibers-glass, carbon, ceramic and aramid fibers; Matricespolymer, graphite, ceramic and metal matrices; characteristics of fibers and matrices. Lamina-assumptions, macroscopic viewpoint, generalized Hookes law, reduction of homogeneous orthotropic lamina, isotropic limit case, orthotropic stiffness matrix, commercial material properties, rule of mixtures, transformation matrix, transformed stiffness.	**10**
2	Characterization of Composites: Basic assumptions of laminated anisotropic plates, symmetric laminates, angle ply laminates, crossply laminates, laminate structural moduli, evaluation of lamina properties, determination of lamina stresses, maximum stress and strain criteria, von Mises Yield criterion for isotropic materials, generalized Hill‘s criterion for anisotropic materials, Tsai-Hill‘s	**10**

	criterion for composites, prediction of laminate failure, thermal analysis of composite laminates	
3	Performance Analysis of Composites: Analysis of laminated platesequilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies	**8**
4	Fabrication and application of Composites: Manufacturing of composite materials, bag molding, compression molding, pultrusion, filament welding, other manufacturing processes, Industrial Application of Composite Materials	**8**

Text Books:

1. Composite materials, K.K. Chawala, 2nd ed., (1987) Springer-Verlag, New York.
2. Nanocomposite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun, (2003), Wiley-VCH Verlag GmbH Co. KgaA, Weinheim.
3. Mechanics and Analysis of Composite Materials, V.V. Vasiliev and E.V. Morozov,(2001), Elsevier Science Ltd, The Boulevard, Kidlington, Oxford OX5Lgb, UK.
4. Ceramic matrix composites, K.K. Chawala, 1st ed., (1993) Chapman & Hall, London

CO-PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	2	1	-	-	-	-	-	1	-	-	2	-	2
CO2	2	-	1	2	1	-	-	1	-	1	2	1	2	-	2
CO3	2	2	2	1	1	1	-	-	-	1	1	1	2	-	2
CO4	2	1	2	2	1	1	-	1	-	1	2	3	2	-	2

COURSE NAME: RAPID PROTOTYPING
COURSE CODE: ME704
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisite: Manufacturing technology, 3D printing

Course Objectives:
The course provides students with a comprehensive understanding of additive manufacturing technologies and their role in modern product development. The course aims to introduce the principles, processes, and classifications of rapid prototyping techniques, including methods such as Fused Deposition Modeling (FDM), Stereolithography (SLA), Selective Laser Sintering (SLS), and Laminated Object Manufacturing (LOM). Students will learn how to convert 3D CAD models into physical prototypes through data preparation, slicing, and machine interfacing. The course emphasizes the advantages of rapid prototyping in reducing product development cycles, enhancing design flexibility, and supporting customization. In addition, students will gain insights into material selection, accuracy considerations, post-processing techniques, and the integration of RP with reverse engineering and tooling applications.

Course Outcomes:
CO1: explain the fundamental concepts, historical development and applications of Rapid Prototyping
CO2: discuss the operating principles, capabilities and advantages of Solid based RP systems
CO3: describe conceptual design and product development of powder based RP systems
CO4: use suitable software in evaluation of STL file problems
CO5: explain typical applications of RP technologies in traditional and value-added industries

Course Contents

Module No.	Syllabus	Contact Hrs.
1	**Introduction**, Prototype fundamentals, Historical development, Fundamentals of Rapid Prototyping, Process Chain, Classification of RP systems, applications and benefits of Rapid Prototyping. **Liquid-Based Rapid Prototyping Systems:** Stereo Lithography Apparatus (SLA), Models and specifications, working principle, process, Photopolymers, Photo polymerization, layering technology, Laser and Laser scanning, advantages and disadvantages, applications. Micro Stereo lithography. Rapid Freeze Prototyping (RFP) Process: Principle and process description, major hardware used in the system, Potential applications. Solid Ground Curing (SGC) Process: Models and specifications, working principle, process, materials used for creating parts, applications, advantages and disadvantages.	**7**

