Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)
(under Maharashtra Act No. XXIX of 2014)
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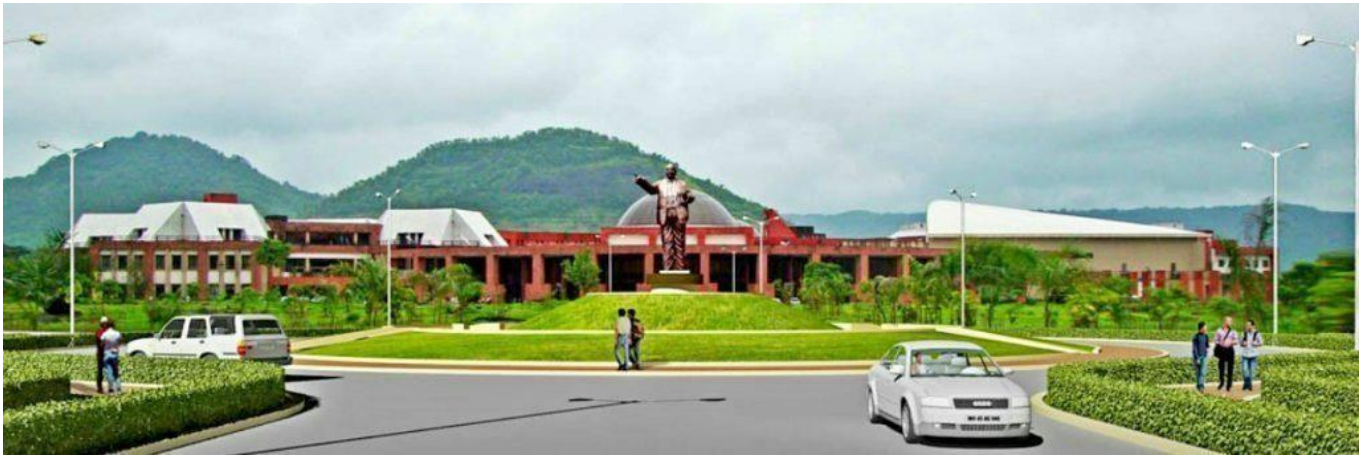
Course Structure and Contents
for
M.Tech. in Mechanical Engineering
(For Affiliated Institutes Only)

Syllabus as per the guidelines of National Education Policy 2020
To be implemented from Academic Year 2024-25.



Vision

The vision of the Department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education, looking after holistic development of students and conducting need based research and extension activities.

M.Tech. in Electric Vehicle Technology

Program Educational Objectives are broad statements that describe the career and professional accomplishments that the Electrical Vehicle Technology program is preparing graduates to achieve.

Programme Educational Objectives (PEOs)

No.	PEO
PEO1	To emerge as competent professionals and leaders in Electrical Vehicle Technology, contributing to global enterprises while upholding a strong background in ethics and societal responsibilities.
PEO2	To possess the ability to independently conduct research, investigation, and development work in Electrical Vehicle Technology, actively contributing to advancements in the field.
PEO3	To demonstrate a high level of competence in addressing diverse and complex challenges within the domain of Electrical Vehicle Technology, and apply contemporary engineering tools and procedures for sustainable development, while promoting a culture of self-learning and ethical practice in their professional endeavours.
PEO4	To enable post graduates to carry out innovative and independent research work, disseminate the knowledge in Academia/Industry/Research Organizations to develop systems and processes in the related field.

Programme Outcomes (POs)

At the end of the program, the students will be able to:

No.	PO
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**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.
PO3	**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.

PO4	**Conduct investigations of complex problems:** User research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5	**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.
PO6	**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.
PO7	**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.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**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.
PO12	**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.

Department PSO's

PSO-1: Engineering graduates can explore knowledge of electrical & electronics engineering in core as well as multidisciplinary areas in innovative, dynamic and challenging environment, for the research based teamwork.

PSO-2: Engineering graduates can provide hands on experience in the fields of Non-conventional and Renewable Energies.

