| Devi Ahilya Vishwavidhyalaya, Indore, India<br>Institute of Engineering & Technology | | | | | II Year B. Tech. (Mechanical Engineering) Full Time | |
|---|---|---|---|---|---|---|
| **Course Code & Name** | **Instructions Hours per Semester and Credits** | | | | | |
| **3RMPC3**<br><br>**APPLIED THERMODYNAMICS** | **Classroom Instruction (CI)** | | **Lab Instruction (LI)** | **Term Work (TW) and Self Learning (SL)** | **Total no. of Hours Per semester** | **Total Credits (Total Hours/30)** |
| | **L** | **T** | **P** | **TW+SL** | | |
| | **30** | **10** | **00** | **50** | **90** | **3** |

**Course Learning Objectives:**

1. Apply the First and Second Laws of Thermodynamics to analyze closed and open systems, heat engines, refrigerators, and real cyclic devices
2. Evaluate entropy changes, reversibility, irreversibility, and the feasibility of thermodynamic processes
3. Demonstrate the ability to connect thermodynamic principles to real-world engineering applications such as power plants, IC engines, and refrigeration systems.
4. Analyze combustion processes, air–fuel ratios, and flue gas compositions for different types of fuels.
5. Assess the performance of gas compressors, including single-stage and multistage compression systems.

**Pre requisite(s):** Engineering Physics, Engineering Mathematics

## COURSE CONTENTS

### UNIT-I

**Second Law of Thermodynamics:** Cyclic Heat Engine, Kelvin Planck Statement, Claussius Statement, Equivalence of Kelvin Planck and Claussius Statements, Reversibility and Irreversibility, Carnot Cycle, Carnot's Theorem, Absolute Thermodynamic Temperature Scale, Efficiency of the Reversible Heat Engine, Illustrative Problems.

### UNIT-II

**Entropy:** Introduction, Claussius Theorem, Property of Entropy, Inequality of Claussius, Entropy change in an Irreversible Processes, Entropy Principle, Applications of Entropy Principle, Entropy Transfer with Heat Flow, Entropy and Disorder, Absolute Entropy Illustrative Problems.

### UNIT-III

**Fuels and Combustion:** Introduction, Classifications of fuels, Combustion Equations, Theoretical Air and Excess Air, Stoichiometric Air-Fuel Ratio, Weight of Carbon in Flue Gases, Weight of Flue Gases per kg of Fuel Burnt, Analysis of Exhaust and Flue Gases.

## UNIT-IV

**Thermodynamic Relations:** Mathematical Theorems, Maxwell's Equations, TdS Equations, Difference in Heat Capacities, Ratio of Heat Capacities, Energy Equation, Joule-Kelvin Effect, Illustrative Problems.

## UNIT-V

**Gas Compressors:** Compression Processes, Work of Compression, Single Stage Reciprocating Air Compressor, Volumetric Efficiency, Multi Stage Compression, Illustrative Problems.

## BOOKS RECOMMENDED:

[1] T.D. Eastop & A. McConkey*, Applied Thermodynamics for Engineering Technologists,* 5th Edition, Pearson Education

[2] P.K. Nag, *Engineering Thermodynamics*, 5th Edition, McGraw Hill Education.

[3] Yunus A. Çengel & Michael A. Boles, *Thermodynamics: An Engineering Approach*, 9th Edition, McGraw Hill

[4] V. Ganesan, *Internal Combustion Engines*, 4th Edition, McGraw Hill Education

| **Course Out Comes (CO)** | **After completion of the course, students will be able to:** |
|---|---|
| CO1 | Explain Second Law of Thermodynamics, reversibility, Carnot cycle, and heat engine concepts. |
| CO2 | Apply entropy principles to reversible and irreversible thermodynamic processes |
| CO3 | Analyze combustion equations, air–fuel ratios, and flue gas composition |
| CO4 | Apply Maxwell relations, TdS equations, and thermodynamic property relations |
| CO5 | Evaluate performance of single and multistage gas compressors with calculations |

**CO-PO-PSO Relationship**

| CO | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 2 | 1 | 1 |
| CO2 | 3 | 3 | 1 | 3 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 3 | 0 | 1 | 1 | 0 | 2 | 1 | 2 | 3 | 3 |
| CO5 | 3 | 3 | 2 | 3 | 2 | 0 | 1 | 1 | 1 | 2 | 1 | 2 | 2 | 3 |