2	Fusion Deposition Modeling (FDM): Models and specifications, working principle, process, applications, advantages and disadvantages. Laminated Object Manufacturing (LOM): Models and specifications, Principle, process, materials used, advantages and disadvantages, applications. Multi-Jet Modeling(MJM): Working principle, process, applications, advantages and disadvantages. Plastic Sheet Lamination(PSL)Process: Working principle, process, advantages and disadvantages, applications.Shape Deposition Manufacturing(SDM) process: Principle, process, part materials and support materials, advantages and disadvantages, applications.	**7**
3	Selective Laser Sintering (SLS)Process: Models and specifications, working principle, process, materials used, applications, advantages and disadvantages. Laser Engineered Net Shaping (LENS) process: Models and specifications, working principle, process, applications, advantages and disadvantages. Three Dimensional Printing (3DP) process; Models and specifications, working principle, process, applications, advantages and disadvantages. Mask less Mesoscale Material Deposition(M3 D) process: Concept, process description, applications, advantages. Electronic Beam Melting(EBM) process: Principle, process, hardware components, applications, advantages and disadvantages. Multiphase Jet Solidification(MJS) process: Principle, data preparation, model building, influence of process parameters, advantages and disadvantages, applications.	**8**
4	STL format, STL file problems, consequences of building valid and invalid tessellated models, STL file repairs: Generic solution, other translators, newly proposed formats. Features of RP software like MAGICS, MIMICS, Solid view, Velocity2, Rhino, View expert,3D Doctor.	**7**
5	Rapid Tooling: Introduction, Conventional tooling Vs Rapid tooling, need for Rapid tooling. Rapid tooling classification: Indirect Rapid tooling methods: Spray metal deposition, RTV Epoxy tools, Ceramic tools, Investment casting, Spin casting, Die casting, Sand casting,3D Keltool process. Direct Rapid tooling methods: Direct AIM, LOM tools, DTM Rapid tool process, EOS direct tool process, direct metal tooling using 3DP. RP applications: Material relationship, application in design, application in Engineering, Analysis and Planning, Aerospace industry, Automotive industry, Jewelry industry, Coin industry, Tableware industry, GIS applications, Arts and Architecture applications, Medical and Bioengineering applications.	**7**

Text Books:

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 3rd Edition, World scientific publications, 2014.

Reference Books:

1. Pham,D.T. and Dimov.S.S., Rapid manufacturing, Springer, London, 2001.
2. Fuewen Frank Liou, Rapid prototyping and Engineering Applications, CRC Press, 2019.
3. Ian Gibson,David W Rosen,Brent Stucker " Additive manufacturing technologies : 3D printing, Rapid Prototyping and Direct Digital manufacturing" 2nd edition,Springer,2015.
4. Ali.k. Kamrani,E.A.Nasr " Rapid Prototyping: Theory and practice",Springer,2006

CO-PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	-	-	-	-	-	1	-	-	2	-	2
CO2	2	-	1	2	1	-	-	1	-	1	2	1	2	-	2
CO3	2	2	2	1	1	1	-	-	-	1	1	1	2	-	2
CO4	2	1	2	2	1	1	-	1	-	1	2	3	2	-	2

COURSE NAME: INTRODUCTION TO AR/VR
COURSE CODE: EC(ME)701A
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisite: C++, Python,3D modeling concepts, human-computer interaction (HCI)

Course Objectives:
The course objectives are to familiarize students with the fundamental concepts, technologies, and applications of immersive media. The course aims to introduce the theoretical and practical aspects of AR and VR systems, including the principles of human-computer interaction, spatial computing, 3D environments, and real-time rendering. Students will gain an understanding of the hardware components such as head-mounted displays (HMDs), motion trackers, sensors, and controllers, as well as the software platforms and development tools used to create AR/VR experiences. The course also emphasizes the differences between AR, VR, and Mixed Reality (MR), and explores their applications across various domains including gaming, healthcare, education, manufacturing, and training simulations. Additionally, students will learn about design considerations, user experience, and performance metrics in immersive environments.