(Effective from AY 2024-25)

	Course Code	Course Title	L	T	P	Credits	Categorization
SEM- I	12612PC101	Advanced Thermodynamics	3	1	-	4	PCC
	12612PC102	Machining and Forming Processes	3	1	-	4	PCC
	12612PC103	Mechanical Vibrations	3	1	-	4	PCC
	12612PE104	Program Elective-I	3	-	-	3	PEC
	12612PE105	Program Elective-II	3	-	-	3	PEC
	12612SE107	Seminar	-	-	2	1	ELC
	12612AU108	Stress Management	-	-	2	-	Audit Course
		Total	**15**	**3**	**04**	**19**	
SEM- II	12612PC201	Advanced Fluid Mechanics and Heat Transfer	3	1	-	4	PCC
	12612PC202	Mechanical Design Analysis	3	1	-	4	PCC
	12612PE203	Program Elective-III	3	-	-	3	PEC
	12612OE204	Open Elective I	3	-	-	3	OE
		Research Methodology	3	--	--	3	MLC
	12612PC205 L	PG Lab	-	-	4	2	PCC
	12612MP206	Mini-Project	-	-	2	1	ELC
	12612AE207	IKS Bucket	2	-	-	2	AEC/VEC/IKS
	12612AU208	Disaster Management	-	-	2	-	Audit Course
		Total	**15**	**2**	**08**	**22**	

Abbreviations: PCC (Programme Core Course), PEC (Programme Elective Course), ELC (Experiential Learning Courses), OE (Open Elective), AEC (Ability Enhancement Courses), VEC (Value Education Courses), IKS (Indian Knowledge System), MD M (Multidisciplinary Minor).

	Program Elective -I
A)	Advanced Machine Design
B)	Utilization of Solar Energy
C)	Advanced I.C. Engines

	Program Elective -II
A)	Manufacturing Planning and Control
B)	Hydraulic, Pneumatic and Fluidic Control
C)	Wind Energy
D)	Finite Element Method

	Program Elective -III
A)	Numerical Methods and Computational Techniques
B)	CAD- CAE
C)	Computational Fluid Dynamics
D)	Advanced Refrigeration
E)	Design of Heat Exchangers
F)	Alternative Fuels for I.C. Engines

	Open Elective I
A)	New Labor Codes of India
B)	Urban Utilities Planning: Water Supply, Sanitation and Drainage
C)	Environment and Development
D)	Entrepreneurship
E)	Research Methodology

	Open Elective II
A)	Student Psychology
B)	Business To Business Marketing (B2B)
C)	Organizational Behavior
D)	Principles Of Economics
E)	Intellectual Property & Rights
F)	Introduction to Public Administration

	Multidisciplinary Minor
A)	Design Of Mechatronic Systems
B)	Ethical Hacking
C)	Sustainable Power Generation Systems
D)	Components And Applications of Internet of Things
E)	Linear Algebra
F)	Artificial Intelligence and Machine Learning

IKS Bucket

	Indian Knowledge System (IKS)
A)	Indian Knowledge System (IKS): Concepts and Applications in Engineering
B)	Indian Knowledge System (IKS): Humanities and Social Sciences

12612PC101	ADVANCED THERMODYNAMICS	PCC	L-T-P-C: 3-1-0-4
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

Pre-Requisites: Thermodynamics

Course Objectives

- The course is intended to Provide analytical methods for the determination of the direction of processes from the first and second laws of thermodynamics and to Introduce methods in using equations of potentials, availability, and exergy for thermodynamic analysis.
- Gain the knowledge on non-reactive mixture properties, Psychometric Mixture properties and psychrometric chart and Air conditioning processes.
- Develop the ability of analyzing vapor and Gas power cycles.
- Provide in-depth knowledge of Direct Energy Conversion of Fuel Cells, Thermoelectric energy, Thermionic power generation, Thermodynamic devices Magneto Hydrodynamic Generations and Photovoltaic cells.
- Develop communication and teamwork skills in the collaborative course project.

Course Outcomes

At the end of the course, the student will be able to:

CO1: Explain basic thermodynamic concepts and laws.
CO2: Describe the concepts entropy and exergy and their use in analyses of thermal energy systems.
CO3: Analyze power plants, refrigeration plants and thermal/chemical installations.
CO4: Evaluate means for minimizing energy losses in selected processes.
CO5: Use advanced thermodynamics on a research case.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1		2		1						
CO2	2	1										
CO3	1	2		1						1		
CO4	2	2	1	1		2						
CO5												

12612PC102	MACHINING AND FORMING PROCESSES	PCC	L-T-P-C: 3-1-0-4
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

Course Outcomes

At the end of the course, the student will be able to:

CO1: Understand the machining theory and cutting forces in machining

CO2: Explain the advanced forming processes and effect of parameters like strain rate, working temperature and composition on forming processes

CO3: Understand the mechanics of grinding and grinding economics

CO4: Explain different advanced machining and forming processes

CO5: Develop the manual part programming and generate tool paths for a given profile

12612PC103	MECHANICAL VIBRATIONS	PCC	L-T-P-C: 3-1-0-4
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

Pre-Requisites: Mathematics, Theory of Machines. Course Objectives

- To introduce classical Vibration theories, relating to discrete and continuous systems with applications.
- To teach various numerical techniques including FEA for analysis of complex structures and modal testing for natural frequencies and mode shapes.
- To introduce special cases of non-linearity and random phenomena in vibrating systems including their stability.
- To provide the sufficient knowledge of Mechanical vibration measurement and its control.

