BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK
(Effective from Academic Session: Monsoon 2024)

Bachelor of Technology

DEPARTMENT OF MECHANICAL ENGINEERING

INSTITUTE VISION

To become a Globally Recognized Academic Institution in consonance with the social, economic, and ecological environment, striving continuously for excellence in education, research, and technological service to the National needs.

INSTITUTE MISSION

- To educate students at Undergraduate, Postgraduate, Doctoral, and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education, and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

DEPARTMENT VISION

The Mechanical Engineering Department of Birla Institute of Technology, Mesra, Ranchi strives to be globally recognized for quality engineering education and research leading to well qualified engineers, academicians and researchers who are innovative, entrepreneurial, and successful in achieving excellence in their field of study.

DEPARTMENT MISSION

- To impart quality education to the students and enhancing their knowledge and skills to be globally competitive Mechanical Engineers.
- To maintain state of the art research facilities to provide its students and faculty to create, interpret, apply, and disseminate knowledge with an understanding of the limitations.
- To develop linkages and interaction with industry, R & D organization, and educational institution for excellence in consultancy practices, research, and teaching.
- To provide conducive environment for learning, creativity, and problem-solving skill.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. To provide a quality undergraduate education for students entering the mechanical engineering profession of seeking carriers in related fields.
2. To advance scientific knowledge through basic and applied research through scholarly publication, conferences, and continuing education.
3. To enable to acquire knowledge of relevant technologies and multidisciplinary fields including broad social, ethical, and environmental issues within which the engineering is practiced.
4. To develop problem solving approach using analytical abilities, effective communication skills and teamwork.
5. To create awareness and understanding related to social issues, apart from developing a sense of commitment to the community and profession with sincere involvement.

PROGRAMME OUTCOMES (POs)

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems**.**
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. The student will be able to design mechanical systems in various fields and challenges such as machine elements, thermal systems, manufacturing, and industrial and inter disciplinary fields like additive manufacturing, soft computing to meet the demand of the day in industry as well as society.
2. The student will be capable to start their entrepreneurship, be employable and suitable for various fields like design, manufacturing, production industries, academic and industries, research, and development organizations in and outside the country.
3. The student will be able to pursue advanced degrees in engineering, business or other professional fields through their knowledge and learnt skills through formal as well as informal self-study and motivation.

Mapping of Pos and PSOs with PEOs

	PEO1	PEO2	PEO3	PEO4	PEO5
PO1	3	3	3	2	1
PO2	3	3	3	3	2
PO3	3	3	3	3	2
PO4	3	3	3	2	1
PO5	3	3	3	3	2
PO6	2	2	3	1	3
PO6	2	2	3	1	3
PO7	1	1	3	1	3
PO8	1	1	3	3	3
PO9	1	1	2	3	3
PO10	1	3	1	3	1
PO12	3	3	3	3	2
PSO1	3	3	3	2	1
PSO2	3	3	2	1	1
PSO3	1	3	3	1	1

Mapping of Departmental Mission (M1) and PEOs

	PEO1	PEO2	PEO3	PEO4	PEO5
M1	3	2	2	3	3
M2	2	3	3	2	3
M3	2	3	3	2	3
M4	3	2	2	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

Program Course Structure

Birla Institute of Technology, Mesra, Ranchi

Course Structure for B.Tech. (Mechanical Engineering)

Based on NEP-2020, CBCS and OBE, Effective from 2024-2025

Sr. No.	Semester of Study (Recommended)	Category of Course	Course Code	Subjects	Mode of Delivery & Credits *L-Lecture; T-Tutorial; P-Practical*			Total Credits
					L (*Periods/ Week*)	T (*Periods/ Week*)	P (*Periods/ Week*)	
	FIRST	**THEORY**						
I.1		FS	MA24101	Mathematics - I	3	1	0	4
I.2			PH24101	Physics	3	1	0	4
I.3			BE24101	Biological Science for Engineers	2	0	0	2
I.4		GE	CS24101	Programming for Problem Solving	3	1	0	4
I.5			EE24101	Basics of Electrical Engineering	2	1	0	3
		LABORATORIES						
I.6		FS	PH24102	Physics Laboratory	0	0	2	1
I.7		GE	CS24102	Programming for Problem Solving Laboratory	0	0	2	1
I.8			EE24102	Electrical Engineering Laboratory	0	0	2	1
I.9		HSS	HS24131	Communication Skill - I	0	0	3	1.5
I.10		MC	MC24 101/102/103 /104/105	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA) /Entrepreneurship	0	0	2	1
TOTAL (Theory + Labs)								**22.5**
	SECOND	**THEORY**						
II.1		FS	MA24103	Mathematics - II	3	1	0	4
II.2			CH24101	Chemistry	3	1	0	4
II.3		GE	EC24101	Basic Electronics	2	1	0	3
II.4			ME24101	Basics of Mechanical Engineering	2	1	0	3
II.5		FS	CE24101	Environmental Science	2	0	0	2
		LABORATORIES						
II.6		FS	CH24102	Chemistry Laboratory	0	0	2	1
II.7		GE	EC24102	Basic Electronics Laboratory	0	0	2	1
II.8			ME24102	Engineering Graphics	0	0	4	2
I.9			PE24102	Workshop Practice	0	0	2	1

I.10		MC	MC24 106/107/108/109 /110	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA) /Entrepreneurship	0	0	2	1
TOTAL (Theory + Labs)								**22**
GRAND TOTAL FOR FIRST YEAR								**44.5**
Vocational Courses for Exit after 1st Year								
VOC I: ME24104: Working with AUTOCAD					1	0	4	3
VOC II: PE24190; Welding Technology					1	0	4	3
	THIRD		**THEORY**					
III.1		PC	ME24201	Thermodynamics	3	0	0	3
III.2		PC	ME24203	Fluid Mechanics and Hydraulic Machines	3	0	0	3
III.3			ME24205	Strength of Materials	3	1	0	4
III.4			PE24201	Introduction to Materials Engineering	3	0	0	3
III.5			PE22297	Manufacturing Processes	3	0	0	3
III.6		FS	MA24201	Numerical Methods	2	0	0	2
III.7		HSS	MT24131	UHV-II: Understanding Harmony	3	0	0	3
				LABORATORIES				
III.8		FS	MA24202	Numerical Methods Lab	0	0	2	1
III.9		PC	ME24202	Fluid Mechanics and Hydraulic Machines Lab	0	0	2	1
III.10		MC	MC24 201/202/203/204 /205	Choice of : NCC/NSS/ PT & Games/ Creative Arts (CA) / Entrepreneurship	0	0	2	1
	TOTAL (Theory + Labs)							**24**
	FOURTH		**THEORY**					
IV.1		PC	ME24207	Kinematics and Dynamics of Machines	3	1	0	4
IV.2		PC	ME24209	Thermal Energy Conversion Systems	3	1	0	4
IV.3		PC	ME24211	Machine Design	3	1	0	4
IV.4		PE	ME24,215, 217, 219	Programme Elective -I	3	1	0	4
IV.5		OE	XXXXXX /MO24201	Open Elective - I / MOOC - I	3	0	0	3
IV.6		HSS	HS24211	Indian Knowledge System	2	0	0	0
				LABORATORIES				
IV.7		PC	ME24208	Basic Mechanical Engineering lab	0	0	2	1
IV.8		PC	ME24210	Dynamics of Machines Lab	0	0	3	1.5
IV.9		PC	PE24298	Manufacturing processes Lab	0	0	3	1.5
IV.10		MC	MC24 206/ 207/208 /	Choice of :	0	0	2	1

			209/210	NCC/NSS/ PT & Games/ Creative Arts (CA) / Entrepreneurship				
TOTAL (Theory + Labs)								**24**
GRAND TOTAL FOR SECOND YEAR								**48**
Vocational Courses for Exit after 2nd Year								
VOC III: ME24212: Installation, Testing and maintenance of Solar Appliances					1	0	4	**3**
VOC IV: PE24290: CNC Machining					1	0	4	**3**
	FIFTH	THEORY						
V.1		PC	ME24301	I C Engines and Gas Turbines	3	1	0	4
V.2		PC	ME24303	Mechanical Vibration	3	0	0	3
V.3		PC	ME24305	Heat and Mass Transfer	3	0	0	3
V.4		PE	ME24 313, 315, 317, 319, PE24313	Programme Elective -II	3	0	0	3
V.5		PE	ME24 321,323, 325, PE24315	Programme Elective -III	3	0	0	3
V.6		OE	XXXXXXX /MO24301	Open Elective - II / MOOC - II	3	0	0	3
		LABORATORIES						
V.7		PC	ME24302	Heat Transfer Lab	0	0	2	1
V.8			ME24304	Internal Combustion Engines Lab	0	0	2	1
V.9		HSS	HS24133	Communication Skill - II	0	0	3	1.5
V.10		PC	ME24300	Project - I				2
TOTAL (Theory + Labs)								**24.5**
	SIXTH	**THEORY**						
VI.1		PC	ME24307	Computer Aided Design	2	0	0	2
VI.2		PC	ME24309	Automobile Engineering	3	1	0	4
VI.3		PC	ME24311	Robotics Engineering	3	1	0	4
VI.4		PE	ME24, 331, 333, 329, PE24335	Programme Elective -IV	3	0	0	3
VI.5		PE	ME24 335, 337,339 PE24345	Programme Elective -V	3	0	0	3
VI.6		OE	XX24XXX/ MO24303	Open Elective - III / MOOC - III	3	0	0	3
		LABORATORIES						
VI.7		PC	ME24306	Robotics and Automation Lab	0	0	3	1.5
VI.8			ME24308	Automobile Engineering Lab	0	0	3	1.5
VI.9			ME24310	Computer Aided Design and Drafting lab	**0**	**0**	**2**	1
VI.10			ME24350	Project - II				2
TOTAL (Theory + Labs)								**25**
GRAND TOTAL FOR THIRD YEAR								**49.5**

	SEVENTH	**THEORY**						
VII.1		PC	ME24401	Refrigeration and Air Conditioning	3	1	0	4
VII.2		PE	ME24 403, 405, 407, PE24 407, 413	Prog Elective -VI	3	0	0	3
VII.3		PE	XXXXXX/MO24401	Open Elective - IV / MOOC - IV	3	0	0	3
VII.4		HSS	MT24204	Constitution of India	2	0	0	0
		LABORATORIES						
VII.5		PC	ME24404	Refrigeration and Air Conditioning Lab	**0**	**0**	**2**	1
VII.6		MC	MC24400	Summer Training (Minimum Four Weeks / 160 Hrs)				4
VII.7		PC	ME24400	Project - III				3
TOTAL (Theory + Labs)								**18**
VIII.1	**EIGHTH**	PC	ME24450/ ME24490	Project-IV / Industry Internship				6
VIII.2			ME24498	Comprehensive Viva				2
	TOTAL (Theory + Labs)							**8**
GRAND TOTAL FOR FOURTH YEAR								**26**
GRAND TOTAL FOR B.TECH.								**168**

DEPARTMENT OF MECHANICAL ENGINEERING
PROGRAM ELECTIVES (PE)

Level	Course Code	Course Name	Mode of delivery & credits *L-Lecture; T-Tutorial; P-Practical*			Total Credit *C- Credit*
			L (*Periods/ week*)	**T (*Periods/ week*)**	**P (*Periods/ week*)**	**C**
2(PE-I) 4th SEM	ME24215	Composite Materials	3	1	0	4
	ME24217	Renewable Energy Resources	3	1	0	4
	ME24219	Non-Destructive Testing	3	1	0	4
3(PE-II) 5th SEM	ME24313	Measurement & Instrumentation	3	0	0	3
	ME24315	Turbomachinery	3	0	0	3
	PE24313	Advanced Welding Technology	3	0	0	3
	ME24317	Finite Element Methods	3	0	0	3
	ME24319	Computational Fluid Dynamics	3	0	0	3
3(PE-III) 5th SEM	ME24321	Advanced Solid Mechanics	3	0	0	3
	ME24323	Mechatronics	3	0	0	3
	PE24315	Rapid Prototyping and Tooling	3	0	0	3
	ME24325	Industrial Tribology	3	0	0	3
3(PE -IV) 6th SEM	ME24329	Design of Mechanisms	3	0	0	3
	PE24335	Surface Engineering & Laser Additive Manufacturing	3	0	0	3
	ME24331	Power Plant Engineering	3	0	0	3
	ME24333	Gas Dynamics	3	0	0	3
3(PE -V) 6th SEM	ME24335	Hydraulic & Pneumatic Control	3	0	0	3
	ME24337	Power Gear Train	3	0	0	3
	PE24345	Engineering Optimization	3	0	0	3
	ME24339	Combustion	3	0	0	3
4(PE-VI) 7th SEM	ME24403	Industrial Management	3	0	0	3
	ME24405	Advanced Heat Transfer	3	0	0	3
	ME24407	Theory of Elasticity	3	0	0	3
	PE24407	Non- Conventional Machining Processes	3	0	0	3
	PE24413	A I and Data Analytics	3	0	0	3

DEPARTMENT OF MECHANICAL ENGINEERING
OPEN ELECTIVES (OE)*

Level	Course Code	Course Name	Mode of delivery & credits *L-Lecture; T-Tutorial; P-Practical*			Total Credit *C- Credit*
			L (*Periods/ week*)	**T *(Periods/ week)***	**P *(Periods/ week)***	**C**
2(OE-I) 4th SEM	ME24223	Smart & New Materials	3	0	0	3
	ME24225	Experimental Methods in Engineering	3	0	0	3
3(OE-II) 5th SEM	ME24341	Renewable Energy Sources	3	0	0	3
	ME24343	Elements of Hydel & Thermal Power Plants	3	0	0	3
3(OE-III) 6th SEM	ME24345	Elements of Nuclear & Diesel Power Plants	3	0	0	3
4(OE-IV) 7th SEM	ME24411	Mechatronics & its applications	3	0	0	3
	ME24413	Industrial Robotics & Automation	3	0	0	3

*** OPEN ELECTIVES TO BE OFFERED ONLY TO THE STUDENTS OF OTHER DEPARTMENT.**

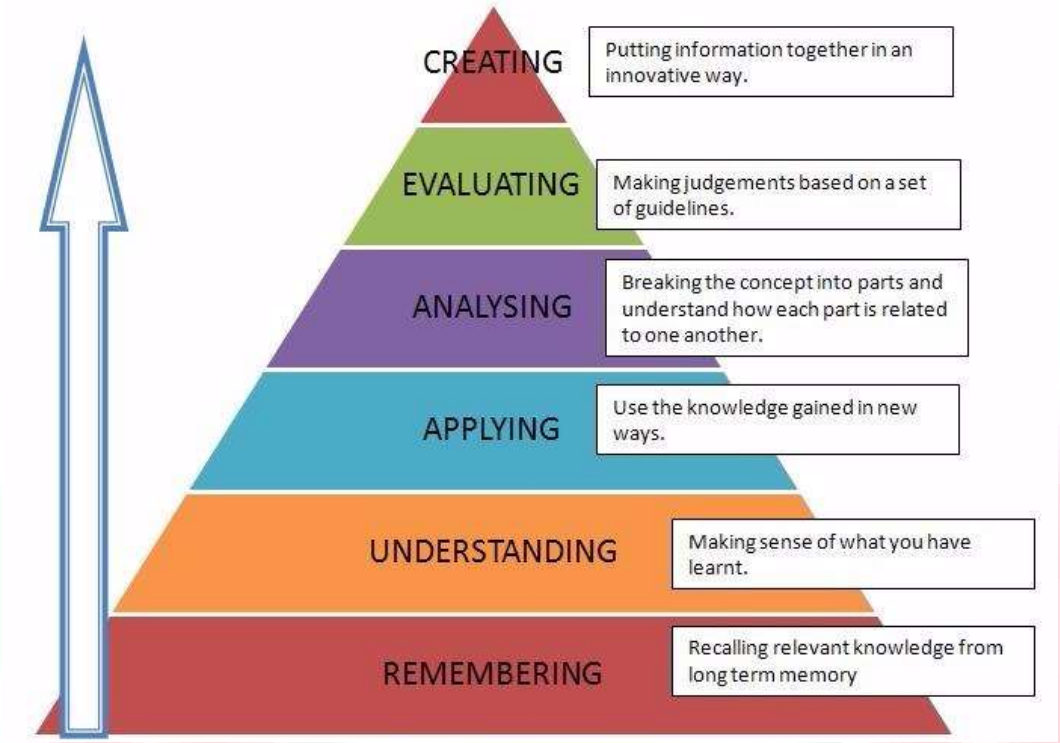
DEPARTMENT OF MECHANICAL ENGINEERING
Course Structure for B.Tech. MINOR in "Mechanical Engineering"
Based on NEP-2020, CBCS and OBE, Effective from 2024-2025

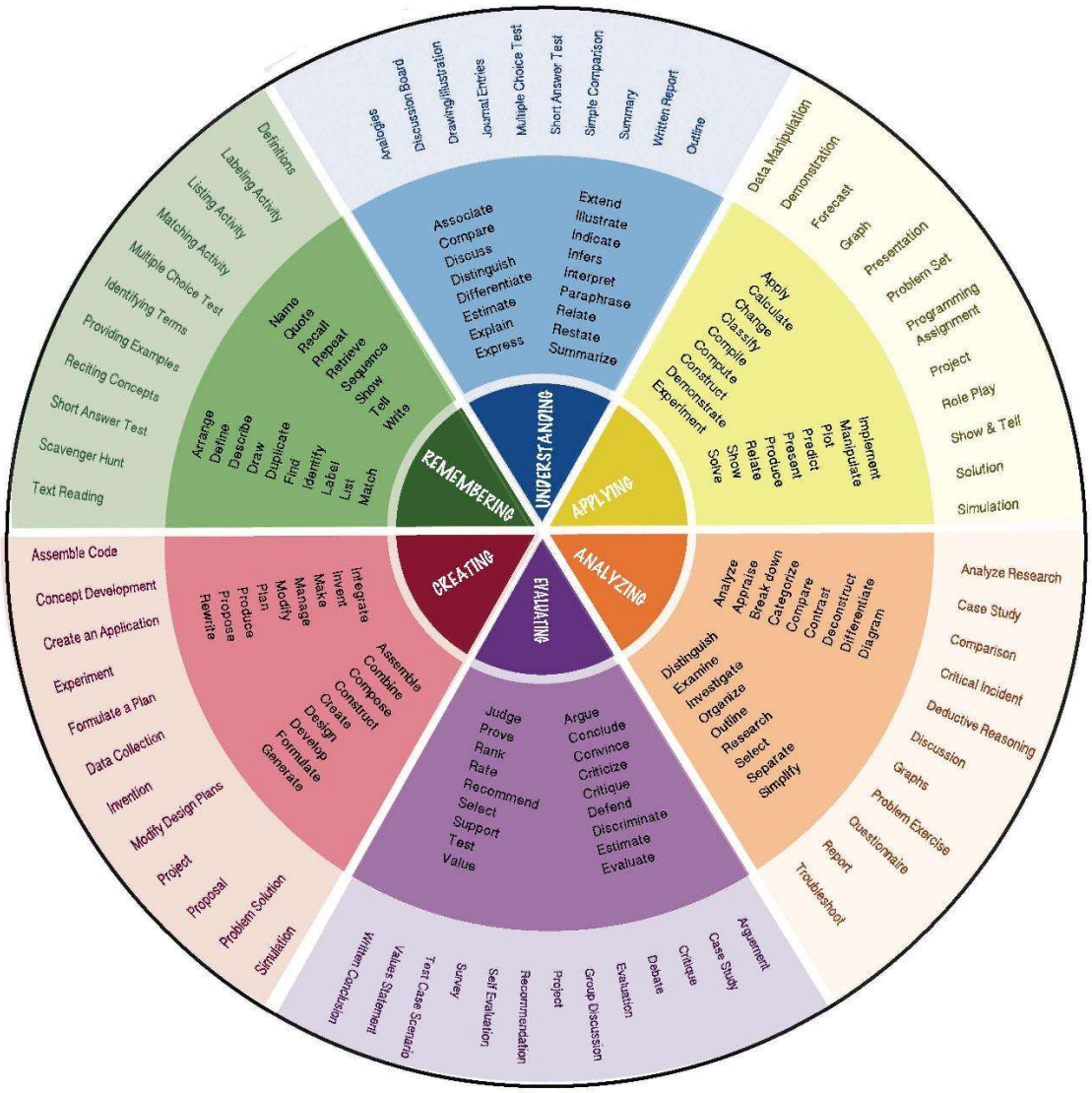
Sr. No.	Semester of Study (Recommended)	Category of Course	Course Code	Subjects	Mode of Delivery & Credits *L-Lecture; T-Tutorial; P-Practical*			Total Credits
					L (*Periods/ Week*)	**T (*Periods/ Week*)**	**P (*Periods / Week*)**	
	FIFTH	**THEORY**						
I.1		PC	ME24305	Heat and Mass Transfer	3	0	0	3
I.2			ME2203	Fluid Mechanics and Hydraulic Machines	3	0	0	3
		LABORATORY						
I.3		PC	ME24202	Fluid Mechanics and Hydraulic Machines Lab	0	0	2	1
TOTAL (Theory + Labs)								**7.0**
	SIXTH	**THEORY**						
II.1		PC	ME24301	I C Engines and Gas Turbines	3	1	0	4
II.2			ME24205	Strength of Martials	3	1	0	4
		LABORATORY						
II.3		PC	ME24304	Internal Combustion Engines Lab	0	0	2	1
TOTAL (Theory + Labs)								**9.0**
	SEVENTH	**THEORY**						
III.1		PC	ME24211	Machine Design	3	1	0	4
		LABORATORY						
III.2		PC	ME24310	Computer Aided Design and Drafting lab	0	0	2	1
		TOTAL (Theory + Labs)						**5**
		GRAND TOTAL **Minimum requirement for minor degree award**						**21.0**

BLOOM'S TAXONOMY FOR CURRICULUM DESIGN AND ASSESSMENT:

Preamble

The design of curriculum and assessment is based on Bloom's Taxonomy. A comprehensive guideline for using Bloom's Taxonomy is given below for reference.




REMEMBERING
UNDERSTANDING
APPLYING
ANALYZING
EVALUATING
CREATING
Definitions
Labeling Activity
Listing Activity
Matching Activity
Multiple Choice Test
Identifying Terms
Providing Examples
Reciting Concepts
Short Answer Test
Scavenger Hunt
Text Reading
Name
Quote
Recall
Repeat
Retrieve
Sequence
Show
Tell
Write
Arrange
Define
Describe
Draw
Duplicate
Find
Identify
Label
List
Match
Analogies
Discussion Board
Drawing/Illustration
Journal Entries
Multiple Choice Test
Short Answer Test
Simple Comparison
Summary
Written Report
Outline
Associate
Compare
Discuss
Distinguish
Differentiate
Estimate
Explain
Express
Extend
Illustrate
Indicate
Infers
Interpret
Paraphrase
Relate
Restate
Summarize
Data Manipulation
Demonstration
Forecast
Graph
Presentation
Problem Set
Programming Assignment
Project
Role Play
Show & Tell
Solution
Simulation
Apply
Calculate
Change
Classify
Compile
Compute
Construct
Demonstrate
Experiment
Implement
Manipulate
Plot
Predict
Present
Produce
Relate
Show
Solve
Assemble Code
Concept Development
Create an Application
Experiment
Formulate a Plan
Data Collection
Invention
Modify Design Plans
Project
Proposal
Problem Solution
Simulation
Integrate
Invent
Make
Manage
Modify
Plan
Produce
Propose
Rewrite
Assemble
Combine
Compose
Construct
Create
Design
Develop
Formulate
Generate
Analyze Research
Case Study
Comparison
Critical Incident
Deductive Reasoning
Discussion
Graphs
Problem Exercise
Questionnaire
Report
Troubleshoot
Analyze
Appraise
Break down
Categorize
Compare
Contrast
Deconstruct
Differentiate
Diagram
Distinguish
Examine
Investigate
Organize
Outline
Research
Select
Separate
Simplify
Argument
Case Study
Critique
Debate
Evaluation
Group Discussion
Project
Recommendation
Self Evaluation
Survey
Test Case Scenario
Values Statement
Written Conclusion
Argue
Conclude
Convince
Criticize
Critique
Defend
Discriminate
Estimate
Evaluate
Judge
Prove
Rank
Rate
Recommend
Select
Support
Test
Value

BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK
(Effective from Academic Session: Monsoon 2024)

Bachelor of Technology

DEPARTMENT OF MECHANICAL ENGINEERING
FIRST YEAR (SEMESTER – I)

COURSE INFORMATION SHEET

Course Code: MA24101
Course Title: Mathematics-I
Pre-requisite(s): -
Co- requisite(s): --
Credits: 4 (L: 3 T: 1 P: 0)
Class schedule per week: 4
Class: B. Tech.
Semester / Level: FIRST
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand infinite sequences and series
2.	Apply theory of matrices including elementary transformations, rank and its application in consistency of system of linear equations, eigenvalues, eigenvectors etc.
3.	Understand multivariable functions, partial differentiation, properties and applications of partial derivatives.
4.	Apply integrals of multivariable functions viz. double and triple integrals with their applications
5.	Acquitted with properties like gradient, divergence, curl associated with derivatives of vector point functions and integrals of vector point functions

COURSE OUTCOMES (COs)

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

CO1	Decide the behavior of sequences and series using appropriate tests.
CO2	handle problems related to the theory of matrices including elementary transformations, rank and its application in consistency of system of linear equations, eigenvalues, eigenvectors etc.
CO3	Get an understanding of partial derivatives and their applications in finding maxima - minima problems.
CO4	Apply the principles of integrals (multivariable functions viz. double and triple integrals) to solve a variety of practical problems in engineering and sciences.
CO5	Get an understanding of gradient, divergence, curl associated with derivatives of vector point functions and integrals of vector point functions and demonstrate a depth of understanding in advanced mathematical topics, enhance and develop the ability of using the language of mathematics in engineering.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
MODULE – I: Sequences and Series Sequences, Convergence of Sequence. Series, Convergence of Series, Tests for Convergence: Comparison tests, Cauchy's Integral test, Ratio test, Cauchy's root test, Raabe's test, Gauss test, Alternating series, Leibnitz test, Absolute and Conditional Convergence.	**9**
MODULE – II: Matrices Rank of a Matrix, elementary transformations. Vectors, Linear Independence and Dependence of Vectors. Consistency of system of linear equations. Eigenvalues, Eigenvectors, Cayley - Hamilton theorem.	**9**
MODULE – III:: Advance Differential Calculus Function of several variables, Partial derivatives, Euler's theorem for homogeneous functions, Total derivatives, Chain rules, Jacobians and its properties, Taylor series for function of two variables, Maxima – Minima.	**9**
MODULE – IV: Advance Integral Calculus Double integrals, double integrals in polar coordinates, Change of order of integration, Triple Integrals, cylindrical and spherical coordinate systems, transformation of coordinates, Applications of double and triple integrals in areas and volumes.	**9**
MODULE – V: Vector Calculus Scalar and vector point functions, gradient, directional derivative, divergence, curl. Line Integral, Work done, Conservative field, Green's theorem in a plane, Surface and volume integrals, Gauss – divergence theorem, Stoke 's theorem.	**9**

TEXTBOOKS:

1. M. D. Weir, J. Hass and F. R. Giordano: Thomas' Calculus, 11th edition, Pearson Educations, 2008E.
2. H. Anton, I. Brivens and S. Davis, Calculus, 10th Edition, John Wiley and sons, Singapore Pte. Ltd., 2013.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint,2010.

REFERENCE BOOKS:

1. M. J. Strauss, G. L. Bradley And K. J. Smith, Calculus, 3rd Ed, Dorling. Kindersley (India) Pvt. Ltd. (P Ed), Delhi, 2007.
2. David C. Lay, Linear Algebra and its Applications (3rd Edition), Pearson Ed. Asia, Indian Reprint, 2007.
3. Robert Wrede & Murray R. Spiegel, Advanced Calculus, 3rd Ed., Schaum's outline series, McGraw-Hill Companies, Inc.,2010.
4. D. G. Zill and W.S. Wright, Advanced Engineering Mathematics, Fourth Edition, 2011.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) --

POS MET THROUGH GAPS IN THE SYLLABUS --

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN ---

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN --

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Quiz	20
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	1	0	0	0	0	0	1	2			
CO2	3	3	2	2	2	0	0	0	0	0	1	2			
CO3	3	3	2	2	1	0	0	0	0	0	1	2			
CO4	3	3	3	3	2	1	0	0	0	0	1	2			
CO5	3	3	2	3	2	1	1	1	1	1	2	2			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD6
CO4	CD1, CD2, CD6
CO5	CD1, CD2, CD6

COURSE INFORMATION SHEET

Course Code: PH24101
Course Title: Physics
Pre-requisite(s): Intermediate Physics and Intermediate Mathematics
Co- requisite(s): Mathematics I
Credits: 4 (L: 3 T: 1 P: 0)
Class schedule per week: 4
Class: B. Tech.
Semester / Level: FIRST
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students:

1.	The principles of physical optics and basic concept of fiber optics.
2.	Fundamental laws of electromagnetism leading to Maxwell's equations.
3.	The posulates of special theory of relativity, Lorenz transformation equation and their consequences: Einstein energy mass relation and relativistic energy-momentum relation
4.	The limitations of classical physics and basic concepts such as wave-particle duality, and working of quantum mechanics with the help of particles in a box problem
5.	Concepts of stimulated emission and working principle of laser with examples, concepts of nuclear physics and plasma physics

COURSE OUTCOMES (COs)

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

CO1	Analyse the intensity variation of light due to polarization, interference and diffraction.
CO2	Formulate and solve the problems on electromagnetism
CO3	Explain and apply concepts of special theory of relativity and its consequences
CO4	Apply the concepts of quantum mechanics such as wave-particle duality and obtain the solution of simple quantum mechanical problems.
CO5	Explain working principle of lasers and to summarize its applications, describe basic concepts of nuclear and plasma physics

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: **Physical Optics:** Polarization, Malus' Law, Brewster's Law, Double Refraction, Interference in thin parallel films, Interference in wedge-shaped layers, Newton's rings, Fraunhofer diffraction by single slit and double slit. Elementary ideas of fibre optics and application of fibre optic cables.	**8**
Module – II: **Electromagnetic Theory:** Gradient, Divergence and Curl, Statement of Gauss theorem & Stokes theorem, Gauss's law, Applications, Concept of electric potential, Relationship between E and V, Polarization of dielectrics and dielctric constant, Boundary conditions for E & D, Gauss's law in magnetostatics, Ampere's circuital law, Boundary conditions for B & H, Equation of continuity, Displacement current, Maxwell's equations.	**8**
Module – III: **Special Theory of Relativity:** Introduction, Inertial frame of reference, Galilean transformations, Postulates, Lorentz transformations and its conclusions, Length contraction, time dilation, velocity addition, Mass change, Einstein's mass energy relation.	6
Module – IV: **Quantum Mechanics:** Planck's theory of black-body radiation, Compton effect, Wave-particle duality, De Broglie waves, Davisson and Germer's experiment, Uncertainty principle, Brief idea of Wave Packet, Wave Function and its physical interpretation, Schrodinger equation in one-dimension, free particle, particle in an infinite square well.	9
Module – V **Modern Physics:** Laser-Spontaneous and stimulated emission, Einstein's A and B coefficients, Population inversion, Light amplification, Basic laser action, Ruby and He-Ne lasers, Properties and applications of laser radiation, Nuclear Physics: Binding Energy Curve, Nuclear Force, Liquid drop model, Introduction to Shell model, Applications of Nuclear Physics, Concept of Plasma Physics and its applications.	9

TEXTBOOKS:

- A. Ghatak, Optics, 4th Edition, Tata Mcgraw Hill, 2009
- Mathew N.O. Sadiku, Elements of Electromagnetics, Oxford University Press, 2001
- Arthur Beiser, Concept of Modern Physics, 6th edition, Tata McGraw- Hill, 2009
- F. F. Chen, Introduction to Plasma Physics and controlled Fusion, Springer, Edition 2016.

REFERENCE BOOKS:

1. Fundamentals of Physics, Halliday, Walker and Resnick

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Mid Sem Examination	25
End Sem Examination	50
Quiz	20
Teacher's assessment / Assignment	05

Continuous Internal Assessment	% Distribution
Mid Sem Examination	50
Quiz	40
Teacher's assessment / Assignment	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	Y	Y	Y	Y	
Semester End Examination	Y	Y	Y	Y	Y

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Self- learning such as use of NPTEL materials and internets

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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				2	1		1			
CO2	2	2		1	1				2	1		1			
CO3	2	1		1	1				2	1		1			
CO4	2	1		1	1				2	1		1			
CO5	2	1		1	1				2	1		1			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD1, CD2, CD3
CO3	CD1, CD2, CD3
CO4	CD1, CD2, CD3
CO5	CD1, CD2, CD3

COURSE INFORMATION SHEET

Course Code: BE24101
Course Title: Biological Science for Engineers
Pre-requisite(s):
Co- requisite(s):
Credits: 2 (L:2 T: 0 P:0)
Class schedule per week: 2
Class: B. Tech.
Semester / Level: First
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand fundamental concepts of biology relevant to engineering.
2.	Explore the structure and function of biological molecules and cells.
3.	Learn about genetic principles and molecular biology techniques.
4.	Understand the applications of biological science in various engineering fields considering global challenges and ethical considerations.

COURSE OUTCOMES (COs)

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

CO1	Comprehend and apply the fundamental concepts of biological sciences in the context of engineering.
CO2	Analyze the structure and function of biological molecules and cells and their relevance to engineering solutions.
CO3	Demonstrate understanding of genetic principles and molecular biology techniques and their applications in engineering.
CO4	Apply knowledge of biological sciences to innovate and develop solutions in various engineering domains and critically evaluate the role of biological sciences in addressing global challenges, including ethical and safety considerations.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module I: Introduction to Biological Sciences Overview and importance of biology in engineering, Origin of Life, Cell Theory and Structure.	6
Module II: Molecular Biology and Genetics Central Dogma of Molecular Biology, DNA, RNA and Protein structure and function, Mendelian Genetics, rDNA Technology and Genome Editing.	6
Module III: Biochemistry Cell Metabolism, Enzymes and Catalysis, Cell Communication and Signalling.	6
Module IV: Applications of Biological Sciences in Engineering Biomaterials, Bioinformatics, Biosensors and Bioelectronics (Biological Sensors- Ear & Eye), Synthetic Biology, Nanobiotechnology.	6
Module V: Global Challenges and Ethical Considerations Convergence of AI and Biology, Climate change and food security, Biosafety and Biohazards, Ethical Considerations.	6

TEXTBOOKS:

1. Lehninger A, Principals of Biochemistry
2. Stryer L, Biochemistry
3. K. Wilson & K.H. Goulding, A biologist's guide to Principles and Techniques of Practical Biochemistry.
4. Biology for Engineers" by Arthur T. Johnson

REFERENCE BOOKS:

1. Purves et al, Life: The Science of Biology
2. R. Dulbecco, The Design of Life.
3. Biological Science Edited by Soper, Cambridge low price edition.
4. Synthetic Biology: A Primer" by Paul S. Freemont and Richard I. Kitney
5. "Introduction to Bioinformatics" by Arthur Lesk Genomes" by T.A. Brown

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz	20
Teacher's Assessment/Assignent	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	1	1	1	2	1	1	1	1			
CO2	3	3	3	3	1	1	1	2	1	1	1	1			
CO3	1	3	3	3		1	1	1		1	1	1			
CO4	2	2	2	2		2	2	2		1	1	2			
CO5	3	3	3	3	1	1	1	2	1	1	1	1			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **CS24101**
Course Title: **Programming for Problem Solving**
Pre-requisite(s): **School level mathematics and Science**
Co- requisite(s):
Credits: **4** **(**L: 3 T: 1 P:0)
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **First**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Develop Programming Skill.
2.	Understand the fundamental Concepts of Coding
3.	Learn how to Debug Programs
4.	Convert Problems to Programs

COURSE OUTCOMES (COs)

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

CO1	Formulate Algorithms for arithmetic and logical problems.
CO2	Translate the algorithms to programs.
CO3	Test and execute the programs and correct syntax and logical errors.
CO4	Apply programmatic skills for solving scientific problems.
CO5	Decompose problems into functions and structured programming.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Representation of an Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs: source code, variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.	**6**
Module – II Structure of a C program, variables and data types, Operators – precedence and associativity, Evaluating expressions, Basic I/O – use of printf, scanf, getchar etc. and format specifiers, Conditional Branching statements – If, If - else, If-else- if, switch case, Writing nested conditional statements.	**8**
Module – III Iterative programming structures – for loops, while loops, do while loops. Understanding break and continue and their usage. Writing Nested loops, Arrays – creation and usage, Strings and string handling.	**8**
Module – IV Functions (including using built in libraries), Parameter passing in functions, call by value, Recursion, as a different way of solving problems, Nested function calls. Understanding scope and lifetime of a variable.	**8**
Module – V Structures - Defining structures, Accessing structures elements, Creating an array of Structures, Nested structures. Some advanced concepts – typedef, enum, macros. An introduction to pointers – understanding, creating pointers and accessing variables using pointers. Passing arrays to functions: idea of call by reference, passing parameters to main.	**10**

TEXTBOOKS:

1. Let us C, Yashwant Kanetkar, 18th Edition, BPB Publications
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
4. R.G.Dromey, How to Solve it by Computer, Pearson Education

REFERENCE BOOKS:

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

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

- The syllabus focused on the concepts and basics of Program writing skills.
- Industry often requires debugging of their existing programs/software compare to the new program, which is a knowledge beyond the basics, including real-world software (collection of programs) experience.
- More memory management practices, file handling and library functions

POS MET THROUGH GAPS IN THE SYLLABUS: YES [PO1-PO5 & PO10-PO12]

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

File Handling with memory management, pre processor directives, Graphics, Data Arrangement, Task scheduling and assembly level programs.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: YES
[PO1-PO5]

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT
1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5, CD7
CO4	CD2, CD3, CD4, CD6, CD7
CO5	CD1, CD3, CD5, CD7

COURSE INFORMATION SHEET

Course Code: EE24101
Course Title: Basics of Electrical Engineering
Pre-requisite(s): Basic Sciences
Co- requisite(s):
Credits: 3 (L:2 T: 1 P: 0)
Class schedule per week: 3
Class: B. Tech.
Semester / Level: FIRST
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Realize the electrical signals, elements, and their properties.
2.	Understand the mathematical representation of AC, DC signals and theorems/laws for solving electrical circuits with variations of voltage and frequency.
3.	Perceive the 3-phase AC signal representation and 3-phase circuit analysis for balanced and unbalanced condition.
4.	Understand the characteristics of magnetic material and analysis of magnetic circuits.

