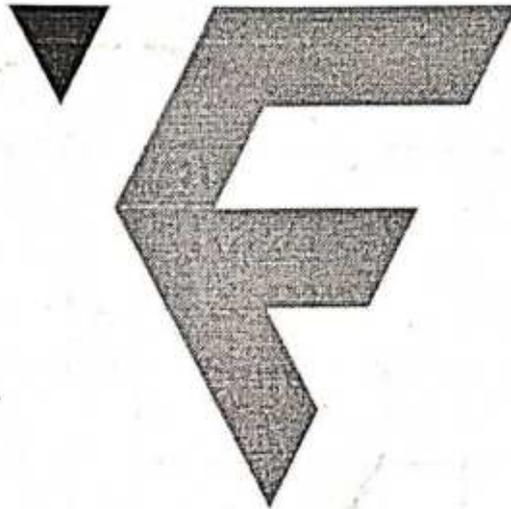


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**Affiliated to Dr. Babasaheb Ambedkar Technological University (BATU),
Lonere**



**In line with the
National Education Policy (NEP) 2020
Compliant Curriculum
For
POST GRADUATE PROGRAMME
(MECHANICAL ENGINEERING)
First & Second Year M. Tech.
(Sem-I, Sem-II, Sem-III & Sem-IV)
(w.e.f. A.Y. 2025-26)**



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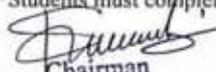
Curriculum for Mechanical Engineering M. Tech. with effect from A.Y. 2026-27

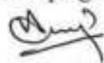
Semester I

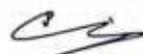
Course Type	Course Code	Name of the Course	Engagement Hours			Credits	In Semester Evaluation Scheme		End Semester Evaluation Scheme		Total Marks
			L	T	P		MSE	ICA	ESE	OE/POE	
							M	M	M	M	
PCC	25PME11171	Advanced Engineering thermodynamics and heat cycle	3	-	-	3	30	10	60	-	100
	25PME11172	Advanced Manufacturing Processes	3	-	-	3	30	10	60	-	100
	25PME11173	Industrial product design	3	-	-	3	30	10	60	-	100
	25PME11174	PG Lab-I	-	-	2	1	-	50	-	-	50
PEC	25PME11271	Professional Elective Courses-I	3	1	-	4	30	10	60	-	100
	25PME11272		3	1	-	4	30	10	60	-	100
	25PME11273		3	1	-	4	30	10	60	-	100
ELC	25PME11671	Research methodology and IPR	3	1	-	4	30	10	60	-	100
	25PME11672	Seminar	-	-	2	1	-	50	-	-	50
AEC	25PEE11471	Hands on Research and Analysis Tool	-	-	2	1	-	50	-	-	50
Total			15	02	06	20	150	200	300	-	650

Abbreviations: L= Lecture, T= Tutorial, P= Practical, M= Marks

*Students must complete a student induction program at the start of the first semester to ease their transition into the academic environment.


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In addition to above courses the following Groups are offered as Multidisciplinary Minor by Mechanical Engineering Department

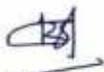
Professional Elective Courses-I [PEC]

Sr. No	Subject Code	Subject Name
1	25PME11271	Robotics
2	25PME11272	Manufacturing Planning and Control
3	25PME11273	Solar and Wind Energy


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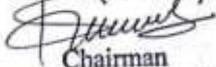
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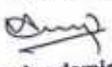
Semester II

Course Type	Course Code	Name of the Course	Engagement Hours			Credits	In Semester Evaluation Scheme		End Semester Evaluation Scheme		Total Marks
			L	T	P		MSE	ICA	ESE	OE/POE	
							M	M	M	M	
PCC	25PME12175	Advanced fluid mechanics	3	-	-	3	30	10	60	-	100
	25PME12176	Advanced design engineering	3	-	-	3	30	10	60	-	100
	25PME12177	Advanced metal joining process	3	-	-	3	30	10	60	-	100
	25PME12178	PG Lab -II	-	-	2	1	-	50	-	-	50
PEC	25PME12274	Professional Elective Course-II	3	1	-	4	30	10	60	-	100
	25PME12275										
	25PME12276										
PEC	25PME12277	Professional Elective Course-III	3	1	-	4	30	10	60	-	100
	25PME12278										
	25PME12279										
VSE	25PME12172	Mini Project	-	-	2	1	-	50	-	-	50
ELC	25PET12673	Research Publication and Ethics	-	-	4	2	-	50	-	-	50
Total			15	02	08	21	150	200	300	-	650

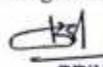
Abbreviations: L= Lecture, T= Tutorial, P= Practical, M= Marks

In addition to above courses following Groups are offered as Professional Elective Course by Mechanical Engineering Department


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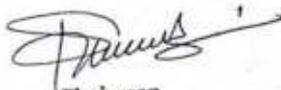

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Professional Elective Course-II [PEC-II]

Sr. No.	Course Code	Name of the Course
1	25PME12274	Automatic control engineering
2	25PME12275	Alternative fuels for IC engine
3	25PME12276	Computational fluid dynamics

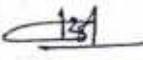
Professional Elective Course - III [PEC- III]

Sr. No.	Course Code	Name of the Course
1	25PME12277	Advanced engineering material
2	25PME12278	Entrepreneurship development
3	25PME12279	New labour codes of India


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		Curriculum for Mechanical Engineering B. Tech. with effect from A.Y. 2026-27 Semester III										
Course Type	Course Code	Name of the Course	Engagement Hours			Credits	In Semester Evaluation Scheme		End Semester Evaluation Scheme		Total Marks	
			L	T	P		MSE	ICA	ESE	OE/POE		
							M	M	M	M		
PCC	26PME21179	Additive Manufacturing	3	1	-	4	30	10	60	-	100	
ELC	26PME21674	MOOC's/NPTEL, Self Learning Courses/MKCL	2	-	-	2	-	50	-	-	50	
OEC	26PME21571	Open Elective Course -IV	3	1	-	4	30	10	60	-	100	
	26PME21572											
	26PME21573											
ELC	26PME21675	Dissertation Phase -I	-	-	12	6	-	100	-	100	200	
Total			08	02	12	16	60	170	120	100	450	
Abbreviations: L= Lecture, T= Tutorial, P= Practical, M= Marks												

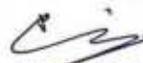
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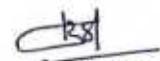
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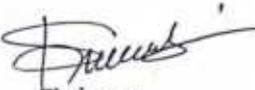
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In addition to the above courses, the following courses are offered as Open Electives (OE) by the Mechanical Engineering Departments

Open Elective Course [OEC- IV]

Sr. No.	Course Code	Name of the Course
1	26PME21571	Business Analytics
2	26PME21572	Non-Conventional Energy
3	26PME21573	Organizational Behavior

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		Curriculum for Mechanical Engineering B. Tech. with effect from A.Y. 2027-28									
		Semester IV									
Course Type	Course Code	Name of the Course	Engagement Hours			Credits	In Semester Evaluation Scheme		End Semester Evaluation Scheme		Total Marks
			L	T	P		MSE	ICA	ESE	OE/POE	
ELC	26PME22676	Dissertation Phase -II	-	-	24	12	-	200	-	200	400
		Total			24	12	-	200	-	200	400
Abbreviations: L= Lecture, T= Tutorial, P= Practical, M= Marks											


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SEMESTER I



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First Year M. Tech.

Semester-I (w.e.f. A.Y. 2025-26)

Advanced Engineering thermodynamics and heat transfer (25PME11171)

Teaching Scheme:

Evaluation Scheme:

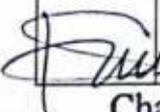
	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	-	-	ICA:	10 Marks
Practical:	-	-	ESE:	60 Marks
Total:	3	3	OE/POE:	-

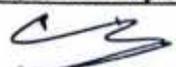
Course Outcomes: At the end of this course, students shall be able to

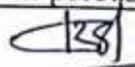
BL Level

CO 1	Apply the first and second laws of thermodynamics, entropy generation, and exergy analysis to analyze and improve the performance of thermal systems.	BL-3:
CO 2	Analyze real gas behavior using advanced equations of state and evaluate phase equilibrium in multi-component systems.	BL-4 BL-5
CO 3	Solve complex heat conduction problems using analytical and numerical methods, including finite difference techniques for transient and multi-dimensional systems.	BL-3 BL-4
CO 4	Analyze and interpret forced and natural convection mechanisms and evaluate heat transfer performance in industrial systems using empirical and theoretical models.	BL-4 BL-5
CO 5	Design thermal systems considering combined modes of heat transfer (conduction, convection, and radiation), and assess radiation effects in enclosures and participating	BL-6 BL-5