Course Outcomes:
CO1: Describe the concept of virtual reality and Communication Media.
CO2: Understand current virtual reality hardware and software.
CO3: Understand various modeling approaches.
CO4: Illustrate the concepts of Human Factors and Applications of VR.
CO5: Build a Virtual Reality Application.

Course Contents

Module No.	Syllabus	Contact Hrs.
1	**Introduction to Virtual Reality (Vr):** Defining Virtual Reality, Key elements of virtual reality experience, Virtual Reality, Telepresence, Augmented Reality and Cyberspace. Bird's-Eye View: Hardware, Software, Human Physiology and Perception.	8
2	**Input Devices: (Trackers, Navigation, and Gesture Interfaces):** Three-dimensional position trackers, navigation and manipulation, interfaces and gesture interfaces. Output Devices: Graphics displays, sound displays & haptic feedback	7
3	**Modeling:** Geometric modeling, Kinematics modeling, Physical modeling, Behaviour modeling, Model management.	6
4	**Augmented Reality (AR):** Taxonomy, Technology and Features of Augmented Reality, AR Vs VR, Challenges with AR, AR systems and functionality, Augmented Reality Methods, Visualization Techniques for Augmented Reality, Enhancing interactivity in AR Environments,	8

	Evaluating AR systems AR software development : AR software, Camera parameters and camera calibration, Marker-based augmented reality, AR Toolkit.	
5	**Interaction & Audio:** Interaction- Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio-The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering. Interaction- Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio-The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.	**7**

Textbooks:

1. Virtual Reality Technology, Second Edition, Gregory C. Burdea & Philippe Coiffet, John Wiley & Sons, Inc, 2017.
2. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016.

References:

1. Rajesh K. Maurya, Computer Graphics with Virtual Reality System, 3rd Edition, Wiley Publication, 2018.
2. William R. Sherman and Alan B. Craig, Understanding Virtual Reality Interface, Application, and Design, 2nd Edition, Morgan Kaufmann Publishers, Elsevier, 2019.
3. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, 2nd Edition, Wiley,2017.
4. K.S. Hale and K. M. Stanney, Handbook on Virtual Environments, 2nd Edition, CRC Press, 2015.

CO-PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	2	2	1	-	-	-	-	-	1	-	-	2	-	2
CO2	2	-	1	2	1	-	-	1	-	1	2	1	2	-	2
CO3	2	2	2	1	1	1	-	-	-	1	1	1	2	-	2
CO4	2	1	2	2	1	1	-	1	-	1	2	3	2	-	2

COURSE NAME: ELECTRIC VEHICLES
COURSE CODE: EE(ME)701B
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisite: Power Electronics and Electric Drives.

Course Objectives:
The course objectives are to provide students with a comprehensive understanding of the principles, design, and technology behind electric mobility solutions. The course aims to introduce the fundamentals of electric vehicle (EV) architecture, including the types of electric drivetrains, battery technologies, power electronics, and electric motors used in EVs. Students will gain knowledge of energy storage systems, charging infrastructure, regenerative braking, and vehicle control strategies. The course also covers performance analysis, efficiency considerations, and environmental impact in comparison to conventional internal combustion engine vehicles. Emphasis is placed on the integration of electrical, electronic, and mechanical systems in EV design and operation.

Course Outcomes:
CO1. Identify EV concepts, EV configurations and various EV parameters for better understanding of the EV technology.
CO2. Analyse the EV propulsion system and electric motors for vehicular applications & power electronics converters required for their control.
CO3. Analyse DC motor & induction motor drives and discuss methods for controlling them.
CO4. Elaborate various hybrid electric vehicle configurations and Identify different energy sources used in EV and analyse the various methods used in charging these energy sources.