Course Outcomes

At the end of the course, the student will be able to:

CO1: Derive the equation of motion by creating the mathematical model of Free and Forced vibration systems.

CO2: Apply the knowledge of numerical techniques for the analysis of Multi degree freedom system.

CO3: Analyze the methods for solving the problems of continuous, random, and non-linear vibrations.

CO4: Understand the vibration control and measurements methods.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2								2
CO2	3	2	3	3	1							3
CO3	1	3	3	3								2
CO4	1	1		3	3							1

12612PE104A	ADVANCED MACHINE DESIGN	Program Elective-I	L-T-P-C: 3-0-0-3
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

Course Outcomes

At the end of the course, the student will be able to:

CO1: To analyze variance, factorial design and regression and understand reliability theory, design and analysis of reliability.

CO2: Students will have the ability to analyze behavior of mechanical elements under fatigue and creep

CO3: To study optimization and its methods.

CO4: To study composite materials and its characteristics.

CO5: To design mechanical components for various materials and process.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		1			1						2
CO2	1											3
CO3	1		1			1						2
CO4		1			1							1
CO5	1		1			2						

12612PE104B	UTILIZATION OF SOLAR ENERGY	Program Elective-I	L-T-P-C: 3-0-0-3
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

Course Outcomes

At the end of the course, the student will be able to:

CO1: Acquire knowledge on solar radiation principles with respect to solar energy estimation.

CO2: Get familiarized with various collecting techniques of solar energy and its storage.

CO3: Learn the solar photovoltaic technology principles and different types of solar cells for energy conversion and different photovoltaic applications.

CO4: Understand the working principles of several solar appliances like Solar cookers, Solar hot water systems, Solar dryers, Solar Distillation, Solar greenhouses.

CO5: Summarize the basic economics of the solar energy collection system.

12612PE104C	ADVANCED I. C. ENGINES	Program Elective-I	L-T-P-C: 3-0-0-3
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

Course Outcomes

At the end of the course, the student will be able to:

CO1: Describe and compare different types, Constructional details, Cycles of operation and operative systems of I. C. Engines.

CO2: Compare the Design, Performance and Fuel quality Factors affecting to avoid the detonation/ knocking in SI and CI engines.

CO3: Evaluate the Performance Parameters of I.C. Engines and analyze the Performance maps.

CO4: Understand the importance of BHARAT STAGE Emission Norms and technologies associated for meeting the same.

CO5: Understand the research trend in alternative fuels, Fuel cell, Hybrid and Electric vehicles and analyze engine heat transfer.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2										
CO2			1	1		1		2				
CO3				1	1		1	2				
CO4												
CO5												

Research Methodology

	Research Methodology	MLC	3-0-0	3 Credits
Examination Schedule				
Mid-Sem Examination 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Explain the need and significance of research
CO2	Explain the need for the research design
CO3	Explain the role of hypothesis testing in research work
CO4	Explain the significance of data collection
CO5	Explain the need of interpretation

12612PE105A	**MANUFACTURING PLANNING AND CONTROL**	**Program Elective-II**	**L-T-P-C: 3-0-0-3**
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

Course Outcomes

At the end of the course, the student will be able to:

CO1: Apply the systems concept for the design of production and service systems.

CO2: Make forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques.

CO3: Apply the principles and techniques for planning and control of the production and service systems to optimize/make best use of resources.

CO4: 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.

CO5: Understand the lot sizing and production scheduling

CO6: Study about quality planning, cost planning and control.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2										
CO2			1	1		1		2				
CO3				1	1		1	2				
CO4												
CO5												

12612PE105B	HYDRAULIC, PNEUMATIC AND FLUIDIC CONTROL	Program Elective-II	L-T-P-C: 3-0-0-3
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

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

CO1 Understand the type of control system and their utility
CO2 Describe the hydraulic power generation.
CO3 Design pneumatic and hydraulic circuits for a given application
CO4 Discuss steady state operating forces, transient forces and valve instability
CO5 Design of pure fluid digital elements, Lumped and distributed parameter fluid systems