Unit	Course Contents	No. of lectures (hrs.)
Unit 1	Advanced Thermodynamic Concepts Thermodynamic systems, properties, and equilibrium, First law and second law of thermodynamics (advanced applications), Entropy generation and minimization, Exergy analysis: concept, calculations for closed and open systems, Thermodynamic optimization techniques, Thermodynamic relations and Maxwell's equations	6
Unit 2	Real Gas Behavior and Equations of State Behavior of real gases and deviations from ideal gas law, Equations of state: van der Waals, Redlich-Kwong, Peng-Robinson, Fugacity and activity, multi-component systems and chemical potential, Phase equilibrium and Gibbs phase rule, Thermodynamic property estimation using equations of state	6
Unit 3	Advanced Heat Conduction and Numerical Methods General heat conduction equation in Cartesian, cylindrical, and spherical coordinates Analytical solutions for steady and unsteady conduction problems, Extended surfaces (fins) and their efficiency, Numerical techniques: Finite difference method for 1D and 2D problems, Crank-Nicolson and ADI methods, Heat generation and boundary conditions in complex geometries	6
Unit 4	Convective Heat Transfer and Applications Forced convection: internal and external flows, turbulent boundary layers, Natural convection: governing equations, similarity solutions, Heat transfer in porous media,	6


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	Heat transfer enhancement techniques, Applications in heat exchangers, electronics cooling, and industrial systems, Empirical correlations and dimensionless analysis (Nu, Re, Pr, Gr)	
Unit 5	Radiation Heat Transfer and Combined Modes Fundamentals of thermal radiation, blackbody and gray body concepts, Radioactive properties of surfaces, view factors, Radiation exchange between surfaces: enclosure theory, Spectral and directional considerations, Combined conduction-convection-radiation problems, Radiation in participating media and combustion systems	6
Text Books:		
1)	Bejan, A. "Advanced Engineering Thermodynamics" – Wiley	
2)	Incropera, F. P., DeWitt, D. P., Bergman, T. L., and Lavine, A. S. "Fundamentals of Heat and Mass Transfer" – Wiley	
Reference Books:		
1)	Nag, P.K. Engineering Thermodynamics – McGraw Hill Education	
2)	Arpaci, V. S. "Principles of Heat Transfer" – Pearson	

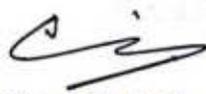
Mapping of Cos and POs:

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



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First Year M. Tech.

Semester-I (w.e.f. A.Y. 2025-26)

Subject – Advanced Manufacturing Processes (25PME11172)

Teaching Scheme:

Evaluation Scheme:

	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	-	-	ICA:	10 Marks
Practical:	-	-	ESE:	60 Marks
Total:	3	3	OE/POE:	-

Course Outcomes: At the end of this course, students shall be able to

BL Level

CO 1	Understand the machining theory and cutting forces in machining	BL-2 Understand
CO 2	Explain processing methods of plastics and composites	BL-2 Understand
CO 3	Identify and apply various process variables of advanced welding processes	BL-3 Apply
CO 4	Explain different advanced machines and rapid prototyping processes	BL-2 Understand
CO 5	Develop the manual part programming and generate tool paths for a given profile	BL-3 Apply

Unit	Course Contents	No. of lectures (hrs.)
Unit 1	Fundamentals of Metal Cutting Advanced machining theory & practices- material removal mechanism, mechanism of chip formation, types of chips, single point cutting tool geometry, shear angle relations and theoretical determination of cutting forces in orthogonal cutting.	6
Unit 2	Processing of Plastics and Composites Processing of plastics- Extrusion, Blow Molding, Thermoforming, Compression Molding, and Transfer Molding. Introduction to composite materials along with its basic requirements, Definition of composite material, Classification based on matrix and topology, Constituents of composites. Fabrication of Metal Matrix Composites: Commonly used Matrices, Basic Requirements in Selection of constituents, solidification processing of composites - XD process, Spray processes - Osprey Process, Dispersion Processes - Stir-casting & Compo casting, Screw extrusion.	6
Unit 3	Advanced Joining Processes Introduction, Importance and application of welding, classification of welding process. Selection of the welding process. Brief review of conventional welding process, Principles, working process variables and	6

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	applications of -Gas welding, Electric Arc welding, MIG, TIG welding. Resistance welding. Advanced welding Techniques-Principles, working and applications of advanced welding techniques such as -Plasma Arc welding, Laser beam welding and Electron beam welding, Ultrasonic welding.	
Unit 4	Advanced Machining Processes Advanced machining processes - Details of EDM, WEDM, ECM, AJM, LBM their process parameters, advantages, limitations and applications, Rapid Prototyping-Introduction, process of RP, classification of RP, Liquid based system- Stereolithography Apparatus (SLA) - Principle, process, advantages and applications, Solid based system-Fused Deposition Modeling, Laminated Object Manufacturing— Principle, process, advantages, limitations and applications, Powder Based Additive Manufacturing Systems Selective Laser Sintering, -Principles of SLS process, Process, advantages and applications, Three-Dimensional Printing-Principle, process, advantages and applications.	6
Unit 5	CNC Machining Introduction to NC & CNC Machines, encoders, servo motors, Tool holders, ATC, CNC Part Programming Fundamentals- G and M Codes, Methods of CNC Part Programming, writing a part programme using G & M codes for a given component, High speed machining.	6

Text Books:

- 1) Geoffery Boothroyd, Fundamentals of Metal cutting and Machine Tools, Mc Graw Kogakusha
- 2) Bhattacharya, "Metal Cutting, Theory and Practice", New Central Book Agency
- 3) Plastic Engineering Handbook-by Joel Frados
- 4) Handbook of Engineering Plastics-by Brown/Dercock

Reference Books:

- 1) Arshinov, "Metal Cutting Theory and Design", MIR Publishers.
- 2) Rees Rawlings, Frank Matthews, "Composite Materials" Springer, New edition, 1999.
- 3) Little R L, Welding and Welding Technology, Tata McGraw Hill Education Private Limited, 1stst Edition, 2005.

In Semester Examination (ISE): 30 Marks

Internal Continuous Assessment (ICA): 10 Marks

Sr. No.	Name of Tutorial / Assignment
1)	
2)	
3)	
4)	
5)	

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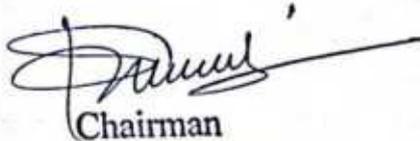
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Mapping of Cos and POs:

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

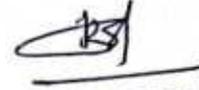
The strength of mapping is to be written as 1: low, 2: Medium, 3: High.



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First Year M. Tech.

Semester-I (w.e.f. A.Y. 2025-26)

Industrial Product Design (25PME11173)

Teaching Scheme:

Evaluation Scheme:

	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	-	-	ICA:	10 Marks
Practical:			ESE:	60 Marks
Total:	3	3	OE/POE:	

Course Outcomes: At the end of this course, students shall be able to

BL Level

CO 1	Explain the concept development, industrial product development process and models used in industrial design	BL- 2:
CO 2	Apply industrial design methodology while designing new product	BL-3:
CO 3	Apply the aesthetic and ergonomics concepts in product design.	BL-3:
CO 4	Apply the creative thinking and ideation techniques in new product development and explain the requirements of standards	BL-3:
CO 5	Apply the economics and environment consideration in design	BL- 3:

Course Description- This course covers the fundamentals of industrial product design, focusing on creativity, user needs, aesthetics, ergonomics, and sustainable development. Students learn the complete design process from concept to prototype using modern tools and techniques.

Unit	Course Contents	No. of lectures (hrs.)
UNIT 1	Introduction. Need of industrial design, concept development process, design and development process of industrial product, assessing the quality of industrial design, problem faced by industrial designer, types of models used in industrial design: clay studies, mockups, scale models, prototype	6
UNIT 2	Industrial product design. Design of industrial and consumer products, setting specification, requirements and rating, their importance in design, study of market requirement and manufacturing aspects of industrial design, challenges of product development.	7
UNIT 3	Aesthetic and Ergonomic Concepts Concept of unity and order with variety, concept of purpose, style and environment, aesthetic expressions of symmetry, balance, contrast continuity, proportion. Mechanics of seeing, psychology of seeing, influence of line and form, effect of color on product appearance, reactions to color and color combinations, man-machine relationship. Use and limitations of anthropometric data, aspects of ergonomic design of machine tools, testing equipment, instruments, automobiles, process equipment etc. Interpretation of information, physiological factors, psychology factors, anatomy factors	7