Course Contents

Module No.	Syllabus	Contact Hrs.
1	**Introduction:** Past, Present & Future of EV, Current Major Issues, Advanced Electric drive vehicle technology, Comparison of EV Vs IC Engine. Components of Hybrid Electric Vehicle, Economic and environmental impacts of Electric hybrid vehicle: Comparative study of vehicles for economic, environmental aspects. In-wheel drives EV Parameters: Weight, size, force, energy & performance parameters.	6
2	**Dynamics of Electric vehicles:** General description of vehicle movement. Choice of electric propulsion system, block diagram of EV propulsion system, Factors affecting vehicle motion- Vehicle resistance, tires ground adhesion, rolling resistance, aerodynamic drag, equation of grading resistance, dynamic equation. Drive train configuration, Automobile power train, classification of vehicle power plant , need of gear box, Concept of EV Motors, classification of EV motors, single motor and multi-motor	8

	configurations, fixed & variable geared transmission, In wheel motor configuration.	
3	**Required Power Electronics & Control:** Comparison of EV power devices, introduction to power electronics converter, four quadrant DC chopper, three-phase full bridge voltage-fed inverter, soft-switching EV converters, comparison of hard-switching and soft-switching converter, three-phase voltage-fed resonance dc link inverter.	**6**
4	**EV Motor Drives:** DC Motor: Type of wound-field DC Motor, Torque speed characteristics. DC-DC Converter, Two quadrant DC Chopper, two quadrant zero voltage transition converter-fed dc motor drive, speed control of DC Motor. Induction Motor Drive: Three Phase Inverter Based Induction Motor Drive, Equal Area PWM, Three Phase Auxiliary resonant snubber (ARS) Inverter Type (ZVC & ZCS), Single Phase ARS Inverter Topology, Speed Control of Induction Motor, Sliding mode Control.	**8**
5	**Energy Sources & Charging:** Different Batteries and Ultra-capacitors, Battery characteristics (Discharging & Charging) Battery Chargers: Conductive (Basic charger circuits.). Arrangement of an off-board conductive charger, Standard power levels of conductive chargers, Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Fast Charging Station.	**8**

Text Books:

1. A.K. Babu, Electric & Hybrid Vehicles, Khanna Publishing House, New Delhi (Ed. 2018).
2. Ehsani, M. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press.
3. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York, 2001.
4. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. David Andrea, "Battery Management System for Large Lithium -Ion Battery Packs", Artech house, 2010.

CO-PO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	3	2	1	2	-	-	-	-	1	-	2	2	-	2
CO2	2	3	2	2	2	-	-	1	-	1	2	1	2	-	2
CO3	2	3	2	2	2	1	-	-	-	1	1	1	2	-	2
CO4	2	1	2	2	1	1	-	1	-	1	2	3	2	-	2

COURSE NAME: CYBER SECURITY AND BLOCKCHAIN
COURSE CODE: CS(ME)701C
CONTACT: 3:0:0
TOTAL CONTACT HOURS: 36
CREDIT: 3

Prerequisite: Basic understanding of computer networks, operating systems, and basic programming skills (preferably in Python, Java, or C/C++). Familiarity with cryptography fundamentals, data structures, and web technologies.

Course Objectives:
To provide a foundational understanding of cyber security principles, threats, vulnerabilities, and countermeasures in digital systems. Introduce the basic concepts of cryptography, network security, and system-level security mechanisms. Explore the architecture, components, and functioning of blockchain technology and its applications beyond cryptocurrencies. Familiarize students with the integration of cybersecurity techniques in blockchain systems for secure, decentralized applications.To develop the ability to assess cyber risks and apply blockchain solutions to enhance data integrity, privacy, and trust in various domains.

Course Outcomes:
CO1: Understand and explain key concepts of cyber security, types of attacks, and protective mechanisms for information systems.
CO2: Analyze and evaluate threats, vulnerabilities, and risk mitigation strategies in networked systems.
CO3: Describe the structure and working of blockchain technology, including blocks, hash functions, consensus algorithms, and smart contracts.
CO4: Demonstrate the ability to design and implement secure, decentralized applications using blockchain principles.