COURSE OUTCOMES (COs)

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

CO1	Explain the voltage, current signals and their characteristics in electrical circuit elements.
CO2	Apply the theorems/laws for electrical circuit analysis.
CO3	Solve the electrical circuits for variable voltage and frequency to observe the resonance, power and power factor in the electric circuit.
CO4	Analyze the 1-phase and 3-phase AC balanced and unbalanced circuits
CO5	Apply the concept of magnetic circuits for magnetic circuit analysis.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction:** Importance of Electrical Engineering in day-to-day life, Electrical elements, properties (linear, non-linear, unilateral, bilateral, lumped and distributed, etc.) and their classification, Ideal and Real Sources, Source Conversion, Star-Delta conversion, KCL and KVL, Mesh current and Nodal voltage method.	**8**
Module – II **D.C. Circuits**: Steady state analysis with independent and dependent sources; Series and Parallel circuits. **Circuit Theorems:** Superposition, Thevenin's, Norton's, and Maximum Power Transfer theorems for Independent and Dependent Sources applied to DC circuits.	**8**
Module – III **Single-phase AC Circuits:** Common signals and their waveforms, RMS and Average value. Form factor & Peak factor of a sinusoidal waveform. **Series Circuits:** Impedance of Series circuits. Phasor diagram. Active Power. Power factor. Power triangle. **Parallel Circuits:** Admittance method, Phasor diagram, Power and Power factor Power triangle, Series-parallel Circuit, Power factor improvement, Circuit Theorems applied to AC circuits. **Series and Parallel Resonance**: Resonance curve, Q–factor, Dynamic Impedance, and Bandwidth.	**12**
Module – IV **Three-Phase AC Circuits:** Importance and use of a 3-phase network, types of 3-phase connections- Star and Delta, Line and Phase relations for Star and Delta connection, Phasor diagrams, Power relations, analysis of balanced and unbalanced 3-phase circuits, Measurement of Power in 3-phase star and delta network.	**6**
Module – V **Magnetic Circuits:** Introduction, Series-parallel magnetic circuits, Analysis of Linear and Non-linear magnetic circuits, Energy storage, A.C. excitation, Eddy currents and Hysteresis losses. **Coupled Circuits:** Dot rule, Self and mutual inductances, Coefficient of coupling, working of transformer.	**6**

TEXTBOOKS:

1. W. H. Hayt, Jr J. E. Kemmerly and S. M. Durbin, Engineering Circuit Analysis, 7th Edition TMH, 2010.
2. Hughes, Electrical Technology, Revised by McKenzie Smith, Pearson.
3. Fitzgerald and Higginbotham, Basic Electrical Engineering, McGraw Hill Inc, 1981.

REFERENCE BOOKS:

1. D. P. Kothari and I. J. Nagrath, Basic Electrical Engineering, 3rd Edition, TMH, New Delhi, 2009.
2. Electrical Engineering Fundamental, Vincent Del Toro, Prentice Hall, New Delhi.
3. Rajendra Prasad, Fundamentals of Electrical Engineering, 2nd Edition, PHI, New Delhi, 2011.
4. Raymond A. DeCarlo, Prn-Min Lin, Linear Circuit Analysis Time Domain, Phasor and Laplace Transform Approaches, 2nd Edition, Oxford University, 2001
5. Abhijit Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, Basic Electrical Engineering, Tata McGraw Hill Publication, 2009.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

1. Application of principles of magnetic circuits to electrical machines like transformers, generators and motors.
2. Field applications of three phase equipment and circuits in power system.
3. Applications of circuit theorems in electrical and electronics engineering.

POS MET THROUGH GAPS IN THE SYLLABUS; 3, 4, 12.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

1. Concepts of electric, magnetic and electromagnetic fields.
2. 3 - Φ power generation, transmission, and distribution.
3. Power factor improvement for three phase systems.
4. Utility of reactive power for creation of electric and magnetic fields.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN-2, 3, 4, 12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1		1	1				1					
CO2	3	3	3	1	2	1				1					
CO3	3	3	3	2	2	1	1			1		1			
CO4	3	3	3	2	2	1				1					
CO5	3	3	3	2	2	1				1					

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **PH24102**
Course Title: **Physics lab**
Pre-requisite(s): **Intermediate Physics**
Co- requisite(s):
Credits: **1** L: 0 T: 0 P: 2
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **FIRST**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course enables the students to:

1.	Understand the fundamentals of physical measurements and learn to account for inevitable errors in physical measurements.
2.	Understand and verify the basic principles of physics by hands-on experiments and making suitable measurements.
3.	Make electrical connections reliably to form functional circuits for measuring electrical quantities such as voltage, current, resistance, and resistivity
4.	Learn to set up different types of oscillating systems study their characteristics, viz - a-viz resonant frequency, frequency response, phase relationship, bandwidth, and quality factor
5.	Develop an understanding of optical phenomena like dispersion, interference and diffraction and make measurements on the patterns produced to obtain physical quantities such as wavelength of light and refractive index of transparent materials.

COURSE OUTCOMES (COs)

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

CO1	Make reliable measurements and report results along with errors.
CO2	Wire simple electrical circuits for experimentally determining measurable electrical quantities.
CO3	Build oscillating systems and make measurements over them.
CO4	Set up and customize simple second-order electrical circuits, characterize them, and gain knowledge about their applications such as electrical filters, and tank circuits.
CO5	Produce interference and diffraction patterns and make measurements for determining physical quantities.

SYLLABUS (List of experiments)

1. Error analysis in Physics Laboratory (CO: 1)
2. To determine the frequency of AC mains with the help of a sonometer. (CO:1, 2, 3)
3. To determine the resistance per unit length of a Carey Foster's bridge wire and resistivity of unknown wire. (CO:1, 2)
4. Measurement of electrical equivalent of heat (CO:1, 2)
5. To determine the wavelength of sodium lines by Newton's rings method (CO:1, 5)
6. To determine the frequency of tuning fork using Melde's Experiment (CO:1,3)
7. Measurement of voltage and frequency of a given signal using CRO (CO: 1,2, 3, 4)
8. To determine the emf of a cell using stretched wire potentiometer (CO:1, 2)
9. Determination of refractive index of the material of a prism using spectrometer and sodium light (CO:1, 5)
10. To study the frequency response of a series LCR circuit (CO:1, 2, 3,4)
11. To study Lorentz force using Current balance (CO:1,2)
12. To study electromagnetic induction and verification of Faraday's laws. (CO:1,2,3)
13. To measure the wavelength of prominent spectral lines of mercury light by a plane transmission grating. (CO:1, 5)
14. To determine the Planck's constant using photocell and optical wavelength filters. (CO:1, 2)

REFERENCE MATERIALS:

1. Lab manuals (available on department website)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Lab Journal	30
Lab quizes	20
Progressive viva	20
End Sem Examination	30

Continuous Internal Assessment	% Distribution
Lab Journal	30
Lab quiz	10
Progressive viva	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	Y	Y	Y	Y	Y
Semester End Examination	Y	Y	Y	Y	Y

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Introductory lecture by use of boards/LCD projectors
CD2	Laboratory experiments/ teaching aid
CD3	Self- learning such as use of NPTEL materials and internets

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	1				2	1		1			
CO2	3	3		1	1				2	1		1			
CO3	3	2		1	1				2	1		1			
CO4	3	2		1	1				2	1		1			
CO5	3	2		1	1				2	1		1			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD1, CD2, CD3
CO3	CD1, CD2, CD3
CO4	CD1, CD2, CD3
CO5	CD1, CD2, CD3

COURSE INFORMATION SHEET

Course Code: CS24102
Course Title: Programming for Problem Solving Lab
Pre-requisite(s): School level Mathematics and Science
Co- requisite(s): Programming for Problem Solving
Credits: 1 (L: 0 T: 0 P:2)
Class schedule per week: 2
Class: B. Tecgh.
Semester / Level: First
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course enables the students to:

1.	Compile, write and debug simple programs with sequential logic.
2	Apply selection and iteration constructs to solve real-world problems.
3	Explore the use arrays and string handing in implementing solutions to problems.
4	Design and develop solutions to problems using modular programming constructs such as functions.
5	Explore the use of structures and pointers to solve real-world problems.

COURSE OUTCOMES (COs)

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

CO1	Formulate Algorithms and draw flowchart for arithmetic and logical problems.
CO2	Translate the algorithms/flowcharts to programs.
CO3	Test and execute the programs and correct syntax and logical errors.
CO4	Decompose a problem into functions and develop modular reusable code.
CO5	Use arrays, pointers, strings and structures to solve real-world problems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I 1. Learn how to compile and debug C programs. (preference should be given to XNIX environments.) 2. Write simple programs using sequential logic requiring the declaration of variables for data types. 3. Write programs that produce formatted output. 4. Write programs to acquire data from users and use them in their programs.	**4**
Module – II 1. Write simple programs to understand the workings of selection structures. 2. Write programs using concepts of nested selection structures. 3. Learn how to program the switch case structure.	**4**
Module – III 1. Write programs using different iterative structures. 2. Write programs using nested iterative structures. 3. Write programs that embed selection structures in loops and vice versa. 4. Writing programs to create and use arrays. 5. Write programs to manipulate strings	**4**
Module – IV 1. Write simple functions demonstrating the concepts of parameter passing and return values. 2. Write programs to access global/extern variables from functions. 3. Write programs to demonstrate calling functions from functions.	**6**
Module – V 1. Write programs to create and use structures. 2. Write programs to demonstrate the concept of array of structures and passing structure variables to functions. 3. Writing programs to create pointers and understanding their basic properties. 4. Performing call by reference function calls.	**8**

TEXTBOOKS:

1. Let us C, Yashwant Kanetkar, 18th Edition, BPB Publications
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
4. R.G.Dromey, How to Solve it by Computer, Pearson Education

REFERENCE BOOKS:

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

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

- The syllabus focused on the concepts and basics of Program writing skills.

- Industry often requires debugging of their existing programs/software compared to the new program, which is a knowledge beyond the basics, including real-world software (collection of programs) experience.
- More memory management practices, file handling and library functions

POS MET THROUGH GAPS IN THE SYLLABUS: YES [PO1-PO5 & PO10-PO12]

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

File Handling with memory management, preprocessor directives, Graphics, Data Arrangement, Task scheduling and assembly level programs.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: YES [PO1-PO5]

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & Lab files	30
Quiz	10
Viva	20

End Semester Examination	% Distribution
Examination Experiment Performance	30
Quiz	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	20%[12]	20%[12]	20%[12]	20%[12]	20%[12]
Semester End Examination	20%[8]	20%[8]	20%[8]	20%[8]	20%[8]

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**
2. **Student Feedback on Faculty/Content Delivery**
3. **Student Feedback on Evaluation Procedures**

COURSE DELIVERY METHODS

CD1	Demonstration by use of smart boards/LCD projectors
CD2	Assignments
CD3	Viva-Voce/Quiz (s)
CD4	Software and Hardware
CD5	Laboratory experiments/Coding

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	0	0	1	2	1	1			
CO2	3	3	3	3	2	1	0	0	2	1	1	2			
CO3	3	3	3	3	2	1	0	0	1	2	1	2			
CO4	3	3	3	3	2	2	0	0	2	2	2	2			
CO5	3	2	2	1	2	2	0	0	1	2	2	2			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5
CO4	CD2, CD3, CD4
CO5	CD1, CD3, CD5

COURSE INFORMATION SHEET

Course Code: **EE24102**
Course Title: **Electrical Engineering Laboratory**
Pre-requisite(s): **Physics, Fundamentals of Mathematics and Electrical Engineering**
Co- requisite(s):
Credits: **1** **(**L:0 T: 0 P: 2)
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **FIRST**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	To describe students' practical knowledge of active and passive elements and operation of measuring instruments
2.	To demonstrate electrical circuit fundamentals and their equivalent circuit models for both 1-φ and 3-φ circuits and use circuit theorems
3.	To establish voltage & current relationships with the help of phasors and correlate them to experimental results
4.	1. To conclude performance of 1 – Φ AC series circuits by resonance phenomena 2. To evaluate different power measurement for both 1-φ and 3- φ circuits

COURSE OUTCOMES (COs)

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

CO1	classify active and passive elements, explain working and use of electrical components, different types of measuring instruments;
CO2	illustrate fundamentals of operation of DC circuits, 1-φ and 3- φ circuits and also correlate the principles of DC, AC 1-φ and 3- φ circuits to rotating machines like Induction motor and D.C machine
CO3	measure voltage, current, power, for DC and AC circuits and also represent them in phasor notations;
CO4	analyze response of a circuit and calculate unknown circuit parameters;
CO5	recommend and justify power factor improvement method in order to save electrical

SYLLABUS

LIST OF EXPERIMENTS ***(The experiment list may vary to accommodate recent development in the field)***

1. **Name:** Measurement of low & high resistance of DC shunt motor
   Aim:
   (i) To measure low resistance of armature winding of DC shunt motor
   (ii) To measure high resistance of shunt field winding of DC shunt motor
2. **Name:** AC series circuit
   Aim:
   (i) To obtain current & voltage distribution in AC RLC series circuit and to draw the phasor diagram
   (ii) To obtain power & power factor of single-phase load using 3- Voltmeter method and to draw phasor diagram.
3. **Name:** AC parallel circuit
   Aim:
   (i) To obtain current & voltage distribution in AC RLC parallel circuit and to draw the phasor diagram
   (ii) To obtain power & power factor of single-phase load using 3- Ammeter method and to draw the phasor diagram
4. **Name:** Resonance in AC RLC series circuit
   Aim:
   (i) To obtain the condition of resonance in AC RLC series circuit
   (ii) To draw phasor diagram
5. **Name:** 3-phase Star connection
   Aim:
   (i) To establish the relation between line & phase quantity in 3 phase star connection
   (ii) To draw the phasor diagram
6. **Name:** 3-phase Delta connection
   Aim:
   (i) To establish the relation between line & phase quantity in 3 phase delta connection
   (ii) To draw phasor diagram
7. **Name:** 3-phase power measurement
   Aim:
   (i) To measure the power input to a 3-phase induction motor using 2 wattmeter method
   (ii) To draw the phasor diagram
8. **Name:** Self & mutual inductance
   Aim: To determine self & mutual inductance of coils
9. **Name:** Verification of Superposition, Thevenin's and the Reciprocity theorem
   Aim:
   (i) To verify the Superposition theorem for a given circuit
   (ii) To verify Thevenin's theorem for a given circuit
10. **Name:** Verification of Norton's, Tellegen's and Maximum Power transfer theorem
    Aim:
    (i) To verify Norton's theorem for a given circuit
    (ii) To verify the Maximum Power transfer theorem for a given circuit

BOOKS:

1. H. Hayt, Jr J. E. Kemmerly and S. M. Durbin, Engineering Circuit Analysis, 7th Edition TMH, 2010.
2 .Hughes, Electrical Technology, Revised by McKenzie Smith, Pearson.
3 Fitzgerald and Higginbotham, Basic Electrical Engineering, McGraw Hill Inc, 1981.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

1. Application of principles of magnetic circuits to electrical machines like transformers, generators and motors
2. Visualize Phase sequence

POS MET THROUGH GAPS IN THE SYLLABUS -, 2, 3, 7.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

1. Assignment: Simulation of electrical circuits with dependent/independent sources by various techniques (Mesh current/Node Voltage/Thevenin's theorem/Norton's theorem/Maximum power transfer theorem etc.) using MATLAB/PSIM/C++ softwares.

2. Active/reactive power calculation for 3 – Φ circuits

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN -5, 6, 7, 8, 9.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Lab Journal	30
Lab quizes	20
Progressive viva	20
End Sem Examination	30

Continuous Internal Assessment	% Distribution
Lab Journal	30
Lab quiz	10
Progressive viva	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	Y	Y	Y	Y	Y
Semester End Examination	Y	Y	Y	Y	Y

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Introductory lecture by use of boards/LCD projectors
CD2	Laboratory experiments/ teaching aid
CD3	Self- learning such as use of NPTEL materials and internets

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	1	3	1	1	1				2			
CO2	3	3	3	1	3	1	1	1				2			
CO3	3	3	3	3	3	1	2	2		1	1	2			
CO4	3	3	3	1	3	1	1	1		1	1	2			
CO5	3	3	3	3	3	1	1	1	1	1	1	2			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD1, CD2, CD3
CO3	CD1, CD2, CD3
CO4	CD1, CD2, CD3
CO5	CD1, CD2, CD3

COURSE INFORMATION SHEET

Course Code: HS24131
Course Title: Communication Skills I
Pre-requisite(s):
Co- requisite(s):
Credits: 1.5 (L:0 T:0 P: 3)
Class schedule per week: 3
Class: B. Tech.
Semester / Level: FIRST
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	**Develop Language Proficiency and communicative competence**: Improve students' ability to read, write, speak, and listen effectively in English. In addition, students will also learn and improve politeness strategies in communicative contexts.
2.	**Enhance Verbal and Non-Verbal Communication**: Train students in both spoken and body language communication for personal and professional interactions.
3.	**Enhance Reading Ability:** Equip students with the ability to strategically comprehend and interpret visual and textual information.
4.	**Enhancing Writing Proficiency**: Enable students to write structured reports, emails, resumes, and other professional documents.
5.	**Developing Presentation and Public Speaking Skills:** Self-assurance during talks, presentations and speeches.

COURSE OUTCOMES (COs)

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

CO1	In a variety of pragmatic and communicative contexts, students will be able to confidently and fluently articulate their ideas.
CO2	This will enable learners to accurately interpret messages for effective interaction by comprehending audio texts and listening selectively.
CO3	Learners will be able to examine texts for particular and intricate details, draw inferences, and provide interpretations.
CO4	Learners will be capable of creating organized written pieces, including paragraphs, essays, and narratives, and will also be able to summarize, paraphrase, and create précis of ideas effectively.
CO5	Learners will be capable of confidently using verbal and non-verbal communication during speeches and presentations.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Theory** **Principles of Fundamental Communication.** Communication theory, various types and methods of communication, communication flow (upward, downward, and horizontal), characteristics of successful communication, obstacles, and approaches, verbal and non-verbal communication, and social context communication—requests, refusals, compliments, and providing constructive feedback. **Practice** **Communication:** Study relevant materials or case studies on effective communication, obstacles, strategies, and both verbal and non-verbal aspects. Understand and contextualize the influence of culture and society on communication in both writing and speaking. **Role plays:** Engage in scenario-based questions focusing on communication, body language, and courtesy. **Dialogue writing:** Presenting viewpoints based on various situations or scenarios—including requests, refusals, compliments, and criticism—in both writing and speaking.	**6**
Module – II **Theory** **Communicating, Depicting, and Hearing:** Salutations, Presenting oneself/others, Descriptive communication for locations, objects, scenarios, challenges, etc. Proficient listening abilities and the various aspects of listening, including types such as intensive, responsive, selective and extensive. A brief introduction to Varieties of English Accents (neutral accent) through audio and video examples. **Practice tasks** **Introducing people/Describing people:** - Introducing oneself and others - Characterizing an individual, image, circumstance - Discussing traits (positive/negative/critical) about a person, object, scenario, or image. **Listening skills:** - Engaging in attentive listening activities - Listening selectively to complete the blanks - Hearing a passage and rephrasing the precise information in your own words (listening comprehension) - Listening to a discussion on a topic and responding critically. - Attending to informal workplace interactions and dialogues.	**6**
Module – III **Theory** **Enhancing Vocabulary and Grammar** Lexicon (Affixes- Inflections-Derivations), Registers, Idiomatic Expressions and Phrasal Verbs, vocabulary in context. Opposites, similar words, and one-word alternatives. Sentence constructions (word order like SVO, etc.), Paragraphs (Thesis statement, main idea, topic sentences), Generating ideas for paragraph composition. W. S Allen (Book) **Practice** **Vocabulary Building:** - Students utilize specific vocabulary related to various registers to construct paragraphs, narratives, and more. - Students incorporate phrasal verbs to create a coherent paragraph. - Exercises involving antonyms, synonyms, and word substitution can be conducted using	**6**

worksheets. - Engage graphic organizers such as word associations and concept mapping for vocabulary enhancement activities. Identify suffixes, prefixes, idioms, and phrasal verbs: - Analyze texts to find suffixes and prefixes along with their definitions. - Word association and spider diagrams can be utilized to uncover suffixes and prefixes. **Paragraph writing:** - Generate ideas about a topic/concept/idea and prompt students to compose a detailed paragraph.	
Module – IV **Theory** **Elements of Reading and Writing** Present the sub-skills involved in reading and writing, including the different types of reading such as close reading and intensive reading. Techniques like mind mapping and note-taking. Generating ideas through brainstorming, structuring thoughts, and creating coherent written pieces consisting of an introduction, body, and conclusion. Writing letters, summaries, précis, resumes, essays, narratives, biographies, and news articles. **Practice** **Reading:** - Encourage students to distinguish between factual and inferential information from a text. - Read a passage and create a mind map outlining the main and supporting ideas of the content. - Read the text and take notes. - Read and interpret the author's perspective. - Read and conduct a critical analysis of the text. - Read a passage and provide constructive feedback. (speaking/writing modality) **Writing:** - Compose a summary. - Write a précis. - Create a resume. - Develop an essay. - Write a narrative account, whether personal or about others. - Produce a news column.	**6**
Module – V **Theory** **Public speaking and presentation abilities** Public speaking and presentation techniques Public speaking, objectives of a speech – to inform, entertain, persuade, or commemorate/celebrate. Methods of persuasion in speeches – ethos, logos, and pathos. Speech preparation – researching background information, organizing content, crafting an introduction, developing main points, and concluding effectively. Showcasing structured speeches – welcome addresses, farewell remarks, expressions of gratitude (examples may be provided in written scripts, videos, or audio recordings). Presentation etiquette, verbal presentations, poster displays, and delivering speeches. **Practice** **Public speaking:** - Deliver an opening speech (during the Annual day, General meeting, sports day, cultural events) - Present a farewell address - Express gratitude through a vote of thanks - Make a persuasive speech (given a specific scenario) - Engage in an extempore speech	**6**

Presentations: - Conduct a role play - Prepare a PowerPoint presentation - Create a poster presentation	

TEXTBOOKS:

1) Communication Skills (2015) 2nd edition, Sanjay Kumar & Pushp Lata, Oxford University Press
2) Business Correspondence and Report Writing (2017), R.C.Sharma, Krishna Mohan. McGraw Hill

REFERENCE BOOKS:

1) Basic Business Communication-(2004). Lesikar I Flatley, McGraw Hill
2) Business Communication Today, (2017), Bovee, Thill and Chatterjee, Pearson
3) Krishnan, M, & Jha, S.(2024). *Focus: A course in Communication Skills*. Cambridge University Press
4) Suparna Dutta, 2013 Business Communication, PHI Learning Pvt Ltd, New Delhi

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester exams	40

Continuous Internal Assessment	% Distribution
Day-to-day performance & assignments	30
Quiz 1	10
Viva- Voce	20

End Semester Examination	% Distribution
Examination: Submission of reports	30
Viva- Voce	10

Assessment Components	CO1	CO2	CO 3	CO 4	CO 5
Continuous Internal Assessment	✔	✔	✔	✔	✔
Examination: Submission of reports	✔	✔	✔	✔	✔

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning, such as the use of NPTEL materials and the internet
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	1	1	1		1	1		2	3	3	2	3			
CO2	1			1	1	1		1	2	2	1	2			
CO3	2	3	1	2	2	1		1	2	2	1	3			
CO4	2	2	2	1	2	1		2	2	3	2	3			
CO5	1	1	1		2	2	1	2	3	3	2	3			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD2, CD 3
CO2	CD 3, CD 6
CO3	CD 1, CD 2
CO4	CD 3, CD6
CO5	CD 2, CD3, CD6

BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK
(Effective from Academic Session: Monsoon 2024)

Bachelor of Technology

DEPARTMENT OF MECHANICAL ENGINEERING
FIRST YEAR (SEMESTER – II)

COURSE INFORMATION SHEET

Course Code: MA24103
Course Title: Mathematics II
Pre-requisite(s): Mathematics - I
Co- requisite(s):
Credits: 4(L: 3 T: 1 P: 0)
Class schedule per week: 4
Class: B.Tech.
Semester / Level: Second
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	various methods to solve linear differential equations of second and higher order
2.	special functions viz. Legendre's and Bessel's and different properties associated with them
3.	diverse mathematical techniques for solving partial differential equations of first order, along with their applications in wave and heat equations using Fourier series
4.	the theory of functions of a complex variable, complex differentiation and integration
5.	about random variables and elementary probability distribution

COURSE OUTCOMES (COs)

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

CO1	Investigate the occurrence of ordinary differential equations in real-life problems and identify the suitable methods available for their solutions.
CO2	Develop skills to solve and implement various forms of differential equations and special functions in diverse domains.
CO3	Learn to solve various forms of partial differential equations arising in real-world.
CO4	Gain an understanding of complex variable functions and their properties in science and engineering.
CO5	Comprehend and apply the concept of probability distributions in solving problems related to uncertainty.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I: Ordinary Differential Equations – I Linear differential equations, Wronskian, Linear independence and dependence of solutions, Linear differential equations of 2nd and higher order with constant coefficients, Operator method, Euler – Cauchy's form of linear differential equation, Method of variation of parameters.	**9**
Module – II: Ordinary Differential Equations – II Ordinary and singular points of differential equation, Power and Frobenius' series solutions (root differ by non-integer and equal roots). Bessel's differential equation, Bessel function of first kind and its important properties. Legendre's differential equation, Legendre's polynomial and its important properties.	**9**
Module – III: Fourier series and Partial Differential Equations Fourier series: Euler formulae for Fourier series, Half range Fourier series. Partial Differential Equations: Method of separation of variables and its application in solving one dimensional wave and heat equations.	**9**
Module – IV: Complex Variable-Differentiation & Integration Function of a complex variable, Analyticity, Analytic functions, Cauchy – Riemann equations. Cauchy's theorem, Cauchy's Integral formula, Taylor and Laurent series expansions. Singularities and its types, Residues, Residue theorem.	**9**
Module – V: Applied Probability Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, variance. Introduction to Binomial, Poisson and Normal Distribution.	**9**

TEXTBOOKS:

1. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. D. G. Zill and W.S. Wright, Advanced Engineering Mathematics, Fourth Edition, 2011.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., McGraw Hill, 2004.
4. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing, 3rd Ed, 2009.
5. R. A. Johnson, I. Miller and J. Freund: Probability and Statistics for Engineers, PHI
6. S. C. Gupta and V. K. Kapoor: Fundamental of Mathematical Statistics, Sultan Chand and Sons

REFERENCE BOOKS:

1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
3. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
4. G. F. Simmons, Differential Equations with Applications and Historical Notes, TMH, 2nd ed., 2003.
5. P. L. Meyer: Introductory Probability and Statistical Applications, Oxford & IBH.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) --

POS MET THROUGH GAPS IN THE SYLLABUS --

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN ---

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN –

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid semester examination	25
Quiz	20
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	3	2	1	1	0	0	0	1	2			
CO2	3	3	2	3	2	1	1	0	0	1	1	2			
CO3	3	3	2	3	2	1	1	0	0	1	1	2			
CO4	3	2	2	2	2	1	1	0	0	1	1	2			
CO5	3	3	2	2	2	1	1	1	1	1	2	3			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD6
CO3	CD1, CD2, CD6
CO4	CD1, CD2, CD6
CO5	CD1, CD2, CD6

COURSE INFORMATION SHEET

Course Code: **CH24101**
Course Title: **Chemistry**
Pre-requisite(s): **Intermediate level chemistry**
Co- requisite(s):
Credits: **4** L:3 T:1 P: 0
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **SECOND**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the concept of chemical bonding in coordination chemistry
2.	Understand the basics of stereochemistry, aromaticity and reaction mechanism of organic molecules
3.	Understand the reaction dynamics and to know different types of catalysis
4.	Apprehend the basic principles and the application of vibrational, electronic and NMR spectroscopy
5.	Develop knowledge on the physical state and electrochemistry of molecules

COURSE OUTCOMES (COs)

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

CO1	Explain the bonding in a coordination complex
CO2	Explain the 3D structure, aromaticity and stereochemistry of organic molecules
CO3	Predict the rate, molecularity and mechanism of a simple as well as catalytic reaction
CO4	Explain the UV-vis, IR and NMR spectra of unknown molecules
CO5	Interpret the phase diagram of simple one and two component heterogeneous systems in equilibrium and the electrochemical behavior of the molecules

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Module I: Coordination Complex and Symmetry:** Introduction to coordination complexes, Crystal Field Theory, Octahedral, Tetrahedral, and Square Planar complexes, Crystal Field Stabilization Energy (CFSE), Jahn-Teller Theorem, Spectral, Electronic, and Magnetic Properties of Coordination Complexes, Point group symmetry and symmetry operation & applications.	**8**
Module – II **Organic Structure and Reactivity:** Aromaticity, Geometrical isomerism, Optical isomerism & Chirality; Wedge, Fischer, Newmann and Sawhorse projection formulae and interconversions; Conformational studies of cyclohexane, CIP Rule of geometrical and optical isomerism & nomenclature. Addition, Elimination, Substitution and Rearrangement reaction.	**8**
Module – III **Kinetics and Catalysis:** Kinetics of Chain, Parallel/Competing/Side, Consecutive reactions; Fast reactions; Outline of Catalysis, Acid-base catalysis, Enzyme catalysis (Michaelis-Menten equation), Important catalysts in industrial processes: Hydrogenation using Wilkinson's catalyst, Phase transfer catalyst.	**8**
Module – IV **Spectroscopic Techniques:** Absorption Spectroscopy, Lambert-Beer's law, Principles and applications of UV-Visible spectroscopy, Principles and applications of Vibrational spectroscopy; Introduction of NMR spectroscopy.	**8**
Module – V **Phase and Chemical equilibrium:** Phase rule: terms involved, Phase diagram of one component (Water) & two component (Pb/Ag) system & their applications; Nernst Equation, Standard electrode potential, EMF measurement and its application, Principle and application in Lithium-ion battery, H_2-O_2 fuel cell, supercapacitor, and electric vehicle.	

TEXTBOOKS:

1. Huheey, J.E., Inorganic Chemistry: Principles of Structure and Reactivity, 4th edition, Pearson.
2. Morrison, R.N. & Boyd, R.N. Organic Chemistry, Seventh Edition, Pearson.
3. Atkins, P.W. & Paula, J. Physical Chemistry, 10th Ed., Oxford University Press, 2014.

REFERENCE BOOKS:

1. Lee, J. D. Concise Inorganic Chemistry ELBS, 1991.
2. Mortimer, R.G. Physical Chemistry 3rd Ed., Elsevier (2009).
3. William Kemp, Organic Spectroscopy, 3rdEd., 2008 Macmillan

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	20
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

2. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	1			1		1		2			
CO2	3	3	2	1	1			1		1		2			
CO3	3	3	2	2	2			1		1		3			
CO4	3	2	2	2	3			1		2		3			
CO5	3	3	2	2	2	1	1	1		2	1	3			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **EC24101**
Course Title: **Basic Electronics**
Pre-requisite(s):
Co- requisite(s):
Credits: **3** **(**L:2 T:1 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SECOND**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand PN Junction, diodes and their applications.
2.	Comprehend BJT and the bias configurations.
3.	Understand operating principles of FETs
4.	Understand op amp and its applications.
5.	Apprehend number system, Logic Gates and Boolean algebra.

COURSE OUTCOMES (COs)

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

CO1	Understand the characteristics of electronic devices like PN-diode, BJT, JFET and MOSFET
CO2	Classify and analyze the various circuit configurations of BJTs and MOSFETs.
CO3	Analyze the characteristics of operational amplifier.
CO4	Design electronic circuits using diodes, transistors, op-amp and logic gates for analog and digital applications.
CO5	Solve day-to-day life problems using electronic circuits.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Diodes and Applications:** Introduction to semiconductor materials, PN junction diode, barrier potential, depletion layer width, junction capacitance, diode current equation, I-V plot, diode-resistance, temperature dependence, breakdown mechanisms, Zener diode – operation and applications, Diode as a Rectifier: Half Wave and Full Wave Rectifiers with and without C-Filters.	**8**
Module – II **Bipolar Junction Transistors (BJT):** Basic operation of PNP and NPN Transistors, Input and Output Characteristics of CB, CE and CC Configurations. Transistor biasing: operating point, Fixed bias, emitter bias, voltage divider bias, stability factor, small signal analysis (h-parameter model) of CE configuration.	**8**
Module – III **Field Effect Transistors:** JFET: Principle of operation, transfer characteristics, MOSFET: Operation of N-MOS, P-MOS, enhancement and depletion type, transfer characteristics, CS biasing of JFET and MOSFET.	**8**
Module – IV **Operational Amplifiers:** Introduction of Operational Amplifier, Characteristics of Operational Amplifier, Differential Amplifier, CMRR, Slew Rate, input and output offset voltages, Inverting and non-inverting amplifiers, Summing Amplifier, Difference amplifier, Differentiator and Integrator.	**8**
Module – V **Boolean Algebra and Logic Gates:** Boolean Algebra, Boolean operators, Truth table of different digital logic gates (AND, OR, NOT, NAND, NOR, EXOR, EX-NOR), application of diode for design of logic gates, realization of logic gates using universal gates, adder, subtractor.	**8**

TEXTBOOKS:

1. Millman J., Halkias C.C. “Integrated Electronics: Analog and Digital Circuits and Systems”, Tata McGraw-Hill.
2. Boylstead R.L., Nashelsky L., “Electronic Devices and Circuit Theory”, Pearson Education, Inc, 11/e.
3. Mano M.M., Michael D. Ciletti, “Digital Design”, Pearson Education, Inc, 5/e, 2011.

REFERENCE BOOKS:

1. Millman J., Halkias C.C., Parikh Chetan, “Integrated Electronics: Analog and Digital Circuits and Systems”, Tata McGraw-Hill, 2/e.
2. Millman J., Halkias C.C., Satyabrata Jit, “Millman’s Electronic Devices and Circuits”, Tata McGraw-Hill, 3/e.
3. Albert Paul, Malvino, David J. Bates, “Electronic principles”, McGraw-Hill, 8/e, 2015.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz	20
Teacher's Assessment/ Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

3. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	1	2	3	1	1	2	2	3	2	2			
CO2	3	3	1	2	3	1	1	2	2	3	2	2			
CO3	3	3	1	2	3	1	1	2	2	3	2	2			
CO4	3	3	1	2	3	1	1	2	2	3	2	2			
CO5	3	3	1	2	3	1	1	2	2	3	2	2			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24101**
Course Title: **Basics of Mechanical Engineering**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L: 2 T:1 P: 0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **SECOND**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Introduce system of forces, and write equation of equilibrium.
2.	Analyse motion of particle and rigid body subjected to force.
3.	Grasp the importance of internal and external combustion engines.
4.	Apprehend the fundamentals of friction.
5.	Understand the different sources of energy.

COURSE OUTCOMES (COs)

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

CO1	Explain the basics of Mechanical Engineering.
CO2	Apply various laws of mechanics on static and dynamic elements and bodies.
CO3	Analyse various problems of mechanics related to static and dynamic bodies.
CO4	Evaluate the real life problem related to mechanics and energy for its probable solution.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **System of Forces and Structure Mechanics;** Addition of Forces, Moment of a Force, Couple, Varignon's theorem, Free Body Diagram, Equilibrium in Two and Three Dimensions, Equivalent Forces and Moment. Types of Plane Trusses, Analysis of Plane Trusses by: Method of Joints and Method of Sections. Hooke's Law of elasticity, Stress and Strain, Relation between elastic constants.	**8**
Module – II **Kinematics & Kinetics of rigid bodies:** Types of rigid body motion– translation, rotation about fixed axis, equations defining the rotation of a rigid body about a fixed axis, plane motion, absolute and relative velocity in plane motion, instantaneous center of rotation. Equation of motion and D'Alembert's principle.	**8**
Module – III **Friction :** Interfacial Friction (a) Laws of dry friction, static & kinetic co-efficient of friction, Analysis of static, kinetic and rolling friction. (b) Analysis of frictional forces in inclined planes, wedges, screw jacks and belt drives.	**8**
Module – IV **Boilers and Internal Combustion Engine;** Classification of Boilers, Fire tube and Water Tube boilers. Boiler Mountings and Accessories. Boiler efficiency. Classification of I C Engines. Basic components and terminology of IC engines, working principle of four stroke and two stroke - petrol and diesel engine.	**6**
Module – V **Non-Conventional Energy Sources** Renewable and Non-renewable Energy Resources, Advantages and Disadvantages of Renewable Resources, Renewable Energy Forms and Conversion- Solar Energy, Wind Energy, Hydro Energy.	**5**

TEXTBOOKS:

1. Engineering Mechanics, Irving H. Shames, P H I. ltd, 2011.
2. Boiler operator, Wayne Smith, LSA Publishers, 2013.
3. Internal Combustion Engines, M. L. Sharma and R. P. Mathur, Dhanpat Rai Publications, 2014.
   Fundamentals of Renewable Energy Processes, Aldo Vieira Da Rosa, Elsevier publication, 2012.

REFERENCE BOOKS:

1. Engineering Mechanics : statics, James L. Meriam, L. G. Kraige, Wiley, 7th Edition, 2011.
2. Engineering Mechanics, S. Rajasekaran & G. Sankarasubramaniam, Vikash publishing house, 2018.
3. An Introduction to Steam Boilers, David Allan Low, Copper Press Publisher, 2012.
4. Internal Combustion Engines – V Ganesan, McGraw hill, 2017.
5. Non Conventional Energy Resources, B. H. Khan, McGraw Hill Education Publisher, 2017.
6. Principles of Mechanical Engineering, R. P. Sharma & Chilkesh Ranjan, Global Academic Publishers, 2016.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) : NIL

POS MET THROUGH GAPS IN THE SYLLABUS: NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NIL

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

4. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	1		1	2	1	1		2	NA	NA	NA
CO2	3	3	2	2	2	1	1	1	2	1	1	2	NA	NA	NA
CO3	3	3	3	3	2	1	1	1	2	2	2	2	NA	NA	NA
CO4	2	3	3	3	3	2	2	2	2	2	2	3	NA	NA	NA

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **CE24101**
Course Title: **Environmental Science**
Pre-requisite(s): **NIL**
Co- requisite(s):
Credits: **2** L: 2 T: 0 P:0
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **SECOND**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Develop basic knowledge of ecological principles and their applications in environment.
2.	Identify the structure and composition of the spheres of the earth, the only planet sustaining life.
3.	Analyse, how the environment is getting contaminated and probable control mechanisms for them.
4.	Generate awareness and become a sensitive citizen towards the changing environment.