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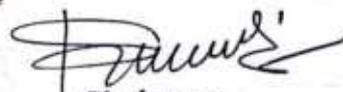
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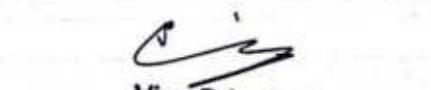
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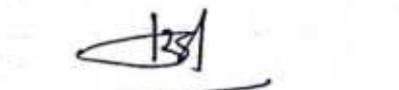
UNIT 4	New Product Development Imitation, idea collection, creative design, brainstorming, creative thinking, development, inventiveness, conception, design, function and use, legal standard requirements, international standards, prototype design, pre-production, inspection.	7
UNIT 5	Economic and Environment Considerations in Design Economic considerations: selection of materials and processes for production (DFP), impact of DFP on other factors, cost reduction, break-even analysis. Environment considerations: need, guidelines, product life cycle assessment, techniques to reduce environmental impact.	6
Text Books:		
1)	Product Design and Development, Karl T. Ulrich, Steven D. Eppinger and Anita Goyal, McGill Education	
2)	Product Design and Manufacture, A. K. Chitale and R. C. Gupta, PHI Learning, 5th Edition	
Reference Books:		
1)	Industrial Design for Engineers, W. H. Mayall, London Lifee books Ltd.	
2)	Product Design: Fundamentals and Methods, Roozenburg, N. F., & Eekels, J., John Wiley & Sons Inc.	
3)	Product Design: Fundamentals and Methods, Roozenburg, N. F., & Eekels, J., John Wiley & Sons Inc.	
4)	Universal Principles of Design (revised and updated): 125 Ways to Enhance Usability, Influence Perception, Increase Appeal, Make Better Design Decisions, and Teach Through Design, Lidwell, W., Holden, K., & Butler, J., Rockport Pub.	
5)	Industrial Design: Materials and Manufacturing Guide, Jim Lesko, Wiley	

Mapping of Cos and POs:

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


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First Year M. Tech.

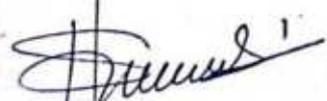
Semester-I (w.e.f. A.Y. 2025-26)

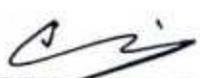
Mechanical Engineering PG Lab1 (25PME11174)

Teaching Scheme:			Evaluation Scheme:	
	No. of Hrs./week	No. of Credits		
Lectures:	-	-	ISE:	-
Tutorials:	-	-	ICA:	50 Marks
Practical:	2	1	ESE:	-
Total:	2	1	OE/POE:	-

<i>Course Outcomes:</i> At the end of this course, students shall be able to		<i>BL Level</i>
CO 1	Apply engineering principles to perform and analyze experiments in thermal and fluid systems.	BL 3,4
CO 2	Interpret and calculate experimental errors and uncertainties in measurements.	BL4,5
CO 3	Conduct experiments related to heat transfer and fluid machinery and interpret results.	BL3,4
CO 4	Design and model mechanical components using CAD software.	BL6
CO 5	Perform FEM-based stress analysis of mechanical components using analysis tools.	BL3,5
CO6	Prepare structured reports summarizing experimental work, analysis, and conclusions.	BL6

Ex.	Experiment Details (<i>Study include performance evaluation, calibration of measuring instrument/s and error analysis, innovative experiment/s</i>)	No. of Ex. Sessions (hrs.)
Ex. 1	Heat Transfer Enhancement	4
Ex. 2	Computerized Single Cylinder Diesel Engine using Alternative Fuel	4
Ex. 3	Air Conditioning Test-rig	4
Ex. 4	Centrifugal/Gear Pump at Variable speed	4
Ex. 5	Unsteady State Heat Transfer	4
Ex. 6	Blower Test-rig	4
Ex. 7	CAD modelling of any two machine components using Catia/Pro-E/Solid edge/ any suitable modelling software	4
Ex. 8	Mini project: On FEM analysis of any two machine members by using reputed commercial software for stress distribution, stress concentration and report writing on results of analysis. Using Ansys/Nastran/ Hyper mesh/ LS-DYNA / any suitable analysis software. Study includes performance evaluation, calibration of measuring instrument/s and error analysis, innovative experiment/s	4


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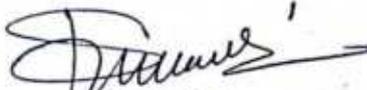
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Mapping of Cos and POs:

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


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First Year M. Tech.

Semester-I (w.e.f. A.Y. 2025-26)

Subject – Robotics (25PME11271)

Teaching Scheme:

Evaluation Scheme:

	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	1	1	ICA:	10 Marks
Practical:	-	-	ESE:	60 Marks
Total:	4	4	OE/POE:	-

Course Outcomes: At the end of this course, students shall be able to

BL Level

CO 1	List the various components of a typical Robot, grippers, sensors, drive system and describe their functions	BL-L1, L2
CO 2	Calculate the world to joint and joint to world coordinates using forward and reverse transformations	BL-L4 & L5
CO 3	Calculate the gripper forces, drive sizes, etc.	BL-L3,L4
CO 4	Develop simple robot program for tasks such as pick and place, arc welding, etc. using some robotic language such as VAL-II, AL, AML, RAIL, RPL, VAL	BL-L2
CO 5	Evaluate the application of robots in applications such as Material Handling, process operations and Assembly and inspection	BL-L3,
CO6	Discuss the implementation issues and social aspects of robotics.	BL3 L5

Course Description-

Unit	Course Contents	No. of lectures (hrs.)
Unit 1	Introduction: Various basic components of a Robotic system, various configurations, work envelopes, Manipulators, Controllers, etc., Parameters	6
Unit 2	Mechanical System in Robotics: Motion conversion, Kinematic chains, position analysis, forward and reverse transformations, natural and joint space coordinates, homogeneous transformation and robot kinematics, Manipulator path control, Robot Dynamics.	6
Unit 3	Drives and Sensors Robotics: Electrical drives, Stepper motors, Servo motors, DC motors, AC motors, hydraulic and pneumatic drives, hybrid drives, drive selection for robotic joints. Position sensor, velocity sensor, Proximity sensors, touch sensors, force sensors, miscellaneous sensors etc.	6

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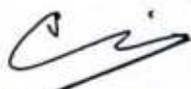
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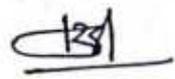
Unit 4	Robot End Effector: Types of end effectors, Mechanical Grippers, Design of End Mechanical Grippers, and Other Principles of gripping, Tools and end effectors, Considerations in gripper selection and design.	6
Unit 5	Robot Programming and AI: Path planning, Lead through (manual and powered) programming, teach pendant mode, programming languages, Simple statements from AL, AML, RAIL, RPL, VAL Languages Artificial Intelligence for Robots: Knowledge Representation, Problem representation and problem solving, search techniques in problem solving. Application of robots in: Material handling, assembly and inspection, process operations, etc. Economic Analysis for robotic implementation	6
Text Books:		
1)	M. P. Grover, "Industrial Robotics: Technology, Programming and Applications", Tata Mc Graw Hill Publication.	
2)		
3)		
Reference Books:		
1)	Saeed B. Niku, "Introduction to Robotics, Analysis, Systems, Applications", Pearson Education	
2)		

Mapping of Cos and POs:

PO→	PO											
CO↓	1	2	3	4	5	6	7	8	9	10	11	12
CO1	1	1	1		1				3	1		-
CO2	2	3	2	1	2	1			3	2		-
CO3	3	2	2	1	1				3	2		-
CO4	3	3	2	1	2		1		3	2		-
CO5	3	1	1		1		1		3	2		-
CO6	1	1	1						3	2		


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First Year M. Tech.

Semester-I (w.e.f. A.Y. 2025-26)

Manufacturing Planning and Control (25PME11272)

Teaching Scheme:

Evaluation Scheme:

	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	1	1	ICA:	10 Marks
Practical:			ESE:	60
Total:	4	4	OE/POE:	

Course Outcomes: At the end of this course, students shall be able to

BL
Level

CO 1	Apply the systems concept for the design of production and service systems	BL-1
CO 2	Make forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques.	BL-2:
CO 3	Apply the principles and techniques for planning and control of the production and service systems to optimize/make best use of resources.	BL-3:
CO 4	Understand the importance and function of inventory and to be able to apply selected techniques for its control and management under dependent and independent demand circumstances.	BL-2:
CO 5	Study about quality planning, cost planning and control.	BL-3:

Course Description- This course provides an in-depth understanding of planning, scheduling, and control activities in manufacturing systems. It covers production strategies, forecasting, capacity planning, inventory management, materials requirement planning (MRP), shop floor control, and lean manufacturing practices to optimize resources and ensure timely product delivery.