Course Contents

Module No.	Syllabus	Contact Hrs.
1	**Introduction:** Objective, scope and outcome of the course.	**01**
2	**Introduction Block chain:** History, Definition, Types of Block chain, Hash Functions, Properties of Hash Function, Digital Signature, Working of Block chain, Issues and needs of Block chain, Benefits and Challenges of Block chain, features of Block chain, Block chain Network and Nodes, Peerto-Peer Network.	**06**
3	**Block chain Architecture:** Mining Mechanism, Life cycle of Block chain, Merkle Patricia Tree, Gas Limit, Transaction Fees, Anonymity, Reward, Chain policy, Applications of Block chain, Fork and its Types, Generic elements of Block chain, Cryptography in Block chain, Nash Equilibrium, Prisner's Dilemma, ZeroSum Games.	**06**
4	**Introduction to Cybercrime and Laws:** Definition and Origins of Cybercrime, information Security, Who are Cybercriminals? Classifications of Cybercrimes. How Criminals Plan Them – Introduction, How Criminals Plan the Attacks, Cyber-cafe and	**04**

	Cybercrimes, Bot-nets, Attack Vector, The Indian IT ACT 2000 and amendments.	
5	**Tools and Methods used in Cybercrime:** Introduction, Proxy Server and Anonymizers, Password Cracking, Key-loggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow.	**05**
6	**Phishing and Identity Theft:** Introduction, Phishing - Methods of Phishing, Phishing Techniques, Phishing Toolkits and Spy Phishing. Identity Theft – PII, Types of Identity Theft, Techniques of ID Theft. Digital Forensics Science, Need for Computer Cyber forensics and Digital Evidence, Digital Forensics Life Cycle	**07**
7	**Network Defense tools:** Firewalls and Packet Filters: Firewall Basics, Packet Filter Vs. Firewall, How a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding, the basic of Virtual Private Networks, Linux Firewall, Windows Firewall, Snort: Introduction Detection System.	**07**

Text Books:

1. DejeyNurugan: Cyber forensics, Oxford University Press
2. Jennifer L. Bayuk: Cyber Security, Policy Guide Book, Wiley Publisher
3. Nina Godbole: Cyber Security, Wiley Publisher, Latest Edition
4. Hands-On Cyber security with Block chain by Rajneesh Gupta, Packt Publication, June 2018, ISBN9781788990189.
5. Cyber security by Nina Gobole & Sunit Belapune; Pub: Wiley India.
6. Justice Yatindra Singh, Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).

Reference Books:

1. Kenneth J. Knapp, ―Cyber Security and Global Information Assurance: Threat Analysis and Response Solutions‖, IGI Global, 2009.
2. Jonathan Rosenoer, ―Cyber law: the Law of the Internet‖, Springer-verlag, 1997
3. Sudhir Naib, The Information Technology Act, 2005: A Handbook, OUP, New York,
4. Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003)

CO-PO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	3	2	1	2	-	2	-	-	1	-	2	2	-	2
CO2	2	3	2	2	2	-	3	1	-	1	2	1	2	2	2
CO3	2	3	2	2	2	1	3	-	-	1	1	1	2	-	2
CO4	2	1	2	2	1	1	3	1	-	1	2	3	2	-	2

COURSE NAME: INDUSTRIAL ENIGINEERING AND MANAGEMENT
COURSE CODE: HU(ME)701 801
CONTACT: 2:0:0
TOTAL CONTACT HOURS: 24
CREDIT: 2

Prerequisite: General management principles, Engineering Economics, Operations Research, Manufacturing Processes etc.

Course Objectives:
The course aims to equip students with the knowledge and skills required to manage engineering and industrial operations efficiently.