COURSE OUTCOMES (COs)

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

CO1	Explain the structure and function of ecosystems and their importance in the holistic environment. (K_1,K_2)
CO2	Identify the sources, causes, impacts and control of air pollution. (K_1,K_2)
CO3	Distinguish the various types of water pollution happening in the environment and understand about their effects and potential control mechanisms. (K_1,K_2)
CO4	Judge the importance of soil, causes of contamination and need of solid waste management. (K_1,K_2)
CO5	Know the impacts of noise pollution and its management (K_1,K_2)

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Ecosystem and Environment :** Concepts of Ecology and Environmental science, ecosystem: structure, function and services, Biogeochemical cycles, energy and nutrient flow, ecosystem management. Concept of Biodiversity.	**5**
Module – II **Air Pollution :** Structure and composition of unpolluted atmosphere, classification of air pollution sources, types of air pollutants, effects of air pollution, monitoring of air pollution, Air pollution control and management.	**5**
Module – III **Water Pollution** : Water Resource; Water Pollution: types and Sources of Pollutants; effects of water pollution; Water quality monitoring, Water quality index, water and wastewater treatment: primary, secondary and tertiary.	**5**
Module – IV **Soil Pollution and Solid Waste Management :** Soil profile, soil properties, soil pollution, Municipal solid waste management. MSW – Functional elements of MSW.	**5**
Module – V **Noise Pollution :** Noise pollution: introduction, sources, outdoor and indoor noise propagation, Effects of noise on health, criteria noise standards and limit values, Noise measurement techniques, prevention and control of noise pollution.	**5**

TEXTBOOKS:

1. A, K. De. (3rd Ed). 2008. Environmental Chemistry. New Age Publications India Ltd.
2. R. Rajagopalan. 2016. Environmental Studies: From Crisis to Future by, 3rd edition, Oxford University Press.
3. Eugene P. Odum. 1971. Fundamentals of Ecology (3rd ed.) -. WB Sunders Company, Philadelphia.
4. C. N. Sawyer, P. L. McCarty and G. F. Parkin. 2002. Chemistry for Environmental Engineering and Science. John Henry Press.
5. S.C. Santra. 2011. Environmental Science. New Central Book Agency.

REFERENCE BOOKS:

1. D.W. Conell. Basic Concepts of Environmental Chemistry, CRC Press.
2. Peavy, H.S, Rowe, D.R, Tchobanoglous, G. Environmental Engineering, Mc-Graw - Hill International
3. G.M. Masters & Wendell Ela. 1991. Introduction to Environmental Engineering and Science, PHI Publishers.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz	20
Teacher's Assessment/Assignment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

5. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1		1	3			1	3								
CO2		1	3			1	3								
CO3		1	3			1	3								
CO4		1	3			1	3								
CO5		1	3			1	3								

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: CH24102
Course Title: Chemistry Lab
Pre-requisite(s): Intermediate level Chemistry
Co- requisite(s):
Credits: 1 (L:0 T:0 P:2)
Class schedule per week: 2
Class: B. Tech.
Semester / Level: SECOND
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand about synthesis of Organic and Inorganic compounds.
2.	Understand the spectroscopic data
3.	Develop concept of potentiometric and pH metric titration of acid and base
4.	Understand the rate constant of chemical reaction
5.	Develop knowledge of melting point and estimation of Eutectic and transition temperature

COURSE OUTCOMES (COs)

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

CO1	Perform Synthesis of Organic and Inorganic compounds.
CO2	Analyze the spectroscopic data
CO3	Perform potentiometric and pH metric titration of acid and base
CO4	Determine the rate constant of chemical reaction
CO5	Perform measurement of melting point and estimation of Eutectic and transition temperature

SYLLABUS

List of Experiments:

1. Gravimetric estimation of Nickel by Dimethylglyoxime.
2. Quantitative estimation of Ca^{2+} and Mg^{2+} ions by complexometric titration using Na_2-EDTA.
3. To verify Bears Law using Fe^{3+} solution by spectrophotometer/colorimeter and to determine the concentration of a given unknown Fe^{3+} solution.
4. Preparation of Diazoamino Benzene and report the melting point and yield of product.
5. Draw melting point-mass percent composition diagram for two component mixture and determine the Eutectic Temperature.
6. To study the kinetics of acid-catalyzed hydrolysis of ethyl acetate and to evaluate the value of the rate constant.
7. To determine the strength of the given strong acid by strong base potentiometrically.
8. To determine the transition temperature of the given salt hydrate.
9. Qualitative detection of special elements in organic compounds.
10. To draw the pH-titration curve of strong acid vs strong base.

BOOKS:

1. Experimental Physical Chemistry, By B. Viswanathan, P. S. Raghavan, Narosa Publishing House (1997).
2. Vogels Textbook of Practical Organic Chemistry
3. Experiments in General chemistry, C. N. R. Rao and U. C. Agarwal
4. Experimental Organic Chemistry Vol 1 and 2, P R Singh, D S gupta, K S Bajpai, Tata McGraw Hill

Lab Check-In:

General:

- Laboratory apron and experimental notebook is mandatory to work in the laboratory.
- Be sure that all of your glassware, labwares, equipment etc. is present with you to conduct your experiment.
- Once you have checked-in, you will be responsible for missing labware items issued to you. Pay particular attention to the labwares, which is expensive and required for several students for their experiments, treat it with respect.
- It is your responsibility to clean all of the used labwares, glassware etc. and your work place after completion of your experiment before leaving lab.
- Learn the cleaning and drying technique for glassware's. Always use clean and dry glassware's for your experiment.
- Learn Good and Safe Laboratory Practice. Learn the safe handling of labwares, glassware's, chemicals, equipment, etc. Ask you lab instructor/Teacher for any queries.
- You need to maintain your lab record book updated as per instruction and be sure to get verified &

signed by your teacher in every lab classes.

- Keep your personal safety googles, lab aprons etc. with you for your next time use.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Lab Journal	30
Lab quizes	20
Progressive viva	20
End Sem Examination	30

Continuous Internal Assessment	% Distribution
Lab Journal	30
Lab quiz	10
Progressive viva	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	Y	Y	Y	Y	Y
Semester End Examination	Y	Y	Y	Y	Y

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Introductory lecture by use of boards/LCD projectors
CD2	Laboratory experiments/ teaching aid
CD3	Self- learning such as use of NPTEL materials and internets
CD4	
CD5	
CD6	
CD7	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	1	1	1	2	2	2	3			
CO2	2	2	3	1	3	1	2	2	2	3	2	2			
CO3	2	3	2	3	2	2	1	1	2	2	2	2			
CO4	3	3	3	3	3	1	2	1	2	2	2	2			
CO5	2	3	2	2	3	1	1	1	2	2	2	3			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD1, CD2, CD3
CO3	CD1, CD2, CD3
CO4	CD1, CD2, CD3
CO5	CD1, CD2, CD3

COURSE INFORMATION SHEET

Course Code: **EC24102**
Course Title: **Basic Electronics Lab**
Pre-requisite(s):
Co- requisite(s):
Credits: **1** L:0 T:0 P: 2
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **SECOND**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Measure magnitude, time-period, frequency, phase of signals using CRO
2.	Know PN junction characteristics and its applications
3.	Understand the working of transistor amplifier
4.	Understand the working of operational amplifier and circuits
5.	Realize logic gates and implement simple Boolean expression

COURSE OUTCOMES (COs)

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

CO1	Familiarize with electronics components like diode, transistors, ICs
CO2	Make use of measuring instruments and function generators
CO3	Verify characteristics of diodes, transistors and op-amp
CO4	Design electronic circuits using diodes, transistors, op-amp for analog applications
CO5	Design electronic circuits using logic gates for digital applications

SYLLABUS

List of Experiments

Experiment No.	Name of the Experiments
	(A) HARDWARE BASED EXPERIMENTS
1.	**MEASURMENTS USING CRO** AIM-1: To understand the Measurement of voltage, time-period and frequency of different signals on CRO. AIM-2: To measure the frequency and phase of two different signals using Lissajous pattern.
2.	**HALF-WAVE AND FULL WAVE RECTIFIER CIRCUITS** AIM-1: To understand the basic operation principle of Half-wave rectifier circuit and measurement of rectification efficiency and ripple factor with and without C-Filter. AIM-2: To understand the basic operation principle of Full-wave rectifier circuit and measurement of rectification efficiency and ripple factor with and without C-Filter.
3.	**COMMON EMITTER (CE) TRANSISTOR AMPLIFIER** AIM-1: To understand the basic operation principle of CE transistor amplifier circuit and finding its frequency response. AIM-2: To determine the gain bandwidth product of CE transistor amplifier from its frequency response.
4.	**INVERTING OPERATIONAL AMPLIFIER (OP-AMP)** AIM: To design the inverting operational amplifier using IC741 OP-AMP and find its Gain and Frequency Response.
5.	**DIFFERENTIAL AMPLIFIER** AIM-1: To design common mode and differential mode circuit using IC741 OP-AMP AIM-2: To obtain common mode gain and differential mode gain and calculate CMRR.
6.	**REALIZATION OF LOGIC GATES** AIM-1: To understand basic Boolean logic functions (NOT, AND, OR). AIM-2: To realize the basic logic gates (AND, OR, NOT) using NAND Gate (IC-7400).
	(B) SOFTWARE BASED EXPERIMENTS
1.	**PN JUNCTION CHARACTERISTICS** AIM-1: To determine the forward bias V-I characteristics of PN junction diode and finding its forward cut-in voltage. AIM-2: To determine the reverse bias V-I characteristics of PN junction diode and finding its reverse breakdown voltage.
2.	**ZENER DIODE CHARACTERISTICS** AIM-1: To design a basic voltage regulator circuit using Zener diode. AIM-2: To determine the reverse bias V-I characteristics of Zener diode and finding its reverse breakdown voltage.
3.	**FIELD EFFECT TRANSISTOR CHARACTERISTICS** AIM-1: To determine the output and transfer characteristics of JFET. AIM-2: To measure the voltage, gain of JFET.
4.	**NON-INVERTING OPERATIONAL AMPLIFIER (OP-AMP)** AIM: To design the non-inverting operational amplifier using IC741 OP-AMP and find its Gain and Frequency Response.
5.	**DIFFERENTIATOR AND INTEGRATOR CIRCUITS USING OP-AMP** AIM-1: To design differentiator circuit using IC741 OP-AMP and observe waveforms. AIM-2: To design integrator circuit using IC741 OP-AMP and observe waveforms.

6.	**IMPLEMENTATION OF BOOLEAN FUNCTION** AIM-1: To understand the AND Gate IC (IC 7408) and OR Gate IC (IC 7432) AIM-2: To implement a given Boolean expression using logic gate ICs.

TEXTBOOKS:

1. Millman J., Halkias C.C., Parikh Chetan, "Integrated Electronics: Analog and Digital Circuits and Systems", Tata McGraw-Hill, 2/e.
2. Mano M.M., "Digital Logic and Computer Design", Pearson Education, Inc, Thirteenth Impression, 2011.

REFERENCE BOOKS:

1. Boylstead R.L., Nashelsky L., "Electronic Devices and Circuit Theory", Pearson Education, Inc, 10/e.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	**(60)**
Attendance Marks	**12**
Day-to-day performance Marks	**06**
Lab Viva marks	**20**
Lab file Marks	**12**
Lab Quiz-I Marks	**10**
End SEM Evaluation	**(40)**
Lab Quiz-II Marks	**10**
Lab performance Marks	**30**

INDIRECT ASSESSMENT

6. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of Boards/LCD Projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini Projects/Projects
CD5	Laboratory Experiments/Teaching Aids
CD6	Industrial/Guest Lectures
CD7	Industrial Visits/In-plant Training
CD8	Self- learning such as use of NPTEL Materials and Internets
CD9	Simulation

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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		1	1	1	1	1	2			
CO2	2	2	3	2	3			1	2	1	1	2			
CO3	2	2	3	1	3		1	1	2	2	2	2			
CO4	1	1	2	1	2	3	2	2	1	1	1	2			
CO5	1	1	1	1	2			2	3	2	2	2			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD5, CD9
CO2	CD1, CD5, CD9
CO3	CD1, CD5, CD9
CO4	CD1, CD5, CD9
CO5	CD1, CD5, CD9

COURSE INFORMATION SHEET

Course Code: **ME24102**
Course Title: **Engineering Graphics**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits:2 **(**L:0 T: 0 P:4)
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **SECOND**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the basic principles of Engineering Graphics, which include projections of 1D, 2D and 3D objects.
2.	Visualize a solid object (including sectioned) and convert it into drawing.
3.	Visualize different views of any object.
4.	Develop skill to draw objects using AutoCAD software.
5.	Inculcate the imagination and mental visualization capabilities for interpreting the geometrical details of common engineering objects.

COURSE OUTCOMES (COs)

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

CO1	Explain the fundamentals of Engineering Graphics and projection and acquire visualization skills.
CO2	Demonstrate the concept of projections of points and lines for various engineering applications.
CO3	Apply the concept of projections to construct planes and solids, and its orthographic projections which are positioned in various configurations..
CO4	Demonstrate the understanding of AutoCAD software commands to draw projections of points, lines, planes and solids.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to Engineering Graphics, dimensioning and projections, orthographic projections, Fundamentals of First and Third Angle projection, Orthographic projections of points.	**9**
Module – II Orthographic projections of straight lines: lines parallel to HP and VP, lines inclined to HP and Parallel to VP, line inclined to VP and parallel to HP, line inclined to both reference planes. Orthographic projections of planes/lamina: lamina perpendicular to both HP and VP, lamina parallel to HP and perpendicular to VP (and vice versa), lamina inclined to HP and perpendicular to VP, lamina inclined to VP and perpendicular to HP, lamina inclined to both reference planes.	**9**
Module – III Projections of solids (cube, prism, pyramid, tetrahedron) - axis perpendicular to HP and inclined to VP and inclined to one or both planes. Section of solids: sectional plane perpendicular to one plane and parallel/inclined to another plane.	**9**
Module – IV Working with AutoCAD Commands, Cartesian Workspace, Basic Drawing & Editing Commands, Drawing: Lines, Rectangles, Circles, Arcs, Polylines, Polygons, Ellipses, Creating Fillets and Chamfers, Creating Arrays of Objects, Working with Annotations, Adding Text to a Drawing, Hatching, Adding Dimensions, Dimensioning Concepts, Adding Linear Dimensions, Adding Radial & Angular Dimensions, Editing the Dimensions.	**9**
Module – V Create views of points, lines, planes, and various types of solids (cube, prism, pyramid, tetrahedron, etc.) using AutoCAD software.	**9**

TEXTBOOKS:

1. Engineering Drawing by N. D. Bhatt, Charotar Publishing House Pvt.Ltd., 53rd, Edition, 2014.
2. Engineering Drawing and Graphics + AutoCAD by K. Venugopal, New Age International (P) Limited, 4th Reprint: June, 2017.

REFERENCE BOOKS:

1. Engineering Graphics with Autocad by J. D. Bethune, Prentice Hall, 2007.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) : NIL

POS MET THROUGH GAPS IN THE SYLLABUS: NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NIL

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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			
CO2	3	3	2		2					2		2			
CO3	3	3	3	2	2				2	2		2			
CO4	2	2	2	2	3				2	3	2	2			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3

COURSE INFORMATION SHEET

Course Code: PE24102
Course Title: Workshop Practice
Pre-requisite(s): None
Co-requisite(s): None
Credits: 1 (L:0 T:0 P: 2)
Class schedule per week: 2
Class: B.Tech.
Semester / Level: SECOND
Branch: Mechanical Engineering
Name of Teacher:

Course Objectives:
This course enables the students to:

1	Familiarize with the basics of manufacturing processes.
2	Impart knowledge and skill to use tools, machines, equipment, and measuring instruments.
3	Practice on manufacturing of components using workshop trades.
4	Educate students on the safe handling of machines and tools.
5	Exercise individual as well as group activity with hands-on training in different workshop trades.

Course Outcomes:
At the end of the course, a student should be able to:

CO1	Be conversant with the basic manufacturing processes.
CO2	Identify and apply suitable tools and instruments for carpentry, foundry, welding, fitting, and conventional and modern machining.
CO3	Manufacture different components using various workshop trades.
CO4	Take safety and precautionary measures for self and machines during operations.
CO5	Develop skills to work as an individual or in a team during trade practices.

SYLLABUS

LIST OF EXPERIMENT	**(NO. OF PRACTICAL HOURS)**
1. CARPENTRY SHOP **EXPERIMENT-I: Carpentry Tools and Instruments** **Objective**: To study the various tools, instruments, and equipment used in carpentry practice.	**2**
2. CARPENTRY SHOP **EXPERIMENT-II: Carpentry Practice** **Objective:** To perform the carpentry work by making a wooden job using different tools.	**2**
3. FOUNDRY SHOP **EXPERIMENT-I: Green Sand Moulding** **Objective:** To get acquainted with various tools and equipment used in making green sand mould (to practice green sand mould making with single-piece patterns).	**2**
4. FOUNDRY SHOP **EXPERIMENT-II: Aluminium Casting** **Objective:** To get acquainted with melting and pouring metal in a mould (given two-piece patterns of handle) and to make aluminium casting.	**2**

5. WELDING SHOP **EXPERIMENT-I: Manual Metal Arc Welding** **Objective:** To study arc welding processes including arc welding machines (AC & DC), electrodes and equipment. To join two pieces of given metal by the arc welding process.	**2**
6. WELDING SHOP **EXPERIMENT-II: Gas Welding** **Objective:** To study gas welding processes, including types of flames produced, filler metals and fluxes, etc. To join two pieces of given metal by the gas welding process.	**2**
7. FITTING SHOP **EXPERIMENT-I: Fitting Tools and Measuring Instruments** **Objective**: To study the various tools used in the fitting shop and perform fitting operations (like marking, chipping, hack-sawing, filing, drilling, etc.)	**2**
8. FITTING SHOP **EXPERIMENT-II: Fitting Assembly Practice** **Objective:** To make a job clamping plate as per the given drawing by fitting operations and to check for its assembly with a given component.	**2**
9. MACHINE SHOP **EXPERIMENT – I: Centre Lathe Machine** **Objective**: To study lathe machine and to machine a given job on the center lathe as per drawing.	**2**
10. MACHINE SHOP **EXPERIMENT-II: Shaper Machine** **Objective:** To study the Shaper machine and to machine a given job on the shaper as per drawing.	**2**
11. MODERN MACHINE SHOP **EXPERIMENT – I: CNC Lathe Machine** **Objective**: To provide an introduction to the functionality and operation of the CNC Lathe Machine through practical demonstration.	**2**
12. MODERN MACHINE SHOP **EXPERIMENT-II: CNC Surface Grinding Machine** **Objective:** To provide an introduction to the functionality and operation of the CNC Surface Grinding Machine through practical demonstration	**2**

Books recommended:

TEXT BOOK

1. S K Hajra Choudhury, A K. Hajra, "Elements of Workshop Technology: Vol- I and Vol -II", Media Promotors Pvt Ltd. **(T1)**
2. B S Raghuwanshi, "A course in Workshop Technology", Dhanpat Rai Publications. **(T2)**

REFERENCE BOOK

1. P.N. Rao, "Manufacturing Technology Vol-1and Vol-II", Tata McGraw Hill. **(R1)**
2. Kalpakjian, "Manufacturing Engineering and Technology", Pearson. **(R2)**

Gaps in the syllabus (to meet Industry/Profession requirements):

POs met through Gaps in the Syllabus:

Topics beyond syllabus/Advanced topics/Design:

POs met through Topics beyond syllabus/Advanced topics/Design:

Course Delivery Methods:

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	√

Course Evaluation:

Direct Assessment-

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
Semester End Examination	40

Continuous Internal Assessment	**% Distribution**
Day to day performance & Lab files	30
Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Quiz 2	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Examination: Experiment Performance	√	√	√	√	√

Indirect Assessment –

1. Student Feedback on Course Outcome

Mapping of Course Outcomes (COs) onto Program Outcomes (POs) and Program Specific Outcomes (PSOs):

COs	**POs**												**PSOs**		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CO1	3	2	1		1	1	1	1	1	1	1	2			
CO2	2	3	2	1	3	1	1	1	1	2	2	2			
CO3	2	2	3	2	3	1	1	1	2	2	2	2			
CO4	1	1	2	1	2	2	2	3	1	1	1	2			
CO5	1	1	2		1			1	3	3	3	2			

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

Mapping Between Course Outcomes (COs) and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD3, CD6
CO2	CD1, CD3
CO3	CD1, CD3
CO4	CD1, CD3
CO5	CD3

BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK
(Effective from Academic Session: Monsoon 2024)

Bachelor of Technology

DEPARTMENT OF MECHANICAL ENGINEERING
SECOND YEAR (SEMESTER – III)

COURSE INFORMATION SHEET

Course Code: **ME24201**
Course Title: **Thermodynamics**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L: 3 T: 0 P: 0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **THIRD**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the basics of classical thermodynamics.
2.	Learn the laws of energy conservation and discuss their limitations
3.	Analyze the laws and apply them to different engineering problems.
4.	Formulate different thermodynamics relations for engineering practice.

COURSE OUTCOMES (COs)

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

CO1	Discuss the basic concepts of thermodynamics.
CO2	Apply the laws of thermodynamics to various flow, non-flow and cyclic systems.
CO3	Evaluate the performance different engineering devices.
CO4	Develop thermodynamics relations for engineering practices.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction: Fundamental Concepts: Macroscopic versus microscopic point of view, definitions of system and surrounding, concept of control volume, thermodynamic state, processes and cycles, point function and path function, quasi-static process, concepts of simple compressible substances, dimensions and units, thermodynamic equilibrium; Zeroth law; ideal gases equation; pure substance and phase, Thermodynamic properties and use of steam tables Thermodynamic definition of work, work done at the moving boundary of a system and other systems , Definition of heat, comparison of Heat and Work.	**8**
Module – II First Law of Thermodynamics: The first law referred to cyclic and non-cyclic processes, concept of internal energy of a system, conservation of energy for simple compressible closed systems; Definitions of enthalpy and specific heats; First law applied to a control volume, general energy equation; steady flow energy equation on unit mass and time basis, application of SFEE for devices such as boiler, turbine, heat exchangers, pumps, nozzles, etc.	**8**
Module – III Second Law of Thermodynamics: Limitations of the first law, concept of a heat engine, heat pump, refrigerator, statements of the second law, their equivalence, Carnot cycle, reversible heat engine, Carnot theorems and corollaries, Concept of reversibility; Internal and external irreversibility, Absolute thermodynamic temperature scale.	**8**
Module – IV Clausius Inequality, entropy, change in entropy in various thermodynamic processes, entropy balance for closed and open systems, Principle of increase-in-Entropy, entropy generation. Concept of reversible work & irreversibility, second law efficiency, Exergy change of a system: closed & open system, Exergy balance equation.	**8**
Module – V Thermodynamics property and relations: Maxwell relations, Clausius-Clapeyron equation, Difference in heat capacities, Ratio of heat capacities, Joule-Thompson coefficient.	**8**

TEXTBOOKS:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons
2. Yonus A Cengel and Michale A Boles, 2002, Thermodynamics: An Engineering Approach, McGraw Hill.

REFERENCE BOOKS:

1. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.
2. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
3. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Modern computational tools (e.g., MATLAB, EES), sustainability concepts, and integration with contemporary applications such as renewable energy, HVAC systems, and energy management technologies.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Thermodynamic analysis and optimization of real-world energy systems using exergy-based design and analysis.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24203**
Course Title: **Fluid Mechanics and Hydraulic Machines**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L: 3 T: 0 P: 0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **THIRD**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Get acquainted with the basic concepts and fundamental aspects of fluid dynamics
2.	Outlining the conservation laws of fluid flow
3.	Study and analyse different hydraulic turbines
4.	Develop and understanding of different power consuming hydraulic devices and pumps.

COURSE OUTCOMES (COs)

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

CO1	Discuss the fundamental properties and behavior of fluids in static and dynamic conditions.
CO2	Apply the principles of fluid kinematics and dynamics to solve engineering problems involving fluid flows.
CO3	Analyse the problems related to fluid flow devices.
CO4	Develop mathematical models and relations for fluid flow and hydraulic systems applicable in engineering practices.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Fluid statics:** Concept of continuum and physical properties of fluids, specific gravity, viscosity surface Tension, vapor pressure. Total pressure and center of pressure, Buoyancy and Meta-Centre Measurement of pressure- Piezometer, U-tube and differential tube manometers.	**8**
Module – II **Fluid kinematics**: Eulerian and Lagrangian description of fluid flow, Stream line, path line and streak lines and stream tub. Classification of fluid flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational, and irrotational flows, equation of continuity. **Fluid dynamics:** Navier- Stokes Equation, Surface and body forces –Euler's and Bernoulli's equations for flow along a stream line, and its applications.	**8**
Module – III **Closed conduit flow:** Reynold's experiment- Darcy Weisbach equation, Minor and major losses in pipes- pipes in series and pipes in parallel- total energy line-hydraulic gradient line. Measurement of flow, pitot-static tube, venturimeter, orifice meter. Concept of Boundary layer, separation of boundary layer and its control.	**8**
Module – IV **Hydraulic Turbines:** Hydrodynamic force of jets on stationary and moving vanes, velocity diagrams, work done and efficiency. Hydraulic Turbines: Classification of turbines, impulse and reaction turbines, working proportions, work done, efficiencies, draft tube theory and functions and efficiency. Performance of hydraulic turbines, geometric similarity, unit and specific quantities, governing of turbines, selection of type of turbine.	**8**
Module – V **Centrifugal pumps :** Classification, working, work done, manometric head, losses and efficiencies, specific speed, pumps in series and parallel, Stodala slip, performance characteristic curves, NPSH, Model studies, Reciprocating pumps, working, discharge, slip, indicator diagrams.	**8**

TEXTBOOKS:

1. Hydraulics, Fluid mechanics and Hydraulic Machinery by MODI and SETH.
2. Fluid mechanics and Hydraulic Machines by R.K. Bansal
2. Hydraulic Machines by Jagdishlal
3. Fluid Mechanics, Fundamentals and Applications (in SI Unit) by Yunus A. Cangel and John M. Cimbala, McGraw Hill.

REFERENCE BOOKS:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria& Sons.
2. Fluid Mechanics with Engineering Application by J.B. Franzini and Finnemore, McGraw Hill.
3. Fluid Mechanics by V. L. Streeter.

Online Resources

https://www.youtube.com/watch?v=fa0zHI6nLUo
https://www.youtube.com/watch?v=XGnGBo-FrlA
http://engineeringvideolectures.com/video/15763

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Fluid-structure interaction, smart pumping systems, energy efficiency optimization.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Non-Newtonian Fluids: Rheology, behavior under stress, applications in industries like polymer and food processing.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24205**
Course Title: **Strength of Materials**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **4** **(**L: 3 T: 1 P: 0)
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **THIRD**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand state of stress at a material point under plane stress and strain conditions.
2.	Evaluate shear force and bending moment and corresponding stresses at a beam cross-section.
3.	Determine deflection of beams using different methods.
4.	Apply energy methods in structural problems.
5.	Derive stress-strain behavior of thin and thick cylindrical shells.

COURSE OUTCOMES (COs)

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

CO1	Understand the stress-strain behavior of deformable bodies.
CO2	Apply the fundamental concepts of stress-strain in real life problems.
CO3	Analyse stresses and strains in simple structural elements under various loading conditions.
CO4	Evaluate deflections and deformations of different structural elements using appropriate methods.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Stress at a point on a plane, Stress transformation equation, Principal stresses, Mohr's circle of stresses, Strain transformation equation, principal strain, strain rosette.	**9**
Module – II Types of Beams, Types of loading and support, Relationship between Shear force, Bending Moment and intensity of loading, SFD, BMD, Point of Contraflexure, second moment of area, parallel axes theorem, Bending stress and shear stress in beam.	**9**
Module – III Deflection of Beams, Double integration method, Macaulay's method, Moment area method, Torsion of circular shafts.	**9**
Module – IV Buckling of columns. Strain energy method, Castigliano's theorem, application of energy method on different types of beams and thin circular ring.	**9**
Module – V Thin and thick cylinders: Radial and circumferential stresses, stresses produced due to shrink fit. Rotating Disc: Stresses in disc of uniform thickness and uniform strength.	**9**

TEXTBOOKS:

1. Strength of Materials by E J Hearn.
2. Strength of Materials by S. S. Rattan.
3. Mechanics of Material by Riley, Sturges, Morris

REFERENCE BOOKS:

1. Mechanics of Materials by S. Timoshenko and James M. Gere.
2. Strength of Materials by Ryder.
3. Advanced Mechanics of Material by Seely& Smith

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Material nonlinearity, fatigue analysis, and real-world design standards and codes.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Analysis and design of composite beams and advanced stress analysis.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **PE24201**
Course Title: **Introduction to Materials Engineering**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L: 3 T: 0 P: 0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **THIRD**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Examine the properties and structures of materials and get acquainted with metallographic principles and material characterization techniques.
2.	Understand the thermodynamics of solids and invariant transformations involved in phase diagrams, comprehend the construction of iron carbon phase diagram and appreciate the effects of alloying elements in steel.
3.	Analyze the kinetics of phase transformation of steel, understand heat treatment operations associated with steels and introduced to concept of hardenability.
4.	Acknowledge important non-ferrous alloys, polymers and understand their properties, microstructure, and applications
5.	Introduced to various material testing methods related to its mechanical and functional properties.

COURSE OUTCOMES (COs)

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

CO1	Analyze and select various engineering materials for various purposes and describe the various material characterization techniques.
CO2	Explain the thermodynamics of solids, elucidate iron carbon diagram and identify the effects of alloying elements on steel.
CO3	Describe the kinetics involved with steel transformation and understand the application of various heat treatment operations.
CO4	Identify the different types of non-ferrous alloys and explain its properties.
CO5	Apply and explain various methods of material testing procedures.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction to Material Science and Metallurgy :**Definition, scope and classification of engineering solids; Properties of engineering solids and their applications; Structure of solids – crystalline and non-crystalline; Basics of crystallography – point/space lattice, unit cell, crystal system, crystal lattice, and crystal structure; Structure of elemental and compound crystal structures with examples; Crystallographic indexing of directions and planes, Influence of crystal structure on properties; Defects in crystalline solids – definition, classification and examples of dimension-wise crystal defects; Macroscopic symmetry elements; Influence of crystal defects on engineering properties; Solid solutions; Synthesis of solids by different routes – from vapour, melt or solids; Solidification of pure and alloyed systems; Evolution and concept of macrostructure – mono and polycrystalline aggregates; Principles of metallography – sample selection, preparation and examination; Optical or light microscopy; Interpretation of optical microstructure; Standard techniques of material characterization – structural examination; Standard techniques of material characterization – compositional analysis.	**8**
Module – II **Phase Diagrams and Fe-C equilibrium Diagram:** Thermodynamics of solids: component, phase, thermodynamic system - single and multicomponent, specific heat, enthalpy, entropy, Free energy concept - Gibbs and Helmholz energy; Condensed and uncondensed systems; Gibbs phase rule and degree of freedom – examples and application; Phase equilibrium and phase transformations; Invariant and non-invariant phase changes; Binary phase diagrams – miscible, immiscible and partially miscible systems; Isomorphous system; Utility of phase diagram; Phase diagrams with invariant transformations involving a liquid phase– peritectic, eutectic, syntactic, monotectic and metatectic; Phase diagrams showing solid state phase invariant transformations; Interpretation of microstructural evolution in binary systems using phase diagrams – effect on properties; Iron-carbon and iron-cementite equilibrium diagram; Definition and microstructure of steel and cast iron; Important phase transformations in steel; Classification of plain carbon steel and cast iron, Properties and utility of steel and cast iron; Effect of alloying elements on steel; Alloy steel – main classes and application; Important non-ferrous alloys and applications – aluminium and copper based alloys; Distinction from steel and ferrous alloys; Strengthening mechanisms of ferrous and non-ferrous alloys.	**10**
Module – III **Transformation curve and Heat Treatment Methods:**Kinetics of phase transformation – mechanism of solute transport; Diffusion; Shear; Isothermal decomposition of austenite in steel (TTT diagram); Non-isothermal decomposition of austenite in steel (CCT diagram); Homogeneous and Heterogeneous Nucleation Mechanism and Growth – Thermodynamics and kinetics; Heat treatments of steel – annealing, normalizing, hardening and tempering; Special heat treatments of steel (TMT, Austempering, Martempering, etc.); Concept of hardenability of steel, Jominy hardenability test; Mechanism of hardening of steel; Cold working and hot working; Strain hardening; Annealing of cold worked alloys - recovery, recrystallization and grain growth; Surface hardening, case hardening and surface engineering of steel; Heat treatment furnaces – types, uses and special features, Ovens, Heating elements, Temperature controllers and principles; Quenching and quanchants – process, stages and equipment, Heat treatment defects – types, causes, effects, precaution and remedies, Inspection and control.	**10**
Module – IV **Types of Alloys and applications:** Types and application of plain and alloyed cast iron – grey, spheroidal graphitic, white and malleable cast iron; Heat treatment and microstructure; Important non-ferrous alloys – Al, Cu, Pb, Zn, Ti, Mg and Ni based alloys; Heat treatments, Important properties and applications; Composition, microstructure, properties and classification of various grades of stainless steel, maraging steel and superalloys, Heat	**6**

treatments, Applications; Engineering ceramics – classification, fabrication, structure and properties; Important ceramics – refractory, glass, clay, cutting tools and functional ceramics; Engineering polymers: synthesis, structure and classification; Engineering properties; Applications.	
Module – V Material Testing methods: Testing of mechanical properties I: Surface (hardness, friction) and bulk (under tension and compression) mechanical properties, Definition and types of wear, Classification of mechanical properties – definition and units; Testing of mechanical properties II: Fatigue, impact, creep – definition, types and significance, Various combinations of important mechanical properties and testing, Review of failures; Functional properties: Thermal conductivity, Electrical conductivity, Emission – photo and thermoelectric, Magnetism, Topography, Colour, Reflection, Surface energy, Wetting, Catalysis, Adhesion/cohesion; Corrosion and oxidation properties and testing, Types, Conditions, Laws, Thermodynamics and kinetics, Prevention; Case studies of engineering failures due to stress, wear, erosion, fatigue cycles, thermal cycles, corrosion, oxidation, creep, etc.	**6**

TEXTBOOKS:

1. V. Raghvan, Material Science and Engineering, Prentice Hall India (T1)
2. William D. Callister Jr., Materials Science and Engineering, Wiley Publication (T2)
3. Y. Lakhtin, Physical Metallurgy (T3)
4. J. F. Shackelford – Introduction to Materials Science and Engineering – (T4)
5. R. E. Reedhill – Physical Metallurgy Principles – (T5)

REFERENCE BOOKS:

1. George Dieter, Physical Metallurgy, McGraw Hill Education (R1)
2. B.D. Cullity, Elements of X Ray Diffraction, Pearson Education (R2)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Study of Advanced Materials, Nano Materials, Non-Destructive Testing methods

POS MET THROUGH GAPS IN THE SYLLABUS

PO 1-5

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Electrical, Optical, Thermal, Magnetic and Electrical properties of materials. Composites, Degradation of Materials, Environmental and Societal Considerations in Material Science. Powder Metallurgy, Plastic Technology.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

PO 1-5, 11-12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

2. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Teacher's Assessment	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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		3	1		3	3	3	3
CO2	3	3	3	3	1	2	2			2		3	3	2	3
CO3	3	3	2	3	1	1	1		2			3	3	2	3
CO4	3	3	2	3	2	3	3	1	2		2	2	2	3	3
CO5	3	3	2	3	3	1			2	2		2	2	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24297**
Course Title: **Manufacturing Processes**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L: 3 T: 0 P: 0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **THIRD**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Examine the technical aspect related to basic manufacturing processes.
2.	Get acquainted with different methods of manufacturing used.
3.	Analyse different aspects of a manufacturing process along with their appropriate usage.
4.	and scope.
5.	Derive relationship and use empirical relations to study the effects of manufacturing parameters on a process.

COURSE OUTCOMES (COs)

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

CO1	Explain the basic principles behind different Casting, Welding, Forming and machining Processes.
CO2	Select appropriate manufacturing process for a given component design.
CO3	Identify advantages and limitations of various casting, welding, machining and forming Techniques.
CO4	Correctly explain and construct mathematical relationships existing amongst various parameters in different manufacturing processes.
CO5	Select appropriate welding process for a given joint.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Casting:** Introduction to foundry process and its importance; sand casting: patterns, pattern allowances, gating system components introduction and significance. Centrifugal casting , Hot chamber and cold chamber die casting; Investment casting	**8**
Module – II **Theory of Metal Cutting:** Geometry of single point cutting tool, Introduction to orthogonal cutting; Tool forces in orthogonal cutting, types of chips, tool failure, tool life, cutting tool materials.	**8**
Module – III **Machine Tools:** Construction, operations and specifications of lathe and shaper. Construction, operations and Specifications of milling & drilling machine. Introduction to grinding and types of grinding processes. .	**8**
Module – IV **Metal Deformation Processes:** Metal forming processes: Introduction to recovery, recrystallization and grain growth; Hot working and cold working Rolling: Classification of rolling processes, rolling mills, products of rolling and main variables Forging: Open and closed die forging, forging operations Extrusion: Classification of extrusion processes, hot and cold extrusion processes Sheet metal forming operations: Blanking and piercing, deep drawing, bending.	**8**
Module – V **Welding:** Principle, working and application of oxy- acetylene gas welding. Electric arc welding: MMAW/SMAW, SAW, GTAW and GMAW, Resistance welding. Soldering and Brazing.	**8**

TEXTBOOKS:

1. SeropeKalpakjian and Steven Schmidt , Manufacturing Processes for Engineering Materials, Pearson Education, 6th Edition
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Material. Processes, and systems, 2nd Edition, Wiley India, 2007
3. P.N. Rao, Manufacturing Technology – Metal Cutting and Machine Tools, McGraw Hill.
4. P.N. Rao, Manufacturing Technology, Foundry, Forming and Welding, McGraw Hill
5. Hajra Choudhury, Elements of Workshop Technology–Vol.-II, Media Promoters and Publishers

REFERENCE BOOKS:

1. E. P. DeGarmo, J. T. Black, and R. A. Kohser, Materials and processes in Manufacturing, PHI.
2. P. F. Ostwald, and Jairo Munoz, Manufacturing Processes and Systems, 9th ed., Wiley, India, 2002
3. Principles of metal casting, Rosenthal. P. C, Tata Mc Graw Hill
4. M. C. Shaw, Metal Cutting Principles, Oxford University Press, Oxford, 1984

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

CNC and automation technologies, additive manufacturing, advanced quality control methods, safety standards, and environmental sustainability.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Design and analysis of advanced manufacturing systems using CAD/CAM integration and automation in modern production environments.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, 11-12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE
DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT
1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	2		1	1		1	1	2	3	2	2
CO2	3	3	3	2	2	1	1	1	1	2	2	2	3	3	2
CO3	2	3	2	1	2	1	1	1	1	2	2	2	3	3	2
CO4	3	2	2	2	3		1	1		1	1	3	3	2	3
CO5	2	3	3	1	2	1	1	1	1	1	2	2	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **MA24201**
Course Title: **Numerical Methods**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **2** **(**L: 2 T: 0 P: 0)
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **THIRD**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Comprehend suitable numerical methods to solve algebraic and transcendental equations.
2.	Learn proper numerical methods to solve linear system of equations.
3.	Approximate a function using various interpolation techniques.
4.	Evaluation of derivatives and integrals using interpolating polynomials.
5.	Find the numerical solutions of initial value problems.