Unit	Course Contents	No. of lectures (hrs.)
UNIT 1	Overview of manufacturing systems and various issues of interest: assembly line, repetitive batch manufacturing.	6
UNIT 2	Cellular manufacturing, FMS, JIT, CIM, preplanning: forecasting, economic analysis, aggregate planning, capacity planning, inventory planning.	7
UNIT 3	Decision making in design of manufacturing systems: group technology, line balancing, plant layout.	7
UNIT 4	Operations planning: MRP, MRP II, hierarchical planning systems, JIT systems.	7
UNIT 5	Quality planning and control, cost planning and control, Simulation analysis of manufacturing systems, case studies.	6

Text Books:

D.D. Bedworth and J.E Bailey, *Integrated Production Control, System-management,*

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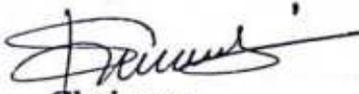
Analysis and Design, John Wiley, 1983

Reference Books:

- 6) E.A.Elsayed and T.O.Boucher , *Analysis and Control of Production Systems*, Prentice Hall, 1985..
- 7) J. R.King ,*Production Planning and Control*, Pergamon Press, Oxford, 1975
- 8) P.F.Bestwick and K.Lockyer, *Quantitative Production Management*, Pitman Publications, 1982.
- 9) A.C.Hax and D.Candea, *Production and Inventory Management*, Prentice-Hall, 1984
- 10) M.G.Korgaokar, *JIT Manufacturing*, Macmillan, 1992.

Mapping of Cos and POs:

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



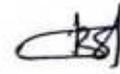
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First Year M. Tech.

Semester-I (w.e.f. A.Y. 2025-26)

Subject- Solar & Wind Energy (25PME11273)

Teaching Scheme:

Evaluation Scheme:

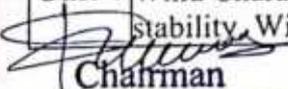
	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	1	1	ICA:	10 Marks
Practical:	-	-	ESE:	60 Marks
Total:	4	4	OE/POE:	-

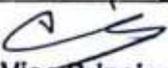
Course Outcomes: At the end of this course, students shall be able to

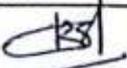
BL

CO1	Describe the measurement of direct, diffuse, and global solar radiations falling on horizontal and inclined surfaces.	BL-2
CO2	Analyze the performance of the flat plate collector, air heater, and concentrating type collector.	BL-4
CO3	Study and compare various types of thermal energy storage systems.	BL-3
CO4	Analyze wind characteristics and apply statistical and aerodynamic methods to estimate power output and evaluate the economics of wind energy systems	BL-4
CO5	Understand and analyze the configuration, components, design, and economic aspects of solar-wind hybrid energy systems for efficient energy generation.	BL-2,4

Unit	Course Contents	No. of lectures (hrs.)
Unit 1	Solar Radiation Introduction, spectral distribution, solar time, diffuse radiation, Radiation on inclined surfaces, measurement of diffuse, global and direct solar radiation.	7
Unit 2	Collectors & Air Heaters Liquid Flat Plate Collectors -Introduction, performance analysis, overall loss coefficient and heat transfer correlations, collect or efficiency factor, collect or heat removal factor, testing procedures. Concentrating Collectors - Types of concentrating collectors, performance analysis Solar Air Heaters Introduction, types of air heater, testing procedure	7
Unit 3	Thermal Energy Storage and Economic Analysis Introduction, sensible heat storage, latent heat storage and thermo chemical storage Solar Pond : Solar pond concepts, description, performance analysis, operational problems. Economic Analysis Definitions, annular solar savings, payback period.	7
Unit 4	Wind Energy Wind Characteristics: Metrology of wind, World distribution of wind, Atmospheric stability, Wind speed variation with height, Wind speed statistics, Weibull	7


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	statistics, Weibull parameters, Rayleigh and normal distribution. Power output from an ideal turbine, Aerodynamics, Power output from practical turbines, Transmission and generation efficiency Economics of Wind Systems	
Unit 5	Solar-Wind Hybrid Energy Systems Introduction to Hybrid Energy Systems, System Configuration and Working Principles, Components of Solar-Wind Hybrid System, Site Selection and Resource Assessment, System Design and Sizing, Economic and Environmental Considerations.	7
Text Books:		
1)	J. A. Duffie, W. A. Beckman, "Solar Energy Thermal Processes", John Wiley, 1974.	
2)	K. Kreith, J. F. Kreider, "Principles of Solar Engineering", Tata McGraw-Hill Publications, 1978.	
Reference Books:		
1)	H. P. Garg, J. Prakash, "Solar Energy: Fundamentals and Applications", Tata McGraw Hill Publications, 1997.	
2)	S. P. Sukhatme, "Solar Energy Principles of Thermal Collection and Storage", Tata McGraw Hill Publications, 1996.	
3)	G. D. Rai, "Solar Energy Utilization", Khanna Publisher, Delhi, 1992.	
In Semester Examination (ISE):		
Internal Continuous Assessment (ICA):		
Sr. No.	Name of Tutorial / Assignment	
1)	One Assignment on each topic	

Mapping of Cos and POs:

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


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First Year M. Tech.

Semester-I (w.e.f. A.Y. 2025-26)

Research Methodology and IPR (25PME11671)

Teaching Scheme:

Evaluation Scheme:

No. of Hrs./week

No. of Credits

Lectures: 3

3

MSE: 30 Marks

Tutorials: 1

1

ICA: 10 Marks

Practical: -

-

ESE: 60 Marks

Total: 4

4

OE/POE: -

Course Outcomes: At the end of this course, students shall be able to

BL Level

CO1	Discuss research methodology and the technique of defining research problem	BL-II: Understand
CO2	Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.	BL-II: Understand
CO3	Explain various research designs, sampling designs, measurement and scaling techniques and different methods of data collections.	BL-II: Understand
CO4	Explain several parametric tests of hypotheses, Chi-square test, art of interpretation	BL-II: Understand
CO5	Discuss various forms of intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR.	BL-II: Understand

Unit

Course Contents

No. of Lectures (Hrs.)

Unit 1	Research Methodology: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India.	5
Unit 2	Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration, Resources for Literature Survey, How to Read a Scientific Paper, White Paper, and Patent, Research Reports, Recording and Summarizing the Findings of Literature Survey, Formulation of the Problem Statement, Scope and Significance of the Research Problem.	5
Unit 3	Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Design, Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs.	5

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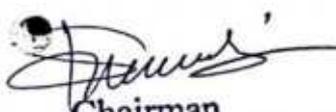
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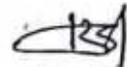
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Unit 4	Data Collection: Types of data, Data Collection, Scaling, Experimental Setup, Data Analysis: Introduction, Regression Analysis, Parameter Estimation, Inferential Statistics, Univariate, Bivariate, and Multivariate Data Analysis, Principal Component Analysis, State Vector Machines.	5
Unit 5	Intellectual Property: Introduction, Significance of Intellectual Property Rights, Forms of IPR, Importance of IPR in Global Economy, Role of Intellectual Property in Technology Patents Act, 1970, Trademark Act, 1999, The Designs Act, 2000, Copyright Act, 1957.	6
Text Book:		
1)	Research Methodology: C R Kothari, Viswa Prakasam Publication, 2014.	
2)	Research Methodology: Vinayak Bairagi, CRC Press, Taylor & Francis Group, 2019.	
Reference Books:		
1)	Research Methodology: Ranjit Kumar, SAGE Publications Ltd, 2014.	
2)	Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.	
Useful Links		
1)	https://research methodology - Research Methodology (RM)	
2)	https:// research methodology and ipr documents - Intellectual Property Rights (IPR)	
End Semester Examination (ESE):60		
In Semester Examination (ISE):30		
Internal Continuous Assessment (ICA):10		
Sr. No.	Name of Tutorial / Assignment	
1)	Fundamentals and Introduction to Research Methodology	
2)	Defining and Formulating a Research Problem	
3)	Introduction to Research Design and Sampling Techniques	
4)	Fundamentals of Data Collection and Statistical Analysis	
5)	Introduction to IPR and Overview of Major Intellectual Property Acts	


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First Year M. Tech.

Semester-I (w.e.f. A.Y. 2025-26)

Seminar (25PME11672)

Teaching Scheme:

Evaluation Scheme:

	No. of Hrs./week	No. of Credits		
Lectures:	-	-	ISE:	-
Tutorials:	-	-	ICA:	50 Marks
Practical:	2	1	ESE:	-
Total:	2	1	OE/POE:	-

Course Outcomes: At the end of this course, students shall be able to

BL Level

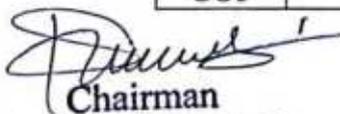
CO1	Identify the topic for seminar from the recent areas and technologies in thermal and fluids engineering or related areas.	BL- 3,4
CO2	Carry out detailed comprehensive surveys of literature related to the selected topic. Use information available from various sources like research papers, patents, websites, discussion with experts on the topic etc.	BL-3,6
CO3	Comprehend the information, organize it and write technical reports. Give presentations on the topic to the group of students.	BL-5
CO4	Identify and report the latest developments and unresolved issues in the selected topic/area.	BL- 3,4
CO5	Analyze the impact of technologies on the environment. Identify green technologies related to selected topic.	BL-4

Course Content-

The seminar shall consist of the preparation of the report by the candidate on the topic mutually decided by himself and the supervisor. The topic should be a problem in the field of Mechanical Engineering and should have sufficient research orientation. The recent development in the field of the chosen topic needs to be understood by the candidate. The report must be presented in front of the examiner's committee and other faculty members and students of the department. The committee should be set up by the PG coordinator and Head, Mechanical Engineering, for evaluation of the seminar.