Course Outcomes:
CO1: To understand the problems and opportunities faced by the operations manager in manufacturing and service organizations.
CO2: To develop an ability to understand and apply PPC concepts in a various area like marketing, accounting, finance, engineering, personnel management, logistics, etc.
CO3: To examine several classic Operations Management planning topics including production planning and inventory control.
CO4: To learn several important contemporary topics relevant to business managers of all functional disciplines, including quality management, lean concepts, and sustainability

Course Contents

Module No.	Syllabus	Contact Hrs.
1	**Principles of Management:** Development, application and scope of Industrial Management. Management, different functions of management: Planning, organizing, coordination and control. Structure of an industrial organization. Functions of different departments., Relationship between individual departments. - Line, Line and staff and Functional relationships- Span of control- Delegation- Management by Objectives.	3 -1 = 2
3	**Personnel management:** Objectives and functions of personnel management- Recruitment-Selection and training of workers- Labour Welfare- Industrial Fatigue- Industrial disputes-Trade Unions- Quality circles. Formation of companies: Proprietory-Partnership-Joint stock companies- Public sector- Joint sector and Co-operative sector.	3 -1 = 2
4	**Productivity & Finance management:** Definition, measurement. Work study and its role in improving productivity of an organization. Types of Production systems. Introduction to production planning and control. Capital budgeting techniques, payback period, ARR, NPV, IRR, PI; Sources of capital; Costs concepts and Break even analysis.	5

6	**Production planning and Control (PPC):** Types and examples of production. PPC : i. Need and importance. ii. Functions. iii. Forms used and their importance. iv. General approach for each type of production. Scheduling- meaning and need for productivity and utilization. Gantt chart- Format and method to prepare, Critical ratio scheduling-method and numeric examples. Scheduling using Gantt Chart (for at least 5-7 components having 5-6 machining operations, with processes, setting and operation time for each component and process, resources available, quantity and other necessary data), At least two examples. Bottlenecking- meaning, effect and ways to reduce.	**4**
7	**Recent Trends in IM:** ERP (Enterprise resource planning) - concept, features and applications, Logistics- concept, need and benefits, Just in Time (JIT)-concept and benefits, Supply chain managementconcept and benefits.	**2**
8	**Operations Research** Linear programming, objective function and constraints, graphical method, Simplex algorithms, transportation assignment, Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling.	**7**

Text Books:

1. Essentials of Management, Koontz a andO'Donne.
2. Finance Sense, Prasanna Chandra
3. Industrial Management, M E Thukaram Rao.
4. Modern Production Management. Buffa.
5. Industrial Engineering & Management. O. P. Khanna

CO-PO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	3	2	1	2	-	2	-	-	1	-	2	2	-	2
CO2	2	3	2	2	2	-	3	1	-	1	2	1	2	2	2
CO3	2	3	2	2	2	1	3	-	-	1	1	1	2	-	2
CO4	2	1	2	2	1	1	3	1	-	1	2	3	2	-	2

COURSE NAME: ADVANCED MANUFACTURING TECHNOLOGY LAB
COURSE CODE: ME791
CONTACT: 0:0:2
TOTAL CONTACT HOURS: 24
CREDIT: 1

Prerequisite: Advanced Manufacturing

Course Outcomes:
CO1: Program a CNC turning or milling machine for preparing a job.
CO2: Evaluate the process parameters involved in CNC machining
CO3: Analyze the principles of Robot programming and carryout hands-on practice
CO4: Study any nonconventional machining process and 3D printing

Course Contents
1. Programming on CNC Lathe.
2. Programming on CNC Milling Machine.
3. Study of geometry of robot manipulator, actuators and grippers.
4. Robot Programming.
5. Parametric Study of Electric-Discharge Machining.
6. Study of AJM/USM/ECM

CO-PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	2	-	2	-	3	-	-	-	2	2	-	-	3
CO2	3	2	2	-	2	-	2	-	-	-	2	2	3	-	-
CO3	2	1	1	-	2	-	2	-	-	-	3	1	-	-	3
CO4	2	2	2	-	3	-	2	-	-	-	3	2	-	2	-

COURSE NAME: AUTOMOBILE ENGINEERING LAB
COURSE CODE: ME792A
CONTACT: 0:0:2
TOTAL CONTACT HOURS: 24
CREDIT: 1

Prerequisite: I.C Engine and Automobile Engineering.

Course Outcomes:
CO1: Understand the basic layout of an automobile.
CO2: Explain the operation of engine cooling, lubrication, ignition, electrical and air conditioning systems.
CO3: Analyze the principles of transmission, suspension, steering and braking systems.
CO4: Evaluate latest developments in automobiles.