Mapping of course outcomes with program outcomes

POs→ COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	2											
CO3	2	2		3	1	1						
CO4	2				3	2	3			2		1
CO5	2	2		2	3							

12612PE105C	WIND ENERGY	Program Elective-II	L-T-P-C: 3-0-0-3
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

Course Objectives: Objectives of this course are

- To understand the history of wind energy and its scope in future.
- To get practical knowledge about use various wind energy measurement indicators, anemometers
- To calculate various parameters of a wind turbine**.**
- To Understand Latest Technologies in wind energy
- To Understand Growth Offshore wind energy technologies

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

CO1	Identify and describe history of wind energy and its scope in future.
CO2	survey and analyze through a literature review world distribution of wind, Weibull
	statistic, variation in wind energy etc.,
CO3	Conduct an experiment to use various wind energy measurement indicators, anemometers, and apply it to analyze and check data obtained from surveys.
CO4	Demonstrate and calculate performance parameters wind energy turbine.
CO5	Illustrate various electrical systems used in wind energy power plant.
CO6	Examine and justify economics of wind system.

Mapping of course outcomes with program outcomes

POs → COs↓	PO1	PO2	PO3	PO 4	PO5	PO 6	PO 7	PO 8	P O 9	PO1 0	PO 11	P0 12
CO1	1	1	1	2								
CO2	1		2		1	1					1	
CO3	2	1	1									
CO4	1			2	1	1						
CO5	1	1										
CO6	1	1			1			1				

12612PE105D	Finite Element Method	Program Elective-II	L-T-P-C: 3-0-0-3
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

Course Outcomes: At the end of the course the student will be able to:

CO1	Understand the basics principle of FE method
CO2	Identify mathematical model for solution of common problems
CO3	Solve structural, thermal problem using FE in 1D Case
CO4	Derive element stiffness matrix by different methods
CO5	Understand the formulation for 2D and 3D case

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2	3	3	1		1							1
CO3	2	2	1	2	2				2			1
CO4	3								2			
CO5	3	2										

12612SE107	SEMINAR	SE	0-0-2	1 Credits
Exam Scheme				
Continuous Assessment 60		End-Sem Evaluation (OR) 40		Total 100

Course Objectives:

1. To understand the open literature
2. To familiarize the students about collection of technical literature, reading and understanding
3. To learn the report writing and presentation

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

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

Mapping of course outcomes with program outcomes

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12

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

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 examiners committee and other faculty members and students of the department. The committee should be set by the PG coordinator and Head, Mechanical Engineering for evaluation of the seminar.

12612AU108	STRESS MANAGEMENT	AUDIT	L-T-P-C: 0-0-2-0
Exam Scheme			
Mid-Sem Test	Continuous Assessment	End-Sem Exam	Audit course

Course Objectives

- Understand the physiological and psychological aspects of stress and its impact on overall well-being.
- Learn and practice specific yoga postures, breathing exercises, and relaxation techniques to alleviate stress.
- Explore the connection between mindfulness, meditation, and stress reduction, fostering mental clarity.
- Discover holistic practices that promote better sleep, nutrition, and overall lifestyle habits for stress management.
- Develop practical skills to manage stress in daily life, enhancing resilience and promoting emotional balance.

Course Outcomes

At the end of the course, the student will be able to:

CO1: Recognize the signs and sources of stress, understanding its effects on mental and physical well-being.

CO2: Master a variety of yoga techniques, including postures, breathing, and meditation, to effectively manage stress

CO3: Acquire relaxation strategies that promote calmness, reduce anxiety, and enhance overall mental clarity.

CO4: Incorporate healthy habits inspired by yoga principles to foster better sleep, nutrition, and self-care routines.

CO5: Develop practical skills to navigate and cope with stress, enhancing emotional balance and promoting a more harmonious life.

CO-PO Mapping

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1		2		1						
CO2	2	1										
CO3	1	2		1						1		
CO4	2	2	1	1		2						
CO5												

12612PC201	ADVANCED FLUID MECHANICS AND HEAT TRANSFER	PCC	3-1-0	4 Credits
Exam Scheme				
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	Explain concepts of fluid kinematics and fluid dynamics
CO2	Explain Boundary layer theory and derive Navier Stokes equation for viscous fluid
CO3	Analyze steady state and transient heat conduction problems of real-life Thermal systems
CO4	Analyze the analytical and numerical solutions for heat transfer problem.
CO5	Analyze extended surface heat transfer problems and problems of phase change heat transfer like boiling and condensation

