ELEMENTS OF MECHANICAL ENGINEERING			
Course Code	21EME15/25	CIE Marks	50
Teaching Hour/Week (L: T:P:S)	2:0:2:0	SEE Marks	50
Total Hours of **Teaching-Learning**	40	Total Marks	100
Credits	03	Exam Hours	03

Course Learning Objectives:

The course will enable the students to

CLO 1. Acquire a basic understanding role of Mechanical Engineering in the industry and **society**

CLO 2. Acquire a basic understanding of the formation of steam and its industrial application.

CLO 3. Acquire a basic understanding of renewable energy resources and basic concepts of Hydraulic turbines.

CLO 4. Acquire knowledge of various engineering materials and metal joining techniques.

CLO 5. Acquire essential experience with heat transfer devices.

CLO 6. Acquire knowledge on automobile technology in transport application and basics of Refrigeration and Air-Conditioning.

CLO 7. Acquire essential experience on basic Power transmission systems, including mechanical linkages.

CLO 8. Acquire knowledge of basic concepts on manufacturing principles and machine tools and their advancement.

Teaching-Learning Process (General Instruction):

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.
6. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Module 1

Introduction to Mechanical Engineering (Overview only):

Role of Mechanical Engineering in Industries and Society- Emerging Trends and Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors and contribute to the GDP.

Steam Formation and Application:

Formation of steam and thermodynamic properties of steam (Simple Problems using Steam Tables), Applications of steam in industries namely, Sugar industry, Dairy industry, Paper industry, Food processing industry for Heating/Sterilization, Propulsion/Drive, Motive, Atomization, Cleaning, Moisturization, Humidification

Energy Sources and Power Plants:

Review of energy sources; Construction and working of Hydel power plant, Thermal power plant, Nuclear power plant, Solar power plant, Tidal power plant, Wind power plant.

Introduction to basics of Hydraulic turbines and pumps:

Principle and Operation of Hydraulic turbines, namely, Pelton Wheel, Francis Turbine and Kaplan Turbine. Introduction to working of Centrifugal Pump.	
Laboratory Components: 1. *Visit any one Conventional or Renewable Energy Power Plant and prepare a comprehensive report.* 2. *Demonstration of Components of any one Turbo-machine through Cut Sections.* 3. *Visit to an Industry using steam for their process and prepare a comprehensive report.*	
Teaching-Learning Process	1. Power-point Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving (In-general). 4. Laboratory Demonstrations and Practical Experiments
Module 2	
Properties, Composition, and Industrial Application of Engineering Materials: **Metals**-Ferrous: Tool steels and stainless steels. Non-ferrous /metals: aluminum alloys. **Ceramics**- Glass, optical fiber glass, cermets. **Composites**- Fiber reinforced composites, Metal matrix Composites. Smart materials- Piezoelectric materials, shape memory alloys, semiconductors, and super-insulators. **Metal Joining Processes:** **Soldering, Brazing and Welding**: Definitions. Classification and methods of soldering, brazing, and welding. Brief description of arc welding, Oxy-acetylene welding, Introduction to TIG welding and MIG welding. **Heat Transfer Applications:** Review of modes of Heat Transfer; Automobile Radiators; Condensers and evaporators of refrigeration systems; Cooling of Electrical and Electronic Devices; Active, Passive, and Hybrid Cooling.	
Laboratory Components 1. *One exercise each involving Welding, Soldering, and Brazing.* 2. *Study oxy-acetylene gas flame structure and its application to gas welding* 3. *Demonstration of **anyone** Heat transfer application device and prepare a comprehensive report.*	
Teaching-Learning Process	1. PowerPoint Presentation, 2. Video demonstration or Simulations, 3. Chalk and Talk are used for Problem Solving (In-general). 4. Laboratory Demonstrations and Practical Experiments
Module 3	
Fundamentals of IC Engines: Review of Internal Combustion Engines, 2-Strokes and 4-Strokes engines, Components and working principles, Application of IC Engines in Power Generation, Agriculture, Marine and Aircraft Propulsion, Automobile. **Insight into future mobility technology;** Electric and Hybrid Vehicles, Components of Electric and Hybrid Vehicles, Drives and Transmission. Advantages and disadvantages of EVs and Hybrid vehicles. **Refrigeration and Air-Conditioning:** Principle of refrigeration, Refrigeration effect, Ton of Refrigeration, COP, Refrigerants and their desirable properties. Principles and Operation of Vapor Compression and Vapor absorption refrigeration. Domestic and Industrial Applications of Refrigerator.	

Working Principles of Air Conditioning, Classification, and Applications of Air Conditioners. Concept and operation of Centralized air conditioning system,

Laboratory Components:

1. *Study of Engine Components through Cut Sections*
2. *Demonstrate Components and Working principles of Domestic Refrigerator and prepare a comprehensive report **OR** Study/visit any commercial centralized Air-Conditioning unit, understand various components and operations, and prepare a comprehensive report.*

Teaching-Learning Process	1. PowerPoint Presentation, 2. Chalk and Talk are used for Problem Solving (In-general). 3. Video demonstration or Simulations, 4. Laboratory Demonstrations and Practical Experiments

Module 4

Mechanical Power Transmission:

Gear Drives: Types - spur, helical, bevel, worm and rack and pinion, velocity ratio,

Gear Trains and their application: simple and compound Gear Trains, Simple numerical problems on Gear trains involving velocity ratios

Belt Drives: Components of belt drive and concept of velocity ratio; Types of belt drives, Flat-Belt Drive, V-Belt Drive and Application of Belt Drives.