Course Contents
1. Study of an Automobile Chassis
2. Study of Differential Mechanism of an Automobile
3. Study of Multiple Clutch of an Automobile
4. Study of Braking System (Hydraulic / Air Brake)
5. Study and Demonstration of different circuit of carburetor
6. Checking the spark plug and setting the port and check the ignition in the spark plug
7. Calibration of Bourdon's tube Pressure Gauge
8. Study the Electrical System of an Automobile
9. Study the assembly of Car Engine
10. Air Pollution testing of CO2, CO, HC, and NOX.

CO-PO/PSO Mapping:

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	3	1	2	1	2	2	2	1	-	1	1	2	3	-	-
CO2	2	1	1	-	2	3	2	1	-	1	1	2	-	2	-
CO3	3	2	2	-	2	2	3	1	-	1	1	2	-	-	2
CO4	2	1	3	1	2	2	2	1	-	1	2	3	-	2	2

COURSE NAME: COMPUTER AIDED DESIGN LAB
COURSE CODE: ME792B
CONTACT: 0:0:2
TOTAL CONTACT HOURS: 24
CREDIT: 1

Prerequisite: Computer Aided Design

Course Outcome:
CO1. Apply geometric transformations and projection methods in CAD.
CO2. Develop geometric models to represent curves.
CO3. Develop surface models for engineering design.
CO4. Model engineering components using solid modelling techniques for design.

Course Contents

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component
6. Writing a small program for FEM for 2 spring system and validation of program or using a FEM Package.
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

CO– PO/PSO Mapping:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	1	3	1	2	-	2	2	2	1	1	2	1	-	2
CO2	3	2	1	-	2	1	-	1	-	1	1	2	2	-	2
CO3	3	2	3	2	3	2	1	1	-	1	1	2	1	-	2
CO4	3	1	3	2	3	2	1	1	1	1	1	3	2	-	2

COURSE NAME: TURBOMACHINERY LAB
COURSE CODE: ME792C
CONTACT: 0:0:2
TOTAL CONTACT HOURS: 24
CREDIT: 1

Prerequisite: Fluid Mechanics and Fluid Machinery

Course Outcomes:
CO1: Get Basic knowledge about rotary machines, nozzle, diffuser etc.
CO2: Understand about the calculation of efficiency, power etc. of steam turbines and hydraulic turbine.
CO3: Evaluate of efficiency, power required etc. of pumps and compressor
CO4: Design of various incompressible and compressible flow machines.

Course Contents

1. Study of flow through blade cascades.
2. Performance analysis of centrifugal blowers.
3. Performance analysis of micro-axial flow fans used in cooling of Electronics.
4. Performance analysis of pumps.
5. Study of Turbo-prop Engine.

CO-PO/PSO Mapping:

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	3	-	-	-	-	2	1	-	-	-	1	3	2		
CO2	3	2	-	-	-	-	-	-	1	-	1	3		2	
CO3	3	2	-	-	-	-	-	-	2	-	1	3		1	3
CO4	3	3	3	3	1	2	1	-	1	-	2	3	2		2

COURSE NAME: SEMINAR & GROUP DISCUSSION
COURSE CODE: HU(ME)791
CONTACT: 0:0:2
TOTAL CONTACT HOURS: 24
CREDIT: 1

Prerequisite: English language

Course Contents:

Forms of Technical Communication: Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; 7 Cs of effective business writing: concreteness, completeness, clarity, conciseness, courtesy, correctness, consideration, C.V./Resume writing; Technical Proposal: Types, Structure & Draft.

Technical Presentation: Strategies & Techniques: Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Technical Communication Skills: Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and nonverbal means.