Mapping of Cos and POs:

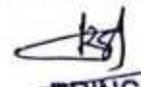
PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO↓												
CO1			2		1		3	2		1		2
CO2			2		2		2		2			
CO3			1		1			2		2	1	
CO4					3	1	2		2	1		3
CO5					1	1				1		2


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First Year M. Tech.

Semester-I (w.e.f. A.Y. 2025-26)

Hands on Research & Analysis Tool (25PEE11471)

Teaching Scheme:			Evaluation Scheme:	
	No. of Hrs./week	No. of Credits		
Lectures:	-	-	ISE:	-
Tutorials:	-	-	ICA:	50 Marks
Practical:	2	1	ESE:	-
Total:	2	1	OE/POE:	-

Course Outcomes: At the end of this course, students shall be able to		BL Level
CO 1	Apply analytical and numerical methods using tools like MATLAB, Python, and simulation software to model and solve basic engineering and research problems.	BL- 3,4
CO 2	Demonstrate proficiency in using modern research tools, including LaTeX, reference managers, optimization platforms, and AI-based tools for effective technical documentation and research exploration.	BL-3,6

Course Description- This course offers hands-on experience through small, assignment-based activities using various research and analysis tools. The content is organized into modules, each requiring specific prerequisite knowledge to effectively complete the associated practical sessions. Students will be introduced to widely used research tools and their applications, enabling them to explore the field of research with the foundational knowledge gained from this course.

Ex.	Experiment Details	No. of Ex. Sessions (hrs.)
Ex. 1	Assignment on analytical modeling using MATLAB or any equivalent software	04
Ex. 2	Implementation of any one numerical method using Python	02
Ex. 3	A case study on basic simulations using any one analysis Software	06
Ex. 4	Introduction to any one optimization tool	02
Ex. 5	Hands on with LATEX word processing software	04
Ex. 6	Hands on reference manager Tools	02
Ex. 7	Assignment on AI research Tools	02

Mapping of Cos and POs:

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	3	3	-	-	3	-	-	-	-	-	-	-
CO2	-	-	-	-	3	-	-	-	2	2	-	2

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SEMESTER II

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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Subject - Advanced Fluid Mechanics and Machinery (25PME12175)

Teaching Scheme:

Evaluation Scheme:

	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	1	1	ICA:	10 Marks
Practical:	-	-	ESE:	60 Marks
Total:	4	4	OE/POE:	-

Course Outcomes: At the end of this course, students shall be able to

BL Level

CO 1	Understands fluid properties and apply fundamental laws to analyze fluid flow behavior.	BL-L2, L3 & L4 Understand, Apply & Analyze
CO 2	Analyze pipe flow and evaluate frictional losses and boundary layer effects.	BL-L4 & L5 Analyze & Evaluate
CO 3	Apply dimensional analysis and model studies to solve fluid mechanics problems.	BL-L3 Apply
CO 4	Explain turbine working principles and assess performance based on velocity triangles and efficiency.	BL-L2 & L5 Understand Evaluate
CO 5	Classify and analyze pump types and evaluate their performance characteristics.	BL-L3, L4 & L5 Apply, Analyze & Evaluate

Unit	Course Contents	No. of lectures (hrs.)
Unit 1	Fluid Properties and Flow Characteristics: Properties of fluids, Fluid statics, Pressure Measurements, Buoyancy and floatation, Flow characteristics, Eulerian and Lagrangian approach, Concept of control volume and system, Reynold's transportation theorem, Continuity equation, energy equation and momentum equation, Applications.	6
Unit 2	Flow Through Pipes and Nozzle: Loss of energy in pipes, Concept of HGL & TTEL, Flow through Syphon, Flow through pipes-Compound, Equivalent, Parallel, Branched, Power transmission through nozzle, condition of maximum power transmitted through nozzle, Diameter of nozzle for maximum transmission of power through nozzle.	6
Unit 3	Dimensional Analysis and Model Studies: Fundamental dimensions, Dimensional homogeneity, Rayleigh's method and Buckingham Pi theorem, Dimensionless parameters,	6

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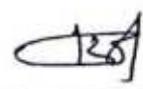
	Similitude and model studies, Distorted and undistorted models.	
Unit 4	Turbines: Impact of jets, Velocity triangles, Theory of rotodynamic machines, Classification of turbines, Working principles, Pelton wheel, Modern Francis turbine, Kaplan turbine, Work done, Efficiencies, Draft tube, Specific speed, Performance curves for turbines, Governing of turbines.	6
Unit 5	Pumps: Classification of pumps, Centrifugal pumps, Working principle, Heads and efficiencies, Velocity triangles, Work done by the impeller, Performance curves Reciprocating pump working principle, Indicator diagram and it's variations, Work saved by fitting air vessels, Rotary pumps.	6
Text Books:		
1)	Fluid Mechanics and Hydraulic Machines by Dr. R.K. Bansal.	
2)	Fluid Mechanics and Fluid Machines by S K Som and G Biswas, TMH	
3)	Fluid Mechanics by Joseph H Spurk and NuriAksel, Springer	
Reference Books:		
1)	An Introduction to Computational Fluid Mechanics by Chuen-Yen Chow, Wiley Publication.	
2)	Computational Methods for Fluid Dynamics by Ferziger and Peric, Springer Publication.	

Mapping of Cos and POs:

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


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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Advance Design Engineering (25PME12176)

Teaching Scheme:

Evaluation Scheme:

	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	1	1	ICA:	10 Marks
Practical:			ESE:	60 Marks
Total:	4	4	OE/POE:	

Course Outcomes: At the end of this course, students shall be able to

BL Level

CO 1	Determine performance parameter of hydrodynamic journal bearing	BL- 3:
CO 2	Explain the fatigue behaviour in design for manufacturing and assembly	BL-3:
CO 3	Explain Tribology aspect in design of component	BL-3:
CO 4	To design mechanical components for various materials and process.	BL-2:
CO 5	Understand the design of mechanical components.	BL- 2:

Course Description- This course focuses on the advanced concepts of mechanical design, integrating failure theories, fatigue analysis, design for reliability, and optimization techniques. Emphasis is placed on critical component design under complex loading, material selection, and modern design methodologies using CAD and FEA tools..

Unit	Course Contents	No. of lectures (hrs.)
UNIT 1	Hydrodynamic lubrication and Hydrodynamic journal bearing Pressure development mechanism, converging and diverging films and pressure induced flow, Reynolds's equation with assumptions Introduction to idealized full journal bearings, load carrying capacity of idealized full journal bearings, Somerfield number and its significance (numerical treatment), introduction to hydro static and elasto-hydrodynamic bearings.	6
UNIT 2	Fatigue Analysis and Design for manufacturing and Assembly. Introduction, fatigue strength, factors affecting fatigue behavior, high cycle and low cycle fatigue, cumulative damage in fatigue, and fatigue under complex stresses, design for manufacturing and assembly	7
UNIT 3	Introduction to Tribology. Introduction, friction, wear, wear characterization, lubrication, Newton's law of viscous forces, effect of pressure and temperature on viscosity	7
UNIT 4	Design for Materials and Process: Design for brittle fracture, Design for fatigue failure, Design for different machining process, assembly & safety etc.	7

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UNIT 5 **Design of Mechanical components: -**
 a) Gear Design: - Involute gears, tooth thickness, interference, undercutting, rackshift etc. Profile modification, S and So spur, helical gears etc.
 b) Spring Design:- Vibration and surging of helical springs, helical springs for maximum space efficiency , analysis of Belleville springs, ring spring, volute spring & rubber springs.
 Design for spring suspension.
 c) Design of Miscellaneous components (to be detailed) Cam shaft with valve opening mechanism, piston, cylinder, connecting rod etc.