COURSE OUTCOMES (Cos)

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

CO1	Solve algebraic and transcendental equations using numerical methods for real-world problem solving.
CO2	Apply numerical techniques to solve linear system of equations in scientific and engineering computations.
CO3	Use interpolation methods to approximate functions in data analysis and modelling.
CO4	Compute derivatives and integrals for complex mathematical and physical problems.
CO5	Solve ordinary differential equations numerically for dynamic system modeling and Simulations.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Errors and nonlinear equations:** Types and sources of errors, Propagation of errors. Bisection method, Regula-Falsi method, Secant method, Newton-Raphson method and its variants, General Iterative method.	**5**
Module – II **System of linear equations:** Gaussian Elimination, Gauss-Jordan, LU Decomposition (Crout's method), Gauss-Jacobi and Gauss-Siedel methods to solve linear system of equations.	**5**
Module – III **Interpolation:** Lagrange's interpolation, Newton's divided differences interpolation formulas, Interpolating polynomial using Newton forward and backward differences.	**5**
Module – IV **Differentiation and integration:** Differentiation using interpolation formulas, Integration using Newton-Cotes formulas: Trapezoidal rule, Simpson's one-third and three-eighth rules.	**5**
Module – V **Solution of ordinary differential equations:** Euler's method, modified Euler's method, Runge-Kutta Methods of second and fourth order to solve initial value problems.	**5**

TEXTBOOKS:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age Publications, Fourth Edition, 2004.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, Fourth Edition, 2005.
3. E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

REFERENCE BOOKS:

1. S.C. Chapra and R. P. Canale, Numerical Methods for Engineers, McGraw Hill, Seventh Edition, 2014.
2. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, Seventh Edition, 2003.
3. R. W. Hamming, Numerical Methods for Scientists and Engineers, Second Edition, Dover Publications Inc. 1987.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution

Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **MT24131**
Course Title: **UHV2: UNDERSTANDING HARMONY**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L: 3 T: 0 P: 0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **THIRD**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Develop a holistic perspective based on self- exploration about themselves (human being), family, society and nature/existence.
2.	Understand (or developing clarity) of the harmony in the human being, family, society and nature/existence
3.	Strengthen of self-reflection
4.	Develop the commitment and courage to act

COURSE OUTCOMES (COs)

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

CO1	At the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature); they would become more responsible in life, and in handling problems

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Course Introduction - Need, Basic Guidelines, Content and Process for Value Education:** 1. Purpose and motivation for the course, recapitulation from Universal Human Values-I. 2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration. 3. Continuous Happiness and Prosperity- A look at basic Human Aspirations. 4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority. 5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario 6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels. Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.	**8**
Module – II **Understanding Harmony in the Human Being - Harmony in Myself!** 1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'. 2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility. 3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer). 4. Understanding the characteristics and activities of 'I' and harmony in 'I'. 5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail. 6. Programs to ensure Sanyam and Health. Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.	**8**
Module – III **Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship:** 1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship 2. Understanding the meaning of Trust; Difference between intention and competence 3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship 4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals 5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family. Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.	**8**
Module – IV **Understanding Harmony in the Nature and Existence - Whole existence as Coexistence:**	**8**

1. Understanding the harmony in the Nature 2. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self-regulation in nature. 3. Understanding Existence as Co-existence of mutually interacting units in all- pervasive space. 4. Holistic perception of harmony at all levels of existence. 5. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.	
Module – V **Implications of the above Holistic Understanding of Harmony on Professional Ethics:** 1. Natural acceptance of human values 2. Definitiveness of Ethical Human Conduct 3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order 4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. 5. Case studies of typical holistic technologies, management models and production systems 6. Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers b) At the level of society: as mutually enriching institutions and organizations 7. Sum up. Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions e.g. to discuss the conduct as an engineer or scientist etc.	**8**

TEXTBOOKS:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010

REFERENCE BOOKS:

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Assessment by faculty mentor	10
Self-assessment	10
Assessment by peers	10
Socially relevant project/Group ctivities/Assignments	20

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√				
Semester End Examination	√				

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1			2	1	1	3	3	3	2	2	1	3	1	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24202**
Course Title: **Numerical Methods Lab**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **1** **(**L: 0 T: 0 P: 2)
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **THIRD**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Execute appropriate numerical methods to solve algebraic and transcendental equations correct up to some certain level of significance.
2.	Solve linear system of equations using direct and iterative methods.
3.	Approximate a function by polynomial using various interpolation techniques along with computation of derivatives and integrals.
4.	Compute numerical solutions of initial value problems.
5.	Handle numerical problems efficiently through programming languages like C, C++ etc. on computer.

COURSE OUTCOMES (COs)

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

CO1	Employ numerical techniques to solve algebraic and transcendental equations
CO2	Analyze and implement numerical methods for solving systems of linear equations
CO3	Construct numerical approximations of functions using interpolation techniques
CO4	Compute derivatives and definite integrals using numerical differentiation and integration methods
CO5	Develop solutions of ordinary differential equations using appropriate numerical schemes

List of Assignments

Write a program to :

1. Find a simple root of $f(x) = 0$ using Bisection method. Read the end points of the interval in which the root lies, maximum number of iterations and error tolerance eps.
2. Find a simple root of $f(x) = 0$ using Regula-Falsi method. Read the end points of the interval in which the root lies, maximum number of iterations and error tolerance eps.
3. Find a simple root of $f(x) = 0$ using Secant method. Read the end points of the interval in which the root lies, maximum number of iterations and error tolerance eps.
4. Find a simple root of $f(x) = 0$ using Newton Raphson method. Read any initial approximation, maximum number of iterations and error tolerance eps.
5. Find the solution of a system of linear equations using Gauss elimination method.
6. Find the solution of a system of linear equations using Gauss-Jordan method.
7. Find the solution of a system of linear equations using Jacobi method.
8. Find the solution of a system of linear equations using Gauss-Seidel method.
9. Approximate the function using Lagrange interpolation formula.
10. Approximate the function using Newton divided difference formula.
11. Approximate the function using Newton's forward and backward interpolation formulae.
12. Evaluate the integral using Trapezoidal rule.
13. Evaluate the integral using Simpson's one-third and three-eighth rules.
14. Solve an IVP, $\frac{dy}{dx} = f(x, y), y(x_0) = y_0$ using Euler method.
15. Solve an IVP, $\frac{dy}{dx} = f(x, y), y(x_0) = y_0$ using the classical Runge-Kutta fourth order method.

TEXTBOOKS:

1. Jain M.K, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age Publications, 2004.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, Fourth Edition, 2005.
3. Y. Kanetkar, Let Us C, BPB Publications, Fifteenth Edition, 2016.

REFERENCE BOOKS:

1. S.C. Chapra and R. P. Canale, Numerical Methods for Engineers, McGraw Hill, Seventh Edition, 2014.
2. R. W. Hamming, Numerical Methods for Scientists and Engineers, Second Edition, Dover Publications Inc. 1987.
3. H. Schildt, C++: The Complete Reference, McGraw-Hill Education, Fourth Edition, 2017.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	3	1	1	1	1	2	1	3	3	2	2
CO2	3	3	2	3	3	1	1	1	2	2	2	3	3	2	2
CO3	3	3	3	3	3	1	2	1	2	3	2	3	3	3	3
CO4	3	3	3	3	3	1	2	1	2	3	2	3	3	2	3
CO5	3	3	3	3	3	1	2	1	2	3	2	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3
CO5	CD3

COURSE INFORMATION SHEET

Course Code: **ME24202**
Course Title: **Fluid Mechanics and Hydraulic Machines Lab**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **1** **(**L: 0 T: 0 P: 2)
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **THIRD**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Familiarize with the different hydraulic equipment's and machines.
2.	Impart knowledge and skill to use common hydraulic machines equipment and measuring instruments.
3.	Educate students of safe handling of various hydraulic machines.

COURSE OUTCOMES (COs)

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

CO1	Be conversant with the basic fluid dynamics principles used in hydraulics and hydraulic machines.
CO2	Explain the basic principles of fluid dynamics using various Instruments, and Equipment's.
CO3	Apply the fundamentals of fluid dynamics principles to perform experiments.
CO4	Develop skills to work as an individual or in a team during Lab Experiments.

List of experiments:

1. To determine the center of pressure of plane surface under partial and submerged condition.
2. To verify Bernoulli's theorem.
3. To determine the friction factor 'f' for the turbulent flow through the commercial pipes of various sizes.
4. To determine the co-efficient of discharge through Venturimeter.
5. To measure the co-efficient of discharge through Orifice meter.
6. To study the effect of liquid impact of jet on hemispherical Vane/flat plate Vane.
7. To draw the characteristic curves of Francis turbine.
8. To draw the characteristic curves of multistage centrifugal pump.
9. To draw the characteristic curves of reciprocating pump.
10. To draw the characteristic curve of a Pelton wheel at a constant speed.
11. To determine the surface profile of liquid under free and forced vortex conditions.
12. To determine the operating characteristics of the modern Francis Turbin (Mixed Flow Type).
13. To study the discharge over different types of notches.

TEXTBOOKS:

1. Hydraulics, Fluid mechanics and Hydraulic Machinery by MODI and SETH.
2. Fluid mechanics and Hydraulic Machines by R.K. Bansal
2. Hydraulic Machines by Jagdishlal
3. Fluid Mechanics, Fundamentals and Applications (in SI Unit) by Yunus A. Cangel and John M. Cimbala, McGraw Hill.

REFERENCE BOOKS:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria& Sons.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO2	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO3	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO4	3	3	3	3	3	3	2	3	3	3	2	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3

BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK
(Effective from Academic Session: Monsoon 2024)

Bachelor of Technology

DEPARTMENT OF MECHANICAL ENGINEERING
SECOND YEAR (SEMESTER – IV)

COURSE INFORMATION SHEET

Course Code: **ME24207**
Course Title: **Kinematics and Dynamics of Machines**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **4** **(**L:3 T:1 P:0)
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **FOURTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand basic principles of kinematic chains, Degree of freedom.
2.	Analyze velocity and acceleration of planar mechanisms, balancing in rotary and reciprocating machinery, forces and moments acting in planar mechanism
3.	Evaluate and design contact ratio, tooth profile and related parameters of gears.
4.	Design cam profiles for specified motion of follower, Flywheel and governor.
5.	Understand conservation of angular momentum and gyroscopic couple.

COURSE OUTCOMES (COs)

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

CO1	Explain kinematic and dynamic principles of planar mechanism.
CO2	Apply the basic principles into planar mechanisms for relevant applications.
CO3	Anlayse the acceleration and forces during the motion of machines and mechanisms.
CO4	Evaluate the problems related to the motions of machines and mechanism.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Planar mechanisms and kinematic analysis:** Mechanisms and machines, kinematic pairs, kinematic chains, kinematic inversions, mobility and range of movement, velocity and acceleration analysis, Coriolis' component of acceleration, instantaneous center of zero velocity, Aronhold-Kennedy theorem of three centers.	**9**
Module – II **Gear and Cam:** Basic terminology of a spur gear, types of gears, fundamental law of gearing, contact ratio, interference and undercutting, gear trains, basic terminology of cam, displacement diagram, velocity and acceleration of follower.	**9**
Module – III **Flywheel and Governor**: D'Alembert's principle and dynamic equilibrium, Dynamic force analysis (analytical method), Dynamically equivalent link, turning moment on crank shaft, Turning moment diagram, fluctuation of energy and speed, flywheel. **Principles of centrifugal governors:** Porter, Proell and Hartnell governor.	**9**
Module – IV **Balancing:** Balancing of reciprocating and rotating masses, two plane balancing, Balancing of inline, V twin, and radial engines.	**9**
Module – V **Gyroscope:** Gyroscopic couple, gyroscopic effect on aeroplanes, gyroscopic effect on naval ships, stability of an automobile, stability of a two-wheel vehicle, rigid disc at an angle fixed to a rotating shaft.	**9**

TEXTBOOKS:

1. S. S. Rattan, Theory of Machines, Tata McGraw Hill education, Third Edition.
2. Thomas Bevan, The theory of Machines, CBS Publishers and Distributers Privet Limited, Third edition.

REFERENCE BOOKS:

1. John J. Uicker, Gordon R. Pennockand, Joseph E. Shigley Theory Of Machine and Mechanisms, Oxford University Press; 4th edition.
2. R. L. Norton, Kinematics and Dynamics of Machinery, McGraw Hill Education.
3. A. Ghosh and A. K. Mallik, Theory of Mechanisms and Machines, Affiliated East-West Press Privet Limited, Third edition.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Real-world applications (such as robotics or mechatronics), and industry-relevant software for kinematic and dynamic analysis.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Kinematic synthesis and optimization of mechanisms for specific motion or force transmission requirements.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	2	2	2	2	2	2	1	2	2	2	3
CO2	3	3	3	3	2	3	2	2	2	2	1	2	2	2	3
CO3	3	3	3	3	2	2	2	2	2	2	1	2	2	2	3
CO4	3	3	3	3	2	2	2	2	2	2	1	2	2	2	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24209**
Course Title: **Thermal Energy Conversion Systems**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **4** **(**L:3 T:1 P:0)
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **FOURTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Provide basic understanding of steam power thermodynamical cycle and to analyse and apply different methods for improvement of overall the thermal performance of the plants.
2.	Develop comprehensive knowledge and understanding of the operating principles of different components of thermal power plants for effective application and utilization heat power conversion theories in engineering practices.
3.	Develop an intuitive understanding of thermal energy conversion systems by emphasizing the scientific and engineering arguments.
4.	Enable students to classify and analyse different thermal energy conversion systems and to correlate with real-life engineering problems.
5.	Equip with problems solving skills and to give a feel of how thermal energy conversion principles can be applied in engineering practice.

COURSE OUTCOMES (COs)

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

CO1	Discuss vapor power cycles to evaluate performance and efficiency
CO2	Assess combustion and boiler performance using thermodynamics principles.
CO3	Analyse the flow and efficiency of steam nozzle and turbines.
CO4	Evaluate steam condensers for improved heat exchange and system efficiency.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Vapour Power Cycle:** Components of steam power system; Carnot vapour cycle and Rankine cycle; their comparisons; P-v, T-s & h-s diagrams; Deviation of actual vapour power cycle from ideal cycle; mean temperature of heat addition; Reheat cycle; Ideal regenerative cycle; feed water heaters.	**9**
Module – II **Fuels and Combustions:** Classification of fuels; basic chemistry and combustion equations; conversion of volumetric to weight analysis and vise-versa; theoretical and excess air; Boiler performance: Equivalent evaporation; Boiler efficiency; Heat balance; Boiler Draught and its classification; Chimney height, maximum discharge and efficiency.	**9**
Module – III **Steam Nozzles:** Introduction; types of steam nozzles; nozzle efficiency; velocity of steam flow through the nozzle; discharge and condition of maximum discharge through a nozzle; physical significance of critical pressure ratio and choked flow; Supersaturated flow through nozzle; General relationship between area, velocity and pressure in nozzle flow.	**9**
Module – IV **Steam Turbines:** Classifications; compounding of turbines; working principle, velocity diagrams, diagram work and efficiency of impulse and reaction turbine; degree of reaction, Parsons turbine, condition for maximum efficiency impulse and reaction turbine; Losses in steam turbines, reheat factor and condition line; governing of steam turbine; Back-pressure and pass-out Turbine.	**9**
Module – V **Steam condensers:** Classification of condensers; sources of air leakage into the condenser; effects of air leakage in condenser; vacuum efficiency; condenser efficiency; cooling water calculations; Air ejector. Cooling pond.	**9**

TEXTBOOKS:

1. Steam and Gas Turbines – R. Yadav, Central Publishing House
2. Elements of Heat Engine – Pandey & Saha
3. Thermal Engineering – R. K. Rajput
4. Power Plant Engineering – P.K. Nag; Tata McGraw-Hill publication

REFERENCE BOOKS:

1. Power Plant Technology- M.M.Ei. -Wakil, McGraw Hill
2. Theory and Practice of Heat Engine – D. A. Rangham; Camb. Univ. Press.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Modern Boiler and Turbine Technologies, Waste Heat Recovery & Cogeneration.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Exergy Analysis in Power Plants, Pinch Analysis for Heat Exchangers: Optimizing heat exchanger networks to improve efficiency.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2						1	1			1	1	1	2
CO2	3	2						1	1			1	1	1	2
CO3	3	2	1	1				1	1			1	1	1	2
CO4	3	2						1	1			1	1	1	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: ME24211
Course Title: Machine Design
Pre-requisite(s): NIL
Co- requisite(s): NIL
Credits: 4 (L:3 T:1 P:0)
Class schedule per week: 4
Class: B. Tech.
Semester / Level: FOURTH
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Apply the concepts of stress analysis, theories of failure to select appropriate material and design machine components.
2.	Design the variety of mechanical components.
3.	Apply mechanical engineering theories for static and dynamic loading in design of mechanical components.
4.	Judge, solve and correlate various parameters required for the performance of machine design at industry level.
5.	Classify, solve, and correlate machine design problems.

COURSE OUTCOMES (COs)

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

CO1	Explain the principles of machine design and failure theories.
CO2	Apply the design concepts on various joints and components of machines.
CO3	Analyse the forces and strength of for different parts of the machine components.
CO4	Evaluate different conditions problems associated to machine components.
CO5	Create or design the components according to specific/special conditions.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Failure of Materials:** Principles of Machine Design, standardization, Tolerances, Design against static and fluctuating loads, Theories of failures, Design of cotter joint and knuckle joint, Fatigue failure, Endurance limit, Notch Sensitivity, Gerber, Soderberg, Goodman, and Modified Goodman criteria, Design against combined loads.	**9**
Module – II **Design of Threaded, Welded, and Riveted joints:** Threaded joints: Basic types of screw fastening, Bolt of uniform strength, Terminology of screw threads, Bolt under tension. Welded joints: Butt joints, Fillet joints, Strength of butt and fillet welds. Riveted joints: Types of rivet heads, types of rivet joints, Strength equations, Efficiency of joint, Caulking and fullering, Eccentrically loaded bolted, riveted and welded joints.	**9**
Module – III **Design of Brakes and Clutches:** Types of Brakes and Clutches, Clutch/Brake selection and specification, Clutch and Brake materials, Disc Clutches, Shoe, Band and Disk Brakes.	**9**
Module – IV **Design of Springs and Bearing:** Spring configuration, Spring materials, Design of helical springs. Bearings, Types of sliding contact bearings, bearing materials, lubricating oils, Petroff's equation, McKee's Investigation, Rolling contact & Sliding contact bearings.	**9**
Module – V **Design of Gears:** Types of gear, Terminology of gear, standard systems of gear tooth, Force analysis of spur, helical, bevel, and worm gears, Beam and wear strength of gears, Lewis and Buckingham's equation, Effective load on spur gear tooth.	**9**

TEXTBOOKS:

1. Mechanical Engineering Design by J.E. Shigley, C.R. Mischke & R.G. Budynas, McGraw Hill.
2. Machine elements in Mechanical Design by R.L. Mott, Prentice Hall.
3. Machine Design, An Integrated Approach by Robert L. Norton, Second Edition.
4. Mechanical Design of Machine Components by Ansel C. Ugural.

REFERENCE BOOKS:

1. Introduction to Machine Design by V. B. Bhandari
2. Machine Design Data Handbook by K. Lingaiah
3. Mechanical Design by P. Childs, Elsevier.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Surface failures in different machine elements.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Addressed about the surface failures of machine parts by giving real world examples, like machine body failures, gears, automobile parts etc.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1						1		2	3	2	3
CO2	3	3	3	2	2					1		2	3	2	3
CO3	3	3	3	3	2							2	3	3	2
CO4	3	3	3	3	3	1						2	2	3	2
CO5	3	3	3	3	3	1	1			1	1	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24215 (Program Elective-I)**
Course Title: **Composite Materials**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **4** **(**L:3 T:1 P:0)
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **FOURTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present a comprehensive exposure to different composite materials
2.	Lay the groundwork for various types and kinds of composite materials
3.	Develop an intuitive understanding of Polymer, ceramic, metal based Composite materials.
4.	Present a comprehensive exposure to different manufacturing and testing techniques for composites.
5.	Present a wealth of real-world engineering examples to give students a feel for how composite materials are replacing the materials in all types of engineering products.

COURSE OUTCOMES (COs)

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

CO1	Explain the classification and characteristics of PMC, MMC, and CMC.
CO2	Apply the Rule of Mixtures and Halpin-Tsai equations to predict the mechanical properties of fiber-reinforced composites.
CO3	Analyse the design and processing factors of specialty composites.
CO4	Evaluate different composite manufacturing techniques for specific applications, considering material properties, efficiency and cost.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction to Composite Materials:** Definition of composites, Classification of composites; General characteristics of reinforcement- classification, terminology used in fiber science, CMC, MMC and PMC.	**6**
Module – II **Polymer Matrix Composites:** Thermoplastic and thermosetting resins; Commonly used matrix reinforcement system;Fibre, Flake and particulate reinforced composites, Reinforcements used in PMC's- glass, carbon, aramids, boron, Roving's, yarns, fabrics, etc.; Thermoset matrices for aerospace components- polyesters, epoxies, phenolics, vinyl esters, cyanate esters, etc.; Thermoplastic matrices for advanced composites- PEEK, polysulfones, polyimides, etc. concept of A stage, B stage and C stage resins; **Particulate and Fiber Filled Polymeric Composites**: Applications, Function of matrix, Function of fibres, Polymer-fibre interface, Factors influencing the performance of composite, Coupling agents, Bonding agents, short fibre composites, Theories of stress transfer, Analysis of short fibre composites, Critical fibre length, Rule of mixtures; **Continuous Fiber Polymeric Composites:** Analysis of long fiber composites, Longitudinal behavior of unidirectional composites; Failure mechanism and strength, Factors influencing longitudinal and transverse strength and stiffness, Halpin-Tsai equations for transverse modulus, Prediction of Poisson's ratio, Various failure modes.	**12**
Module – III **Specialty Composites:** Composites for satellites and advanced launch vehicles, Design considerations PMC- for structural composites, Theory and application of ablatives, MMC-design, applications; Silicon carbide composites, design, processing and properties; **Carbon-Carbon Composites:** Matrix precursors, Manufacturing considerations, Multi directional reinforced carbon-carbon composites.	**9**
Module – IV **Nano composites:** Nano particle dispersion in polymer matrix, Polymer- nanoclay composites and polymer-carbon nano tubes composites. **Functionally graded and Hierarchical Composites**; Classification i.e., Natural and Man-made, Uniaxial and bi-axial property gradient, Application in various industrial sectors.	**10**
Module – V **Manufacturing Techniques:** Hand lay-up, Filament winding, Pultrusion, Resin transfer moulding, Processing science of reactive polymer composites, Process steps for production, Selection of processing conditions toolings, Equipments, Carbon-carbon composites, Processing, Thermal and mechanical properties, Quality control. **Testing of composites**: Raw material testing, Property evaluation at laminate level, NDT techniques; **Design and analysis of composite structures**: Macro mechanics of a lamina, Micro mechanics, Laminate analysis, FE model and analysis.	**8**

TEXTBOOKS:

1. R.M. Jones, Mechanics of Composites, 2nd ed., Taylor & Francis, 1999.
2. T. G. Gutowski, (Ed.) Advanced Composites Manufacturing, John Wiley & Sons, New York 1997.

REFERENCE BOOKS:

1. P.M. Ajayan, L. Schadler, P.V. Braun Nano Composite Science and Technology, Wiley VCH, 2003.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Real-world case studies, sustainability considerations, and industry-standard testing protocols.

POS MET THROUGH GAPS IN THE SYLLABUS; PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Advanced design methodologies for smart composites incorporating self-healing and adaptive functionalities.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24217 (Program Elective-I)**
Course Title: **Renewable Energy Resources**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **4** **(**L:3 T:1 P:0)
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **FOURTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the difference between the non-renewable energy system and the renewable energy systems
2.	Lay the groundwork for subsequent studies in the fields of renewable energy sources
3.	Develop an intuitive understanding of the applications of different renewable energy sources like solar, wind, biomass, ocean thermal, geothermal etc.
4.	Understand the working principles related to different renewable energy systems
5.	Understand state of art renewable energy system used in industrial application.

COURSE OUTCOMES (COs)

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

CO1	Explain the various sources of energy.
CO2	Apply the working principle of different Renewable energy systems.
CO3	Analyse various Renewable Energy Resources.
CO4	Evaluate the performances of different Renewable energy systems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Needs of renewable energy, Classification of Energy Resources, Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations, Comparison of Conventional and Non-Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario.	**9**
Module – II Introduction, Solar Radiation, Solar Constant, Basic Sun-Earth Angles, Solar Radiation Geometry and its relation, Measurement of Solar Radiation, Principle of Conversion of Solar Radiation into Heat, Collectors(Flat Plate and Concentrating Collectors), Solar Water Heaters , Solar Cookers , Solar driers, Solar Still, Solar Furnaces, Solar Green Houses. Solar Photovoltaic, Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems (stand-alone and grid connected), Solar PV Applications.	**9**
Module – III Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario – World and India. Basics of lift and drag, Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection consideration, wind farm, Advantages and Disadvantages of WECS.	**9**
Module – IV Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants, energy plantation, Biomass program in India.	**9**
Module – V Tidal Energy, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants. Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle). Geothermal Energy, Resources of geothermal energy, Hydrogen and Storage, Fuel Cell Systems, Hybrid Systems.	**9**

TEXTBOOKS:

1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 1996.
2. Rai. G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
3. Twidell, J.W. & Weir, A., “Renewable Energy Sources”, EFN Spon Ltd., UK, 2006.

REFERENCE BOOKS:

1. Sukhatme. S.P., “Solar Energy”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2. Tiwari. G.N., Solar Energy – “Fundamentals Design, Modelling& Applications”, Narosa Publishing House, New Delhi, 2002.
3. Freris. L.L., “Wind Energy Conversion Systems”, Prentice Hall, UK, 1990.
4. Chetan Singh Solanki, Solar Photovoltaics, “Fundamentals, Technologies and Applications”, PHI Learning Private Limited, New Delhi, 2009.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Renewable Energy Economics & Policy Frameworks, Computational Tools & Simulation.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
AI & IoT in Renewable Energy Systems.
POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE
Design & Optimization of Renewable Systems.

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	1	1	2	2	3	1	1		1	2	3	2	2
CO2	3	3	2	2	2	2	3	1	1		1	2	3	2	2
CO3	3	3	3	3	2	2	3	1	1		1	2	3	3	3
CO4	3	3	3	3	2	2	3	1	1		1	2	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24219 (Program Elective-I)**
Course Title: Non-Destructive Testing
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **4** **(**L:3 T:1 P:0)
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **FOURTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Introduce the methods employed for non-destructive testing (NDT) of structures and materials.
2.	Understand the importance, limitations and applications of different NDT techniques.
3.	Identify the nature of a flaw and apply the theory of NDT for improving reliability of a component.
4.	Apply the knowledge of Non-destructive testing to industrial applications.
5.	Be aware of the developments and future trends in NDT.

COURSE OUTCOMES (COs)

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

CO1	Explain various methods of NDT for detection of surface and sub-surface flaws.
CO2	Apply the principles of visual inspection, magnetism and electromagnetism to inspect surface flaws.
CO3	Demonstrate the use of radiographic and ultrasonic testing for detection of internal discontinuities.
CO4	Analyse various types of flaws and select suitable NDT techniques.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction to NDT and Visual Inspection and Liquid Penetrant Testing:** Introduction and Classification of NDT, Visual Inspection Methods, Dye Penetrant Testing (DPT), Basic Principle of DPT, Types of dye and method of application, DPT-Developer application, and Inspection.	**9**
Module – II **Magnetic Particle Testing (MPT) & Eddy Current Testing (ECT):** Basic definition of Magnetism & Principle of MPT, Magnetizing Techniques, Procedure & Equipment used for MPT, Applications & limitations of MPT. Principle & Instrumentation for ECT, Techniques used in ECT, Advanced ECT methods, Applications & limitations of ECT.	**9**
Module – III **Radiographic Testing:** Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films–graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography.	**9**
Module – IV **Ultrasonic Testing:** Basic Properties of Sound Beam, Ultrasonic Transducers, Inspection techniques, Flaw Characterization Techniques and Detection Equipment, Applications, Advantages & Limitations of Ultrasonic Testing.	**9**
Module – V **Comparison and Selection of NDT methods:** Defects in Materials, Selection of NDT Method, Selection of Instrumentation, Codes/Standards in NDT and Industrial Practices.	**9**

TEXTBOOKS:

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010.

REFERENCE BOOKS:

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17
3. ASNT, American Society for Non-Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 4, Radiographic Testing.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Hands on experience in non-destructive testing methodology, Advanced testing methods.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Industrial/International Standards related to Non-Destructive Testing.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	1	1						1	1	1	1
CO2	3	2	2	2	2	1	1	1	2	1		2	1	1	2
CO3	3	2	2	2	2	1	1	1	2	1		2	1	1	2
CO4	3	2	2	2	2	1	1	1	2	1		2	1	1	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24223 (Open Elective-I)**
Course Title: **Smart and New Materials**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **FOURTH**
Branch: **Other than Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present a comprehensive exposure to various new engineering materials
2.	Lay the groundwork for various smart materials and their applications
3.	Develop an intuitive understanding of Electro-Rheological (Fluids) Smart Materials, Piezoelectric Smart Materials, Shape – Memory (Alloys) Smart Materials etc.
4.	Present a wealth of real-world engineering examples to give students a feel for how new materials are applied in development of engineering products.

COURSE OUTCOMES (COs)

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

CO1	Explain the types and applications of intelligent materials, including structural, functional, and bio-mimetic materials.
CO2	Apply principles of smart materials to design hybrid systems with passive and active sensing capabilities.
CO3	Analyse the behaviour and applications of electro-rheological fluids and piezoelectric materials in smart systems.
CO4	Evaluate the use of shape-memory alloys in various industries, considering their properties and challenges.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction and Historical Perspective** Classes of materials and their usage – Intelligent /Smart materials – Evaluation of materials Science – Structural material – Functional materials – Polyfunctional materials – Generation of smart materials – Diverse areas of intelligent materials –Primitive functions of intelligent materials – Intelligent inherent in materials –Examples of intelligent materials, structural materials, Electrical materials, biocompatible materials etc. – Intelligent biological materials – Bio-mimetics – Wolff's law– Technological applications of Intelligent materials.	**8**
Module – II **Smart Materials and Structural Systems** The principal ingredients of smart materials – Thermal materials – Sensing technologies – Micro sensors – Intelligent systems – Hybrid smart materials – Analgorithm for synthesizing a smart material – Passive sensory smart structures–Reactive actuator based smart structures – Active sensing and reactive smart structures – Smart skins – Aero elastic tailoring of airfoils – Synthesis of future smart systems.	**8**
Module – III **Electro-Rheological (Fluids) Smart Materials** Suspensions and electro-rheological fluids – Bingham-body model – Newtonian viscosity and non-Newtonian viscosity – Principal characteristics of electro rheological fluids – The electro-rheological phenomenon – Charge migration mechanism for the dispersed phase – Electro-rheological fluid domain – Electro-rheological fluid actuators– Electro-rheological fluid design parameter – Applications of Electro-rheological fluids.	**8**
Module – IV **Piezoelectric Smart Materials** Background – Electrostriction – Pyro electricity – Piezoelectricity – Industrial piezoelectric materials – PZT – PVDF – PVDF film – Properties of commercial piezoelectric materials – Properties of piezoelectric film (explanation) – Smart materials featuring piezoelectric elements – smart composite laminate with embedded piezoelectric actuators – SAW filters.	**8**
Module – V **Shape – Memory (Alloys) Smart Materials** Background on shape – memory alloys (SMA) Nickel – Titanium alloy (Nitinol) –Materials characteristics of Nitinol – Martensitic transformations – Austenitictrans formations – Thermoelastic martensitic transformations – Cu based SMA, chiral materials – Applications of SMA – Continuum applications of SMA fasteners – SMA fibers – reaction vessels, nuclear reactors, chemical plants, etc. – Micro robotactuated by SMA – SMA memorization process (Satellite antenna applications) SMA blood clot filter – Impediments to applications of SMA – SMA plastics – primary molding – secondary molding – Potential applications of SMA plastics.	**8**

TEXTBOOKS:

1. M.V. Gandhi and B.S. Thompson, Smart Materials and Structures Chapman and Hall, London, First Edition, 1992
2. T.W. Deurig, K.N.Melton, D.Stockel and C.M.Wayman, Engineering aspects ofShape Memory alloys, Butterworth –Heinemann, 1990

REFERENCE BOOKS:

1. C.A.Rogers, Smart Materials, Structures and Mathematical issues, Technomic Publising Co., USA, 1989.
2. Brain Culshaw – Smart Structure and Materials Artech House – Borton. London-1996.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Industrial/International Standards related to Non-Destructive Testing.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Design and Integration of AI-Driven Adaptive Smart Material Systems for Real-Time Structural Health Monitoring and Autonomous Response.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24225 (Open Elective-I)**
Course Title: **Experimental Methods in Engineering**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **FOURTH**
Branch: **Other than Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Introduce students to different experimental techniques used in engineering systems.
2.	Provide knowledge in designing experiments, collecting data and interpreting results to enhance engineering system performance.
3.	Familiarize students with advanced techniques for accurate measurement and analysis in engineering systems. Measurement in thermal systems.

COURSE OUTCOMES (COs)

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

CO1	Explain experimentation techniques for enhancing engineering system performance.
CO2	Describe various instruments to measure and assess properties influencing engineering system functionality, incorporating uncertainty analysis.
CO3	Implement and integrate computing tools for real time data acquisition and analysis.
CO4	Organize experimental methods to optimize engineering system design and operation, considering sustainability and efficiency.
CO5	Appraise and implement cutting edge measurement techniques and systems to address complex engineering challenges.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to Experimental Methods in Engineering: Overview of experimental techniques versus simulations, Principles of experimental setups and methodologies, Globule versus local instruments, static versus dynamic calibration.	**8**
Module – II Measurement Systems and Techniques: Analog and digital measurement systems, accuracy, precision and calibration techniques, Selection and use of instruments for temperature, pressure and flow rate measurements, Introduction to optical and non-optical diagnostics in engineering experiments.	**8**
Module – III Uncertainty analysis in Engineering Measurements: Types of errors and uncertainties in experimental data, statistical methods for uncertainty quantification, propagation of uncertainties in engineering measurements, uncertainty analysis in different experiments.	**8**
Module – IV Design of experiments (DOE) in Engineering: Concepts and methodologies of DOE, practical examples and applications in engineering experiments, Flow visualization in fluid flow experiments, Particle Image Velometry(PIV).	**8**
Module – V Optimization Techniques in Engineering Experimentation: Historical development, and engineering applications of optimization techniques, Classification and techniques of optimization in engineering experiments, Introduction to Linear programming and its application in engineering problems, Non-linear optimization techniques, Introduction of Image processing and its application, signal processing.	**8**

TEXTBOOKS:

1. Debin, E.O. Measurement systems – Application and Design, Tata McGraw Hill, New Delhi.
2. Holman, J.P. Experimental methods for Engineering, Tata McGraw Hill.

REFERENCE BOOKS:

1. Bouker, A.H., and Lieberman, G.J. Engineering Statistics, Prentice Hall, New Jersey, 1972.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

IoT-based instrumentation, and industry-standard practices for automation and remote monitoring of experiments.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Advanced experimental techniques using AI-driven data acquisition and real-time optimization in engineering measurements and diagnostics.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	1											
CO2	3	3	2	1			1		1						
CO3	3	3	2	2	3							1			
CO4	3	3	3	2			3	1	1	1	1	1	1		
CO5	3	3	3	2	2		2	1	1	1	1	1	2	1	

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24208**
Course Title: **Basic Mechanical Engineering Lab**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **1** **(**L:0 T:0 P:2)
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **FOURTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Familiarize with the basic Mechanical Engineering principles.
2.	Impart knowledge and skill to use common Mechanical Engineering Equipment and measuring instruments.
3.	Educate students of safe handling of machines and Equipment.

COURSE OUTCOMES (COs)

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

CO1	Be conversant with the basic Mechanical Engineering principles.
CO2	Explain the basic principles of Mechanical Engineering using various Instruments, and Equipment's.
CO3	Apply the fundamentals of Mechanical Engineering principles to perform experiments.
CO4	Develop skills to work as an individual or in a team during Lab Experiments.

SYLLABUS

List of Experiments

1. Experimental determination of forces in members of statically determinant truss.
2. To find out the mechanical advantage, velocity ratio and mechanical efficiency of simple screw jack and plot a graph of applied load vs. actual effort, applied load vs. mechanical advantage and applied load vs. mechanical efficiency.
3. To evaluate the mechanical advantage, velocity ratio and the mechanical advantage of a worm and worm wheel and plot a graph of applied load vs. actual effort, applied load vs. mechanical advantage and applied load vs. mechanical efficiency.
4. To determine the shear force and bending moment in a simply supported and cantilever beam.
5. Determination of modulus of rigidity of a solid and hollow shaft using torsion test.
6. To determine the tensile strength of low and high carbon steel and plot stress-strain for the two specimens.
7. To determine the impact strength of mild steel and cast iron.
8. Measurement of Torque and Power in a rotating shaft.
9. Determination of Brinell and Rockwell hardness of mild steel and cast iron.
10. Plotting of I-V and P-V characteristics of a given solar photo-voltaic module with varying radiation intensity, temperature level and tilt angle.
11. To study the I-V and P-V characteristics of solar modules when (i) connected in series and (ii) connected in parallel.
12. Measurement of dry bulb temperature (DBT), wet bulb temperature (WBT), wet bulb depression and humidity of room air.

