

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ELEMENTS OF MECHANICAL ENGINEERING (Modified on 4<sup>th</sup> Feb 2014)

**SUBJECT CODE: 2110006**

**B.E. 1<sup>st</sup> YEAR**

**Type of course:** Engineering Science

**Prerequisite:** Zeal to learn the subject

**Rationale:** Understanding of basic principles of Mechanical Engineering is required in various field of engineering.

### Teaching and Examination Scheme:

| Teaching Scheme |   |   | Credits | Examination Marks |        |                 |        | Total Marks |
|-----------------|---|---|---------|-------------------|--------|-----------------|--------|-------------|
| L               | T | P | C       | Theory Marks      |        | Practical Marks |        |             |
|                 |   |   |         | ESE (E)           | PA (M) | ESE Viva (V)    | PA (I) |             |
| 4               | 0 | 2 | 6       | 70                | 30*    | 30#             | 20**   | 150         |

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment

### Content:

| Sr # | Topic                                                                                                                                                                                                                                                                       | Teaching Hrs. | Module Weightage |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|------------------|
| 1    | <b>Introduction:</b> Prime movers and its types, Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Change of state, Path, Process, Cycle, Internal energy, Enthalpy, Statements of Zeroth Law and First law               | 4             | 25%              |
| 2    | <b>Energy:</b> Introduction and applications of Energy sources like Fossil fuels, Nuclear fuels, Hydel, Solar, wind, and bio-fuels, Environmental issues like Global warming and Ozone depletion                                                                            | 3             |                  |
| 3    | <b>Properties of gases:</b> Gas laws, Boyle's law, Charles' law, Combined gas law, Gas constant, Relation between Cp and Cv, Various non-flow processes like constant volume process, constant pressure process, Isothermal process, Adiabatic process, Poly-tropic process | 5             |                  |
| 4    | <b>Properties of Steam:</b> Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables, steam calorimeters                                                                                              | 6             | 30%              |
| 5    | <b>Heat Engines:</b> Heat Engine cycle and Heat Engine, working substances, Classification of heat engines, Description and thermal efficiency of Carnot; Rankine; Otto cycle and Diesel cycles                                                                             | 5             |                  |
| 6    | <b>Steam Boilers:</b> Introduction, Classification, Cochran, Lancashire and Babcock and Wilcox boiler, Functioning of different mountings and accessories                                                                                                                   | -             |                  |
| 7    | <b>Internal Combustion Engines:</b> Introduction, Classification,                                                                                                                                                                                                           | 4             | 20%              |

|    |                                                                                                                                                                                                                    |   |     |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|-----|
|    | Engine details, four-stroke/ two-stroke cycle Petrol/Diesel engines, Indicated power, Brake Power, Efficiencies                                                                                                    |   |     |
| 8  | <b>Pumps:</b> Types and operation of Reciprocating, Rotary and Centrifugal pumps, Priming                                                                                                                          | 3 |     |
| 9  | <b>Air Compressors:</b> Types and operation of Reciprocating and Rotary air compressors, significance of Multistaging                                                                                              | 3 |     |
| 10 | <b>Refrigeration &amp; Air Conditioning:</b> Refrigerant, Vapor compression refrigeration system, vapor absorption refrigeration system, Domestic Refrigerator, Window and split air conditioners                  | 4 | 25% |
| 11 | <b>Couplings, Clutches and Brakes:</b> Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc) | 3 |     |
| 12 | <b>Transmission of Motion and Power:</b> Shaft and axle, Belt drive, Chain drive, Friction drive, Gear drive                                                                                                       | 4 |     |
| 13 | <b>Engineering Materials:</b> Types and applications of Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer                                    | 4 |     |

Note: Topic No. 6 of the above syllabus to be covered in Practical Hours.

#### Reference Books:

1. Basic Mechanical Engineering by Pravin Kumar, Pearson
2. Thermal Science and Engineering by Dr. D.S. Kumar, S.K. Kataria & sons, Publication New Delhi
3. Fundamental of Mechanical Engineering by G.S. Sawhney, PHI Publication New Delhi
4. Elements of Mechanical Engineering by Sadhu Singh S. Chand Publication
5. Introduction to Engineering Materials by B.K. Agrawal Tata Mcgrahill Publication, New Delhi

#### Course Outcome:

After learning the course the students should be able to

1. To understand the fundamentals of mechanical systems
2. To understand and appreciate significance of mechanical engineering in different fields of engineering

#### List of Experiments:

1. To understand construction and working of various types of boilers.
2. To understand construction and working of different boiler mountings and accessories.
3. To determine brake thermal efficiency of an I. C. Engine.
4. To understand construction and working of different types of air compressors.
5. To demonstrate vapor compression refrigeration cycle of domestic refrigerator OR window air conditioner OR split air conditioner.

Open Ended Problems: Apart from above experiments a group of students has to undertake one open ended problem/design problem. Few examples of the same are given below.

1. Develop a prototype of gear train/drive for certain velocity ratios.
2. Develop a small boiler with different mountings.
3. Develop a hot air engine

**Major Equipments:** Models of Cochran, Lancashire and Babcock and Wilcox boilers, models of various mountings and accessories, Models of various types of IC engines, Single cylinder two stroke /four stroke petrol/ diesel engine, models of pumps, compressors, refrigerator/air conditioner, models of various types of brakes, coupling, clutches, drives

**List of Open Source Software/learning website:** <http://nptel.iitm.ac.in>, <http://vlab.co.in/>

**\*PA (M):** 10 marks for Active Learning Assignments, 20 marks for other methods of PA

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus of Elements of Mechanical Engineering is covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should be sent to [achievements@gtu.edu.in](mailto:achievements@gtu.edu.in).

**\*\* PA (I):** 10 marks for a case study of Systems, 10 marks for other methods of PA.

The case study of Systems: The case study should be of a working EE system, which shows the working of the concepts, included in the Syllabus.

**# ESE Pr (V):**10 marks for Open Ended Problems, 20 marks for VIVA.

**Note: Passing marks for PA (M) will be 12 out of 30.**

**Passing marks for ESE Pract(V) will be 15 out of 30.**

**Passing marks for PA (I) will be 10 out of 20**