Simple numerical problems on Belt drives involving velocity ratios,

Concept of Chain, Rope drives and their applications

Fundamentals of Mechanical Linkages: Definitions of Machines and Mechanisms. Applications of linear motion, oscillatory motion, rotary motion, ratchet and latches, clamping, reverse motion, pause and hesitation, loading and unloading Mechanisms.

Introduction to Robotics:

Robot anatomy, Joints & links, common Robot configurations. Applications of Robotics in Material Handling, Processing, Assembly, and Inspection.

Laboratory Components:

1. *Demonstration of the machine consists of Gear Trains.*
2. *Demonstration of various elementary mechanisms and their motion.*
3. *Demonstration of any one model of Robot*

Teaching-Learning Process	1. PowerPoint Presentation, 2. Chalk and Talk are used for Problem Solving (In-general).. 3. Video demonstration or Simulations, 4. Laboratory Demonstrations and Practical Experiments

Module 5

Fundamentals of Machine Tools and Operations:

Fundamentals of Machining and machine tools,

Construction and Working Principle of Lathe, Various Lathe Operations: Turning, Facing, Taper Turning and Knurling.

Construction and Working of Milling Machines and applications.

Construction and working of simple Drilling Machines and applications.

(Sketches of layout need not be dealt with for all machine tools)

Introduction to Modern Manufacturing Tools and Techniques:

CNC: Introduction, components of CNC, advantages and applications of CNC, CNC Machining centres and Turning Centers

Concepts of Smart Manufacturing and Industrial IoT.

Introduction to Mechatronics: Concept of open-loop and closed-loop systems, Examples of Mechatronic systems and their working principle.

Laboratory Components:

1. *Demonstration of developing one model involving Lathe, Milling and Drilling*
2. *Study/Visit an Industry using CNC/ modern techniques and submit a report*
3. *Carry out a Case study on anyone Mechatronics device and prepare a comprehensive report.*

Teaching-Learning Process	1. PowerPoint Presentation, 2. Chalk and Talk are used for Problem Solving (In-general). 3. Students are encouraged to practice only line diagrams for exams. 4. Video demonstration or Simulations, 5. Laboratory Demonstrations and Practical Experiments

Course Outcomes:

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

CO 1. Understand basic concepts of mechanical engineering in the fields of energy and its utilization, materials technology, manufacturing techniques, and transmission systems through demonstrations.

CO 2. Understand the application of energy sources in Power generation and utilization, Engineering materials, manufacturing, and machining techniques leading to the latest advancements and transmission systems in day to day activities

CO 3. Apply the skills in developing simple mechanical elements and processes

Assessment Details both (CIE and SEE):

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation: Theory: 30marks and Lab Component: 20 marks= Total 50 marks

1. Topics taught by Lecture hours need to be assessed by
2. Three tests each for a duration of one hour and an average of the marks scored is reduced to 20
3. Any two ***Activities*** Namely quizzes, Assignment, seminar/ presentation, mini-project leading to demonstration will be considered for 10 marks.
4. Practical Sessions need to be assessed by appropriate rubrics and viva-voce methods. This will contribute to 20 marks. ***Note: Minimum of 80% of the laboratory components have to be covered.***
    - Rubrics for each Experiment taken average for all Lab components – 15 Marks
    - Viva-Voce– 5 Marks (more emphasized on demonstration topics)

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks.

- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books:

1. Elements of Mechanical Engineering, K R Gopala Krishna, Subhash Publications, 2008
2. Non-Conventional Energy Sources, G.D Rai, Khanna Publishers, 2003
3. Elements of Workshop Technology (Vol. 1 and 2), Hazra Choudhry and Nirzar Roy, Media Promoters and Publishers Pvt. Ltd., 2010.
4. An Introduction to Mechanical Engineering, Jonathan Wickert and Kemper Lewis, Third Edition, 2012
5. Turbo Machines, M. S. Govindegowda and A. M. Nagaraj, M. M. Publications 7Th Ed, 2012
6. Manufacturing Technology- Foundry, Forming and Welding, P.N.Rao Tata McGraw Hill 3rd Ed., 2003.
7. Internal Combustion Engines, V. Ganesan, Tata McGraw Hill Education; 4th edition, 2017
8. Robotics, Appu Kuttan KK K. International Pvt Ltd, volume 1
9. Web-links
   - (https://www.tlv.com/global/TI/steam-theory/principal-applications-for-steam.html
   - https://www.forbesmarshall.com/Knowledge/SteamPedia/About-Steam/Fundamental-Applications-of-Steam
   - https://rakhoh.com/en/applications-and-advantages-of-steam-in-manufacturing-and-process-industry/)
   - Videos | Makino (For Machine Tool Operation)
   - mechanisms and mechanical devices 4e.pdf (e-book- Mechanical Linkages)

Additional References:

10. Basic and Applied Thermodynamics, P.K.Nag, Tata McGraw Hill 2nd Ed., 2002
11. Standard Handbook of Machine Design, Joseph E Shigley; Charles R Mischke, Thomas H Brown, Jr., McGraw-Hill, New York, 2004.
12. Thermal Management in Electronic Equipment, HCL Technologies, 2010
13. Thermal Management of Microelectronic Equipment, L. T. Yeh and R. C. Chu, ASME Press, New York, 2002
14. Fundamentals of Robotics: Analysis and Control, Robert J. Schilling, Pearson Education (US).