TEXTBOOKS:

1. Basic Mechanical Engineering by Basant Agrawal & C.M. Agrawal, Wiley.
2. Laboratory Manual for Basic Mechanical Engineering by Dr. Anil Singh Yadav & Prof. Sachin Kumar Nikam,

REFERENCE BOOKS:

1. Advance Basic Mechanical Engineering (Practical & Application) by Patel Prakashbhai Ratubhai, Shashwat Publication.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20

End Semester Examination	% Distribution
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3

COURSE INFORMATION SHEET

Course Code: **ME24210**
Course Title: **Dynamics of Machines Lab**
Pre-requisite(s): **Kinematics and Dynamics of Machines**
Co- requisite(s): **NIL**
Credits: **1.5** **(**L:0 T:1 P:3)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **FOURTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Verify basic principles of vibration, its source and effect in different mechanical Systems.
2.	Verify the effect of critical speed in simple rotating systems
3.	Verify and determine gyroscopic couple

COURSE OUTCOMES (COs)

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

CO1	Measure vibration parameters in single degree freedom systems
CO2	Understand the concept of whirling of shaft experimentally
CO3	Perform experiments on balancing of reciprocating masses
CO4	Apply the knowledge of dynamics in balancing of wheels.
CO5	Demonstrate the working principles of gyroscope, cam and governor

SYLLABUS

List of Experiments

Experiment no. 1: Simple pendulum
Objective: To study the motion of simple pendulum.

Experiment no. 2: Compound pendulum
Objective: To verify the relation of a compound pendulum and determination of radius of Gyration.

Experiment no. 3: Bifilar suspension
Objective: To determine the radius of gyration of a given bar using bifilar suspension.

Experiment no. 4: Torsional vibration I
Objective: To study the torsional vibration of a single rotor system.

Experiment no. 5: Torsional vibration II
Objective: To study the torsional vibration of two rotor system.

Experiment no. 6: Effect of damping
Objective: To find the frequency of beam at different damping

Experiment no. 7: Balancing
Objective: Balancing of reciprocating masses.

Experiment no. 8: Wheel balancer
Objective: To balance an unbalanced wheel on the Wheel balancer.

Experiment no. 9: Gyroscope
Objective: To study the gyroscopic couple due to simultaneous spin and precession of a disc.

Experiment no. 10: Whirling of a shaft
Objective: To study the effect of whirling of shaft for different boundary conditions.

Experiment no. 11: Hartnell Governor
Objective: To determine the position of sleeve against controlling force and speed of a Hartnell Governor and to plot characteristic curve for radius of rotation.

Experiment no. 12: Cam follower mechanism
Objective: To construct displacement diagram for cam follower mechanism and to determine Jump speed against different inertia of the follower.

REFERENCE BOOKS:

1. Theory of mechanisms and machines by A. Ghosh and A.K. Mallik, East West Press.
2. Theory of Machines by S.S.Rattan, TMH Pvt. Ltd.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO2	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO3	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO4	3	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	3	2	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3
CO5	CD3

COURSE INFORMATION SHEET

Course Code: **PE24298**
Course Title: **Manufacturing Process Lab**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **1.5** **(**L:0 T:0 P:3)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **FOURTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Examine different patterns used in sand casting.
2.	Get familiar with sand testing methods.
3.	Get hands-on experience of various welding processes and select the best technique in engineering practices.
4.	Develop skills in various machining processes.
5.	Understand about retrofitting of a machine tool.

COURSE OUTCOMES (COs)

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

CO1	Design patterns used in sand casting.
CO2	Ascertain the quality of moulding sand for sand casting.
CO3	Apply arc welding processes for various applications.
CO4	Select and apply various machining processes as per applications.
CO5	Explain about retrofitting of a machine tool.

SYLLABUS

Experiments	Shop/Lab	Title	Objective
1.	FOUNDRY SHOP	Pattern Study	To study different types of patterns used in sand casting.
2.	CARPENTRY SHOP	Pattern Making	To prepare a wooden pattern according to a given dimension for aluminium casting.
3.	FOUNDRY SHOP	Moulding Sand Testing	To determine the permeability number for a given moulding sand sample. To determine the amount of moisture for a given moulding sand sample. To determine the amount of clay for a given moulding sand sample.
4.	WELDING SHOP	Shielded Metal Arc Welding	To study the effect of AC and DC arc in manual/shielded metal arc welding.
5.	WELDING SHOP	Gas Metal Arc Welding	To study Submerged arc welding equipment and perform SAW welding
6.	WELDING SHOP	Spot Welding	To study resistance welding equipment and perform spot welding on thin sheets.
7.	MACHINE SHOP	Center Lathe	To perform different types of center lathe operation on job as per given dimensions.
8.	MACHINE SHOP	Shaper Machine	To machine on a rectangular job using shaper machine as per given job.
9.	MACHINE SHOP	Slotter Machine	To cut a slot on a job as per given dimensions.
10.	MACHINE SHOP	CNC Plasma Machine	To cut a sheet as per given job using CNC Air plasma machine
11.	MACHINE SHOP	CNC Surface Grinding Machine	To machine on a rectangular job using CNC surface grinding machine as per given job.
12.	MACHINING AUTOMATION LAB	Retrofitted Lathe	To study retrofitting attachment used on lathe and learn about retrofitting.

TEXTBOOKS:

1. S K Hajra Choudhury, A K. Hajra, “Elements of Workshop Technology: Vol- I and Vol -II”, Media Promotors Pvt Ltd. **(T1)**
2. B S Raghuwanshi, "A course in Workshop Technology", Dhanpat Rai Publications. **(T2)**

REFERENCE BOOKS:

1. P.N. Rao, “Manufacturing Technology Vol-1and Vol-II”, Tata McGraw Hill. **(R1)**
2. Kalpakjian, "Manufacturing Engineering and Technology", Pearson. **(R2)**

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS) -NIL

POS MET THROUGH GAPS IN THE SYLLABUS - NIL

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN - NIL

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN - NIL

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	3	2	2	1	1	1	1	1	1	2	3	2	1
CO2	3	3	2	3	2	1	1	1	1	1	1	2	3	2	1
CO3	2	2	3	2	3	1	2	1	2	2	2	2	3	2	2
CO4	3	3	3	3	3	1	2	1	2	2	2	3	3	3	2
CO5	2	2	3	2	3	1	2	1	2	2	2	2	3	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3
CO5	CD3

BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK
(Effective from Academic Session: Monsoon 2024)

Bachelor of Technology

DEPARTMENT OF MECHANICAL ENGINEERING
THIRD YEAR (SEMESTER – V)

COURSE INFORMATION SHEET

Course Code: **ME24301**
Course Title: **IC Engines and Gas Turbines**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **4** **(**L:3 T:1 P:0)
Class schedule per week: **4**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the basic operating characteristics of internal combustion engines and differentiate the hypothetical and real operating conditions.
2.	Differentiate the basic phenomena of normal and abnormal combustion between SI and CI engines.
3.	Grasp the importance and function of various types of devices pertaining to fuel supply, cooling and lubrication.
4.	Analyze the performance and testing of various types of engines.
5.	Apprehend the operation of gas turbines and jet engines.

COURSE OUTCOMES (COs)

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

CO1	Explain the working principle of various types of IC Engine and gas turbines.
CO2	Apply the fundamental principles of thermodynamics, combustion and fluid flow in different engine and gas turbine processes.
CO3	Examine the key factors involved in enhancing performance of engine and gas turbine.
CO4	Solve numerical problems based on engine and gas turbine testing and performance.
CO5	Explain design features and performance characteristics of SI and CI engines.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction to I.C. Engine**: SI and CI Engine, Air standard Otto and Diesel cycles, valve timing diagrams, Fuel-air Cycles and actual air cycle and their analysis.	**9**
Module – II **Combustion in SI engines:** Combustion process, stages, ignition lag, factors affecting ignition lag, flame propagation and its factors, knocking and its factors, control of knock. **Combustion in CI engines:** Combustion process, stages of combustion, delay period and affecting factors, detonation and affecting factors, control and comparison with knocking of S.I. engines.	**9**
Module – III **Elementary carburetor and its auxiliary devices**: Choke jet ratio of a simple carburetor, MPFI system. Injection system of C.I. engines. Introduction to supercharging and its purpose. **Engine Cooling:** Introduction to air- and water-cooling systems. **Lubrication:** Objectives and Properties of lubricating oil, Mechanism of lubrication, Role of Additives.	**9**
Module – IV **Testing and performance:** Measurement of air, fuel consumption, indicated power, brake power, Morse test, Heat balance sheet, Performance parameter of S.I. and C.I. engine. **Engine Emission and control:** Engine emissions and their effects, gasoline and diesel emission, methods of measuring pollutants, controlling of engine emission.	**9**
Module – V **Gas turbine:** Theory of gas turbine, thermodynamic analysis of Brayton cycle, and with regeneration, reheat, inter-cooling. Analysis of cycle considering losses. **Jet Propulsio**n: Jet propulsion cycle, elementary idea of turbojet, Turbo-propulsion, ramjet and pulses jet, Classification of Rocket propulsion.	**9**

TEXTBOOKS:

1. Internal combustion engines by E.F.Obert.
2. Gas turbine Theory by Cohen Roger
3. Kohli P L., "Automotive Electrical Equipment", TMH Publishing Co., Delhi, 2004
4. Robert N Brady Automotive Computers and Digital Instrumentation, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.

REFERENCE BOOKS:

1. A course in Internal Combustion Engines by M.L. Mathur and R.P. Sharma.
2. Internal Combustion by V. Ganeshan, McGraw Hill
3. Gas Turbine Jet and Rocket Propulsion by M.L.Mathur and R.P.Sharma
4. Spreadbury .F.G., Electrical Ignition Equipment, Constable & Co Ltd., London, 1962.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Ignition system, Ericson cycle.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Emissions and Environmental Regulations: Euro, Bharat; Sustainable alternatives; Dashboard indicators (Symbols).

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE
DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	1	1			1			1	2	1	1
CO2	3	3	2	2	1	1			1			1	1	1	1
CO3	3	3	2	2	1	1	1		1			2	2	1	1
CO4	3	3	3	3	1	1		1	1	2	1	2	3	1	1
CO5	3	3	3	3	1	1	1	1	1	2	1	2	2	1	1

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24303**
Course Title: **Mechanical Vibration**
Pre-requisite(s): **Basics of Mechanical Engineering**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Obtain the model of vibratory systems of single, multi degrees of freedom system as well as continuous systems.
2.	Perform modal analysis of different systems.
3.	Understand the experimental procedures in vibration analysis.

COURSE OUTCOMES (COs)

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

CO1	Explain the basic elements of vibration models
CO2	Analyze multi degrees of freedom systems.
CO3	Solve the natural frequencies and mode shapes of a vibrating system.
CO4	Analyse the vibration of continuous systems.
CO5	Apply the knowledge of vibration in practical problems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Equation of motion with Newton's method, D' Alembart principle, and energy method, natural frequency, response due to initial condition, Viscously damped free vibration, overdamped, critically damped, and underdamped system, damped frequency, logarithmic decrement, coulomb damping.	**8**
Module – II Harmonic excitation of undamped system, resonance, beating phenomenon, Harmonic excitation of damped system, Magnification factor, rotating unbalance, support excitation, vibration isolation, whirling of rotating shaft.	**8**
Module – III Free vibration analysis of two degrees of freedom system, derivation of equation of motion, coordinate coupling, principal coordinates, orthogonality of modes, Lagrange's equation, Forced vibration analysis of two degrees of freedom system due to harmonic excitation; torsional vibration with two rotor masses.	**8**
Module – IV Determination of natural frequencies and mode shapes of multi degree of freedom system matrix formulation, influence coefficient, flexibility matrix, stiffness matrix, numerical methods: Dunkerley's method, and Method of matrix iteration.	**8**
Module – V Introduction to the vibration of continuous systems; Lateral vibration of string; Longitudinal vibration of bar; Torsional vibration of uniform shaft; Transverse vibration of beams having different types of supports (Euler- Bernoulli beam).	**8**

TEXTBOOKS:

T1. Theory of Vibration with Applications: W. T. Thomson and Marie Dillon Dahleh, Pearson Education.

T2. Introductory Course on Theory and practice of Mechanical Vibrations by J.S.Rao and K. Gupta, Wiley Eastern Ltd

REFERENCE BOOKS:

R1. Mechanical vibrations by Thammaiah Gowda, Jagadeesha T and D V Girish, McGraw Hill.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Real-world case studies, condition monitoring techniques, and industry-standard practices for vibration analysis and control.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Nonlinear vibration analysis and active vibration control techniques.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	2	1		2	-	1	1		2	3	2	1
CO2	3	3	2	2	3	1	2	1	2	2	1	2	3	3	2
CO3	3	3	3	3	3	2	3	1	2	3	2	3	3	3	3
CO4	3	2	3	3	2	3	3	2	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2	3	3	3	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24305**
Course Title: **Heat and Mass Transfer**
Pre-requisite(s): **Thermodynamics**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Classify innumerable cases under the different modes of heat transfer process.
2.	Understand the physical significance and applications of various laws.
3.	Illustrate and formulate mathematically the relations under various heat transfer modes.
4.	Judge, correlate and solve the heat transfer and flow parameters required for the performance studies and thermal design at industry level.
5.	Classify, correlate and solve real life heat and mass transfer problems.

COURSE OUTCOMES (COs)

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

CO1	Understand various modes, laws, thermo-physical properties, dimensionless quantities of heat and mass transfer.
CO2	Describe the governing equations of various modes of heat and mass transfer problems using systematic analysing techniques.
CO3	Interpret, extrapolate and formulate heat and mass transfer problems identifying correlations, tables, charts, etc. using Heat and Mass Transfer Data Book.
CO4	Illustrate the significance of various device, instruments, material, etc. for handling heat transfer problems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Modes of Heat and their fundamental laws, 3D generalized heat conduction equation in cartesian; cylindrical and spherical coordinates; 1D steady state heat conduction for Plane wall, hollow cylinders and spheres without internal heat generation; Composite walls; Contact thermal resistance; Critical thickness of insulation; variable thermal conductivity of plane wall.	**8**
Module – II Extended surfaces (Fins): General equation, temperature distribution and heat transfer analysis for uniform cross-sectioned fins, fin efficiency, effectiveness. Transient heat conduction: lumped heat capacity analysis, Fourier and Biot number.	**8**
Module – III Radiations: Definition and laws of thermal radiation, black body and gray surfaces, shape factor analysis, Radiation heat exchange between black and non-black surfaces, Radiosity and electrical analogy approach two & three body enclosures, radiation shield, re-radiating surfaces.	**8**
Module – IV Forced Convection: Governing Equations, Velocity and Thermal Boundary Layers, related dimensionless numbers, External flow- Empirical solutions of Laminar and Turbulent flow, past flat plate and cylinders, Reynolds and Colburns analogies. Internal flow through pipe. Free convection: Boundary layer concept, Governing equations; buoyancy, related dimensionless numbers, Empirical solutions of Plates, cylinders and enclosed spaces.	**8**
Module – V Heat Exchanger: Classification, LMTD and NTU – effectiveness methods of analysis, correction factor, Fouling Factor, Single and multi-pass heat exchangers, Efficiency and Effectiveness. Mass Transfer: Introduction to Diffusion and Convective mass transfer, concentration, velocities and fluxes, Fick's law of diffusion and diffusion coefficient, species conservation equation, steady state diffusion through stationary media and equimolar counter diffusion.	**8**

TEXTBOOKS:

1. Fundamentals of Heat and Mass Transfer by Incropera, Dewitt, Bergman and Lavine, John Wiley & Sons.
2. Heat and Mass Transfer by Yunus A. Cengel and A. J Ghajar, Tata McGraw Hill.
1. Fundamentals of Engineering Heat and Mass Transfer by R. C. Sachdeva, New Edge.
2. Data Book: Heat and Mass Transfer by C.P. Kothandraman

REFERENCE BOOKS:

1. Principles of Heat Transfer by F. Krieth and M. S. Bohn, Cengage Learning USA
2. Heat Transfer by Ghoshdashtidar, Oxford University Press.
3. Heat and Mass Transfer by J.P. Holman, Tata McGraw Hill.
4. Heat Transfer by S. P. Sukhatme, Universities Press.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Real-world applications of heat transfer in emerging technologies such as electronics cooling, renewable energy systems, and thermal management in electric vehicles.

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5.

Design and optimization of advanced heat exchangers using CFD (Computational Fluid Dynamics) and machine learning techniques.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24313 (Program Elective - II)**
Course Title: **Measurement and Instrumentation**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present a comprehensive knowledge of different measurement and instrumentation technologies available and in practice in modern day industry.
2.	Lay the foundation to understand the basic principles of operation of various sensors and transducers.
3.	Develop the knowledge needed to justify and select any specific type of instrumentation needed for any industrial/domestic application.
4.	Present real world engineering examples of measurements and instrumentation.

COURSE OUTCOMES (COs)

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

CO1	Describe the measurement systems and instrumentation.
CO2	Apply instrumentation characteristics to solve the real life problems.
CO3	Analyse various methodology techniques and measurement techniques.
CO4	Evaluate and select Data acquisition systems for signal analysis for measurement systems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Measurement systems, Standards of measurement, types of errors. Primary sensing elements and transducers: Classification and characteristics of transducers, Mechanical devices, Electric transducer: Resistance, Inductance and Capacitance based, Thermal sensitive devices, Strain gauges, LVDT and RVDT, Piezo-Electric, Hall effect, Optoelectronic devices etc.	**10**
Module – II Instruments Zero, First and Second order instruments, Static and dynamic characteristics of instruments.	**6**
Module – III Methodology: Contact and non-contact measurement techniques, Measurement of length and angle, Dimensional measurement**,** Comparators, Interferometry, Optical flat, measurement of area. Pressure measurement: Mechanical and Electro-mechanical Gauges, Viscosity and Ionization gauges.	**8**
Module – IV Strain gauges, calibration, temperature compensation, and associated circuitry. Force, Torque and Power measurements, Velocity and vibration measurements, Flow measurements and Temperature measurements. Density, Viscosity, Humidity measurement.	**8**
Module – V Data acquisition system using computers. Components of Data acquisition system, DAS hardware, selection criteria for choosing a DAS, techniques for signal analysis, uncertainty analysis**.**	**8**

TEXTBOOKS:

T1. A. K. Sawhney and Puneet Sawney, Mechanical Measurements and Instrumentation and Control, Dhanpat Rai and Co., 2016
T2. R. K. Rajput, Mechanical Measurements and Instrumentation, S.K. Kataria& Sons, 2013
T3. Helfrickand Cooper, Modern Electronic Instrumentation & Measurement Techniques, PHI, 2011

REFERENCE BOOKS:

REFERENCE BOOKS:

R1. D. Patranabis, Sensors and Transducers, PHI, 2003.
R2. H. S. Kalsi, Electronic Instrumentation, McGraw Hill, 2017.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Digital sensors, IoT-based measurement systems, real-time data processing, cybersecurity in instrumentation.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Advanced sensor fusion techniques and intelligent measurement systems using AI and machine learning for predictive diagnostics and real-time monitoring.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME 24315 (Program Elective -II)**
Course Title: **Turbomachinery**
Pre-requisite(s): **Fluid Mechanics abd Hydraulic machines**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present a comprehensive and rigorous treatment of classical turbo machinery while retaining an engineering perspective.
2.	Lay the groundwork for subsequent studies in such fields as analysis of various turbo machines and energy conversion systems and to prepare the students to effectively use Fluid mechanics and thermodynamics theory in the practice of turbo machinery in engineering.
3.	Develop an intuitive understanding of turbo machinery by emphasizing the engineering and engineering arguments.
4.	Present a wealth of real-world engineering examples to give students a feel for how turbo machinery theories are applied in engineering practice.

COURSE OUTCOMES (COs)

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

CO1	Describe concepts of fluid mechanics, thermodynamics, system of control volume to turbomachines.
CO2	Implement fundamental laws of fluid dynamics and thermodynamics to various turbomachines.
CO3	Solve various turbomachines fundamental problems for energy transfer.
CO4	Examine the performance of various turbomachinery components.
CO5	Evaluate optimum aerodynamic design/geometrical dimension of simple, complex turbomachinery components using conventional methods and modern tools.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction to Turbomachines:** Classification of turbomachines, momentum, and moment of momentum theory applied to moving blades, change in total enthalpy and total pressure, velocity triangles for radial and axial flow turbomachines. Dynamics and kinematics similarity (model and prototype), specific speed, flow, head and power coefficient.	**8**
Module – II **Steam and Gas Turbines:** Steam nozzles, critical pressure ratio, and choking of nozzles, throat and exit areas for optimum discharge, Impulse stage and compounding of steam turbine, Reaction stage of steam turbine, velocity diagrams, stage and other efficiencies, condition for maximum efficiency of single stage impulse and reaction turbine. Axial flow gas turbines, turbine characteristics and performance, simple design calculations. Introduction to combined cycle power plant.	**8**
Module – III **Centrifugal compressor**: components and their function, velocity triangle, stage work, stage efficiency, stage pressure rise, degree of reaction, slip factor, effect of blade shape, two-dimensional flow through impeller, vaned diffuser and volute casing, surging and choking of compressors, compressor performance and characteristic curves. **Reciprocating compressors**: Indicated diagram; single and multi-cylinder, efficiency. Introduction to oil-free compressor technology.	**8**
Module – IV **Axial flow compressors:** Cascade analysis, vortex theory, work required, efficiency, pressure rise, degree of reaction, simple design calculations, surging and stalling of compressors, active stall control, compressor performance and characteristic curves.	**8**
Module – V **Fans and Blowers:** Classification, construction and power requirement, pressure rise, efficiency calculations, applications in boilers & cooling towers, reversible fans and blowers, and other industrial applications, simple design calculations. Introduction to smart fan technology. Energy efficiency & sustainability.	**8**

TEXTBOOKS:

T1. Turbines, Compressors & Fans, S. M. Yahya, Tata-McGraw Hill Co.
T2. An Introduction to energy conversion, Volume III - Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers (P) Ltd.
T3. Principles of Turbo Machinery, D. G. Shepherd, The Macmillan Company.

REFERENCE BOOKS:

R1. Fluid Mechanics and Thermodynamics of Turbomachinery, S. L. Dixon.
R2. Fundamentals of Turbomachinery, William W Perg, John Wiley & Sons, Inc.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Real-world case studies, and hands-on experience with industry-standard turbomachinery systems and diagnostics.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Advanced aerodynamic design and optimization of turbomachinery components using computational fluid dynamics (CFD) and machine learning techniques.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	2									3	2	2
CO2	3	3	1	2									3	2	2
CO3	3	3	1	3	2		1		1	1			3	2	2
CO4	3	3	2	3	2	1	1		1	1			3	2	2
CO5	3	3	3	3	3	2	2	1	1	1	1		3	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24317 (Program Elective -II)**
Course Title: **Finite Element Methods**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present a comprehensive treatment on finite element methods.
2.	Lay the groundwork for subsequent studies in the fields of stress, strain, including the design aspects.
3.	Develop an intuitive understanding of various mathematical techniques to solve the problems.
4.	Understand and tackle various problems under different loading conditions.

COURSE OUTCOMES (COs)

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

CO1	Explain the principles of various techniques used in FEM.
CO2	Apply the concepts of FEM to one-dimensional and two-dimensional problems.
CO3	Analyse the thermal and structural problems using FEM.
CO4	Evaluate polar problems associated with real-world applications using FEM.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Energy methods: Variational principles and weighted residual techniques (least square method, collocation, sub-domain collocation, Galerkin method) for one-dimensional equation, Rayleigh-Ritz Formulation.	**8**
Module – II Two dimensional elements; two-dimensional grids, linear triangular elements, Bilinear rectangular elements.	**8**
Module – III Coordinate systems: Local coordinate systems, Natural Coordinate systems, Rectangular elements, Area coordinates, Finite Element problems using Code/Software.	**8**
Module – IV Field equations and boundary conditions: Governing differential equations, Integral equations for the element matrices, Element matrices, Traingular and rectangular elements. Different boundary conditions for fluid flow and heat transfer problems.	**8**
Module – V Applications: Heat transfer, Axial force members, Truss elements, Beam elements, Torsion of non-circular sections.	**8**

TEXTBOOKS:

T1. S.S. Rao, The Finite Element Method in Engineering, 5th Ed., Butterworth-Heinemann, 2012.
T2. T.R. Chandrupatla, A.D. Belegundu, Introduction to Finite Elements in Engineering, 3rd Ed., PHI Learning Pvt. Ltd, 2002.
T3. R.D. Cook, D.A. Malkus, M.E. Plesha, R.J. Witt, Concepts and Applications of finite element analysis, John Wiley & Sons, 4th edition, 2002.

REFERENCE BOOKS:

R1. D.L. Logan, A First Course in Finite Element Method, Fourth Ed., Cengage Learning, 2007.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Advanced computational techniques, nonlinear analysis, 3D element formulations, dynamic simulations, and integration with modern FEA software tool.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Nonlinear Finite Element Analysis and Adaptive Mesh Refinement Techniques.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution

Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	√

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2					1		3	3	2	3
CO2	3	3	3	3	3					1		3	3	3	3
CO3	3	3	3	3	3					1		3	3	3	3
CO4	3	3	3	3	3	1				1		3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6, CD7
CO3	CD1, CD2, CD 6, CD7
CO4	CD1, CD2, CD 6, CD7

COURSE INFORMATION SHEET

Course Code: **ME24319 (Program Elective -II)**
Course Title: **Computational Fluid Dynamics**
Pre-requisite(s): **Fluid Mechanics and Numerical Methods**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Introduce the basic aspect of numerical approach of flow problems.
2.	Cover issues like representation of generalized mathematical formula, classification of flow problems, algebraic approximation techniques and their accuracy, consistency stability analysis; and application to simple practical problems using hands-on coding and CFD software.

COURSE OUTCOMES (COs)

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

CO1	Explain fluid flow and heat transfer problems into various categories of numerical approach.
CO2	Apply the governing equations related to fluid flow and heat transfer problems.
CO3	Analyse numerical schemes like FDM and FVM to discretize the governing equations
CO4	Examine the numerical schemes and select suitable methods of discretization.
CO5	Develop models for simple flow and heat transfer problems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Governing equations: conservative and non-conservative forms of equations; mathematical classification of partial differential equations - Elliptic, Parabolic and Hyperbolic equations; linear and non-linear PDE; equilibrium and marching problems; initial and boundary conditions.	**8**
Module – II Basic aspects of discretization: finite difference approximations by forward, backward and central differencing; explicit and implicit schemes; error analysis; consistency analysis.	**8**
Module – III Stability Analysis: well and ill posed problems, Lax Equivalence Theorem; Matrix and Von-Newmann method. Linearisation: Richtmeyer and Newton's techniques.	**8**
Module – IV Finite Volume Method: introduction and integral formulation for finite volume grid; approximation of volume and surface integrals; methods of interpolation, diffusion problem analysis.	**8**
Module – V Case study with coding and software: diffusion problems in simple geometries; lid driven cavity problem; flow over bluff body.	**8**

TEXTBOOKS:

1. Computational Fluid Dynamics – The Basics with Applications (J. D. Anderson Jr.)
2. Computational Fluid Dynamics (J. D. Anderson)
3. Essential Computational Fluid Dynamics – Oleg Zikanov

REFERENCE BOOKS:

1. Computational Fluid Dynamics – Principles and Applications (J. Blazek)
2. Numerical Computation of Internal and External Flows (C. Hirsch)

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Finite Volume approach.

POS MET THROUGH GAPS IN THE SYLLABUS" PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Tridiagonal/Pentadiagonal Algorithms, Pressure-velocity coupling schemes.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	√

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	1	1							1	3	2	3
CO2	3	3	1	1	1							1	3	3	3
CO3	3	3	2	2	2							1	3	3	3
CO4	3	3	3	3	2			1	1			1	3	3	3
CO5	3	3	3	3	2			1	1			1	3	2	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6, CD7
CO3	CD1, CD2, CD 6, CD7
CO4	CD1, CD2, CD 6, CD7
CO5	CD1, CD2, CD 6, CD7

COURSE INFORMATION SHEET

Course Code: PE 24313 (Program Elective -II)
Course Title: Advanced Welding Technology
Pre-requisite(s): Introduction to Materials Engineering; Foundry, Forming & Welding Technologies / Manufacturing Processes
Co- requisite(s): NIL
Credits: 3 (L:3 T:0 P:0)
Class schedule per week: 3
Class: B. Tech
Semester / Level: FIFTH
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Learn about the fundamental principles, process parameters and application possibilities of solid-state welding and radiant beam welding processes
2.	Learn about the fundamental principles, process parameters and application possibilities of hybrid welding and allied processes
3.	Understand different techniques applied for different welding positions and welding conditions
4.	Understand the use of welding symbols and design procedure for weld joints under different loading conditions
5.	Learn about weldability of specific materials and welding applications

COURSE OUTCOMES (COs)

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

CO1	Classify solid-state welding and radiant beam welding processes and identify their advantages, limitations and application possibilities
CO2	Compare the fundamental principles, equipment, parameters and applications of different hybrid welding, thermal cutting and metal surfacing processes
CO3	Select appropriate techniques for different welding positions and welding conditions
CO4	Design weld joints for different loading conditions and to minimize weld distortion
CO5	Select appropriate welding techniques for different sets of materials for different welding applications

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Solid state welding and radiant beam welding:** Fundamental principles, process parameters, machines and equipment, advantages, limitations and application possibilities of cold welding, diffusion welding, forge welding, friction and inertia welding, explosive welding, ultrasonic welding. Fundamental principles, process parameters, machines and equipment, advantages, limitations and application possibilities of electron beam welding and laser beam welding; principle of conduction mode and keyhole welding.	**8**
Module – II **Advanced welding and allied processes:** Laser arc hybrid welding - fundamental principles, hybrid laser GMAW process, hybrid laser GTAW process, hybrid laser PAW process, paraxial and coaxial arrangements, welding parameters, joint gap, joint configuration and edge preparation, weld quality and industrial applications. Thermal cutting processes – oxygen cutting, arc cutting, high energy beam cutting; metal surfacing – cladding, hard facing, build-up, buttering; metal spaying processes; soldering, brazing and braze welding.	**8**
Module – III **Welding positions and welding conditions:** Processes and conditions for welding in down hand or flat, horizontal, vertical and overhead positions. Welding in wind; welding at low ambient temperatures; welding in vacuum; welding in space; underwater welding processes.	**7**
Module – IV **Residual stress, weld design, and pre/post heat treatments:** Principle of residual stress, types of residual stress, methods of identifying residual and the stress reliving methods. Numerical problems in residual stresses; principle of distortions, types of distortion, methods of the eliminating distortion; Types of welded joints, design of butt joints, lap joints, eccentrically loaded joints, welding symbols, estimation of preheat temperature and post heat temperature.	**9**
Module – V **Weldability of specific materials and welding applications:** Weldability of carbon steels, stainless steels, high alloy steels, cast iron, aluminium, copper and titanium. Application of welding in automobile industries, aerospace industries, ship building industries; concept of robotized welding and welding automation.	**8**

TEXTBOOKS:

1. R. L. Little, Welding and Welding Technology, Tata McGraw Hill **[T1]**
2. R.S. Parmar, Welding Process and Technology, Khanna Publishers [**T2]**
3. O.P. Khanna, Welding Technology, Dhanpat Rai Publication **[T3]**

REFERENCE BOOKS:

1. H.B. Cary and S.C. Helzer, Modern Welding Technology, Pearson/Prentice Hall. **[R1]**
2. J. Lawrence, Advances in Laser Materials Processing 2e, Woodhead Publishing/ Elsevier. **[R2]**
3. Welding Handbook, 9th ed., Vol. 2, Welding Processes. American Welding Society. **[R3]**

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS): NA

POS MET THROUGH GAPS IN THE SYLLABUS: NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Welding of polymers and composites, Simulation of welding process.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-4, 12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	3	1	1	1	1	2	1	2	3	2	2
CO2	3	3	3	2	3	1	1	1	1	2	1	2	3	2	2
CO3	3	2	3	2	3	1	1	1	2	3	2	2	3	2	2
CO4	3	3	3	3	3	2	2	1	2	3	3	3	3	2	2
CO5	3	3	3	2	3	1	2	1	2	3	2	3	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24321 (Program Elective -III)**
Course Title: **Advanced Solid Mechanics**
Pre-requisite(s): **Strength of Materials**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Explain key principles and theories beyond basic solid mechanics.
2.	Apply mathematical models and equations to solve complex engineering problems related to solid mechanics.
3.	Identify relevant factors influencing the behaviour of solid structures under various loading conditions.
4.	Justify decisions regarding failure mechanisms based on thorough analysis of stress distributions, material properties, and structural design.
5.	Propose innovative applications of solid mechanics theories to address current engineering challenges.

COURSE OUTCOMES (COs)

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

CO1	Explain the advanced concepts of solid mechanics
CO2	Apply the theoretical knowledge of solid mechanics to solve the advanced problems
CO3	Analyse different types of advanced solid mechanics problems by segregating the whole problems into different parts to get the solutions
CO4	Evaluate failure of different structural elements by justifying a decision based on advanced analysis of the problems
CO5	Create new ideas based on the established advanced solid mechanics theories to view the subject matter in innovative ways

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Shear Centre: Theory of shear flow, shear flow diagrams and shear centre for thin walled symmetrical sections. Bending of curved beams: Beams of small and large initial curvature, evaluation of circumferential stresses.	**8**
Module – II Pure bending; Asymmetrical bending of straight beams; Inelastic bending of beam; Plastic bending; Plastic hinge; Plastic analysis of beams.	**8**
Module – III Torsion of bars of any cross-section; St. Venant's theory; Prandtl's method.	**8**
Module – IV Thermal stress; Thermo elastic stress-strain relations; Analysis of stress in thin circular disks with symmetrical temperature variation, long circular cylinder when temperature is symmetrical about the axis, Spheres with purely radial temperature variation.	**8**
Module – V Energy methods: Castigliano's theorem, principle of virtual work, Rayleigh-Ritz method, applications of energy methods to various problems.	**8**

TEXTBOOKS:

1. Advanced Mechanics of Solid by L.S. Srinath, Tata Mc-Graw-Hill.
2. Advanced Mechanics of Materials by Richard J. Schmidt and Arthur P. Boresi, Wiley.
3. Mechanics of Materials by James M. Gere and Stephen P. Timoshenko, C B S Publishers & Distributors Pvt. Ltd.

REFERENCE BOOKS:

1. Theory of Elastic stability by S. Timoshenko & G. H. Gere.
2. Introduction to Solid Mechanics by I.H. Shames, J. M. Pitarresi, Prentice-Hall

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Exposure to advanced materials like composites, and practical application through case studies or engineering software like ANSYS or SolidWorks.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Advanced analysis of composite beams and non-linear material behavior under combined loading conditions.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	2							2	3	1	3
CO2	3	3	3	3	2							2	3	1	3
CO3	3	3	3	3	2							2	3	1	3
CO4	3	3	3	3	2							2	3	1	3
CO5	3	3	3	3	3							3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24323 (Program Elective -III)**
Course Title: **Mechatronics**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present a comprehensive treatment on Mechatronics and Real time interfacing.
2.	Lay the groundwork for subsequent studies in the fields of sensors, actuators and digital technologies.
3.	Develop an intuitive understanding of various microcontrollers and automated systems for system design.
4.	Understand and tackle various problems of conventional approach to design and solve case studies with robotics and automation.

COURSE OUTCOMES (COs)

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

CO1	Explain the mechatronic system and its hydraulic and electronic components.
CO2	Apply control theories to design mechatronic system.
CO3	Analyse theoretical and practical aspects of computer interfacing and real time data acquisition and control.
CO4	Evaluate real time problem related to mechatronic system.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction: Definition of Mechatronics, Mechatronics in manufacturing products and design, Review of fundamentals of electronics, Gates and K map Minimization, JK Flip Flop.	**8**
Module – II Signal Conditioning: Mechatronics elements, Data Conversion Devices, Sensors and transducers, Microsensors, Signal processing Devices, Relays, Comparators, Filters, Timers, Transfer Systems, PLC's programming.	**8**
Module – III Processors Controllers and Drives: Microprocessors, Microcontrollers, Drives, Linear motion bearings, cams and ball screws, PID controllers, Closed Loop and Open loop. Concept of Fuzzy Logic, Artificial Intelligence (AI) and Machine Learning (ML) in Mechatronics.	**8**
Module – IV Actuators: Servo motors, Stepper motors, Hydraulic actuators, Flow, Pressure and Direction control valves, Pneumatic Actuators, Distribution and conditioning of Compressed air, system components and graphic representations.	**8**
Module – V Real time Systems, Industrial Robotics, Case Studies. Ergonomics and Safety considerations in Mechatronics system design.	**8**

TEXTBOOKS:

1. Introduction to Mechatronics and Measurement System by David G. Alciatore, Michael B. Histamd, McGraw Hill.
2. Mechatronics by Bolton, Pearson Education
3. Fuzzy Logic and Nural Networks: Basic Concepts and Applications, Chennakesava R. Alavala. New Age Publication.

REFERENCE BOOKS:

1. Mechatronics System Design by Devdas and Shetty, Pearson Education
2. CNC TECHNOLOGIES BY HMT LTD MGH

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Programmable Logic Controllers ,data acquisition system, industrial electronics.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
To design new products with new automation and user friendly.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24325 (Program Elective -III)**
Course Title: **Industrial Tribology**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Introduce the concept of tribology and nature of engineering surfaces.
2.	Analyze the contact of rough surfaces and genesis of friction.
3.	Grasp the importance of wear and methodologies to measure friction and wear.
4.	Understand the properties of lubricants and their behavior in different regimes.
5.	Explain the tribological phenomenon happening in industrial components and its probable solutions.