COURSE NAME: RAPID PROTOTYPING LAB
COURSE CODE: ME781
CONTACT: 0:0:2
TOTAL CONTACT HOURS: 24
CREDIT: 1

Course Contents

This lab is designed to provide students with hands-on experience in the principles and applications of additive manufacturing technologies. The course focuses on familiarizing students with various rapid prototyping processes such as Fused Deposition Modeling (FDM), Stereolithography (SLA), and Selective Laser Sintering (SLS), along with their working principles, materials used, and machine setup. Students will learn how to prepare CAD models for 3D printing by using slicing software and optimizing design parameters for manufacturability. The lab includes sessions on 3D scanning for reverse engineering and part digitization, enabling students to reconstruct digital models from physical components. Practical exercises will cover the complete workflow from conceptual design to prototype fabrication, including post-processing methods such as support removal and surface finishing. Emphasis is placed on troubleshooting common issues in 3D printing, analyzing dimensional accuracy, and comparing prototype quality with traditional manufacturing methods. By the end of the course, students will be capable of independently operating 3D printers, interpreting design requirements for additive manufacturing, and applying rapid prototyping techniques for product development, iterative design, and innovation.

COURSE NAME: MAJOR PROJECT-II
COURSE CODE: ME782
CONTACT: 0:0:8
TOTAL CONTACT HOURS: 96
CREDIT: 4

Course Contents:

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design and formulation of the problem is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester. The students in a group of 4 to 6 works on a topic are to be approved by the head of the department under the guidance of a faculty member. The students prepare a comprehensive project report after completing the work to the satisfaction of the supervisor to be submitted at the end of the semester. The progress of the project is evaluated by a committee may be constituted by the Head of the Department. The project work is evaluated based on oral presentation and the project report may jointly by external and internal examiners constituted by the Head of the Department.

4th Year 2nd Semester

Sl. No.	Category	Course Code	Course Title	Hours per week				Credits
	PRACTICAL			L	T	P	Total	
3	Project	ME881	Grand Viva	0	0	0	8	4
4	Project	ME882	Internship/ Entrepreneurship	0	0	0	8	4
	TOTAL CREDIT							8

*'Mandatory Additional Requirement'(MAR) activities have to be carried out as per university guidelines.

COURSE NAME: GRAND VIVA
COURSE CODE: ME881
CONTACT: 0:0:0
TOTAL CONTACT HOURS: 96
CREDIT: 4

Course Contents
The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and all Faculty members of the department. The Comprehensive Viva-Voce is intended to assess the student's understanding of the courses he/ she studied during the 4 years B. Tech. program.

COURSE NAME: INTERNSHIP/ENTREPRENEURSHIP
COURSE CODE: ME882
CONTACT: 0:0:0
TOTAL CONTACT HOURS: 96
CREDIT: 4

Course Contents

This component is a vital part of the undergraduate engineering curriculum aimed at bridging the gap between academic learning and real-world industrial or entrepreneurial experience. This program offers students the flexibility to either undergo an industrial internship or pursue an entrepreneurial venture, typically after the sixth semester. The **internship track** is designed to provide students with exposure to professional environments where they can apply theoretical knowledge, understand industrial processes, and develop soft skills such as teamwork, communication, and time management. It involves working under the guidance of industry professionals, maintaining progress reports, and submitting a comprehensive internship report along with a completion certificate. Students are evaluated based on their performance during

the internship, the quality of the report, and a final presentation assessed by internal and/or external examiners.

Alternatively, the **entrepreneurship track** encourages students to explore innovative ideas, develop prototypes, and work on real-time business models. This pathway is often supported by Institutional Innovation Cells (IIC), Incubation Centres, or Entrepreneurship Development Cells (EDCs). Students involved in entrepreneurship undertake activities like ideation, market research, prototype development, and business model preparation. They are mentored by faculty or industry experts and are expected to prepare a detailed business plan, demonstrate a prototype if applicable, and present their startup proposal before a review committee. Evaluation is based on the novelty of the idea, execution, feasibility, and presentation.

Both pathways aim to enhance students' problem-solving skills, practical knowledge, industry readiness, and entrepreneurial mindset. Deliverables such as progress logs, final reports or business plans, and presentations form an essential part of the evaluation. The internship/entrepreneurship component not only prepares students for future careers but also inspires innovation and self-reliance in line with national goals like Start-up India and Make in India.