6

Text Books:

- 4) Theory of Machines and Mechanisms, J.E. Shigley McGraw Hill Publication
- 5) Introduction to Tribology of Bearing B. C. Majumdar, Wheeler Publication

Reference Books:

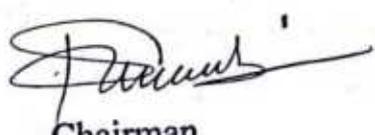
- 11) J.F.Blackburn, G.Rechthof, J.L. Shearer, *Fluid Power Control*, MIT.
- 12) J. R.King, *Production Planning and Control*, Pergamon Press, Oxford, 1975
- 13) Theory of Hydrodynamic Lubrication, O. Pinkus, Stenlitch, McGraw Hill Publication

In Semester Examination (ISE):

Internal Continuous Assessment (ICA):

Mapping of Cos and POs:

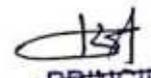
PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO↓												
CO1	3	3	2	2	3	-	-	-	-	-	-	-
CO2	3	2	3		2	-	-	-	-	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-
CO4	3	2	3	2	3	2	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-



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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Subject - Advanced Metal Joining Processes (25PME12177)

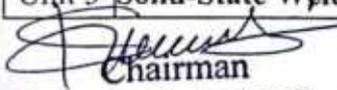
Teaching Scheme:

	No. of Hrs./week	No. of Credits	Evaluation Scheme:	
Lectures:	3	3	ISE:	30 Marks
Tutorials:	-	-	ICA:	10 Marks
Practical:	-	-	ESE:	60 Marks
Total:	3	3	OE/POE:	-

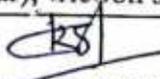
Course Outcomes: At the end of this course, students shall be able to

		BL Level
CO 1	Analyze advanced metal joining processes and their applications.	BL-L2, L3 & L4 Understand, Apply & Analyze
CO 2	Explain the physics, equipment, variables, and applications of emerging welding methods.	BL-L4 & L5 Analyze & Evaluate
CO 3	Select appropriate joining techniques for specific engineering problems.	BL-L3 Apply
CO 4	Evaluate process capability, weld quality, and design considerations.	BL-L2 & L5 Understand Evaluate
CO 5	Design and optimize welding parameters for high-performance joints.	BL-L3, L4 & L5 Apply, Analyze & Evaluate

Unit	Course Contents	No. of lectures (hrs.)
Unit 1	Radiant Energy Welding: Electron Beam Welding (EBW): principles, equipment, process variables, joint design and variants; Laser Beam Welding (LBW): fundamentals, beam types, control parameters, applications.	6
Unit 2	Plasma, Micro-Plasma, and Magnetically Impelled Arc Welding: Plasma arc welding (transferred vs non-transferred), micro plasma welding, magnetically impelled arc butt welding: theory, equipment, advantages, applications.	6
Unit 3	Solid-State Welding Techniques: Friction welding (rotational/linear), friction stir welding	6


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	(tool design, heat/material flow, parameters), diffusion welding, ultrasonic welding, cold pressure welding.	
Unit 4	Explosive Welding, Adhesive Bonding & Underwater Welding: Frontiers of explosive welding, adhesive bonding, underwater welding: principles, joints, equipment, safety, industrial relevance.	6
Unit 5	Welding Design, Defect Control, and Process Selection: Weld design guidelines, thermal stresses, brazing design, defect types/remedies, process selection matrix, pre/post-weld treatments.	6

Text Books:

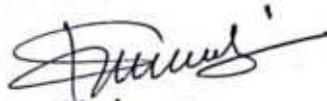
- 4) Modern Welding Technology by Howard B. Cary, Pearson.
- 5) Welding Metallurgy and Weldability by John C. Lippold, John Wiley & Sons.
- 6) Advanced Joining Technologies by Shivraman Thapliyal, CRC Press (Taylor & Francis Group).

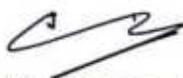
Reference Books:

- 3) Analyze advanced metal joining processes by American Welding Society (AWS)
- 4) Fundamentals of Materials Science and Engineering by William D. Callister Jr. John Wiley & Sons

Mapping of Cos and POs:

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


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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Subject – Automatic Control Engineering (25PME12274)

Teaching Scheme:

Evaluation Scheme:

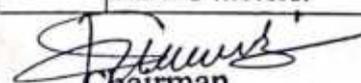
	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	1	1	ICA:	10 Marks
Practical:	-	-	ESE:	60 Marks
Total:	4	4	OE/POE:	-

Course Outcomes: At the end of this course, students shall be able to

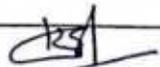
BL Level

CO 1	Describe the basic structure, types, and need for automatic control systems, including open-loop and closed-loop configurations.	BL-L2, L3 & L4
CO 2	Develop mathematical models of mechanical and electrical control components and construct analogous systems for thermal and fluid domains.	BL-L4 & L5
CO 3	Represent and linearize control system components, including electromechanical devices like servomotors and amplifiers, and describe AC/DC motor speed control systems.	BL-L3 Apply
CO 4	Analyze control systems using block diagram algebra and derive closed-loop transfer functions from complex block structures.	BL-L2
CO 5	Evaluate transient response characteristics and system stability using Routh's criterion and Root Locus method	BL-L3,
CO 6	Explain and interpret various control actions (ON/OFF, P, PI, PD, PID), and their effect on system response using graphical methods.	BL3

Unit	Course Contents	No. of lectures (hrs.)
Unit 1	Introduction: Introduction to Automatic Control System Need for control, manual and automatic control, Open loop and closed loop (feedback) control systems, modern control systems.	3
Unit 2	Mathematical Modelling and Representation of control components: Mechanical – helical spring, viscous damper, torsional spring and damper, Electrical – resistor, inductor, capacitor, series and parallel electric circuit and mech. System, grounded chair representation. Analogs – direct and inverse analogs for mechanical, thermal and fluid systems.	8
Unit 3	Representation of control systems: Linearization of non-linear functions, linearization of operating curves, hydraulic amplifier, servomotor, jet pipe amplifier, speed control of AC and DC motors.	6


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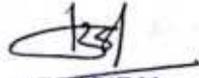
Unit 4	Block diagram algebra: general representation of a feedback control system, transfer functions, rules of block dia. algebra, reduction of block dis. to obtain closed loop transfer function	6
Unit 5	Transient Response and Modes of Control: General operational representation for a differential equation of control system, distinct, repeated and complex conjugate zeros, general form of transient response, Routh's stability criterion for a control system. Root locus method: Significance of Root locus, angle and magnitude conditions, breakaway points, angles of departure and arrival, construction of Root locus using general rules and steps. Modes of control: ON/OFF, proportional (P), Integral (I), Derivative (D) and P+I, P+D, P+I+D controllers, graphical representation of these controllers	8
Text Books:		
1)	Automatic control Engineering: F.H.Raven., McGraw Hill International editions, New Delhi, Fifth edition.	
2)	Control Systems: U.A. Bakshi and V.U. Bakshi, Technical Publications, Pune, Fifth revised edition	
3)	Norman S. Nise, "Control Systems Engineering", John Wiley & Sons	
Reference Books:		
1)	Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India	

Mapping of Cos and POs:

PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO↓												
CO1	3	2	1	-	-	-	-	-	-	1	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-
CO3	3	2	2	2	2	-	-	-	-	-	-	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-
CO5	3	3	3	3	2	-	-	-	-	-	-	-
CO6	3	2	1	-	-	-	-	-	-	1	-	-


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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Alternative fuels for IC engine (25PME12275)

Teaching Scheme:			Evaluation Scheme:	
	No. of Hrs./week	No. of Credits		
Lectures:	2	2	ISE:	30 Marks
Tutorials:	-	-	ICA:	10 Marks
Practical:	-	-	ESE:	60 Marks
Total:	2	2	OE/POE:	-

Course Outcomes: At the end of this course, students shall be able to

BL Level

CO 1	Understand the need, classification, and properties of alternative fuels for IC engines.	BL-2:
CO 2	Evaluate the characteristics and engine performance of alcohol-based fuels	BL-5
CO 3	Analyze the operation and compatibility of gaseous and synthetic fuels in IC engines	BL-4
CO 4	Assess the production, blending, and combustion performance of biodiesel and vegetable oils	BL-5
CO 5	Compare environmental impact, emission characteristics, and economic aspects of alternative fuels	BL-4 BL-5

Unit	Course Contents	No. of lectures (hrs.)
Unit 1	Introduction to Alternative Fuels Need for alternative fuels: energy security, sustainability, and environmental concerns, Classification: bio-fuels, gaseous fuels, synthetic fuels, alcohols, hydrogen, etc. Properties required for IC engine operation Comparison with conventional fuels (gasoline and diesel), Fuel standards and specifications (BIS, ASTM)	6
Unit 2	Alcohol-Based Fuels Types: Methanol, Ethanol, Butanol – properties and production methods, Blending with gasoline/diesel – E10, E20, E85, etc. Engine performance and emissions, Modifications required in SI and CI engines, Storage, handling, and safety aspects, Case studies and commercial use in transport	6
Unit 3	Gaseous and Synthetic Fuels CNG, LPG, Biogas, Producer Gas – production, properties, and applications, Hydrogen as an engine fuel – storage, safety, and combustion characteristics, Dual fuel operation and engine modifications, Synthetic fuels: Fischer-Tropsch diesel, Dimethyl Ether (DME), GTL, BTL, Emission characteristics and performance analysis	6