Mapping of course outcomes with program outcomes

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									
CO2	2	1		3								
CO3	3	2	1									
CO4	3	2	1									
CO5	3	2	1									

12612PC202	**MECHANICAL DESIGN ANALYSIS**	PCC	3-1-0	4 Credits
Exam Scheme				
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

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

CO1	Understand theory of fatigue failure of materials under different conditions and analyze behavior of mechanical elements under fatigue and creep
CO2	Analyze variance, factorial design and regression and understand reliability theory, design and analysis of reliability.
CO3	Describe various optimization techniques and its application.
CO4	Understand various composite materials and its characteristics.
CO5	Design mechanical components for various materials and process

Mapping of course outcomes with program outcomes

POs → COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	2	2								
CO2	1	1	2	2								
CO3	1	2	1		1							
CO4	3		1		1							
CO5	1			2								

12612PE203 A	**NUMERICAL METHODS & COMPUTATIONAL TECHNIQUES**	**PE-III**	**3-0-0**	**3 Credits**
Exam Scheme				
Mid-Sem Test: 20 Marks	Continuous Assessment: 20 Marks	End-Sem Exam: 60 Marks		Total 100 Marks

Course Objectives:

1. To provide the students with sufficient exposure to advanced mathematical methods and tools that are relevant to engineering models.
2. Improving the computational skills of students by giving sufficient knowledge of numerical integration and differentiation techniques useful for solving problems arising in Mechanical Engineering.
3. Imparting the knowledge of real time applications of Autonomous systems, linear systems of ordinary differential equations and partial differential equations.

Course Outcomes: Students will be able to

CO1	Students will be able to understand the Numerical integration and differentiation and solution of ODE.
CO2	Students will be able to analyze and develop the mathematical model of an engineering system using Numerical method for algebraic equation
CO3	Students will be able to solve differential equations using numerical techniques.
CO4	Students will be able to develop the mathematical model using statistical and numerical techniques

Mapping of course outcomes with program outcomes

PO / CO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12
CO1	1											
CO2	1	1	1									
CO3	1	1										
CO4	1			1								

12612PE203B	**Computer Aided Design (CAD) and Computer Aided Engineering (CAE)**	PE II	3-0-0	3 Credits
Exam Scheme				
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

Course Outcomes: At the end of the course the student will be able to:

CO1	Know the different approaches of Design and CAD CAE in the Product Design
CO2	Understand the concepts of Wireframe and Surface Modeling
CO3	Learn various Solid and Assembly Modeling techniques used
CO4	Understand Meshing, Elements and Applications of FEA (CAAE) in Heat Transfer & Fluid Mechanics 1D &2D problems
CO5	Analyze Accuracy of the CAE results

Mapping of course outcomes with program outcomes

Course Outcomes	**Program Outcomes**											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2						1			1		
CO2	2				1							
CO3	2				1							
CO4	3	2	2	2	1							
CO5	3			1	3					1		

12612PEC203C	**COMPUTATIONAL FLUID DYNAMICS**	**PE III**	3-0-0	**3 Credits**
Examination Scheme				
Mid Semester Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

Course Objectives:

1. To Understand the concept of fluid dynamics, CFD techniques, convergence criteria.
2. To familiarize the students about the implementation of CFD in fluid mechanics and heat transfer problems.

Course Outcomes:

At the end of the course, student will be able to:

CO1	Develop an understanding for major theories, approaches and methodologies used in CFD.
CO2	Evaluate solution of aerodynamic flows, appraise & compare various CFD software, which Simplify flow problems and solve them exactly.
CO3	Design and setup flow problem properly within CFD context, performing solid using CAD package and producing grids via meshing tool.
CO4	Interpret both flow physics and mathematical properties of governing Navier-Stokes equation and define proper boundary conditions for solution.
CO5	Apply CFD software to model relevant engineering flow problems, analyze results and compare with the available data and discuss the findings.

Mapping of COs with POs:

POs → Cos↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	-	-	-	-	-	-	-	-	-	-
CO2	1	-	2	3	1	1	-	-	-	-	-	-
CO3	2	1	1	2	1	-	1	-	-	-	-	-
CO4	1	-	-	1	1	1	-	-	-	-	-	-
CO5	-	-	2	2	2	1	-	-	-	2	-	1

12612PE203D	**ADVANCED REFRIGERATION**	Program Elective- III	Load/Per Week-03	Credits-03
Exam Scheme				
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

Course Objective

To present a problem oriented in depth knowledge of Advanced Refrigeration

To address the underlying concepts and methods behind Advanced Refrigeration

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

CO1	Formulate and solve vapor compression refrigeration and multi-stage vapor compression systems.
CO2	Demonstrate different components of refrigeration system & their performance characteristics.
CO3	Enumerate different refrigerants, their application, and action with lubricating oil, retrofitting, refrigerant blends, and effects on refrigeration components.
CO4	Design & select refrigeration system for different applications.
CO5	Describe properties of cryogenic systems and different gas liquefaction.