COURSE OUTCOMES (COs)

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

CO1	Explain the role of tribology in mechanical design.
CO2	Apply the various laws of friction/wear and methodology to quantify them.
CO3	Analyse and understand the mechanisms of friction/wear along with the principles of lubrication and its regimes.
CO4	Evaluate real life problems related to tribology and industrial applications.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Tribology:** Introduction and historical background, nature of engineering surfaces, Role of tribology in MEMS/NEMS, factors influencing tribological phenomena. Engineering surfaces- Surface characterization, Computation of surface parameters, Surface measurement techniques, Introduction to micro and nano tribology, Industrial significance and economic aspects.	**5**
Module – II **Contact of engineering surfaces and friction :** Hertzian and non-hertzian contact. Contact pressure and deformation in non-conformal contacts, Genesis of friction, friction in contacting rough surfaces, sliding and rolling friction, Various laws and theory of friction. Atomic scale understanding of friction, Surface forces (van der Waals, electrostatic, hydrogen bonding etc.), stick-slip phenomenon, friction anisotropy.	**9**
Module – III **Wear:** Wear and wear types, Mechanisms of wear - Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., Wear of metals and non-metals. Wear models - asperity contact, constant and variable wear rate, geometrical influence in wear models, wear damage, wear controlling techniques.	**8**
Module – IV **Lubrication:** Lubricant composition, lubricant types, physical and chemical properties, effect of temperature and pressure on viscosity, additive role and types, elements of lubrication, Lubrication regimes- Boundary Lubrication, Mixed Lubrication, Hydro dynamic lubrication. Analysis of sliding contact bearings, Petroff's equation, Reynold's equation in two dimensions, hydro dynamic theory of journal bearing.	**10**
Module – V **Industrial applications:** Solution of tribological problems and recent developments, an overview of engineering materials having potential for tribological application, rolling element bearings, gears, crank shafts, piston rings, cylinder liners etc.	**8**

TEXTBOOKS:

1. B. Bhushan, Introduction to Tribology, Wiley-Blackwell; 2nd edition, 2013.
2. H. Hirani, Fundamentals of Engineering Tribology with Applications, Cambridge University Press, 2016.
3. P. Sahoo. Engineering Tribology, Prentice Hall India Learning Private Limited.

REFERENCE BOOKS:

1. B.B. Ahuja, S.N. Sengupta, S.K. Basu, Fundamentals of Tribology, PHI.
2. Michael M. Khonsari, E. Richard Booser, Applied Tribology: Bearing Design and Lubrication: Bearing Design and Lubrication, Wiley, 3rd edition, 2017.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Tribology of advanced composite materials, Simulation of tribological processes.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Thrust Bearings, Contact Mechanics, Green Tribology and the society.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **PE24315 (Program Elective -III)**
Course Title: **Rapid Prototyping and Tooling**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand technology used in rapid prototyping and tooling.
2.	Recognized importance of rapid prototyping in advance manufacturing process.
3.	Acquire knowledge, techniques and skills to select relevant rapid prototyping and tooling process.
4.	Comprehend the potential of rapid prototyping and tooling in different industrial sectors.
5.	Illustrated 3D printing technology for Rapid prototyping and tooling

COURSE OUTCOMES (COs)

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

CO1	Explain rapid prototyping and tooling for manufacturing complex geometries.
CO2	Identify and solve problems related to rapid prototyping and tooling.
CO3	Select suitable process and materials for rapid prototyping and tooling
CO4	Distinguish technique of CAD and reverse engineering for geometric transformation in rapid prototyping and tooling.
CO5	Determine part orientation, apply suitable slicing algorithm and generate tool path for minimum build time.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction:** Evolution, basic principle, concept, procedure and need of rapid prototyping and tooling, Classification of rapid prototyping and tooling processes (Additive/Subtractive/Deformative), Classifications of materials used for Rapid prototyping and tooling, Industrial applications of rapid prototyping and tooling, Most commonly used processes for rapid prototyping.	**8**
Module – II **Processes used for rapid prototyping and tooling:** Stereolithography Apparatus (SLA), Fused Deposition Modeling (FDM), Selective Deposition Lamination (SDL), Laminated Object Manufacturing (LOM), Ultrasonic Consolidation, Laser Engineered Net Shaping (LENS), Electron Beam Free Form Fabrication (EBFFF), Selective Laser Sintering (SLS), Electron Beam Melting (EBM). Convectional Tooling vs Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect rapid tooling methods.	**8**
Module – III **CAD for rapid prototyping and tooling:** Preparation of 3D-CAD model in STL format, Reverse engineering, Reconstruction of 3D-CAD model using reverse engineering, Part orientation and support generation, STL Conversion, STL error diagnostics, Slicing and generation of codes for tool path.	**8**
Module – IV **Constructions of manipulator systems for rapid prototyping and tooling:** Axes, Linear motion guide ways, Ball screws, Motors, Bearings, Encoders/ Glass scales, Process Chamber, Safety interlocks, Sensors, Energy delivery systems, Material delivery systems.	
Module – V **Post processing in rapid prototyping and tooling:** Support material removal, Surface texture improvement, Accuracy improvement, Aesthetic improvement, Property enhancements using non-thermal and thermal techniques.	

TEXTBOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010. **[T1]**
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003. **[T2]**
3. Ian Gibson, "Software Solutions for Rapid Prototyping", Professional Engineering Publishing Limited, UK, 2002. **[T3]**

REFERENCE BOOKS:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2007. **[R1]**
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006. **[R2]**
3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000. **[R3]**

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Rapid Freeze Prototyping.

POS MET THROUGH GAPS IN THE SYLLABUS: POs 1,2,5

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Rapid Tooling Injection Molded Prototypes.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: POs 1,8,12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	3	2	3	1	1	1	1	2	1	2	3	2	2
CO2	3	3	2	3	2	1	1	1	1	2	1	2	3	2	2
CO3	3	2	3	2	3	1	1	1	1	2	1	2	3	2	2
CO4	3	3	2	3	3	1	1	1	1	2	1	2	3	2	2
CO5	3	3	3	3	3	1	1	1	1	2	1	2	3	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24341 (Open Elective -II)**
Course Title: **Renewable Energy Sources**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Other than Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the difference between the non-renewable energy system and the renewable energy sources.
2.	Lay the groundwork for subsequent studies in the fields of renewable energy sources.
3.	Develop an intuitive understanding of the applications of different renewable energy sources like solar, wind, biomass, ocean thermal, geothermal etc.
4.	Understand the working principles related to different renewable energy systems.
5.	Understand state of art renewable energy system used in industrial application.

COURSE OUTCOMES (COs)

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

CO1	Explain the various sources of energy
CO2	Apply the working principle of different Renewable energy sources
CO3	Analyse various Renewable Energy Resources
CO4	Evaluate the performances of different Renewable energy systems

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction, Importance of Energy Consumption as Measure of Prosperity, Per Capita Energy Consumption, Needs of renewable energy, Classification of Energy Resources, Conventional Energy Resources - Availability and their limitations; Non-Conventional Energy Resources – Classification, Advantages, Limitations, Comparison of Conventional and Non-Conventional Energy Resources, World Energy Scenario, Indian Energy Scenario.	**8**
Module – II Introduction, Solar Radiation, Solar Constant, Basic Sun-Earth Angles, Solar Radiation Geometry and its relation, Measurement of Solar Radiation, Principle of Conversion of Solar Radiation into Heat, Collectors, (Flat Plate and Concentrating Collectors), Solar Water Heaters , Solar Cookers , Solar driers, Solar Still, Solar Furnaces, Solar Green Houses. Solar Photovoltaic, Solar Cell fundamentals, characteristics, classification, construction of module, panel and array. Solar PV Systems (stand-alone and grid connected), Solar PV Applications.	**8**
Module – III Introduction, Wind and its Properties, History of Wind Energy, Wind Energy Scenario – World and India. Basics of lift and drag, Basic principles of Wind Energy Conversion Systems (WECS), Classification of WECS, Parts of WECS, Derivation for Power in the wind, Electrical Power Output and Capacity Factor of WECS, Wind site selection consideration, wind farm, Advantages and Disadvantages of WECS.	**8**
Module – IV Introduction, Photosynthesis process, Biomass fuels, Biomass conversion technologies, Urban waste to Energy Conversion, Biomass Gasification, Biomass to Ethanol Production, Biogas production from waste biomass, factors affecting biogas generation, types of biogas plants, energy plantation, Biomass program in India.	**8**
Module – V Tidal Energy, Principle of Tidal Power, Components of Tidal Power Plant, Classification of Tidal Power Plants. Ocean Thermal Energy Conversion (OTEC), Principle of OTEC system, Methods of OTEC power generation – Open Cycle (Claude cycle), Closed Cycle (Anderson cycle). Geothermal Energy, Resources of geothermal energy, Hydrogen and Storage, Fuel Cell Systems, Hybrid Systems.	**8**

TEXTBOOKS:

1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 1996.
2.Rai. G.D., “Non-Conventional Energy Sources”, Khanna Publishers, New Delhi, 2011.
3.Twidell, J.W. & Weir, A., “Renewable Energy Sources”, EFN Spon Ltd., UK, 2006.

REFERENCE BOOKS:

1.Sukhatme. S.P., “Solar Energy”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
2.Tiwari. G.N., Solar Energy – “Fundamentals Design, Modelling& Applications”, Narosa Publishing House, New Delhi, 2002.
3.Freris. L.L., “Wind Energy Conversion Systems”, Prentice Hall, UK, 1990.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Renewable Energy Economics & Policy Frameworks.

POS MET THROUGH GAPS IN THE SYLLABUS; PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
PV System Simulation & Optimization: Software like PVSyst and HOMER, Wind Energy Modeling.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24343 (Open Elective -II)**
Course Title: **Elements of Hydel and Thermal Power plants**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Other than Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Classify different types of hydel power plants.
2.	Solve and correlate different measurements needed in the designing of hydel power plants.
3.	Demonstrate different types of steam generators and its components.
4.	Familiarize with different coal handling systems.
5.	Analyse and solve various problems in draught systems.

COURSE OUTCOMES (COs)

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

CO1	Describe the concept of power generation by Thermal & hydel energy.
CO2	Apply the fundamental concept in designing the different hydroelectric and thermal power systems.
CO3	Analyse the economic aspects of Thermal & hydel power generation.
CO4	Solve complex problems related to Thermal & hydroelectric power generation.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Hydel Power plants: Introduction**, Classification of Hydropower plants, Pump Storage power plants, Combine Hydro and Steam turbine Power Plants, essential features of Hydro-electric power plants.	**8**
Module – II **Components of Hydro- electric power plants:** Hydraulic turbines, draft tube, Surge Tanks. Run- off measurements, Hydrograph and Flow duration curve, Mass curve.	
Module – III **Thermal Power Plants:** General layout of thermal power plant, Site selection, Major components. Steam Generators: Boiler mounting and accessories, Different types of super-heaters, Re-heaters, economizers, Air preheaters, Methods of superheat control, Corrosion in boilers and its prevention.	
Module – IV Coal & Ash Handling Systems: Coal handling storage of coal, Burning systems, Pulverized fuel handling systems, Unit and central systems, Pulverized mills, Pulverized coal burners, Oil burners. Necessity of ash disposal with respect to state and central pollution control rules, Mechanical, Hydraulic, pneumatic and steam jet ash handling system, Dust collection and its disposal, Mechanical dust collector, Electrostatic precipitator.	
Module – V **Condensers and Cooling Towers:** Types of condensers, sources of air in condenser, Effects of air leakage, Necessity of cooling towers, Types of cooling towers. **Draught System:** Natural draught- estimation of height of chimney, Maximum discharge, Condition, Forced, Induced and balanced draught, Power requirement by fans.	

TEXTBOOKS:

1. Power Plant Engineering: by Arora & Domkundwar, Dhanpatrai Publication (2016).
2. Power Plant Engineering by P.K.Nag, Tata McGraw Hill Publishing Company Ltd. (2017).
3. Power Plant Engineering by P.C. Sharma, S.K. Kataria & Sons (2015).

REFERENCE BOOKS:

1. Power Plant Engineering: by F.T. Morse. Van Nostrand Reinhold; 3rd edition
2. Power Plant Technology: by M.M.E. Wakil, McGraw Hill Publication (1988).

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Recent advancements in power plant automation and efficiency technologies.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Design and optimization of hybrid renewable energy systems integrating advanced hydropower and thermal power technologies for enhanced efficiency and sustainability.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24302**
Course Title: **Heat Transfer Lab**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **1** **(**L:0 T:0 P:2)
Class schedule per week: **2**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Familiarize with the different equipment related to heat transfer.
2.	Impart knowledge and skill to use common heat transfer equipment and measuring instruments.
3.	Educate students of safe handling of various heat transfer equipment's.

COURSE OUTCOMES (COs)

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

CO1	Be conversant with the thermo dynamics used in heat transfer equipment's.
CO2	Explain the basic principles of heat transfer using various Instruments, and Equipment's.
CO3	Apply the fundamentals of heat transfer principles to perform experiments.
CO4	Develop skills to work as an individual or in a team during Lab Experiments.

SYLLABUS

List of experiments:

1. To determine thermal conductivity of an insulating powder.
2. To determine the forced convection heat transfer rate from a pin fin and compare the temperature distribution with the estimated values.
3. To determine the emissivity of test plate.
4. To find the heat transfer coefficient for dropwise and filmwise condensation.
5. To find heat transfer coefficient for different air flow rates through a pipe.
6. To find heat transfer coefficient for different air flow rates through a pipe with variable heat input.
7. To find transfer coefficient of a vertical cylinder in natural convection.
8. To compare the overall heat transfer coefficient under parallel and counter flow conditions in a shell and tube heat exchanger.
9. To determine the thermal conductivity of a viscous liquid.
10. To determine the free convection heat transfer rate from a pin fin and compare the temperature distribution with the estimated values.
11. To demonstrate the super thermal conductivity by means of heat pipe demonstrator.
12. To calibration a temperature sensor in temperature measurement test setup.

TEXTBOOKS:

1. Fundamentals of Heat and Mass Transfer by Incropera, Dewitt, Bergman and Lavine, John Wiley & Sons.
2. Heat and Mass Transfer by Yunus A. Cengel and A. J Ghajar, Tata McGraw Hill.
3. Fundamentals of Engineering Heat and Mass Transfer by R. C. Sachdeva, New Edge.
4. Data Book: Heat and Mass Transfer by C.P. Kothandraman

REFERENCE BOOKS:

1. Principles of Heat Transfer by F. Krieth and M. S. Bohn, Cengage Learning USA
2. Heat Transfer by Ghoshdashtidar, Oxford University Press.
3. Heat and Mass Transfer by J.P. Holman, Tata McGraw Hill.
4. Heat Transfer by S. P. Sukhatme, Universities Press.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO2	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO3	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO4	3	3	3	3	3	3	2	3	3	3	2	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3

COURSE INFORMATION SHEET

Course Code: **ME24304**
Course Title: **Internal Combustion Engines Lab.**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **1** **(**L:0 T:0 P:2)
Class schedule per week: **2**
Class: **B. Tech**
Semester / Level: **FIFTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Hands-on experience in studying and analyzing the performance of internal combustion engines under various operating conditions.
2.	Reinforce theoretical concepts related to thermodynamics, combustion, fuel systems, and engine performance by offering practical exposure to engine testing, diagnostics, emissions, analysis.
3.	Conduct engine experiments, interpret data, and apply the principles of internal combustion engine technology to real-world engineering problems.

COURSE OUTCOMES (COs)

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

CO1	Observe and analyze the operation of various types of internal combustion engines
CO2	Analyse internal combustion engines with practical, hands-on experience in the operation and testing.
CO3	Investigate engine behavior under various operating conditions.
CO4	Develop skills in measuring engine performance, understanding combustion characteristics, and troubleshooting engine-related problems.

SYLLABUS

List of experiments:

1. Economic speed test on 4- stroke, 4- cylinder Ambassador Petrol Engine.
2. Energy auditing and volumetric efficiency of 4-stroke, 4-cylinder Maruti Zen Petrol Engine.
3. Economic load test on twin cylinder, 4- stroke Peter Kirloskar Diesel Engine.
4. Performance study on M.P.F.I. Petrol Engine using Morse test.
5. Performance study on 4-cylinder, 4-stroke Diesel Engine.
6. Combustion characteristics (P-θ) diagram for variable loads on Mahindra Diesel Engine.
7. Analysis of exhaust emission (NOx, CO) of Diesel Engine.
8. Analysis of Exhaust emission (NOx, CO) of petrol Engine.
9. Study of M.P.F.I./S.P.F.I./ Carburetor system.
10. Study of Wankel rotary Engine.
11. Study of open cycle gas turbine.
12. Port timing diagram of two- stroke, single- cylinder Diesel Engine.

TEXTBOOKS:

1. Internal combustion engines by E.F.Obert.
2. Gas turbine Theory by Cohen Roger
3. Kohli P L., "Automotive Electrical Equipment", TMH Publishing Co., Delhi, 2004
4. Robert N Brady Automotive Computers and Digital Instrumentation, Prentice Hall, Eagle Wood Cliffs, New Jersey, 1988.

REFERENCE BOOKS:

1. A course in Internal Combustion Engines by M.L. Mathur and R.P. Sharma.
2. Internal Combustion by V. Ganeshan, McGraw Hill
3. Gas Turbine Jet and Rocket Propulsion by M.L.Mathur and R.P.Sharma
4. Spreadbury .F.G., Electrical Ignition Equipment, Constable & Co Ltd., London, 1962.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	1	2	3	2	2	1	2	2	2	2	2
CO2	2	1	1	2	2	1	2	1	2	1	1	2	2	2	2
CO3	2	1	2	1	2	2	2	2	2	2	1	2	2	2	2
CO4	2	2	2	1	2	2	2	2	2	2	2	2	2	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3

BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK
(Effective from Academic Session: Monsoon 2024)

Bachelor of Technology

DEPARTMENT OF MECHANICAL ENGINEERING
THIRD YEAR (SEMESTER – VI)

COURSE INFORMATION SHEET

Course Code: **ME24307**
Course Title: **Computer Aided Design**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **2** **(**L:2 T:0 P:0)
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the fundamentals of computer aided design.
2.	Generate the Synthetic Curves.
3.	Learn transformation techniques for design and drawing of mechanical parts.
4.	Develop skills for solid modelling.

COURSE OUTCOMES (COs)

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

CO1	Explain the underlying principles in CAD.
CO2	Apply the concepts of DDA & Bresenham's algorithms to generate different geometry.
CO3	Apply the knowledge of different curves and patches in modelling.
CO4	Evaluate various transformations used in CAD operation.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to CAD; Product life cycle; Input/output devices; Different Coordinate systems; Basic features available in CAD systems; 3D Modeling and viewing; Modeling aids and tools offered by CAD systems.	**5**
Module – II Representation of lines, curves; Line and Curve generation algorithm: DDA, Bresenham's algorithms.	**5**
Module – III Analytic Curves; Synthetic Curves: Concept of continuity, cubic spline curve, Bezier curve, B-Spline curve and NURBS.	**5**
Module – IV Geometric Transformations; Translation, Scaling, Reflection, Rotation, Mappings of Geometric Models; Projections, Animations.	**5**
Module – V Introduction to assembly modeling, IGES, STEP & DXF data exchange format.	**5**

TEXTBOOKS:
1. Mastering CAD/CAM by Ibrahim Zeid, Tata McGraw-Hill
2. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw-Hill.

REFERENCE BOOKS:
1. Computer-Aided Design and Drafting by Martin Zandi, Delmar Cengage Learning Pub.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Parametric modeling, cloud-based collaboration tools, real-time simulation and analysis integration.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.
TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Generative Design and Topology Optimization using AI in CAD Systems.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN; PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	2	2	1		1	1	1		1		2	2	2	1
CO2	3	3	3	2	2	1		1		1		3	2	1	2
CO3	2	2	2	2	3	2		1		1		3	3	2	3
CO4	2	2	2	3	3	1		1		1		2	3	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24309**
Course Title: **Automobile Engineering**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **4** **(**L:3 T:1 P:0)
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Know the basics of automobile in general
2.	Understand the working of different automotive systems and subsystems
3.	Update the latest developments in automobiles

COURSE OUTCOMES (COs)

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

CO1	Understand the principles and applications of automobile engineering, including vehicle systems, components, and their interactions.
CO2	Apply mechanical engineering principles to solve problems related to vehicle dynamics
CO3	Apply electrical and electronic engineering concepts to automotive systems.
CO4	Solve complex issues related to Automobile, such as design challenges and improving system reliability.
CO5	Investigate and integrate emerging technologies in automotive engineering

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction- Definition of an automobile, general aspect of an automobile and their classifications, basic requirements of motor vehicles(i.e. passengers and commercial vehicles), chassis and its components, chassis classification, Frame- its functions and different loads on the frame, frame sections and types, Automobile body and its architecture, aerodynamic considerations in body profiling, automobile components and their functions.	**9**
Module – II Mechanics of Motor Vehicle: Power for propulsion, rolling, air and grade resistance, traction and tractive effort, road performance curves, Acceleration, gradeability and draw par pull , calculation of maximum acceleration, maximum tractive effort and reactions for different drives.	**9**
Module – III Power Transmission Systems: General Arrangement of clutch, friction clutch, gear box, torque transmission. Fluid flywheel, sliding, constant and synchromesh type gear box, epicyclic gear box, live axle transmission, rear engine vehicles, type of axles, axle less transmissions, four wheel drive, torque converter, turbo transmitter converter, automatic transmission, Borg-Warner transmission, Automatic control.	**9**
Module – IV Drive Lines, Brakes and tyres: Universal Joint, Propeller shaft, Live rear axle, final drive, torque reaction, thrust systems, differentials, wheel bearing, front Axle and rear axle, Steering Mechanism and carriage unit, primary construction, Ackerman linkage, centre point steering, Axle construction, wheel alignments, independent and dead axle suspension, frame design, types and action of springs and dampers, chassis lubrication, Brakes, functions and methods of operation, types, linkages, hydraulic mechanism servo and power brakes, types of tyres and tubes.	**9**
Module – V Modern Technology and Microprocessors in Automobiles: Introduction to hybrid vehicles, components, applications, Introduction to electrical components used in hybrid and electric vehicles, configurations, introduction to energy storage requirements in hybrid and electric vehicles, battery based energy storage, fuel cell based energy storage, hybridization of different energy storage devices, Microprocessor and Microcomputer controlled devices in automobiles, instrument cluster, Voice warning system, travel information system, keyless entry system.	**9**

TEXTBOOKS:

T1. Automotive Mechanic by W.H. Course.
T2. Automotive Mechanics by Heitner.
T3. Electric and Hybrid Vehicles: Design and Fundamental by Iqbal Hussein
T4. Modern Electrical Equipment of Automobiles by Judge A.W

REFERENCE BOOKS:

R1. The Motor Vehicles by D.S. Newton and Steeds.
R2. Fundamental of motor vehicle technology by Hillier and Peter Coobes.
R3. Propulsion System for Hybrid Vehicle by John M. Miller.
R4. Automotive Electrical Equipments by Kohli P L.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Advanced driver-assistance systems (ADAS), vehicle diagnostics (OBD systems).

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Advanced Vehicle Dynamics and Autonomous Driving Systems.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	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	2	2	2	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	2	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	2	2	3	3	3	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24311**
Course Title: **Robotics Engineering**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **4** **(**L:3 T:1 P:0)
Class schedule per week: **4**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present a comprehensive and rigorous treatment of different robot types.
2.	Lay the mathematical background which is required to understand the mechanical design of different industrial robots used in modern industry.
3.	Develop an intuitive understanding of the limitations of various robots and its safe handling.
4.	Present real world engineering examples to demonstrate how a robot system is applied in engineering practice.

COURSE OUTCOMES (COs)

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

CO1	Explain the fundamental concepts and mathematical foundations of Robotics Engineering, including degrees of freedom, transformation matrices, homogeneous coordinates, and Euler angle representation.
CO2	Utilize the Denavit-Hartenberg representation and various kinematic approaches to solve problems in forward and inverse kinematics of serial robots.
CO3	Evaluate the role of the Jacobian matrix in robot statics, velocity, and acceleration analysis, and solve gravity compensation problems in robotic systems.
CO4	Derive equations of motion for serial robots using Lagrange-Euler and Newton-Euler formulations, and assess different control methods for trajectory following in manipulators.
CO5	Design and implement control strategies for robotic systems, including feedback and closed-loop control, and integrate robotic systems into industrial applications such as PUMA and SCARA configurations.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to Robotics Engineering. Degrees of Freedom for Open and Closed loop systems, Serial robot kinematics: Transformation matrices and homogeneous coordinates, Composite rotation matrix, Rotation about an arbitrary axis, Euler angle representation. Links, Joints and their parameters, Denavit-Hartenberg representation, Forward kinematics.	**9**
Module – II Inverse kinematics of serial robot: Geometrical and Algebraic Approach. Velocity analysis: Jacobian matrix, Acceleration analysis. Role of Jacobian in robot Statics. Gravity compensation.	**9**
Module – III Dynamics of serial robots: Lagrange-Euler formulation, Newton Euler approach, Motion equations of a manipulator. Inverse and Forward dynamics approaches.	**9**
Module – IV Trajectory planning: Cartesian and Joint space trajectories, Cubic trajectory. Linear control of manipulator: Feedback and closed-loop control, Control of second order system, Trajectory following control, Modeling and control of a single joint.	**9**
Module – V Parallel robot structures, Inverse kinematics of parallel robots, Classical Industrial robot systems, PUMA, and SCARA configurations, Robotic system integration, Industrial applications of robotics.	**9**

TEXTBOOKS:

T1. Subir Kumar Saha, Introduction to Robotics, TMH, New Delhi, 2014.
T2. John J. Craig, Introduction to Robotics, Pearson Education, 2011.
T3. J. P. Marlett, Parallel Robots, Springer, 2006.

REFERENCE BOOKS:

R1. Dilip K. Pratihar, Fundamentals of Robotics, Narosa Publishing House, 2016.
R2. KS Fu, C. S. G Lee, R. Gonzalez, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill Education, 1987.
R3. Bruno Siciliano and OussamaKhatib, Handbook of Robotics, Springer, 2016.
R4. Saeed B. Niku, An Introduction to Robotics Analysis, Systems, Applications, Prentice-Hall, 2001.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

AI and machine learning integration in robotics, real-time operating systems, ROS (Robot Operating System), human-robot interaction.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Design and analysis of hybrid robotic systems combining serial and parallel architectures for enhanced performance and flexibility.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	1	1	2	1	1	1	1	2	1	1	2	2	1
CO2	2	3	3	2	3	2	1	1	2	3	2	1	3	3	3
CO3	2	3	2	3	2	3	2	1	1	2	2	1	3	2	3
CO4	2	3	3	3	2	1	1	1	2	3	3	1	2	3	3
CO5	3	3	3	3	3	2	3	2	2	3	3	2	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24329 (Program Elective-IV)**
Course Title: **Design of Mechanisms**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Be able to understand the kinematics of planar mechanisms.
2.	Synthesize a mechanism graphically and analytically.
3.	Analyze the velocity, acceleration, and forces in a mechanism.

COURSE OUTCOMES (COs)

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

CO1	Describe various mechanisms used in mechanical engineering.
CO2	Apply the knowledge of kinematic theory to various motions of linkages.
CO3	Synthesize analytically a four-bar mechanism for motion, path, and function generation
CO4	Analyse and evaluate the different methods to solve the problems related to mechanisms.
CO5	Design suitable mechanisms for the motions of various linkages and pairs.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to Mechanisms and number synthesis: Plane and space mechanisms, Equivalent linkage, Mobility and range of movement, Four and six link mechanisms.	**8**
Module – II Kinematic Synthesis: (Graphical methods) Motion generation with two and three prescribed points, Path generation with three and four points, Function generation with three precession points, The Overlay Method.	**8**
Module – III Kinematic Synthesis: (Analytical Methods) Complex number modelling in kinematic synthesis, The Dyad, Motion path and function generation with three prescribed points, Freudenstein' s equation for three-point function generation, Loop-closer equation technique.	**8**
Module – IV Curvature theory: Fixed and moving centrode, Velocity and Acceleration, Inflection points and inflection circles, The Euler-Savary Equation.	**8**
Module – V Dynamics of Mechanisms: Kinetostatics using matrix method, Lagrange equation of motion, Force and moment balancing of linkages.	**8**

TEXTBOOKS:

1. G. N. Sandor and A. G. Erdman, Advanced Mechanism Design: Analysis and Synthesis - Volume 2, Prentice Hall, New Jersey.
2. R. S. Hartenberg and J. Denavit, Kinematic Synthesis of Linkages, McGraw-Hill Book Company.
3. A. Ghosh and A. K. Mallik, Theory of Mechanisms and Machines, East West Press.

REFERENCE BOOKS:

1. A. G. Erdman, G. N. Sandor and S. Kota, Mechanism Design: Analysis and Synthesis - Volume 1, Prentice Hall, New Jersey.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Modern computational tools (like CAD/CAE software), real-world mechanism design case studies, and integration with automation, robotics.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Synthesis and Optimization of Mechanisms using Genetic Algorithms and Artificial Intelligence Techniques.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	1					1		3	3	1	1
CO2	3	3	3	3	2					1		3	3	2	2
CO3	3	3	3	3	1					1		3	3	1	1
CO4	3	3	3	3	2					2		3	3	2	2
CO5	3	3	3	3	3							3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24331 (Program Elective-IV)**
Course Title: **Power Plant Engineering**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Have clear understanding of different power plant technologies.
2.	Be able to select an appropriate type of plant for given requirement under different situations.
3.	Be able to select the suitable components/equipment/accessories for proper functioning of power plant
4.	Understand the operational requirements and do the economic analysis of power plant.

COURSE OUTCOMES (COs)

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

CO1	Explain the different power plants with their applications.
CO2	Apply the principles of fluid and thermal science applicable for various power plants.
CO3	Analyse the power plant economics and determine the best possible combinations of power plant, depending on requirement.
CO4	Evaluate the performance of power plants.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction:** Principal types of power plants, special features, Advantages and Limitations. Elements of Modern Power Station, Importance of central power station, Review of electricity generation and energy scenario in Indian as well as world context. Application and future trend of developments.	**8**
Module – II **Thermal Power Plants:** Major components, fuels and their properties, storage, preparation, handling and burning, Ash handling and dust collection, Air pre-heater, Feed water treatment plants, insulation, Heat balance of power plant, Modern development in steam boiler.	**8**
Module – III **Diesel and Gas Turbine Power Plants:** Introduction, various system required for operation of Diesel Power Plant. Components of gas turbine power plant, different arrangements, optimum design of Gas turbine unit for combined cycle plant, comparative study of diesel and gas turbine plants. **Hydraulic Power Plants:** Different types of hydraulic power plants, rain fall and run-off measurements and plotting of various curves for estimating power available with or without storage.	**8**
Module – IV **Nuclear Power Plants:** Nuclear Reactors, Types of reactors, Pressurized water reactors, boiling heater reactors, Heavy water-cooled and moderated (CANDU) reactor, Gas-cooled reactors, Liquid metal cooled reactors, Indian Nuclear power installations. **Non-Conventional Power Plants:** Geothermal power plants, Tidal power plants, Wind power plants, solar power plants.	**8**
Module – V **Combined operation of different power plants:** Introduction, Advantages of combined working, load division between power stations, storage type hydro-electric power plant in combination with steam plant, Instrumentation and control. **Economic Analysis:** Difference between Base load and peak load plants, Different terms and definitions, Performance and operating characteristics of power plants, Load division, Tariff method for Electrical Energy.	**8**

TEXTBOOKS:

1. Power Plant Engineering: by F.T. Morse.
2. P. K. Nag, Power Plant Engineering, Tata McGraw-Hill, 2008.
3. Power Plant Technology: by M.M.E. Wakil, McGraw Hill Publication.

REFERENCE BOOKS:

1. Power Plant Engineering: by Arora & Domkundwar, Dhanpatrai Publication
2. Power Plant Engineering: by K.K. Ramalingam, Scitech Publications.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Smart grid integration, renewable energy forecasting, energy storage technologies.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Advanced control systems, optimization techniques for power plant operation, and integration of renewable energy sources in hybrid power plant systems.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	2	2	2	1	1	1	2		1	1		3	3	3	3
CO2	3	3	3	3	2	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	3	2	3	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	2	3	3	2	3	3	3	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24333 (Program Elective-IV)**
Course Title: **Gas Dynamics**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present a comprehensive and rigorous treatment of classical gas dynamics theories retaining an engineering perspective.
2.	Lay the groundwork for subsequent studies in such fields as analysis of various gas dynamics systems and to prepare the students to effectively use gas dynamics theory in the practice of engineering.
3.	Develop an intuitive understanding of gas dynamics by emphasizing the engineering and engineering arguments.
4.	Present a wealth of real world engineering examples to give students a feel for how gas dynamics is applied in engineering practice.

COURSE OUTCOMES (COs)

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

CO1	Explain the basic principles of Gas dynamics.
CO2	Apply the appropriate fundamental laws of gas dynamics to formulate the relations applicable to gas dynamics problems.
CO3	Analyse various types of gas dynamics relations to tackle problems related to gaseous flow.
CO4	Evaluate and solve various problems for appropriate solution in the domain of gas dynamics..

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Fundamental of Gas Dynamics : Energy equation, stagnation state and stagnation properties, bulk modulus of elasticity, sound velocity, Mach number, Mach angle, Bernoulli equation, isentropic flow with variable area ,flow with variable area in adiabatic processes, area ratio as a function of Mach number, flow through convergent nozzles, divergent nozzle.	**8**
Module – II **Flow with Normal Shock Waves**: Development of a normal shock wave, rarefaction wave, governing equations, Prandtl-Meyer relation, Mach number downstream of the normal shock wave, static pressure ratio, total pressure ratio across the shock, temperature ratio across the shock, density ratio across the shock . Rankine-Hugoniot equation, stagnation pressure ratio across the shock, change in entropy across the shock, strength of a shock wave. Tables and Charts for Normal Shock waves.	**8**
Module – III **Flow through oblique shock waves:** Development of oblique shock wave. Nature of flow through oblique shock wave. Fundamental relations, Prandtl's equation, Rankine-Hugoniot equation. Variation of flow parameters. Oblique shock relations from normal shock. Mach waves. Gas Tables and charts for oblique shick. Shock polar diagram. Expansion of supersonic flow.	**8**
Module – IV **Fanno flow:** Fanno curves, Fanno flow equations, solution of Fanno flow equations, variation of flow properties, and change of entropy and variation of Mach number with duct length. Isothermal flow in constant area duct with friction. Tables and Charts for Fanno flow.	**8**
Module – V **Rayleigh flow:** Rayleigh line, constant entropy lines, constant enthalpy lines, general equations in Rayleigh flow process, Rayleigh flow relations, variation of flow properties, maximum heat transfer. Tables and Charts for Rayleigh flow.	**8**

TEXTBOOKS:

T1. Gas Dynamics and Jet Poropulsion, S.L. Somasundaram,, New Age International Publishers.
T2. Fundamentals of Compressible Flow, S. M. Yahya, New Age International Publishers.
T3. Fundamentals of Gas Dynamics, V. Babu, Ane Books India.

REFERENCE BOOKS:

R1. Fluid Mechanics, Fundamentals and Applications(S I Unit), Youns A. Cengel and John M. Cimbala, Tata Mc-Graw Hills Education Pvt. Ltd.
R2. Elements of Gas Dynamics, H.W. Liepmann and A. Roshko, Dover Publications, New York.

ONLINE RESOURCES:

http://nptel.ac.in/courses/112103021/
http://nptel.ac.in/courses/112106166/
http://nptel.ac.in/courses/112106056/

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Supersonic Wind tunnel Practices.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Design and analysis of supersonic nozzles and diffusers using computational fluid dynamics (CFD).

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3		2	2			3		3	3	3	3
CO2	3	3	3	3		2	2		2	3		3	3	3	3
CO3	3	3	3	3	2	2	2		2	3		3	3	3	3
CO4	3	3	3	3	2	2	2		2	3		3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **PE24335 (Program Elective-IV)**
Course Title: **Surface Engineering and Laser Additive Manufacturing**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the science and importance of surfaces, surface dependent properties of engineering solids.
2.	Learn about appropriate testing procedures to evaluate surface dependent engineering properties
3.	Acquire fundamentals and practices of various surface engineering techniques to improve surface dependent engineering properties of metallic, ceramic and polymeric solids.
4.	Get familiar with directed energy beam techniques (laser, ion, and electron beams) and in particular laser assisted surface engineering and material processing.
5.	Develop an understanding of laser assisted additive manufacturing techniques and its application.

COURSE OUTCOMES (COs)

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

CO1	Classify and relate various surface degradation and surface-initiated failure mechanisms of engineering solids occurring under different service conditions.
CO2	Analyze the importance, relative advantages and limitations and overall scope of application of various surface engineering methods.
CO3	Compare and contrast different surface modification and coating technologies from various perspectives of applicability, economy, efficiency, and scopes of further improvement
CO4	Analyze real life surface failure problems (case studies) and prescribe the correct surface engineering solution.
CO5	Explore the applications potential of laser additive manufacturing of engineering components – flexibility, advantages, limitations, current status and future developments awaited.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Structure of Solids, Surface Dependent Engineering Properties and Mechanisms of Surface Degradation and Failures:** Introduction to the structure of solids: structure, morphology, energy, types, and classification, Surface-dependent engineering properties: physical, chemical, and mechanical – their definition, origin, and importance, Common surface-initiated engineering degradation/failures and their mechanism: wear, friction, fatigue, corrosion, oxidation.	**9**
Module – II **Classification and Outline of Surface Engineering Practices and Strengthening Mechanisms of Engineering Solids:** Importance of surface engineering (SE), Classification and scope of surface engineering of alloys and components, Methods and principles of surface modification of materials; Strengthening mechanism of engineering materials – metallic and non-metallic.	**5**
Module – III **Surface Modification Techniques based on Mechanical and Diffusional Treatments (without change in dimension) :** Conventional surface modification methods: shot peening, flame and induction hardening, carburizing, nitriding, diffusion-aided surface alloying.	**6**
Module – IV **Surface Modification Techniques based on Diffusional, Chemical and Electro-chemical Treatments (with change in dimension):** Surface coating techniques by chemical/electrochemical routes: electro/electroless deposition, anodizing, galvanizing, etc.	**10**
Module – V **Advanced Surface Modification Techniques and Laser Additive Manufacturing:** Surface coating by physical routes: thermal/plasma spray, physical/chemical vapor deposition, sputtering, Advanced surface modification methods: ion and electron beam assisted surface engineering, Laser surface engineering involving both changes in microstructure and composition, Additive manufacturing vis-à-vis subtractive manufacturing, Advantages, and challenges, recent trends and innovations, laser-assisted additive manufacturing of polymers, metals and alloys, characterization and testing.	**10**

TEXTBOOKS:

1. Surface Engineering for Wear Resistances (Introduction and classification of Wear), By: K.G. Budinski, Prentice Hall, Englewood Cliffs, 1988
2. Corrosion Engineering (classification of Corrosion), By: M.G. Fontana, M.C. Graw Hill, N. York, 1987

REFERENCE BOOKS:

1. Materials Science and Engineering by W. D. Callister
2. Introduction to Surface Engineering and Functionally Engineered Materials, by Peter Martin, WILEY, 2011
3. Surface Engineering of Metals: Principles, Equipment, Technologies, by: Tadeusz Burakowski, Tadeusz Wierzchon, CRC Press, 1988
4. Surface Engineering for Corrosion and Wear Resistance, by JR Davis, ASM International, 2001.
5. Additive Manufacturing by Andreas Gebhardt and Jan-Steffen Hötter, Springer, 2016.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS): NA

POS MET THROUGH GAPS IN THE SYLLABUS: NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN : NA

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	1	2	3	1	2	1		1		1	3	1	1
CO2	3	3	3	3	3	2	1	1	1	1	1	1	3	2	1
CO3	3	3	3	3	3	1	2	1	1	2	1	2	3	2	2
CO4	3	3	2	3	3	3	3	2	2	3	2	2	3	3	3
CO5	3	3	3	3	3	3	3	2	1	2	3	3	3	2	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24335 (Program Elective -V)**
Course Title: **Hydraulic and Pneumatic Control**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present a comprehensive and rigorous treatment of classical fluid power systems.
2.	Lay the groundwork to appreciate the fundamental principles, design and operation of hydraulic and pneumatic components, systems and their application in recent industrial automation.
3.	Develop an intuitive understanding of fluid power system by emphasizing the engineering aspects of such design.
4.	Present real world engineering examples to give students a feel for how a fluid power system is applied in engineering practice.