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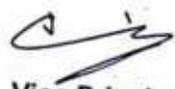
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Unit 4	Biodiesel and Vegetable Oils Sources: Jatropha, Karanja, palm oil, soybean, etc. Biodiesel production – transesterification process, Fuel properties and standards (ASTM D6751, EN14214), Engine compatibility, performance, and emission studies, Blends (B5, B20, B100) and cold weather issues, Lifecycle analysis and sustainability considerations	6
Unit 5	Environmental and Economic Aspects Emission control and environmental benefits of alternative fuels, Comparison of CO ₂ , NO _x , PM, and unburned HC emissions, Carbon footprint and life cycle GHG analysis, Economic viability and policy framework, Government initiatives, subsidies, and mandates (e.g., India's National Bio-Energy Mission), Future trends and research directions	6
Text Books:		
1)	S.S. Thipse – <i>Alternative Fuels: Concepts, Technologies and Developments</i> , Jaico Publishing	
2)	Richard L. Bechtold – <i>Alternative Fuels Guidebook</i> , SAE International	
3)	Mathur and Sharma – <i>Internal Combustion Engines</i> , Dhanpat Rai Publications	
4)	Ganesan, V. – <i>Internal Combustion Engines</i> , Tata McGraw-Hill	
Reference Books:		
1)	H. P. Garg – <i>Alternative Fuels for Transport</i> , TERI Press	
2)	D. P. Mishra – <i>Alternative Fuels for IC Engines</i> , CRC Press	
3)	K.A. Subramanian – <i>Biofuels and Bioenergy</i> , CRC Press	
4)	Society of Automotive Engineers (SAE) – <i>Technical Papers on Alternative Fuels</i>	

Mapping of Cos and POs:

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


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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Subject – Advance Engineering Materials (25PME12276)

Teaching Scheme:

Evaluation Scheme:

	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	1	1	ICA:	10 Marks
Practical:	-	-	ESE:	60 Marks
Total:	4	4	OE/POE:	-

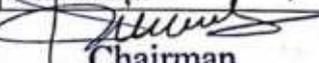
Course Outcomes: At the end of this course, students shall be able to

BL Level

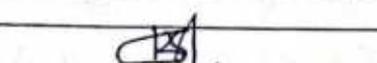
CO 1	Classify various types of engineering materials and explain the criteria for their selection based on required properties.	BL-L2: Understand
CO 2	Explain the classification, properties, processing methods, and industrial applications of non-metallic materials such as rubber, plastics, ceramics, adhesives, optical fibers, and composites.	BL-L2 Understand
CO 3	Analyze the methods of strengthening alloys and evaluate suitable materials for high-strength engineering applications.	BL-L4 Analyze
CO 4	Identify suitable materials for low and high temperature environments by assessing their required thermal and mechanical properties.	BL-L3 Apply
CO 5	Describe different types of nanomaterials and assess their physical and mechanical properties for various engineering applications.	BL-L5 Evaluate

Unit	Course Contents	No. of lectures (hrs.)
Unit 1	Classification and Selection of Materials Classification of materials, Properties required in Engineering materials, Criteria of selection of materials, Requirements / needs of advance materials	6
Unit 2	Non Metallic Materials Classification of non metallic materials, Rubber: Properties, processing and applications, Plastics : Thermosetting and Thermoplastics, Applications and properties. Ceramics : Properties and applications, Adhesives: Properties and applications, Optical fibers : Properties and applications, Composites : Properties and applications	6
Unit 3	High Strength Materials Methods of strengthening of alloys, Materials available for high strength applications, Properties required for high strength materials, Applications of high strength materials	6
Unit 4	Low & High Temperature Materials Properties required for low temperature applications, Materials available for low temperature applications, Requirements of materials for high temperature applications, Materials available for high temperature applications, Applications of low and high temperature materials	6
Unit 5	Nanomaterials Definition, Types of nanomaterials including carbon nanotubes and nanocomposites, Physical and mechanical properties, Applications of nanomaterials.	6

Text Books:


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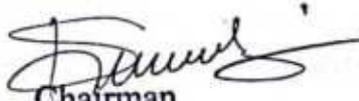

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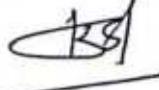
1)	Material science and Metallurgy by V.D. Kodgire
Reference Books:	
1)	Elements Of Material Science And Engineering by Van Vlack
2)	The Science and Engineering of Materials by D. R. Askeland and P. P. Phule
3)	Physical Metallurgy-II by Gulaev
4)	Nano Technology by Gregory Tirp

Mapping of Cos and POs:

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


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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Subject – Entrepreneurship Development (25PME12277)

Teaching Scheme:			Evaluation Scheme:	
	No. of Hrs./week	No. of Credits		
Lectures:	3	3	ISE:	30 Marks
Tutorials:	1	1	ICA:	10 Marks
Practical:	-	-	ESE:	60 Marks
Total:	4	4	OE/POE:	-

Course Outcomes: At the end of this course, students shall be able to		BL Level
CO 1	Understand the concept and role of entrepreneurs	BL-L2: Understand
CO 2	Understand the purpose, structure, and stages of Entrepreneurship Development Programmes (EDPs)	BL-L2: Understand
CO 3	Describe the role, characteristics, and challenges of Micro, Small, and Medium Enterprises (MSMEs)	BL-L2: Understand
CO 4	Apply project planning and appraisal techniques in development of small enterprises	BL-L3: Apply
CO 5	Analyze the entrepreneurial culture and the role of startups, incubators, and IPR in supporting new enterprises	BL-L4 Analyze

Unit	Course Contents	No. of lectures (hrs.)
Unit 1	Entrepreneur and Entrepreneurship Introduction, Evolution of the concept of Entrepreneur, Characteristics and Qualities of Entrepreneur, Classification of entrepreneurs, functions of entrepreneurs. Concept of women entrepreneur, functions and problems of women entrepreneur, growth of women entrepreneurship in India. Entrepreneurial motivation, problems faced by entrepreneurs-managerial, technological, marketing, financial Concept of Entrepreneurship, Growth of Entrepreneurship in India, Role of entrepreneurship in Economic development of countries.	6
Unit 2	Entrepreneurship Development Programmes Entrepreneurship Development programmes (EDPs)- Introduction, need, objectives of EDP, Phase & Evaluation of EDPs, historical perspective of EDPs in India, Course contents and curriculum of EDPs, Problems of EDPs. Institutions in aid of entrepreneurship development-Management Development Institute (MDI), The National Institute for Entrepreneurship and Small Business Development (NIESBUD), EDPs of SIDBI, role of NAYE	6

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Unit 3	Small Scale Industries Introduction, Meaning and definition of Micro, Small and Medium Enterprises (SMEs), concept of small-scale industry, classification of small-scale industry, characteristics of small-scale industries, role of small-scale industries, organization structure, registration process of SSI, . Growth strategies in small scale enterprises- Expansion, diversification, joint venture, mergers and acquisitions, sub-contracting, franchising, Government Policies for Small Scale Industries, Institutional support for SSI- Industrial Estate, DIC, SIDBI, SISI, NABARD, SIDCO, SIDO New Entrepreneurial Development Agencies. taxation benefits for SSI, marketing mechanism in SSI, Export potential of SSI, Problems and prospects of SSI	6
Unit 4	Project Planning and Appraisal for Small Enterprises Meaning of Project, Project Identification and Selection, Project formulation- Concept and Significance, Elements of Project Formulation, Project report- Meaning, Significance and Contents of Project Report. Accounting for Small Enterprises: - Objective of Accounting, Accounting Process, Preparation of Balance Sheet, Project Appraisal-Concept of Project Appraisal, Project Appraisal Methods, Cash Flows as Costs and Benefits, Payback Period, Average Rate of Return. Discounted Cash Flow Techniques, Working Capital Management.	6
Unit 5	Entrepreneurship and Start-up National Entrepreneurial Culture, Government initiatives -Start-up India, make in India, Atmanirbhar Bharat, Entrepreneurial Thermodynamics-push and pull factors, Entrepreneurship and Employment, Startup-Definition, types, Start-up Case Studies, Role of incubators and accelerators, Intellectual property rights, IPR for MSMEs, Challenges in protecting innovation in India,	6

Text Books:

- 1) Entrepreneurial Development – S.S. Khanka (S. Chand) Reprint-2025
- 2) Small Scale industries and Entrepreneurship-Vasant Desai, Himalaya publishing house, Edition-2023

Reference Books:

- 1) Innovation and Entrepreneurship- Peter F. Drucker
- 2) Entrepreneurship: Theory and Practice - Donald F. Kuratko
- 3) Start-Up Nation: The Story of Israel's Economic Miracle - Dan Senor & Saul Singer
- 4) Government Publications/Reports: Start-up India Action Plan, MSME Annual Reports, NITI Aayog Reports on Startups
- 5) Intellectual Property Rights in India: General Issues and Implications-T. Ramakrishna



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CO↓												
CO1	3	2	1	-	-	3	2	1	2	2	2	1
CO2	3	2	2	-	-	2	2	1	2	2	3	2
CO3	3	2	2	-	-	3	2	-	2	2	3	2
CO4	3	3	3	2	2	-	-	-	2	2	3	2
CO5	3	2	2	-	1	3	2	1	2	2	3	2



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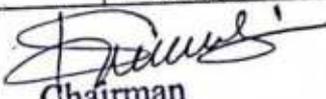
Mini project (25PME12172)

Teaching Scheme:			Evaluation Scheme:	
	No. of Hrs./week	No. of Credits		
Lectures:	-	-	ISE:	-
Tutorials:	-	-	ICA:	50 Marks
Practical:	2	1	ESE:	-
Total:	2	1	OE/POE:	-

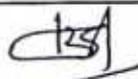
Course Outcomes: At the end of this course, students shall be able to		BL Le
CO 1	Understand a small project based learning on any topic of interest relevant to curriculum.	BL- 2:
CO 2	Design and develop a functional prototype or simulation model using appropriate tools, techniques, and project management skills while considering ethical and environmental aspects.	BL-3:

Course Description- The Mini Project enables students to apply domain knowledge to solve real-world or research problems through design, development, and analysis. It emphasizes innovation, teamwork, technical documentation, and presentation skills.