Mapping of course outcomes with program outcomes

POs→ COs↓	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2	1											
CO3	1											
CO4						1						
CO5	2	1		1		2						

12612PE203E	**DESIGN OF HEAT EXCHANGER**	Elective III	3-0-0	3 Credits
Exam Scheme				
Class Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Demonstrate the heat exchanger design methodology, and design considerations
CO2	Analyze performance of Heat exchanger by applying basic design methods.
CO3	Design double pipe, shell and tube, tube fin, plate type and plate-fin heat exchanger.
CO4	Model and illustrate heat exchanger based on I-law and irreversibility.
CO5	Demonstrate Fouling & Selection criteria of Heat Exchanger

Mapping of course outcomes with program outcomes

POs → COs↓	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO1 2
CO1	2	1							1			
CO2	1	1										
CO3			2						2			
CO4	1											
CO5	2	1							1			

12612PE203F	**ALTERNATIVE FUELS FOR IC ENGINE**	Elective III	3-0-0	3 Credits
Exam Scheme				
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

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

CO1	Demonstrate Structure of petroleum, Refining process, Products of refining process, Selec suitable fuels for use in SI engines. Understand various performances rating in SI engines.
CO2	Illustrate properties of petroleum products and classify them on their characteristic.
CO3	Describe and analyze Need for alternative fuels such as Ethanol, Methanol, LPG, CNG Hydrogen and their manufacturing procedure.
CO4	calculate and estimate performance and emission characteristics of alternative fuels
CO5	Analyze environmental effects of combustion of various fuels, suggest modification in thei usage.

Mapping of course outcomes with program outcomes

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

12612OE204A	NEW LABOUR CODES OF INDIA	OE-I	3-0-0	3 Credits
Exam Scheme				
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

Course Objectives:

1. To comprehend the historical development and evolution of labour laws in India, including the analysis of government policies and key reports shaping these legislations.
2. To analyse the role and significance of trade unions in the industrial landscape of India, including their formation, management, legal recognition, and adherence to constitutional and international frameworks.
3. To understand and apply the principles and procedures involved in resolving industrial disputes, including strikes, lock-outs, layoffs, retrenchment, closures, and disciplinary actions.
4. To examine and implement the provisions of the Code on Wages 2019 and the Code on Social Security 2020, focusing on minimum wages, payment regulations, equal remuneration, employee compensation, benefits, and social security schemes.
5. To develop proficiency in implementing occupational safety standards as per the Occupational Safety, Health and Working Conditions Code, 2020, ensuring compliance with health and safety regulations, working conditions, and special provisions for different categories of workers.

Course Outcomes: Students will

CO1	Analyze the evolution, history, and current government policies of labour laws in India, including key reports and international conventions that shape these laws.
CO2	evaluate the role, formation, management, and recognition of trade unions, along with their constitutional and international frameworks.
CO3	demonstrate the ability to identify and resolve industrial disputes, understanding the concepts of strikes, lock-outs, layoffs, retrenchment, and closures, as well as the procedures for disciplinary actions.
CO4	apply the provisions and implementation strategies of the Code on Wages 2019 and the Code on Social Security 2020, including minimum wages, payment of wages, equal remuneration, employee compensation, benefits, and various social security schemes.
CO5	implement knowledge about the Occupational Safety, Health and Working Conditions Code, 2020, including health and safety regulations, working conditions, and special provisions for different types of workers, ensuring compliance with these standards in various industrial settings.

URBAN UTILITIES PLANNING: WATER SUPPLY, SANITATION AND DRAINAGE

12612OE204B	UUP:SSD	OE-I	3-0-0	3 Credits
Exam Scheme				
Class Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

Course Objectives:

1. To develop a clear understanding of the significance of water supply, sanitation, and drainage systems in urban areas.
2. To explore different sources of water supply for urban areas, including surface water, groundwater, and treated wastewater.
3. To delve into various sanitation systems, such as sewerage networks, on-site sanitation solutions, and wastewater treatment plants.
4. To learn about hydraulic calculations, pipe sizing, pump station design, and related technical aspects.