COURSE OUTCOMES (COs)

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

CO1	Understand the power hydraulic system, pneumatic system, its component details, and discuss the necessities of control theories for hydraulic system.
CO2	Demonstrate working principle of various hydraulic components such as hydraulic pump, hydraulic motor, control valves etc.
CO3	Analyse various system pressure, flow rate, energy loss, system efficiency and other parameters of the hydraulic and pneumatic system and its component.
CO4	Evaluate, design and control of power hydraulic system for real life problems.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to hydraulic and pneumatic systems, advantages and limitations, general layout of components. ISO symbols. Standard tubing sizes. Types of hydraulic fluids and its properties. Governing laws, Power, energy and flow rate calculations. Effect of viscosity on hydraulic system operation, Basic types and constructions of hydraulic pumps and actuators.	**8**
Module – II Distribution system, Sizing and flow rate requirements, Connectors and couplings. Basics of hydraulic flow in pipes, Hydraulic circuit analysis, flow and pressure measurement, losses due to friction. Control components in hydraulic systems, pressure, flow, direction control valves, Servo valves, Fuses, shock absorbers, and switches.	**9**
Module – III Hydraulic circuit design and analysis, Single and double acting cylinder operation, regenerative circuit, pump unloading circuit, double pump hydraulic system, automatic cylinder sequencing, synchronizing and reciprocating circuit, speed control, braking, transmission systems, Mechanical and Hydraulic servo system.	**7**
Module – IV Air preparation and components, Properties of air, Gas laws, Compressors, energy storage device, accumulator, energy storage in accumulator, Conditioners, control valves, pneumatic actuators and vacuum systems. Pneumatic circuit design and analysis, energy losses.	**9**
Module – V Programmable Logic Controllers, Introduction to Boolean algebra, Ladder logic diagram, Moving Part Logic (MPL) control systems, safety, maintenance and troubleshooting of hydraulic and pneumatic systems, filters, strainers, regulators, lubricators, reservoir.	**7**

TEXTBOOKS:

1. Anthony Esposito, Fluid Power with applications, Pearson Education, 1997.
2. John Watton, Fundamental of Fluid power control, Cambridge University press, 2009.
3. Fluid Power Engineering, M GalalRabie, McGraw Hill, 2009.

REFERENCE BOOKS:

1. Andrew Parr, Hydraulics and Pneumatics, A Technician's and Engineer's Guide, Butterworth-Heinemann, 2011
2. Ilango Sivaraman, Introduction to Hydraulics and Pneumatics, PHI Learning Pvt. Ltd., 2017. Sundaram K. Shanmuga, Hydraulic and Pneumatic Controls, S. Chand, 2006.
3. Majumdar, S.R., “Oil Hydraulics Systems- Principles and Maintenance”, Tata McGraw Hill, 2001
4. Majumdar, S.R., “Pneumatic Systems – Principles and Maintenance”, Tata McGraw Hill, 2007.
5. Srinivasan. R, "Hydraulic and Pneumatic Control", IInd Edition, Tata McGraw - Hill Education

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Real-time system simulation tools, Industry 4.0 integration, sensor technology, and advanced diagnostics for predictive maintenance.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Electro-hydraulic and electro-pneumatic systems integration with IoT for smart automation and remote diagnostics.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	2	1	1	1	1	2	1	2	3	2	2
CO2	3	3	2	2	3	1	1	1	2	2	1	2	3	3	2
CO3	3	3	3	3	3	2	2	1	2	2	1	3	3	2	3
CO4	3	3	3	3	3	2	2	1	2	3	2	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24337 (Program Elective -V)**
Course Title: **Power Gear Train**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Identify the speed ratios for a given automobile gearbox.
2.	Determine the epicyclic gear trains with number of gears on Sun, ring and planetary gears in each gear train.
3.	Choose gear materials with respect to the service conditions and design by taking into account tooth load, contact stress and surface durability.
4.	Determine the number of gears on main, lay shaft and idler gear shaft and work out the no of teeth on various gears to provide the desired speed ratios from the given power source.

COURSE OUTCOMES (COs)

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

CO1	Describe the various parameters of a helical gears, straight Bevel gears, Worm and Worm wheel set and gearbox.
CO2	Apply the appropriate fundamental laws of gears to find the design tooth load using factor of safety and effective tooth load using velocity factor and tangential tooth load
CO3	Analyse the number of teeth on various gears to provide the desired speed ratios.
CO4	Evaluate the module of gear-wheel tooth from beam strength and wear strength.
CO5	Create optimum design of a gear box for the given power source to execute the work after taking into account the virtual number of teeth, tooth load and the different strength.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Gear Drive:** Principle of Transmission and Conjugate Action, Gear Materials, Spur Gear, Types of Gear Teeth, Beam Strength of Spur Gear, Effective tooth load, Contact stress and surface Durability	**8**
Module – II **Helical Gears:** Parameters of a Helical Gear, Virtual number of teeth on Helical Gears, Force components on a tooth of Helical Gear, Different strengths of Helical Gear tooth.	**8**
Module – III **Straight Bevel Gears:** Bevel Gear basic rack, spiral Bevel gears, Virtual no of teeth, Force analysis of Bevel gears, beam strength of Bevel gear tooth, wear strength of Bevel gear tooth, effective tooth load on Bevel gear, Spotts's Equation for dynamic tooth load.	**8**
Module – IV **Worm and Worm Wheel Set:** Parameters of Worm gear set, Worm gear proportions, Force analysis in Worm and wheel set, Effect of rubbing velocity on friction in Worm wheel drive, Materials, Temperature rise of lubricating, Beam and wear strengths of worm wheel set.	**8**
Module – V **Gearbox:** Introduction, Resistance to vehicle motion, Types of gearboxes, sliding-mesh gear box, contact-mesh gearbox, synchromesh gearbox, epicyclic gearbox, Wilson gearbox, overdrive, five speed sliding mesh gearbox. Spread sheet applied to the design of Gear train, Gear train diagnostics based on noise and vibration. Case studies of power gear train in Automobiles & Overhead Cranes.	**8**

TEXTBOOKS:
T1. Machine Design by U. C. Jindal.

REFERENCE BOOKS:
R 1. Julian Happian-Smith, Introduction to Modern Vehicle Design, Butterworth Heinemann.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Modern gear manufacturing techniques, CAD-based gear design, real-time condition monitoring systems, and advanced materials or coating.
POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Design and Analysis of High-Performance Gear Systems using Finite Element Method (FEM) and AI-based Predictive Maintenance.
POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution

Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	1					1		3	3	1	1
CO2	3	3	3	3	2					1		3	3	2	2
CO3	3	3	3	3	1					1		3	3	1	1
CO4	3	3	3	3	2					2		3	3	2	2
CO5	3	3	3	3	3							3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24339 (Program Elective-V)**
Course Title: **Combustion**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present an importance of combustion in an engineering perspective.
2.	Develop an intuitive understanding of physics of combustion by emphasizing the engineering and engineering arguments.

COURSE OUTCOMES (COs)

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

CO1	Explain the basic concepts of combustion with its thermodynamic approach.
CO2	Apply the principles of kinetics of combustion
CO3	Analyse various relations related to flames and combustion.
CO4	Evaluate and solve the practical problems on flame and combustion.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction:** Importance of combustion, combustion equipment hostile fire problems, pollution problems arising from combustion. **Thermodynamics of Combustion**: Enthalpy of formation, enthalpy of reaction, heating values, first and second law analysis of reacting systems, chemical equilibrium, equilibrium composition, adiabatic and equilibrium flame temperature.	**8**
Module – II **Kinetics of Combustion:** Law of mass action, reaction rate, simple and complex reactions, reaction order and molecularity, Arhenius Law, activation energy, Chain reaction steady state and partial equilibrium approximations. Chain explosion, Explosion limits and oxidation characteristics of hydrogen, carbon monoxide and hydrocarbons.	**8**
Module – III **Flames:** Premixed Flames: structure and propagation of flames in homogeneous gas mixtures; simplified Rankine Hugoniot relations; properties of Hugoniot curve; analysis of deflagration and detonation branches, properties of Chapman Jouguet wave. Laminar flame structure; theories of flame propagation and calculation of flame speeds, flame speed measurements. Stability limits of laminar flames; flammability limits and quenching distance; burner design. Mechanisms of flame stabilization in laminar and turbulent flows; flame quenching. Diffusion flames; comparison of diffusion with premixed flame. Combustion of gaseous fuel jets Burke and shumann development.	**8**
Module – IV **Burning of Condensed Phase:** General mass burning considerations, combustion of fuel droplet in a quiescent and convective environment. Introduction to combustion of fuel sprays. Ignition: Concepts of ignition, chain ignition, thermal spontaneous ignition, forced ignition.	**8**
Module – V **Combustion Generated Pollution & its Control:** Introduction, nitrogen oxides thermal fixation of atmospheric nitrogen prompt NO, thermal NOx formation and control in combustors Fuel NOx and control , post-combustion destruction of NOx, Nitrogen dioxide carbon monoxide oxidation -quenching , hydro carbons, sulphur oxides.	**8**

TEXTBOOKS:

1. An Introduction to Combustion, concepts and applications by S. R.Turns, McGraw Hill (2000).
2. Principles of Combustion by K. K. Kuo, John Wiley (2005).

REFERENCE BOOKS:

1. Combustion Physics by C.K. Law, Cambridge University Press (2010).
2. Combustion Theory by F.A., Williams Addison Wesley (2007).

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Extinction and methods of extinguishing fires, solid fuel combustion, solid fuel combustion

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Nil

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3		2	3			3		3	3	3	3
CO2	3	3	3	3		2	3		2	3		3	3	3	3
CO3	3	3	3	3	2	2	3		2	3		3	3	3	3
CO4	3	3	3	3	2	2	3		2	3		3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **PE24345 (Program Elective-V)**
Course Title: **Engineering Optimization**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Learn about various optimization techniques used in Engineering
2.	Formulate an Engineering problem in form of an optimization problem
3.	Understand specialized problems such as dynamic programming problem
4.	Understand the simple and classical methods of solving an engineering optimization problem
5.	Understand some heuristics and metaheuristic approaches for solving the optimization problems

COURSE OUTCOMES (COs)

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

CO1	Prepare optimization problem formulation from an engineering problem
CO2	Execute simplex method to solve a linear programming problem
CO3	Apply dynamic programming methods to solve a dynamic problem
CO4	Choose a proper optimization technique to solve a non-linear optimization problem
CO5	Understand heuristics and metaheuristics to solve an optimization problem

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction to optimization and Liner Programming:** Introduction, Statement of an optimization problem, Classifications, Linear programming problems: formulation, graphical solution, simplex method, Big M and Two-phase method.	**10**
Module – II **Dynamic Programming Problems:** Introduction and network representation of dynamic programming problem, Forward and backward recursion method for solution, Mathematical formulation of dynamic programming recursions.	**6**
Module – III **Non-Linear Optimization-I – One dimensional optimization methods:** Unimodal function, Elimination Methods: Unrestricted search, Exhaustive search, Dichotomous search, Interval having method, Fibonacci method, Golden section method, Interpolation Methods: Newton method, Quasi newton method, Secant method.	**9**
Module – IV **Non-Linear Optimization -II – Classical optimization techniques:** Single variable optimization, Multiple variable optimizations with no constraints, Multiple variable optimizations with equity constraints, multiple variable optimization with inequity constraints.	**7**
Module – V **Heuristics and Metaheuristics for solving Optimization problems:** Reasons for using heuristic and metaheuristic approaches, Types of search approaches, Steepest Ascent and Steepest Descent method, Local search heuristics: SWAP, INSERT, genetic crossover, Metaheuristics: Genetic Algorithm, Ant Colony Optimization, Simulated Annealing.	

TEXTBOOKS:

1. S.S. Rao, Engineering Optimization: Theory and Practise, Wiley-Interscience Publications. **(T1)**
2. K. Deb, Optimization for Engineering Design: Algorithms and Examples, PHI publications. **(T2)**

REFERENCE BOOKS:

1. Wayne L. Winston, Operations Research: Applications and Algorithms, Duxbury Press **(R1)**
2. Hamdy A. Taha, Operations Research: An Introduction, Prentice Hall PTR, Pearson **(R2)**

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Integer programming, goal programming, multi-objective optimization

POS MET THROUGH GAPS IN THE SYLLABUS

POs 1-3, 12

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Multi Objective Optimization, Advanced Operations Research

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POs 1, 3, 5, 7, 12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	2	2	2	1	1	1	1	2	2	3	3	2	3
CO2	3	3	2	2	3	1	1	1	1	2	2	3	3	2	2
CO3	3	3	3	3	3	1	1	1	1	2	2	3	3	2	3
CO4	3	3	3	3	3	1	1	1	1	2	2	3	3	2	3
CO5	3	3	2	2	3	2	2	2	1	3	2	3	3	2	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME 24345(OE-III)**
Course Title: **Elements of Nuclear and Diesel Power plants**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Other than Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Familiarize with nuclear fuels and its various applications.
2.	Classify various types of nuclear reactors with its working.
3.	Identify and investigate the safety features of nuclear power plants.
4.	Classify the types of diesel engines and its applications with its auxiliaries.
5.	Evaluate the performance of diesel power plants.

COURSE OUTCOMES (COs)

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

CO1	Explain the concept of power generation by Diesel & Nuclear energy
CO2	Apply the fundamental concept in designing the different Nuclear and Diesel power systems
CO3	Analyse the performance of Nuclear & Diesel Power generation
CO4	Solve various problems related to Nuclear & Diesel Power generation

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction To Nuclear Engineering:** Introduction, Various Energy Sources, Importance of Nuclear power, Medicinal and Societal applications of Nuclear Energy.Types of Nuclear Reactions, Initiation of Nuclear reactions, Nuclear stability, Life of Nuclear Fuel.	**8**
Module – II **Nuclear Power Plants:** Introduction, Fermi pile Experiment, Major Components of nuclear power plants. Classifications of Nuclear reactors, Nuclear Breeding, Breeder reactors, Nuclear Materials.	**8**
Module – III **Nuclear Safety Systems:** Safety objectives, Shutdown systems in PWR, BWR, PHWR, Reactivity Worth of shutdown system, Operating Environment, Grouping of safety systems, Heat Removal systems, Emergency Core Cooling, Containment and subsystem, Site selection and Rejection criterion.	**8**
Module – IV **Introduction to Diesel power plants:** Introduction, Applications, Types of Diesel Engines used for Diesel power Plants, Different Systems of diesel power plants, Supercharging.	**8**
Module – V **Performance of** diesel power plants, Advantages and disadvantages of diesel power plants over Nuclear and Thermal power plants.	**8**

TEXTBOOKS:

1. Nuclear reactor Safety- principles and concept by G. Vaidyanathan, Yes Dee Publishing, (2017).
2. Power Plant Engineering: by Arora & Domkundwar, Dhanpatrai Publication (2016).
3. Power Plant Engineering by P.K.Nag, Tata McGraw Hill Publishing Company Ltd. (2017).

REFERENCE BOOKS:

1. Nuclear Reactor Engineering by Samuel Glasstone, CBS Publishers & Distributors (2004).
2. Introduction to Nuclear Engineering by John R. Lamarsh, Pearson Education India (2014).
3. Power Plant Engineering: by F.T. Morse. Van Nostrand Reinhold; 3rd edition (1953).

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Modern nuclear technologies (like SMRs and fusion), digital instrumentation and control systems, cyber security in nuclear facilities, regulatory frameworks.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Design and Optimization of Advanced Nuclear Reactor Systems and Hybrid Energy Plants.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24306**
Course Title: **Robotics and Automation Lab**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **1.5** **(**L:3 T:0 P:3)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Provide a hands-on experience in a rigging an industrial pneumatics and electro-pneumatics circuits.
2.	Apply PID control techniques to regulate various process parameters, analyzing the system performance and tuning controllers to optimize the system performance.
3.	Be acquainted with standard industrial robot, its sub-systems and prepare a demonstration of a simple programmed task.

COURSE OUTCOMES (COs)

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

CO1	Explain the technical specification of industrial robots and operate pneumatic and electro-pneumatic circuits.
CO2	Apply control techniques to design pneumatic circuits.
CO3	Analyse system performance through controlling process parameters using PID controller and optimize.
CO4	Perform robot calibration and evaluate DH parameters.

SYLLABUS

List of experiments:

1. Pneumatic circuit design for operating single reciprocating double acting pneumatic cylinder.
2. Pneumatic circuit design for operating two reciprocating double acting pneumatic cylinders sequentially.
3. Pneumatic circuit design for operating single reciprocating double acting pneumatic cylinder using On/Off controller.
4. Control various process parameters using PID controller.
5. Introduction to Industrial KUKA Robot: Frames, Safety, Teach Pendant, etc.
6. Identify DH Parameters of the KUKA Robot KR-5.
7. Tool calibration of Industrial KUKA KR5 Robot.
8. Base Calibration of Industrial KUKA Robot.

TEXTBOOKS:

T1. Subir Kumar Saha, Introduction to Robotics, TMH, New Delhi, 2014.
T2. John J. Craig, Introduction to Robotics, Pearson Education, 2011.
T3. J. P. Marlett, Parallel Robots, Springer, 2006.

REFERENCE BOOKS:

R1. Dilip K. Pratihar, Fundamentals of Robotics, Narosa Publishing House, 2016.
R2. KS Fu, C. S. G Lee, R. Gonzalez, Robotics: Control, Sensing, Vision and Intelligence, McGraw-Hill Education, 1987.
R3. Bruno Siciliano and OussamaKhatib, Handbook of Robotics, Springer, 2016.
R4. Saeed B. Niku, An Introduction to Robotics Analysis, Systems, Applications, Prentice-Hall, 2001.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	2	2	1	2	1	1	1	2	2	1	1	2	3	2
CO2	2	3	3	2	2	1	1	1	2	2	2	1	3	3	2
CO3	3	3	3	2	2	1	1	1	3	3	2	1	3	3	2
CO4	2	2	2	3	3	1	1	1	2	2	2	1	3	2	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3

COURSE INFORMATION SHEET

Course Code: **ME24308**
Course Title: **Automobile Engineering Lab**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **1.5** **(**L:0 T:0 P:3)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Make students familiar with various automobile systems and parts
2.	With practical, hands-on experience in the operation, maintenance, and troubleshooting of automobile systems and components.
3.	Enhance their theoretical knowledge gained in classroom lectures by offering real-world insights into vehicle functionality, diagnostics, and repair processes.

COURSE OUTCOMES (COs)

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

CO1	Understand the general construction and working of modern vehicle and to trace the transmission of power from engine to live axle.
CO2	Interpret and apply their knowledge in analyzing the requirements of various systems and sub-systems of a modern vehicle and identify the differences among various alternatives.
CO3	Analyse and evaluate the performance of different systems of a modern vehicle.
CO4	Develop the skill to interpret the recent developments of automotive systems that would help in developing a new vehicle design strategy.

SYLLABUS

List of experiments:

1. To study the construction details and general principles of two- stroke and four stroke CI and SI engines.
2. To study the fuel system of engines (carburetor and injector, injection pump, fuel pump, MPFI, SPFI and CRDi).
3. To study the engine lubrication and cooling system.
4. To study the super charging, electrical system and equipment's of an automobile.
5. To study the clutch, gearbox, torque converters.
6. To study the universal joint, back axle construction, propeller shaft and differential.
7. To study the mechanical hydraulic Servo and power operated braking systems.
8. To study the front axle, steering geometry and wheel alignment of a 4 wheel vehicle.
9. To study the springs, torsion bars, independent suspension and shock absorbers (coil leaf and dampers).
10. To study the tyres and wheel balancing.
11. Performance of a power steering system.
12. To study the charging and ignition system of an automobile.
13. Assembly and disassembly of 6-cylinder Diesel engine.

TEXTBOOKS:

T1. Automotive Mechanic by W.H. Course.
T2. Automotive Mechanics by Heitner.
T3. Electric and Hybrid Vehicles: Design and Fundamental by Iqbal Hussein
T4. Modern Electrical Equipment of Automobiles by Judge A.W

REFERENCE BOOKS:

R1. The Motor Vehicles by D.S. Newton and Steeds.
R2. Fundamental of motor vehicle technology by Hillier and Peter Coobes.
R3. Propulsion System for Hybrid Vehicle by John M. Miller.
R4. Automotive Electrical Equipments by Kohli P L.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1.Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	2	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO3	3	3	3	3	3	2	3	2	3	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3

COURSE INFORMATION SHEET

Course Code: **ME24310**
Course Title: **Computer Aided Design and Drafting Lab**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **1** **(**L:0 T:0 P:2)
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **SIXTH**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the importance of CAD in solving the various engineering problems.
2.	Develop the 2D and 3D models of different component for better understanding and examination.
3.	Analyse the different physical aspects of complex machine parts through modelling and simulation.

COURSE OUTCOMES (COs)

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

CO1	Discuss and familiarization of modelling software AUTOCAD.
CO2	Analysing and modelling of different complex geometry in auto cad.
CO3	Develop the expertise in modelling using software CREO.
CO4	Analysing and modelling of different assembly drawing.
CO5	Develop the model in ANSYS and simulate different practical problems to reduce the error.

SYLLABUS

List of experiments:

1. Understanding of Auto CAD.
2. Practice of command in auto cad like units, limits, grid, line, pline, donut, polygon, chamfer, fillet, offset, text, detext.
3. Draw the part drawing in auto cad without dimensioning using different commands.
4. Draw the dimensional complex geometry like stuffing box using commands in auto cad.
5. Understanding of CREO.
6. Draw the 3D drawing using CREO of different components and show its plan, elevation and side view.
7. Draw the parts and assembly drawing of foot step bearing and steering wheel.
8. Draw the parts and assembly drawing of clutch plate and knuckle joint.
9. Understanding of ANSYS and create the solid models.
10. Determination of deflection and stresses in 2D and 3D trusses.
11. Determination of deflection and stresses in different beams at different conditions.
12. Steady state heat analysis of plane and axi-symmetric components.

TEXTBOOKS:

1. Mastering CAD/CAM by Ibrahim Zeid, Tata McGraw-Hill
2. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw-Hill.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3					1		3	2	3	3
CO2	3	3	3	3	3				2	1		3	2	2	3
CO3	3	3	3	3	3				2	1		3	3	2	3
CO4	3	3	3	3	3				2	1		3	3	3	3
CO5	3	3	3	3	3	2				2		3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3
CO5	CD3

BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK
(Effective from Academic Session: Monsoon 2024)

Bachelor of Technology

DEPARTMENT OF MECHANICAL ENGINEERING
FOURTH YEAR (SEMESTER – VII)

COURSE INFORMATION SHEET

Course Code: ME24401
Course Title: Refrigeration and Air conditioning
Pre-requisite(s): NIL
Co- requisite(s): NIL
Credits: 4 (L:3 T:1 P:0)
Class schedule per week: 4
Class: B. Tech.
Semester / Level: SEVENTH/ IV
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present comprehensive and rigorous treatment of refrigeration and air conditioning for an engineering perspective.
2.	Lay the foundation for subsequent studies in conventional and nonconventional refrigeration system to prepare the students to effectively use it in the practice of engineering.
3.	Lay the foundation for subsequent studies in conventional and nonconventional refrigeration system to prepare the students to effectively use it in the practice of engineering.
4.	Present a wealth of real-world engineering examples to give students a feel for how refrigeration and air conditioning is applied in engineering practice.

COURSE OUTCOMES (COs)

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

CO1	Describe the fundamental principles of refrigeration and Air-conditioning, including the thermodynamic cycles.
CO2	Apply the basic concepts in designing the refrigeration and air- conditioning systems for various applications, including commercial, industrial, and domestic use.
CO3	Analyse the energy consumption of refrigeration and air conditioning systems and evaluate methods to improve energy efficiency.
CO4	Solve complex issues related to refrigeration and air conditioning systems, such as optimizing performance, solving design challenges, and improving system reliability.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction about Refrigeration- Definition of various terms, Method of refrigeration, Air refrigeration system, Bell-Coleman cycle, Introduction about Aircraft Air-conditioning, Evaporative cooling system, Boot strap cooling system, Regenerative cooling system, Reduced ambient system.	**9**
Module – II Analysis of vapour compression cycle, Modifications to basic cycle, Multi pressure system, multi-evaporator system and Cascade system, Study of Refrigerants.	**9**
Module – III Vapour Absorption Refrigeration system and its applications, Thermo-electric Refrigeration system, Steam jet Refrigeration system, magnetic refrigeration, vortex and pulse tube refrigeration system.	**9**
Module – IV Psychrometry- Definition for properties, Introduction to cooling load calculations, Comfort conditions, Effective temperature concept, properties of moist Air-Gibbs Dalton law, Specific humidity, Relative humidity, Enthalpy, Psychometric of Air-conditioning Process, Mixing of air stream.	**9**
Module – V Air-conditioning system- Summer, winter and year-round air-conditioning systems. IQF technique, Freeze drying and Cold storage.	**9**

TEXTBOOKS:

1. Arora, C.P., Refrigeration and Air Conditioning, 3rd ed., Tata McGraw-Hill, 2010.

REFERENCE BOOKS:

1. Stoecker, W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.
2. Dossat R.D., Principle of Refrigeration, 4th ed., Prentice-Hall, 1997.
3. Manohar Prasad, Refrigeration and Air Conditioning, New Age International, 2004.
4. Jones W.P., "Air conditioning engineering." 5th edition, Elsevier Butterworth-Heinemann, 2001.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Modern HVAC automation and control systems, energy efficiency standards, sustainable refrigerants.

POS MET THROUGH GAPS IN THE SYLLABUS-: PO 1-5

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Advanced HVAC system design using energy modeling software and sustainable building integration techniques.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN:

PO 1-5, PO 11-12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24403 (Program Elective-VI)**
Course Title: **Industrial Management**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SEVENTH/ IV**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present the principles associated with basics of industrial management and to apply these principles in the day to day life.
2.	Understand the Human Resource Management and to equip students with the process of man power planning, recruitment, industrial relations and administration.
3.	Understand the material requirements, resource planning and inventory management.
4.	Introduce the basic tools and techniques required in modern financial management.
5.	Understand the philosophy of total quality management and ways of its implementation in the organization.

COURSE OUTCOMES (COs)

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

CO1	Describe the various principles and factor influencing decision making in Industrial management.
CO2	Apply formulations of projects capital investment, projects costing, financing and profitability.
CO3	Analyse the quality control aspects in planning, systems, and management, assurance and improvement techniques.
CO4	Solve various basic problems in the field of engineering and management.
CO5	Create new ideas based on established methods to view the subject matter in innovative ways.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to Industrial management, Brief history of industries in India, Brief definition of management, organization and administration, characteristics of management, functions of management , Principles of management, Nature of management, levels of management, managerial skills, managerial roles, Forms of Organization, Forms of ownerships, concept of Globalization. Definition of Entrepreneur and Entrepreneurship.	**8**
Module – II Strategic importance of HRM, Objectives of HRM, challenges to HR professionals, Role, Responsibilities and competencies of HR professionals, HR department operations, Human Resource Planning - objectives and process, human resource information system. Talent acquisition, recruitment and selection strategies, career planning and management, training and development, investment in training program, executive development.	**8**
Module – III Materials Management- Objectives, Inventory – functions, types, associated costs, inventory classification techniques. Stores Management and Stores Records. Purchase management, duties of purchase manager, associated forms. Concepts of production system, Production planning and control, Work and time study, Plant location, Factors affecting the plant location, comparison of rural and urban sites, methods for selection of plant. Plant Layout, Objectives, types of production, types of plant layout – Material handling, Job decision. Inspection and Quality control, forecasting and line balancing.	**8**
Module – IV Capital Structure, Fixed & working capital, Role of Securities and Exchange Board of India (SEBI), function of money market and capital Market, sources of finance. Introduction to capital budgeting, Techniques of capital budgeting. Structure of Balance Sheet of an Industry. Break even analysis - assumptions, importance, Cost-Benefit analysis. Project Management, Project network analysis, CPM, PERT and Project crashing and resource Leveling.	**8**
Module – V Definition of quality, goalpost view of quality, continuous improvement definition of quality, types of quality – quality of design, conformance and performance, phases of quality management, Juran's and Demings view of quality, Quality Management Assistance Tools: Ishikawa diagram – Pareto Analysis – Pokka Yoke (Mistake Proofing).Quality circles, TQM, Kaizen, Five S (5S), Six sigma Quality Management Standards (Introductory aspects only)- The ISO 9001:2000 Quality Management System Standard- The ISO 14001:2004. Environmental Management System Standard- ISO 27001:2005 Information Security Management System.	**8**

TEXTBOOKS:

1. O. P. Khanna, Industrial Engineering and Management, Dhanpatrai publications.
2. L.C. Jhamb, Savitri Jhamb, Industrial Management – I, Everest Publishing House.
3. Buffa E.S, Modern Production and Operational Management, John Wiley & Sons.

REFERENCE BOOKS:

1. Production, Planning and Inventory Control by S.L. Narasimhan, D.W. McLeavey, P.J. Billington, Prentice Hall.
2. Production Systems: Planning, Analysis and Control by J.L. Riggs, Wiley.

3. Production, Operations Management by Panneerselvam. R., Prentice Hall of India Pvt Ltd.
4. Operation Management by Nigel Slack, Stuart Chambers, Robert Johnston, Pearson Education.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Digital transformation, data-driven decision-making, sustainability practices beyond ISO standards.
POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Integration of Industry 4.0 technologies (like IoT, AI, and Big Data) in Industrial Management for smart manufacturing and decision-making.
POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	√
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	3	2	2	3	3	2	3	3	2	3	3
CO2	3	3	2	2	3	2	2	3	3	2	3	3	2	3	3
CO3	3	3	3	3	3	2	2	3	3	3	3	3	2	3	3
CO4	3	3	3	3	3	2	2	3	3	2	3	3	2	3	3
CO5	3	3	3	2	3	2	2	3	3	2	3	3	2	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1,CD2,CD5,CD6
CO2	CD1,CD2,CD5,CD6
CO3	CD1,CD2,CD5,CD6
CO4	CD1,CD2,CD5,CD6
CO5	CD1,CD2,CD5,CD6

COURSE INFORMATION SHEET

Course Code: **ME24405 (Program Elective-VI)**
Course Title: **Advanced Heat Transfer**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SEVENTH/ IV**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Provide a fundamental understanding of analytic and numerical methods used to solve heat transfer problems
2.	Understand the usage of tables and charts to determine properties for problem solutions
3.	To develop the skill to develop models of real processes and systems and draw conclusions
4.	Apply scientific and engineering principles to analyze and design thermo fluid aspects of engineering systems

COURSE OUTCOMES (COs)

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

CO1	Explain semi –analytical and numerical methods to solve various categories of advanced heat transfer problems.
CO2	Implement advanced mathematical techniques to solve complex heat transfer problems.
CO3	Analyse and evaluate real life heat transfer problems
CO4	Develop mathematical models and computerized codes to solve verities of engineering problems involving one or more modes of heat transfer.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Two-Dimensional Steady-State Conduction: Revision of conduction fundamentals, Method of Separation of Variables, Conduction Shape Factor and the Dimensionless Conduction Heat Rate, Finite-Difference Equations.	**8**
Module – II Transient Conduction: General Lumped Capacitance Analysis, Plane Wall with Convection, Radial Systems with Convection, Semi-Infinite Solid, Objects with Constant Surface Temperatures or Surface Heat Fluxes.	**8**
Module – III Radiation: Revision of fundamentals; blackbody and gray body enclosures, Radiative properties of real surfaces; Spectral surfaces - band analysis and applications; Radiation in participating media - Beer's law, Radiative Transfer Equation, Mean Penetration Depth.	**8**
Module – IV Convection: Boundary Layer Equations, Similarities and Analogies, Flat Plate in Parallel Flow, Cylinder in Cross Flow, Flow over Sphere, Flow Across Banks of Tubes, Impinging Jets, Packed Beds, Internal flow – correlations for laminar and turbulent flow in circular/noncircular tubes and concentric tube annulus.	**8**
Module – V Boiling and Condensation: Dimensionless Parameters, Boiling Modes, Pool Boiling, Forced Convection Boiling. Condensation: Physical Mechanisms, Laminar Film Condensation on a Vertical Plate, Turbulent Film Condensation, Film Condensation on Radial Systems, Condensation in Horizontal Tubes, Drop wise Condensation.	**8**

TEXTBOOKS:

1. Fundamentals of Heat and Mass Transfer by Incropera, F. P. and De Witt, D. P
2. Heat and Mass Transfer by P.K. Nag
3. Fundamentals of Engineering Heat and Mass transfer by R. C. Suchdeva
4. Heat and Mass Transfer by Yunus A. Cengel.
5. Data Book: Heat and Mass Transfer by C.P. Kothandraman

REFERENCE BOOKS:

1. Whitaker, S., Fundamental Principles of Heat Transfer, New York, Pergammon, 1997
2. Heat and Mass Transfer by F. Kids
3. Heat and Mass Transfer by J.P. Holman

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Nanoscale conduction, Biological Heat Transfer, Mathematical modelling of heat transfer problems using modern tools.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Modelling and applications of radiation through participating media.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2	2	2	2	1	3	3	2	3
CO2	3	3	3	3	2	2	2	2	2	2	1	3	3	2	3
CO3	3	3	3	3	2	3	3	2	3	2	2	3	3	3	3
CO4	3	3	3	3	3	3	3	2	3	2	2	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24407 (Program Elective-VI)**
Course Title: **Theory of Elasticity**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SEVENTH/ IV**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Introduce the fundamentals of the theory of elasticity.
2.	Lay the groundwork for subsequent studies in the fields of stress, strain, and various mathematical methods.
3.	Develop an intuitive understanding of various mathematical techniques to solve the problems.
4.	Be able to understand and formulate various problems under different loading conditions.

COURSE OUTCOMES (COs)

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

CO1	Explain the concepts of stress and strain and their physical significance in materials
CO2	Apply the concepts to solve wide variety of elasticity problems
CO3	Analyse different boundary value problems in elasticity
CO4	Evaluate the stresses and strains in various real life elasticity problems

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Fundamentals of stress and strain: Introduction; Body force, surface force and stress vector; The state of stress at a point; Principal stresses; Stress invariants; Octahedral stresses; Hydrostatic and deviator stresses; Generalized Hooke's law.	**8**
Module – II The state of strain at a point; cubicle dilatation, principal strains.	**8**
Module – III Governing equations of equilibrium in Cartesian and cylindrical coordinate systems; generalized Hook's law.	**8**
Module – IV Two dimensional problems: Airy's stress functions in rectangular coordinates; Investigation of Airy's Stress function for simple beam problems.	**8**
Module – V Plane stress and plane strain problems, polar coordinates; axisymmetric problems.	**8**

TEXTBOOKS:
1. S.P Timoshenko, J.N. Goodier, Theory of Elasticity, 3rd Ed., McGraw-Hill Book Company, 1970.

REFERENCE BOOKS:
1. L.S. Srinath, Advanced Mechanics of Solids, 3rd Ed., Tata McGraw-Hill Ed. Pvt. Ltd., 2009.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Modern materials behavior (e.g., composites, nonlinear elasticity), practical case studies.
POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Application of finite element methods (FEM) in solving complex elasticity problems and stress analysis in anisotropic and composite materials.
POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	1			1	1			3	3	2	3
CO2	3	3	3	3	2			1	1			3	3	3	3
CO3	3	3	3	3	3			1	1			3	3	3	3
CO4	3	3	3	3	3			1	1			3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **PE24407 (Program Elective-VI)**
Course Title: **Non-Conventional Machining Processes**
Pre-requisite(s): **Machining Science And Machine Tools / Manufacturing**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SEVENTH/ IV**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Learn about the different non-conventional machining processes and their operational characteristics.
2.	Learn about the basic construction of the different non-conventional machines, and about the tools, equipment and consumable required.
3.	Understand the effects of different process parameters on part quality, and how the parameters are to be controlled.
4.	Study different empirical, analytical and theoretical approach for analysis of material removal for different processes.
5.	Learn about the developments of different hybrid non-conventional machining techniques.