Ex.	Experiment Details	No. of Ex. Sessions (hrs.)
Ex. 1	Topic Selection Description: Students will select a project topic relevant to their domain, preferably addressing real-world or research-based problems. The topic must be approved by the guide or departmental committee.	6
Ex. 2	Report Preparation or Model Development Description: Students must prepare a detailed technical report including literature review, problem statement, methodology, system design, results, and conclusion. Based on the project nature, a working model, prototype, or software tool should be developed.	10
Ex. 3	Presentation or Demonstration Description: Students will present their project work through a formal presentation and demonstrate the functionality of their model or simulation to the evaluation panel.	6


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Mapping of Cos and POs:

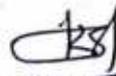
PO→	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO↓												
CO1	1	2	1	1	1	2	1	2	3	2	3	1
CO2	1	2	2	-	3	-	-	2	-	2	3	1



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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Research Publication and Ethics (25PET12673)

Teaching Scheme:			Evaluation Scheme:	
	No. of Hrs./week	No. of Credits		
Lectures:	-	-	ISE:	-
Tutorials:	-	-	ICA:	50 Marks
Practical:	4	2	ESE:	-
Total:	4	2	OE/POE:	-

Course Outcomes: At the end of this course, students shall be able to

BL Le

CO 1	Conduct systematic literature reviews and identify problem	BL- 4:
CO 2	Develop skills in academic writing and manuscript preparation	BL-3:
CO 3	Apply ethical principles in research conduct and publication	BL-3:
CO 4	Use reference management tools and citation standards effectively	BL-3:
CO 5	Prepare and present research findings in various formats	BL- 4:

Course Description- This course introduces MTech students to the principles, practices, and ethics of research publication in engineering and technology. Students will learn the complete research publication lifecycle, from literature review to manuscript submission, while developing a strong foundation in research ethics and integrity

Ex.	Experiment Details	No. of Ex. Sessns (hrs.)
Ex. 1	Database exploration: IEEE Xplore, ScienceDirect, SpringerLink, dataset sites like Kaggle	4
Ex. 2	Identify scope and Journal selection criteria and evaluation	2
Ex. 3	Calculation of Various Indices related to Impact Factor	2
Ex. 4	Systematic Literature review and literature matrix preparation	12
Ex. 5	Research Proposal Development- Synopsis writeup	8
Ex. 6	Manuscript Writeup exercise	8
Ex. 7	Use of Plagiarism detection tools	4
Ex. 8	Final manuscript submission and checklist	4
Ex. 9	Mock peer review exercise and Response to reviewer comments workshop	4
Ex. 10	Authorship agreement drafting and Copyright compliance	4

Text Books:

"The Craft of Research" by Wayne C. Booth, Gregory G. Colomb, Joseph M. Williams, Joseph

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	Bizup, William T. FitzGerald , University of Chicago press.
2)	Research Ethics: A Philosophical Guide to the Responsible Conduct of Research by L. Vaughn, Oxford University Press, 2019
Reference Books:	
1)	"The Elements of Style", by William Strunk Jr., E.B. White, Pearson, 2019
Online Resources:	
1)	Committee on Publication Ethics (COPE) - https://publicationethics.org
2)	Office of Research Integrity (ORI)- https://ori.hhs.gov/
3)	IEEE Author Center - https://ieeauthorcenter.ieee.org/
4)	Springer Nature Author Services - https://authorservices.springernature.com/
5)	Elsevier Author Hub - https://www.elsevier.com/authors
Software and Tools	
1)	Reference Management: Mendeley, Zotero, EndNote
2)	Plagiarism Detection: Turnitin, Grammarly, Copyscape
3)	Writing Tools: LaTeX, Microsoft Word, Google Docs
4)	Statistical Analysis: R, Python, MATLAB
5)	Data Visualization: Tableau, matplotlib, ggplot2
In Semester Examination (ISE):	
Internal Continuous Assessment (ICA):	
Assessment is based on Assignments (4 Assignments +1Case study) and one synopsis. Attendance is also considered for ICA.	

Mapping of Cos and POs:

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


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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Subject - Seminar (25PME11601)

Teaching Scheme:

Evaluation Scheme:

	No. of Hrs./week	No. of Credits		
Lectures:	-	-	ISE:	-
Tutorials:	-	-	ICA:	50 Marks
Practical:	2	1	ESE:	-
Total:	2	1	OE/POE:	-

Course Outcomes: At the end of this course, students shall be able to

BL Level

CO 1	Identify the topic for seminar from the recent areas and technologies in thermal and fluids engineering or related areas.	BL-L3, L4 & L5 Apply, Analyze & Evaluate
CO 2	Carry out detailed comprehensive surveys of the literature related to the selected topic. Use information available from various sources like research papers, patents, websites, discussion with experts on the topic etc..	BL-L3 Apply
CO 3	Comprehend the information, organize it and write technical reports. Give presentations on the topic to the group of students.	BL-L3, L4 & L5 Apply, Analyze & Evaluate
CO 4	Identify and report the latest developments and unresolved issues in the selected topic/area.	BL-L2 & L5 Understand Evalu.
CO 5	Analyze the impact of technologies on the environment. Identify green technologies related to selected topics.	BL-L3 Apply

Unit

Course Contents

The seminar shall consist of the preparation of the report by the candidate on the topic mutually decided by himself and the supervisor. The topic should be a problem in the field of Mechanical Engineering and should have sufficient research orientation. The recent development in the field of the chosen topic needs to be understood by the candidate. The report must be presented in front of the examiner's committee and other faculty members and students of the department. The committee should be set up by the PG coordinator and Head, Mechanical Engineering, for evaluation of the seminar.

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Mapping of Cos and POs:

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

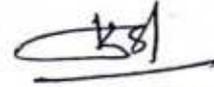
The strength of mapping is to be written as 1: low, 2: Medium, 3: High.



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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Subject - Dissertation Phase -I (26PME21675)

Teaching Scheme:			Evaluation Scheme:	
	No. of Hrs./week	No. of Credits		
Lectures:	-	-	ISE:	-
Tutorials:	-	-	ICA:	100 Marks
Practical:	12	06	ESE:	-
Total:	12	06	OE/POE:	100 Marks

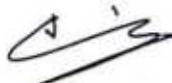
Unit
Course Contents

Note:

- # Students must interact with their dissertation advisor **weekly** for all activities related to **Dissertation Phase I**
- A **progress seminar** must be presented by the student, highlighting the work completed during the dissertation phase.
- All seminars should be delivered using **modern presentation tools**.
- A **hard copy** of the seminar report must be submitted to the **department** before the seminar.
- A **PDF copy** of the report, along with any additional required documents, must be submitted to the **advisor**.
- A **hard copy of the final project report** must be submitted to the department upon completion.
- @ denotes the **contact hours** allocated for student-advisor interactions.


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First Year M. Tech.

Semester-II (w.e.f. A.Y. 2025-26)

Subject - Dissertation Phase -II (26PME22676)

Teaching Scheme:

Evaluation Scheme:

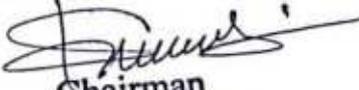
	No. of Hrs./week	No. of Credits		
Lectures:	-	-	ISE:	-
Tutorials:	-	-	ICA:	200 Marks
Practical:	24	12	ESE:	-
Total:	24	12	OE/POE:	200 Marks

Unit

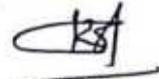
Course Contents

Note:

- # Students must interact with their dissertation advisor weekly for all activities related to **Dissertation Phase II**.
- A **progress seminar** must be presented by the student, highlighting the work completed during the dissertation phase.
- All seminars should be delivered using **modern presentation tools**.
- A **hard copy** of the seminar report must be submitted to the **department** before the seminar.
- A **PDF copy** of the report, along with any additional required documents, must be submitted to the **advisor**.
- A **hard copy of the final project report** must be submitted to the department upon completion.
- @ denotes the **contact hours** allocated for student-advisor interactions.


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