Course Outcomes:

1. Students should be able to demonstrate a clear understanding of the fundamental concepts related to water supply, sanitation, and drainage systems in urban settings.
2. Students should be capable of applying design principles to develop efficient and sustainable water supply, sanitation, and drainage systems that meet the needs of urban populations while considering factors such as population growth, climate change, and land use.
3. Students should be able to outline strategies for the effective management, operation, and maintenance of water supply, sanitation, and drainage infrastructure to ensure long-term sustainability and functionality.

12612OE204 C	**ENVIRONMENT AND DEVELOPMENT**	OE-I	3-0-0	3 Credits
Exam Scheme				
Class Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks		Total 100 Marks

Course Objectives:

1. To demonstrate the intricate relationships that exist between environmental influences and development processes and how these relationships can either help or hinder one another.
2. Identify and assess pivotal environmental challenges stemming from developmental endeavors, encompassing issues such as pollution, resource depletion, deforestation, biodiversity loss, and climate change.
3. Investigate the impact of climate change on the environment through rigorous study and analysis.
4. Analyze real-world case studies exemplifying both effective and unsuccessful endeavors to incorporate environmental considerations into development initiatives and policies.

Course Outcomes:

C01: Demonstrate a deep understanding of the complex interrelationships between environmental factors and socioeconomic development, including how they influence and shape each other.

CO2: Identify and critically analyze key environmental challenges resulting from development activities, and evaluate their impacts on ecosystems, natural resources, and human well-being.

12612OE204D	**ENTREPRENEURSHIP**	OE-I	3-0-0	3 Credits
Exam Scheme				
Class Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

Course Objectives:

1. To understand the role of entrepreneurs in driving innovation and economic growth.
2. Guide students through the process of developing a comprehensive business plan, including market research, financial projections, competitive analysis, and risk assessment.
3. Provide students with essential financial literacy skills, including budgeting, financial forecasting, and understanding different funding options such as bootstrapping, loans, venture capital, and angel investment.
4. Guide students through the process of developing, prototyping, and refining their products or services to meet customer needs and expectations.
5. To explore different sources of funding for technology startups.

Course Outcomes:

1. Students will be able to generate innovative business ideas by identifying market gaps, customer needs, and emerging trends.
2. Students will be capable of developing comprehensive business plans that encompass market research, financial projections, and strategic goals.
3. Students will gain skills in budgeting, financial forecasting, and managing financial resources for their entrepreneurial ventures.
4. Students will be able to identify and manage potential risks associated with entrepreneurship, including financial, operational, and market risks.

12612OE204E	**RESEARCH METHODOLOGY**	**Open Elective**	**3-0-0**	**3 Credits**
Exam Scheme				
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks	

Course Objectives:

1. To synthesize information from literature reviews in engineering to identify and articulate research problems, while discerning gaps in existing knowledge.
2. To evaluate ethical considerations inherent in engineering research, demonstrating ethical behavior across all phases of the research process.
3. To justify the selection of appropriate research designs, data collection methods, and statistical analyses to meet specific engineering research objectives, ensuring methodological rigor.
4. To utilize computational tools and software in engineering to construct mathematical models, and to validate these models against empirical data for the analysis of engineering problems.
5. To communicate research findings effectively in engineering through the creation of well-structured reports, presentations, and visual aids, adhering to established professional standards and conventions.

Course Outcomes: Students will

CO1	Formulate research problems in engineering by synthesizing information from literature review and identifying gaps in existing knowledge.
CO2	Critically assess ethical considerations in research and demonstrate ethical behavior in all stages of the research process.
CO3	Select and justify appropriate research designs, data collection methods, and statistical analyses for specific research objectives.
CO4	Develop mathematical models using computational tools and software, and validate them against real-world data to analyze engineering problems.
CO5	Effectively communicate research findings through well-structured reports, presentations, and visual aids, adhering to professional standards and conventions.

12612PC205L	**PG Lab-II**	**PCC**	**0-0-4**	**2 Credits**
Exam Scheme				
Continuous Assessment: 25 Marks		PR/ OR: 25 Marks		Total: 50 Marks

Course Objectives:

- To apply the theoretical concepts and enhance understanding of the engineering concepts.
- To familiarize the students about the measurements and error calculations during experiments, modeling and simulation.
- To understand the design of experiments and report writing

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

CO1	Study performance of various mechanical devices, analysis software
CO2	Draw and analyze performance curves of these machines/systems, analysis by using various software
CO3	Analyze the results obtained from the tests.