COURSE OUTCOMES (COs)

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

CO1	Explain the fundamental principles, techniques, equipment, applications, advantages and limitations of different non-conventional machining processes.
CO2	Find solutions for meeting demand of machining hard-to-machine materials, producing complex shape and size with greater product accuracy and surface finish
CO3	Analyse the influence of process parameters on part quality
CO4	Explain the developments and operation potential of different hybrid non-conventional machining techniques
CO5	Select appropriate non-conventional machining technique based on work materials used and the part features to be produced

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Introduction and mechanical processes (AJM, WJM, AWJM, USM):** Need and classifications of non-conventional Machining Processes,Fundamental principles, application possibilities, process parameters, schematic layout of machine and operational characteristics of Abrasive Jet Machining (AJM), Water Jet Machining (WJM) and Abrasive Water Jet Machining (AWJM); calculation of material removal rate (MRR) for ductile and brittle materials in AJM. Fundamental principles, application possibilities, process parameters, schematic layout of machine and operational characteristics of Ultrasonic Machining (USM); Calculation of MRR in USM by empirical approach, Cook's model, Shaw theory.	**8**
Module – II **Chemical and electrochemical processes (ChM, ECM):**Fundamental principles, application possibilities, process parameters, operational characteristics and tooling of Chemical Machining (ChM); Chemical Milling, Photochemical Milling, Electropolishing, Fundamental principles, application possibilities, process parameters, schematic layout of machine and operational characteristics of Electrochemical Machining (ECM); electrolytes; electrochemistry of ECM; kinematics and dynamics of ECM, Effect of heat and hydrogen bubble generation; design of tool shape, electrolyte flow and insulation, surface finish and accuracy.	**8**
Module – III **Thermal processes (EDM, WEDM):** undamental principles, application possibilities, process parameters, schematic layout of machine and operational characteristics of Electro Discharge Machining (EDM); mechanics of EDM; theories of material removal in EDM; types of EDM; dielectric fluid; electrode material; pulse generation; flushing techniques, effects on material surface, surface finish and accuracy; dry EDM; Operation principles, applications, process parameters of Wire Electro Discharge Machining (WEDM).	**8**
Module – IV **Thermal Processes (LBM, EBM, PAM, IBM):** Fundamental principles, application possibilities, process parameters, schematic layout of machine and operational characteristics of Laser Beam Machining (LBM); types of lasers and lasing process; mechanics of LBM; surface finish and accuracy; Fundamental principles, application possibilities, process parameters, schematic layout of machine and operational characteristics of Electron Beam Machining (EBM), and Plasma Arc Machining (PAM), Ion Beam Machining (IBM).	**8**
Module – V **Hybrid Machining Processes: F**undamental principles, applications and operational characteristics of Electrochemical Grinding, Electrodischarge Grinding, Electrochemical Discharge Machining and Electrochemical Discharge Grinding, Abrasive Electrodischarge Machining, EDM with Ultrasonic Assistance, Ultrasonic-Assisted ECM, Laser-Assisted ECM, Laser-Assisted Oxygen cutting.	**8**

TEXTBOOKS:

1. P. C. Pandey and H. S. Shan, Modern Machining Processes, Tata McGraw-Hill **[T1]**
2. P. K. Mishra, Non-conventional Machining, Narosa Publishing House **[T2]**
3. Hassan El-Hofy, Advanced Machining Processes, McGraw-Hill **[T3]**

REFERENCE BOOKS:

1. Ghosh and A.K. Mallik, Manufacturing Science, Affiliated East- West Press **[R1]**

2. Bhattacharyya, New Technology, The Institution of Engineers (India) **[R2]**
3. M P. Groover, Fundamentals of Modern Manufacturing, John Wiley & Sons, Inc. **[R3]**

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Hands-on exposure on non-conventional machining processes

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5, 12

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Machining and super-finishing in sub-micron level

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN; PO 1-5, 12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3	1	1	1		2	1	2	3	2	2
CO2	3	3	3	2	3	1	2	1		2	2	2	3	3	2
CO3	3	3	2	3	3	1	2	1		2	2	2	3	2	2
CO4	3	3	3	3	3	1	2	1		2	2	2	3	2	2
CO5	3	3	3	3	3	1	2	1		2	2	2	3	2	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24413 (Program Elective-VI)**
Course Title: **AI and Data Analytics**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SEVENTH/ IV**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Learn about basic tools of AI and the application areas
2.	Understand the concept of ML and various tools under it
3.	Gain knowledge on fuzzy logic and practical applications
4.	Know about data science and its applications in business and decision making
5.	Learn and apply data analytics tools like R and Python

COURSE OUTCOMES (COs)

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

CO1	Apply ML tools to various engineering and management problems
CO2	Develop fuzzy systems for inference using Matlab simulation app
CO3	Develop ANN based deep learning models for practical problems
CO4	Implement data pre-processing like cleaning, sorting, reduction, etc.
CO5	Apply various data analytics tools using software or programming

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Fundamental of AI:** AI Concepts, terminology and application areas, Components and tools of AI, Comparison of features and characteristics of AI systems with biological systems, Examples of real-life practical application of AI, Societal impact and Ethical issues.	**7**
Module – II **Machine Learning (ML):** ML techniques overview, Decision trees, classification and clustering as ML tools, Artificial Neural Network (ANN), Supervised, unsupervised and reinforced learning, Perceptron and back propagation, Deep learning, Applications and real-life examples.	**8**
Module – III **Fuzzy Logic and Applications:** Introduction to fuzzy set theory, Fuzzy set properties and operations, Linguistic variables, Fuzzy rules, Fuzzy quantifiers, Fuzzy logic, Mamdani and Sugeno Fuzzy Inference Systems (FIS), Matlab© simulations, Examples of real-life applications of fuzzy systems.	**8**
Module – IV **Introduction to Data Science:** Introduction, Types of data, Big data, Data Pre-processing, Knowing data, Data cleaning, Data reduction, Data transformation, Data discretization - Visualization and Graphing, Application of Python© programming, Numerical examples.	**7**
Module – V **Data Analytics:** Data Analytics Process, Qualitative verses Quantitative Analysis, Data Analysis and Data Mining, Business Analytics, Types of Data Analytics: Diagnostic Analysis, Predictive Analysis, Prescriptive Analysis, Statistical Analysis (Descriptive and Inferential), Text Analysis, Examples and Application of R and Python© programming.	**10**

TEXTBOOKS:

1. S. Rajasekaran and Vijayalakshmi Pai, Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications, PHI, India **(T1)**
2. Ajit Kumar Roy and Pradip Kumar Choudhury, Applied Big Data Analytics, ISBN-13 : 978-1512347180 **(T2)**
3. Russell, Norvig, Artificial Intelligence: A Modern Approach, Third edition, Prentice Hall, 2010 **(T3)**

REFERENCE BOOKS:

1. Bharti Motwani, Data Analytics Using Python, Wiley, India **(R1)**
2. Garret Grolemund and Hadley Wickham, R for Data Science, ISBN-13: 978-1491910399 **(R2)**

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS): NA

POS MET THROUGH GAPS IN THE SYLLABUS: NA

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NA

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: NA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	2	3	3	1	1	1	2	2	2	3	3	2	3
CO2	3	3	2	3	3	1	1	1	2	2	2	3	3	2	2
CO3	3	3	2	3	3	1	1	1	2	2	2	3	3	2	3
CO4	3	3	2	3	3	1	1	1	2	2	2	3	3	2	3
CO5	3	3	2	3	3	1	1	1	2	2	2	3	3	2	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24411 (Open Elective-IV)**
Course Title: **Mechatronics and its Applications**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SEVENTH/ IV**
Branch: **Other than Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Present a comprehensive treatment on Mechatronics and Real time interfacing.
2.	Lay the groundwork for subsequent studies in the fields of sensors, actuators and digital technologies
3.	Develop an intuitive understanding of various microcontrollers and automated systems for system design
4.	Be able to understand and tackle various problems of conventional approach to design and solve case studies with robotics and automation

COURSE OUTCOMES (COs)

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

CO1	Explain the mechatronic system and its hydraulic and electronic components.
CO2	Apply control theories to design mechatronic system.
CO3	Analyse theoretical and practical aspects of computer interfacing and real time data acquisition and control.
CO4	Evaluate real time problem related to mechatronic system.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Basics of Mechatronics:** Definition of Mechatronics, Mechatronics in product design, Fundamentals of electronics, Gates and K map Minimization, JK Flip Flop, Mechatronic in Office ,Home and Automation.	**8**
Module – II **Digital Inputs and Output Conditioning**: Basic Operations in Signal conditioning, Amplification, Filtering, Digital Inputs and Outputs, A to D and D to A converters, Voltage Regulators.	**8**
Module – III **Sensors and Actuators:** Sensor Design, Fundamental Sensors and Interface Circuits, Light Sensors, Strains, Temperature, Magnetic Field, Proximity, Position, Acceleration, Force, Pressure, Actuators**,** Servo motors, Stepper motors, Hydraulic actuators, Flow, Pressure and Direction control valves, Pneumatic Actuators.	**8**
Module – IV **Rapid Prototyping**: Introduction, Solid Modeling Tools, Electrical system Rapid Prototyping, 3D RP Techniques, SLA, SLS, FDM, Soft Mold Castings. Ergonomics and Safety considerations in design aspect.	**8**
Module – V **Electro pneumatic & electrohydraulic systems using relay logic circuits:** Programmable Logic Controllers (PLC) based control system, programming languages & instruction set, ladder logic, functional blocks, structured text, and applications. Human Machine Interface (HMI) & Supervisory Control and Data Acquisition System (SCADA). Concept of Fuzzy Logic, Artificial Intelligence and Machine learning.	**8**

TEXTBOOKS:

1. Introduction to Mechatronic Design ,Carryer, Ohline, Kenny, Pearson
2. Introduction to Mechatronics and Measurement System by David G. Alciatore, Michael B. Histamd, McGraw Hill.
3. Mechatronics by Bolton, Pearson Education
4. Fuzzy Logic and Nural Networks: Basic Concepts and Applications, Chennakesava R. Alavala. New Age Publication.

REFERENCE BOOKS:

1. Mechatronics System Design by Devdas and Shetty, Pearson Education
2. CNC Technologies By Hmt Ltd MGH

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)
Industrial Automation and Electronics.

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN
Design and Development of New Products Embedded Systems.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4
Continuous Internal Assessment	√	√	√	√
Semester End Examination	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	3	2	2	2	3					2		2	3	2	2
CO2	3	3	3	2	3					2		3	3	2	2
CO3	3	3	3	3	3					2		3	3	2	2
CO4	3	3	3	3	3					3		3	3	3	2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24413 (Open Elective-IV)**
Course Title: **Industrial Robotics and Automation**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **3** **(**L:3 T:0 P:0)
Class schedule per week: **3**
Class: **B. Tech.**
Semester / Level: **SEVENTH/ IV**
Branch: **Other than Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Understand the robot anatomy, kinematics, economic, social and safety aspects in automated industrial environment.
2.	Develop mathematical model simulating the mechanics of robotic manipulator which facilitates mechanical design of different industrial robots in modern industry.
3.	Develop an intuitive understanding on various control techniques and space trajectories of industrial robots.
4.	Present real world engineering examples to demonstrate how a robot system is applied in engineering practice and various industry.

COURSE OUTCOMES (COs)

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

CO1	Explain the fundamental concepts of industrial robotics, including robot anatomy, classification, subsystems, degrees of freedom, and kinematic transformations.
CO2	Utilize actuators, sensors, and kinematic principles to solve problems related to robot motion and workspace.
CO3	Evaluate the velocity and acceleration analysis of robotic systems using the Jacobian matrix, and assess the role of Jacobian in statics and singularities.
CO4	Implement and assess various control techniques such as PID control, and perform trajectory planning in Cartesian and Joint space.
CO5	Design and analyze industrial automation applications, including programming methods, performance analysis, and consideration of economic, social, and safety aspects.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Industrial robot anatomy: Robot classification and its application in industry, Robot subsystems, Serial and Parallel robot, Links and Joints, Degrees of Freedom (DoF), Position and orientation of a rigid body, Co-ordinate transformation, Homogeneous transformation, Denavit and Hartenberg (DH) Parameters, Introduction to Forward and Inverse kinematics of serial robot.	**9**
Module – II Actuators and Sensors: Joint actuating system, transmission, servomotors, power amplifiers, power supplies. Actuators, Electric and hydraulic drives, Sensors: Position, Velocity, Force, Range, and Vision sensors. Robot Workspace: Workspace of manipulator, Type of workspaces, Workspace of a two-link serial manipulator.	**8**
Module – III Velocity analysis: The Jacobian matrix, Link velocities, Jacobian computation, Acceleration analysis, Role of Jacobian in statics, Singularities. Trajectory planning: Cartesian and Joint space trajectories and Cubic polynomial.	**8**
Module – IV Control Theory: Different control techniques, Transfer Function, State space representation, Proportional control, Integral control, Proportional plus Derivative control, PID control.	**7**
Module – V Industrial automation applications, Methods of programming: Robot languages, Lead-through programming, Point-to-point and motion interpolation. Performance analysis of Industrial robots, Economic, Social and Safety aspects in automated industrial environment.	**8**

TEXTBOOKS:

1. S. K. Saha, Introduction to Robotics, Tata McGraw-Hill Education, New Delhi, 2014.
2. John J. Craig, Introduction to Robotics: Mechanics and Control, Pearson Education, 2011.
3. M. P. Groover, M. Weiss, R. N. Nagel, N. G. Odery, A. Dutta, Industrial Robotics, McGraw Hill Education, 2015.
4. S.B. Niku, Introduction to robotics: analysis, control, applications. John Wiley & Sons, 2020.

REFERENCE BOOKS:

1. R. K. Mittal, I. J. Nagrath, Robotics and Control, McGraw Hill Education, 2016.
2. M. W. Spong, M. Vidyasagar, Robot Dynamics and Control, Wiley Student Edition, 2013.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

Advanced AI-based perception and decision-making, real-time control systems, collaborative robotics (cobots).

POS MET THROUGH GAPS IN THE SYLLABUS: PO 1-5.

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

Design and optimization of robotic manipulators using AI-driven algorithms and multi-objective optimization techniques.

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN: PO 1-5, PO 11-12.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

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

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **MT24204**
Course Title: **Constitution of India**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **0** **(**L:2 T:0 P:0)
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **SEVENTH/ IV**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	To describe the importance and role of Constitution of India
2.	To explain the provisions related to social problems and issues.
3.	To explain the significance of the constitution for maintaining social unity and integrity.
4.	To describe the process for formulating and designing public policies in accordance with the constitutional provisions.

COURSE OUTCOMES (COs)

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

CO1	Outline the need and importance of the Indian constitution.
CO2	Explain the fundamental rights and duties of the citizens of India.
CO3	Relate appropriate constitutional provisions with relevant social issues
CO4	Describe the role of different departments of government.
CO5	Critique the Government policies and programmes designed for the society at large.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Introduction to the Constitution of India, Salient Features of the Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.	**5**
Module – II Union and State Executives: President and Prime Minister, Council of Ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha. Governor: Role and Position, Chief Ministers and Council of ministers.	**5**
Module – III The Indian Judicial System – The Supreme Court and The High Court's – composition, Jurisdiction and functions, The Role of the Judiciary.	**5**
Module – IV Local Government- District's Administration: Role and Importance, The Panchayatas – Gram Sabha, Constitution and Composition of Panchayats, Constitution and Composition of Municipalities.	**5**
Module – V Miscellaneous- Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women.	**5**

TEXTBOOKS:

1. The Constitution of India by "Ministry of Law India" Kindle Edition
2. Constitutional History of India by Prof.M.V.PYLEE-S.Chand Publishing
3. Indian Administration by Avasti and Avasti-Lakshmi Narain Agarwal Educational Publishers.2017 edition.
4. Introduction to the Constitution of India by D D Basu by Lexis Nexis : 20th edition.
5. Constitution of India V.N.Shukla's EBC Explorer Edition 13th ,2017

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Mid Semester Examination	25
Quiz, Assignment	10 + 10
Teacher's Assessment	5

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. **Student Feedback on Course Outcome**

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	√
CD2	Assignments/Seminars	√
CD3	Laboratory experiments/teaching aids	
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	√
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	1	1				3	2	3	1	2	1				1
CO2	1	1				3	2	3	2	2	1				1
CO3	1	2				3	3	3	2	2	1				1
CO4	2	2	1	1	1	2	2	2	3	3	3				2
CO5	2	2	1	1	1	3	3	2	2	3	3				2

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD 6
CO2	CD1, CD2, CD 6
CO3	CD1, CD2, CD 6
CO4	CD1, CD2, CD 6
CO5	CD1, CD2, CD 6

COURSE INFORMATION SHEET

Course Code: **ME24404**
Course Title: **Refrigeration and air conditioning Lab.**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: **1** **(**L:0 T:0 P:2)
Class schedule per week: **2**
Class: **B. Tech.**
Semester / Level: **SEVENTH/ IV**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	To evaluate and analyze the different refrigeration and air conditioning machine.
2.	To familiarize the students to perform experiments related to refrigeration machine and equipment.
3.	To study and evaluate performance analysis of refrigeration and air conditioning machine and look prospects of alternative source of input.

COURSE OUTCOMES (COs)

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

CO1	Understand the procedure to conduct experiments of refrigeration and air conditioning machines.
CO2	Understand various parameters influence the performance of the refrigeration and air conditioning machines.
CO3	Analyse the observations made through experiments and evaluate the machine performance.
CO4	Apply the experimental knowledge how to perform the experiments and study parameters for further improvements.
CO5	Able to find out the different energy sources for refrigeration and air conditioning machines.

SYLLABUS

List of experiments

1) Comparative study of vapour compression system and vapour absorption system
2) To evaluate the coefficient of performance of vapour absorption system with load and without load
3) To evaluate the coefficient of performance of vapour absorption system with different heating system (gas and electricity) and comparative energy analysis.
4) To evaluate coefficient of performance of thermoelectric cooler
5) Performance study of cooling using peltier effect by varying flow rate of water in cooling and heating side.
6) Performance evaluation of vapour compression test rig
7) Performance evaluation of variable load refrigeration test rig
8) Performance evaluation of variable load refrigeration system by varies flow rate through expansion valve/capillary
9) Measurement of relative humidity using psychometer.
10) Study of the effect of the flow rate of fan in room humidity
11) Study of electrical and electronics connection of air conditioning system and fault detection.
12) Study of prospect of solar energy in refrigeration and air conditioning industry.

TEXTBOOKS:

1. Arora, C.P., Refrigeration and Air Conditioning, 3rd ed., Tata McGraw-Hill, 2010.

REFERENCE BOOKS:

1. Stoecker, W.F. and Jones J.W., "Refrigeration and Air Conditioning", McGraw Hill, New Delhi, 1986.
2. Dossat R.D., Principle of Refrigeration, 4th ed., Prentice-Hall, 1997.
3 Manohar Prasad, Refrigeration and Air Conditioning, New Age International, 2004.
4. Jones W.P., "Air conditioning engineering." 5th edition, Elsevier Butterworth-Heinemann, 2001.

GAPS IN THE SYLLABUS (TO MEET INDUSTRY/PROFESSION REQUIREMENTS)

POS MET THROUGH GAPS IN THE SYLLABUS

TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

POS MET THROUGH TOPICS BEYOND SYLLABUS/ADVANCED TOPICS/DESIGN

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	60
End Semester Test	40

Continuous Internal Assessment	% Distribution
Day to day performance & Lab files	30
Lab Quiz 1	10
Viva-voce	20
End Semester Examination	**% Distribution**
Examination: Experiment Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

COURSE DELIVERY METHODS

CD1	Lecture by use of boards/LCD projectors/OHP projectors	
CD2	Assignments/Seminars	
CD3	Laboratory experiments/teaching aids	√
CD4	Industrial/guest lectures	
CD5	Industrial visits/in-plant training	
CD6	Self- learning such as use of NPTEL materials and internets	
CD7	Simulation	

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO2	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO3	3	3	3	3	3	2	2	2	2	2	1	3	3	2	3
CO4	3	3	3	3	3	3	2	3	3	3	2	3	3	3	3
CO5	3	3	3	3	3	3	2	3	3	3	2	3	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

MAPPING BETWEEN COURSE OUTCOMES AND COURSE DELIVERY METHOD

Course Outcomes	Course Delivery Method
CO1	CD3
CO2	CD3
CO3	CD3
CO4	CD3
CO5	CD3

BIRLA INSTITUTE OF TECHNOLOGY

NEP-2020 CURRICULUM BOOK
(Effective from Academic Session: Monsoon 2024)

Bachelor of Technology

DEPARTMENT OF MECHANICAL ENGINEERING
FOURTH YEAR (SEMESTER – VIII)

COURSE INFORMATION SHEET

Course Code: **ME24450**
Course Title: **Project-IV**
Pre-requisite(s):
Co- requisite(s):
Credits: **6** L: T: P:
Class schedule per week:
Class:
Semester / Level: **Eighth**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Use the relevant knowledge and skills acquired during the domain course to solve the problem.
2.	Extract relevant literature survey information and formulate project specifications, and implement project plan
3.	Use appropriate techniques and tools to conduct experiments, analyse data and draw appropriate results-based conclusions and identify applications
4.	Draw appropriate conclusions based on the results and identify applications
5.	Prepare a technical report in the form of a thesis and effectively communicate using multimedia tools through oral presentation

COURSE OUTCOMES (COs)

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

CO1	Identify and understand current trends and real-world issues in production engineering.
CO2	Formulate project specifications, identify a set of feasible solutions and prepare and implement project plan.
CO3	Use critical thinking skills to review, analyse and interpret data and results.
CO4	Demonstrate work knowledge of ethics and professional responsibility at various stages such as project formulation, design, implementation and presentation.
CO5	Publish the results of the project work in journal or conference proceedings, present the work effectively and communicate with confidence in the defence of the work.

Course Evaluation:
Project work can be carried out preferably independently or by a group of students not exceeding three (3). More than three students in a group shall be discouraged. Department Committee shall be appointed by the Head of the Department. The Guide of the candidate shall not participate in the evaluation process by the department committee.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Progressive Evaluation	% Distribution
Assessment by Department Committee	25
Assessment by Project Guide (s):	25
End Semester Examination	**% Distribution**
End Sem Exam (External Examiner)	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Assessment by Department committee	√	√	√	√	√
Assessment by Project Guide (s):	√	√	√	√	√
End Sem Exam (External Examiner)	√	√	√	√	√

INDIRECT ASSESSMENT

1. Student Feedback on Course Outcome

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	1	2	2	2	1	1	1	0	3	3	2	3
CO2	3	3	3	3	3	1	1	1	2	2	3	3	3	3	3
CO3	2	3	2	3	3	1	1	1	1	1	1	3	2	2	3
CO4	1	2	2	2	1	3	2	3	2	2	2	2	2	2	2
CO5	2	2	2	2	2	1	1	2	2	3	2	2	2	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

COURSE INFORMATION SHEET

Course Code: ME24490
Course Title: Industry Internship
Pre-requisite(s):
Co- requisite(s):
Credits: 6 **L:** **T:** **P:**
Class schedule per week:
Class: B. Tech.
Semester / Level: Eighth
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

6.	Apply the technical knowledge and skills acquired during the program to solve various problems in the real-life industry
7.	Get acquainted with industry and corporate culture
8.	Use appropriate tools and techniques to conduct experiments, analyse data and draw results-based conclusions
9.	Provide suggestions based on technical findings for improvement in operations/processes of the industry they work with
10.	Prepare an internship report containing problem statement, solution methodology, result and analysis and communicate effectively through oral presentation

COURSE OUTCOMES (COs)

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

CO1	Identify technical problems and develop a set of feasible solutions in industries
CO2	Apply their technical knowledge and skill to real-world problems in the domain of mechanical engineering
CO3	Use critical thinking skills to review, analyse and interpret data and results
CO4	Demonstrate professional responsibility, work ethics and team spirit at the workplace
CO5	Document the internship work in the form of a complete report and communicate the work effectively in their defense presentation

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

DIRECT ASSESSMENT

Assessment Tool	% Contribution during CO Assessment
Progressive Evaluation	50
End Semester Examination	50

Progressive Evaluation	% Distribution
Assessment by Department Committee	25
Assessment by Coordinator(s):	25
End Semester Examination	**% Distribution**
End Sem Exam	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Assessment by Department committee	√	√	√	√	√
Assessment by Project Coordinator(s):	√	√	√	√	√
End Sem Exam	√	√	√	√	√

INDIRECT ASSESSMENT

2. Student Feedback on Course Outcome

MAPPING BETWEEN COURSE OUTCOMES AND POs and PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO1	2	3	3	2	2	1	1	1	2	2	2	2	3	3	3
CO2	3	3	3	2	2	1	1	1	2	2	2	3	3	3	3
CO3	2	3	2	3	2	1	1	1	2	2	2	2	3	3	3
CO4	1	1	1	1	1	2	1	3	3	2	2	2	3	3	3
CO5	1	1	1	1	2	1	1	1	2	3	2	2	3	3	3

Grading: No correlation – 0, Low correlation - 1, Moderate correlation – 2, High Correlation - 3

Vocational Courses

The department, in collaboration with the allied departments, offers two skill-based vocational courses at the end of the first year (Level 1) and two more at the end of the second year (Level 2). Each course is worth 3 credits and is mandatory for students who plan to exit after the first or second year. However, these courses are optional and non-credit for other students.

COURSE INFORMATION SHEET

Course Code:	**ME 24104**
Course Title:	**Working with Autocad**
Pre-requisite(s):	**Engineering Graphics**
Co- requisite(s):	
Credits:	**3** L:1 T: 0 P: 4
Class schedule per week:	**5**
Class:	**Certificate in Engineering**
Semester / Level:	**First**
Branch:	**Mechanical Engineering**

COURSE OBJECTIVES

This course envisions to impart to students to:

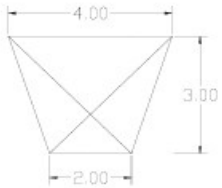
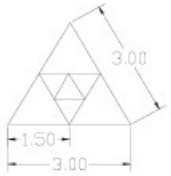
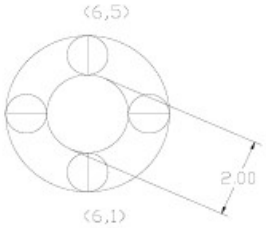
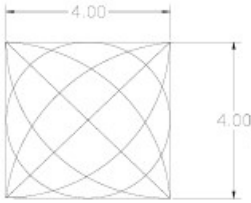
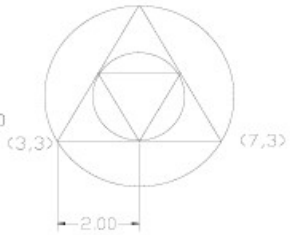
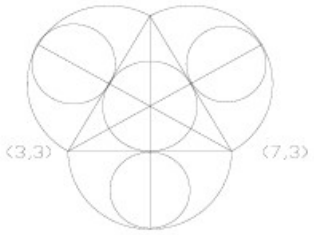
1	Familiarization with basic commands of AutoCAD.
2	Utilization of various tools of AutoCAD to draw various engineering drawings.

COURSE OUTCOMES (COs)

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

CO1	Be conversant with the basic AutoCAD commands.
CO2	Explain the basic utilities available in AutoCAD.
CO3	Apply the basic AutoCAD commands to draw various figures related to Engineering and Technology.
CO4	Develop skills to work as an individual or in a team during Lab Exercises.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Draw the following figures with the help of AutoCAD commands studied Units, limits, grid, line, spline, donut, polygon, circle, rectangle, chamfer, fillet, offset, move, scale, text, Dimensioning.	
Module – II Draw the following figures with the help of AutoCAD commands studied.  Fig 2.1  Fig 2.2  Fig 2.3  Fig 2.4  Fig 2.5  Fig 2.5	
Module – III Draw the following figures with the help of AutoCAD commands studied.	

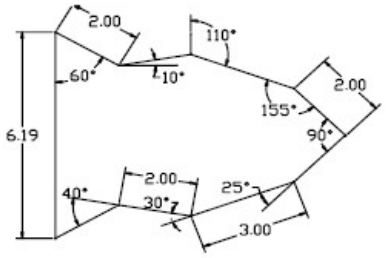


FIG:- 3.1

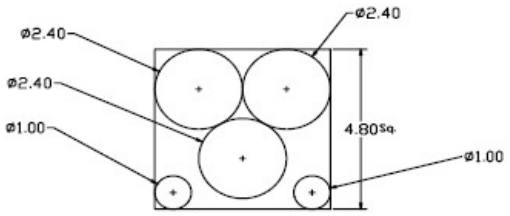


Fig:- 3.2

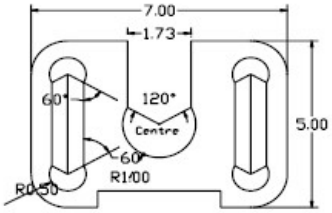


FIG : 3.3

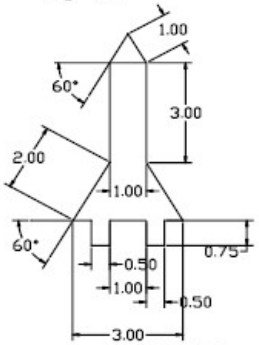


FIG:- 3.4

Module – IV

Draw the following figures with the help of AutoCAD commands studied.

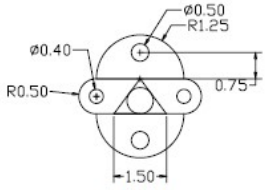


Fig :- 4.1

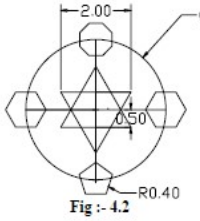


Fig :- 4.2

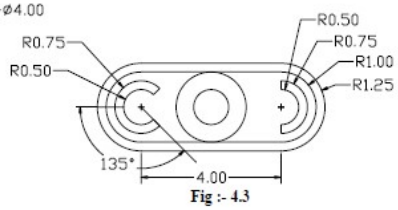


Fig :- 4.3

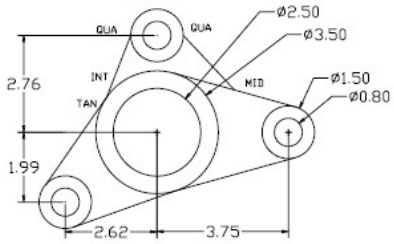


Fig :- 4.4

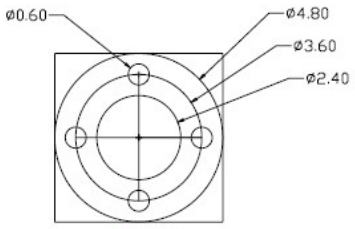
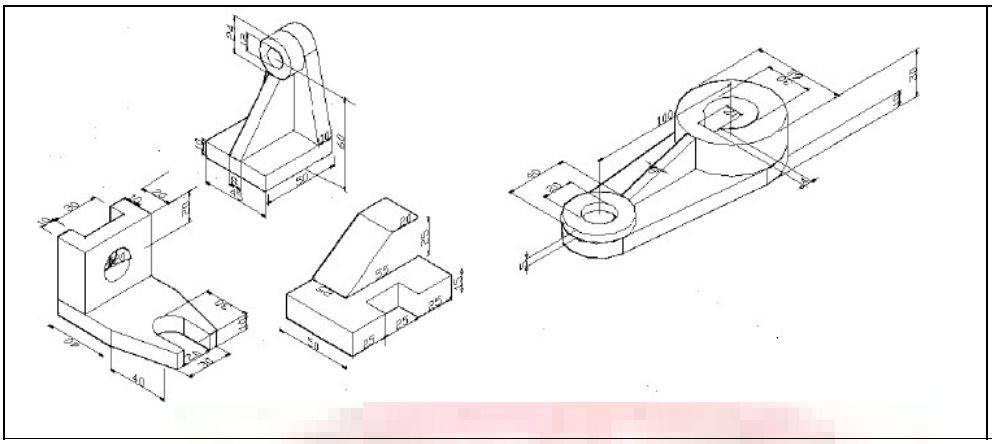


Fig :- 4.5

Module – V

Draw the Drawings with the help of AutoCAD commands studied.



BOOKS:

1. Learn AutoCAD; Sunil K. Pandey, S.K. Kataria & Sons; ISBN: 978-8185749785
2. AutoCAD 2020 Beginners Guide; Amit Bhatt; CADFOLKS; ISBN: 978-8193063071
3. Learning AutoCAD A-Z Coverage of Every Feature and Command; Atish B. Mane, PBT
4. A Hand Book on AutoCAD Tools Practice, Azhar Wahab, PBT

COURSE INFORMATION SHEET

Course Code: **PE 24190**
Course Title: **Welding Technology**
Pre-requisite(s):
Co- requisite(s):
Credits: **3** L:1 T: 0 P: 4
Class schedule per week: **5**
Class: **Certificate in Engineering**
Semester / Level: **First**
Branch: **Mechanical Engineering**
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1.	Learn about the fundamental principles, process parameters and application possibilities of arc and gas welding processes.
2.	Learn about the fundamental principles, process parameters and application possibilities of GMAW and GTAW processes.
3.	Understand welding principles, equipment setup, parameters, and SAW practice.
4.	Understand welding principles, equipment setup, parameters, and practice spot welding.
5.	Learn about to Friction stir welding principles, equipment setup, parameters

COURSE OUTCOMES (COs)

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

CO1	Understand welding terminology, principles, positions, joint preparation for gas/arc welding techniques and identify their advantages, limitations, applications.
CO2	Compare GMAW/GTAW principles, setup, techniques, advantages, limitations, and applications.
CO3	Explain the SAW principles, setup, parameters, and identify advantages, limitations, applications.
CO4	Understand the spot-welding principles, setup, parameters, skills, advantages, limitations, applications.
CO5	Perform the FSW welding and identify their advantages, limitations and application possibilities.

SYLLABUS

MODULE
Module – I **Introduction to Welding:** Classification of welding processes, terminology, general principles, welding positions, joint types, and edge preparation. Overview and hands-on practice with gas welding techniques and equipment. Overview and hands-on practice with arc welding techniques and equipment.
Module – II **Gas Metal Arc Welding (GMAW) and Gas Tungsten Arc Welding (GTAW):** Principles and Process Characteristics: Understanding welding principles, process characteristics, and equipment setup and operation. Exploring welding parameters and their effects on weld quality. Practical sessions on Gas Metal Arc Welding (GMAW) and Gas Tungsten Arc Welding (GTAW).
Module – III **Submerged arc welding (SAW):** Principles and process characteristics, Equipment setup and operation, Welding parameters and their effects. Hands-on practice on SAW.
Module – IV **Spot welding :** Principles and process characteristics, Equipment setup and operation, Welding parameters and their effects. Hands-on practice on Spot welding.
Module – V **Friction stir welding:** Principles and process characteristics, Equipment setup and operation, Welding parameters and their effects. Setup and operation of FSW equipment and hands-on practice on welding of non-ferrous materials.

BOOKS:

1. A text book of Welding Technology by O. P. Khanna. Dhanpat Rai Publication.
2. Foundation of Welding Technology by K. S. Ghosh. PHI Publication.
3. Welding Technology and Design by V.M. Radahrishnan and M. Kamaraj. New Age International Pub.

COURSE INFORMATION SHEET

Course Code: ME24212
Course Title: Installation, Testing and Maintenance of Solar Appliances
Pre-requisite(s): NIL
Co- requisite(s): NIL
Credits: 3 L:1 T:0 P:4
Class schedule per week: 5
Class: Diploma in Engineering
Semester / Level: SECOND
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1	Familiarization with Solar panels
2	Design and Installation of Solar devises.
3	Testing of various Solar Appliances

COURSE OUTCOMES (COs)

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

CO1	Be conversant with the Solar Panels.
CO2	Explain the basic utilities of Solar Panels.
CO3	Apply the basic knowledge of Solar Panels for its optimal usage.
CO4	Develop skills to work as an individual or in a team during the Installation and Testing

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I Solar Panel Installation: Site Assessment: Evaluate property suitability and energy needs. Design and Sizing: Customize the system for maximum efficiency. Permitting and Approvals: Obtain necessary permits and comply with regulations. Equipment Procurement: Source reliable, high-quality components.	
Module – II Installation: Mount panels and make electrical connections. System Testing: Ensure optimal performance and functionality. System Activation: Start generating clean, renewable energy.	
Module – III Solar Panel Maintenance: Regular Cleaning: Remove dirt and debris to maximize fficiency. Inspection and Monitoring: Identify issues and track performance.	
Module – IV Electrical System Maintenance: Check connections and wiring. Professional Service: Engage experts for comprehensive care. Performance Optimization: Explore upgrades and monitoring solutions.	
Module – V Testing a Solar Panel: Follow the Safety Precautions. Measurement of Voltage, current and Resistance.	

BOOKS:

1. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K., 1996.
2. Rai. G.D., "Non-Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
3. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.
4. Sukhatme. S.P., "Solar Energy", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.
5. Tiwari. G.N., Solar Energy – "Fundamentals Design, Modelling& Applications", Narosa Publishing House, New Delhi, 2002.
6. Freris. L.L., "Wind Energy Conversion Systems", Prentice Hall, UK, 1990. 4. Chetan Singh Solanki, Solar Photovoltaics, "Fundamentals, Technologies and Applications", PHI Learning Private Limited, New Delhi, 2009.

COURSE INFORMATION SHEET

Course Code: PE24290
Course Title: CNC Machining
Pre-requisite(s): NIL
Co- requisite(s): NIL
Credits: 3 L:1 T:0 P:4
Class schedule per week: 5
Class: Diploma in Engineering
Semester / Level: SECOND
Branch: Mechanical Engineering
Name of Teacher:

COURSE OBJECTIVES

This course envisions to impart to students to:

1	Gain foundational knowledge of CNC machines, numerical control, programming languages, and CNC features.
2	Develop proficiency in CNC programming, including toolpath generation and optimizing machining cycles.
3	Learn programming and execution of turning, facing, interpolation, and thread-cutting on CNC lathes.
4	Acquire skills in programming profile milling, interpolation, and pocket milling on CNC milling machines.
5	Understand setup, safety, and perform basic to advanced grinding operations on CNC grinding machines.

COURSE OUTCOMES (COs)

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

CO1	Understand CNC machines, numerical control, programming languages, and their advantages and limitations.
CO2	Proficiency in CNC programming, including toolpath generation and optimizing machining cycles.
CO3	Competence in programming and executing turning, facing, interpolation, and thread-cutting on CNC lathes.
CO4	Develop program profile milling, interpolation, and pocket milling on CNC milling machines.
CO5	Perform grinding operations on CNC grinding machines, including toolpath optimization and troubleshooting.

SYLLABUS

MODULE	(NO. OF LECTURE HOURS)
Module – I **Foundational Knowledge :** Introduction to CNC Machines, Basic Concept of numerical control, Understanding CNC Programming Languages, Advantages and Limitations of CNC of CNC, Features of CNC.	
Module – II **CNC Programming Basics :** Coordinate Systems, G-code and M-code, Toolpath Generation, Basic machining cycles, Advanced machining cycles, Mirroring commands, Subroutines (Subprogram) and, how to reduce the machining cycle time.	
Module – III **CNC lathe:** Program for Turning, Facing operation, circular interpolation, thread-cutting operation and Machining.	
Module – IV **CNC milling ;** Program for profile milling operation, circular interpolation, rectangular pocket milling and Machining.	
Module – V **CNC grinding :** Understand CNC grinding machine setup, safety, and perform basic surface and cylindrical grinding tasks. Learn advanced grinding operations, toolpath optimization, troubleshooting, and complete a comprehensive hands-on grinding job.	

BOOKS:

1. CNC Machines by M. Adithan and B.S. Pable.New Age International Pub.
2. CNC Machining Technology: Volume I: Design, Development and CIM Strategies-1, by Graham T. Smith.Springer Verlag.
3. CNC Machining Technology: Volume II Cutting, Fluids and Workholding Technologies-2, by Graham T. Smith.Springer Verlag.