Mapping of course outcomes with program outcomes

POs → COs↓	PO 1	P O2	PO 3	PO 4	PO 5	PO 6	P O7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	1		1			2					2	
CO2	1			1								
CO3	2					1						

12612MP206	**MINI PROJECT**	**MP**	**0-0-2**	**1 Credits**
Exam Scheme				
Continuous Assessment 25 Marks		End-Sem Evaluation (PR/OR) 25 Marks		Total 50 Marks

Course Objectives:

1. To apply the basic engineering laws through a modeling/ model/setup
2. To understand the report writing and result analysis
3. To understand the problem formulation

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

CO1	Identify methods and materials to carry out experiments/develop code.
CO2	Reorganize the procedures with a concern for society, environment and ethics.
CO3	Analyze and discuss the results to draw valid conclusions.
CO4	Prepare a report as per recommended format and defend the work
CO5	Explore the possibility of publishing papers in peer reviewed journals/conference Proceedings.

Mapping of course outcomes with program outcomes

POs → COs ↓	PO	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1		2	2	1	1	2	2	1	2
CO2	1	1	2	2			2	2	1	2	1	2
CO3	2	2		3					2	2		1
CO4				2				2	2	3		1
CO5		1		2	2			2	2	3		1

INDIAN KNOWLEDGE SYSTEM (IKS)- CONCEPTS AND APPLICATIONS IN

ENGINEERING COURSE CODE: 12612AE207A (credit =3)

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

CO1: To familiarize learners with major sequential development in Indian science, engineering, and technology.

CO2: To review & strengthen the ancient discovery and research in physics, chemistry, maths, metallurgy, astronomy, architecture, textile, transport, agriculture, and Ayurveda etc.

CO3: To help students to trace, identify and develop the ancient knowledge systems to make meaningful contribution to development of science today.

CO4: To help to understand the apparently rational, verifiable, and universal solution from ancient Indian knowledge system for the scientific, technological, and holistic development of physical, mental, and spiritual wellbeing.

12612AE207B	**INDIAN KNOWLEDGE SYSTEM (IKS)**	3-0-0	3 Credits
Exam Scheme			
Mid-Sem Test 20 Marks	Continuous Assessment 20 Marks	End-Sem Exam 60 Marks	Total 100 Marks

Course Objective

1. Introduce students to the foundational concepts, philosophies, and components of Indian knowledge systems, including ancient scriptures, philosophies, and traditional practices.
2. Introduce students to Vedic mathematical principles and computational techniques from ancient Indian texts, demonstrating their practical use in engineering calculations.
3. Explore the potential benefits of incorporating yogic and meditative practices into engineering to enhance focus, creativity, and overall well-being.
4. Study architectural concepts from Indian traditions and evaluate how they can inform modern urban planning and sustainable architecture.
5. Encourage students to draw inspiration from IKS to develop innovative engineering solutions that align with ancient wisdom while meeting contemporary needs.

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

CO1	Gain a comprehensive understanding of the philosophical, scientific, and technological aspects of Indian Knowledge Systems and their historical development.
CO2	Understand the philosophical underpinnings of IKS, including concepts like dharma, karma, and holistic thinking, and explore their relevance to engineering.
CO3	Understand Vedic mathematical principles and computational methods, and their potential relevance in solving modern engineering problems
CO4	Investigate the connections between yoga, meditation, and stress management, and their potential impact on mental well-being in engineering contexts.
CO5	Reflect on the ethical, cultural, and social dimensions of integrating IKS concepts into engineering practices and applications.

Mapping of course outcomes with program outcomes

POs→	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
COs↓												
CO1	1											
CO2	1											
CO3	1											
CO4						1						
CO5	2	1		1		2						

12612AU208	**DISASTER MANAGEMENT**		0-0-2	Audit course
Exam Scheme				
Class Test	Continuous Assessment	End-Sem Exam		

Course Objectives:

1. Mastering strategies to manage disasters and ensure public safety during emergencies.
2. Identifying hazards, vulnerabilities, and crafting plans to reduce disaster impact.
3. Collaborative Skills: Working across disciplines to address complex disaster challenges.
4. Developing, improving, and implementing disaster management policies. Community Empowerment: Educating and engaging communities for proactive disaster readiness.

Course Outcomes:

1. Learners will be able to understand the basic concept of disaster(s) and disaster management, their significance, and types.
2. Learners will develop the analytical skills to study relationship between vulnerability, disasters, disaster prevention and risk reduction
3. Learners will gain a preliminary understanding of approaches to Disaster Risk Reduction (DRR)
4. Learners will be empowered with the awareness of institutional processes in the country for Disaster Management