FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **Bachelor of Technology (Automobile Engineering)**

Semester: **III**

Course Code: **202090301**

Course Title: **Engineering Thermodynamics**

Course Group: **Professional Core Course**

Course Objectives: The course is designed to strengthen the fundamentals of Thermal Science. The present course gives the detailed idea about the thermodynamic properties and various laws of thermodynamics. Fundamentals of available and unavailable energy for the system along with second law efficiency, thermodynamic cycle used in power generation and I C engines are studied and analyzed through this course

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50 / 18	25 /9	50 / 17	25 / 9	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Fundamental Concept**: Microscopic and macroscopic point of view, Thermodynamic system and control volume, Thermodynamic properties, processes and cycles, Homogeneous and heterogeneous systems, Thermodynamic equilibrium, Quasi-static process, Pure substance, Concept of continuum, Various types of energies, Zeroth law and temperature measurement.	02
2	**Laws of Thermodynamics**: First law for a closed system undergoing a cycle and change of state, internal energy- a property of the system, PMM1, Steady flow energy equation applied to Nozzle, Diffuser, Compressor, Turbine, Throttling process, Heat exchanger, Filling and emptying process, Limitation of the first law of thermodynamics, cyclic heat engine, energy reservoir, Kelvin-Plank and Clausius' statements, equivalence of the statements, reversibility and irreversibility, Causes of irreversibility, Carnot's theorem and its corollary, Thermodynamic temperature scale, Statement of third law of thermodynamics	15

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3	**Entropy and Exergy Analysis:** Clausius theorem, The property of entropy, inequality of Clausius, Entropy change for reversible and irreversible processes, principle of increase of entropy, application of entropy principle, High and low grade energy, Available and unavailable energy, Hemholtz & Gibbs function, availability (exergy) of closed; steady flow; and open system processes, Irreversibility and Guoy Stodola Theorem, Second law efficiency	**06**
4	**Properties of Pure Substance:** Thermodynamic properties of pure substances in solid, liquid and vapour phases, P-v-T behavior of simple compressible substances, phase rule, thermodynamic property tables and charts, ideal and real gases, ideal gas equation of state and van der Waals equation of state; law of corresponding states, compressibility factor and generalized compressibility chart	**04**
5	**Thermodynamic Cycle** Vapour power cycle: Carnot vapor cycle, Rankine cycle, comparison of Carnot and Rankine cycle, calculation of cycle efficiencies, variables affecting efficiency of Rankine cycle, reheat cycle, regenerative cycle, reheat-regenerative cycle, feed water heaters Gas power cycles: Recapitulation of Carnot, Otto and Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, air standard efficiency, mean effective pressure, brake thermal efficiency, relative efficiency, Simple Brayton cycle	**15**
6	**Ideal Gas Mixtures and Combustion:** Ideal gas mixtures: Dalton's and Amagat's laws, properties of ideal gas mixtures and simple thermodynamic processes involving them, specific and relative humidity's. Combustion equations, stoichiometric air fuel ratio, enthalpy of formation, adiabatic flame temperature.	**03**

List of Practicals / Tutorials:

1	Fundamentals and introduction of Thermodynamics
2	To verify First and Second law of thermodynamics with I C Engine
3	To understand SFEE with the help of double pipe heat exchanger and to verify an entropy principle for the same
4	Studies on various applications of SFEE.
5	Performance on Two Stage Reciprocating air compressor.
6	Studies on absolute thermodynamic temperature scale, Clausius Inequality and Entropy generation principle.
7	Studies on vapor power cycle with reheating and regeneration.
8	Understanding and comparison of Otto, Diesel and Dual Cycle.
9	Performance on a 5 kW steam power cycle.
10	To find out calorific value of gaseous fuel.

Reference Books:

1	Engineering Thermodynamics by P. K .Nag, McGraw Hill Education.
2	Fundamentals of Engineering Thermodynamics by Moran M. J., Shapiro H.N., John Wiley & Sons.

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3	Introduction to Engineering Thermodynamics by Sonntag R. E., Borgnakke C., John Wiley & Sons.
4	Thermodynamics: An Engineering Approach by Boles M.A., Cengel Y.A., McGraw Hill Education.

Supplementary learning Material:	
1	NPTEL resources

Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods

Internal Evaluation :

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
20%	15%	10%	40%	15%	0%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	**Course Outcome Statements**	**%weightage**
CO-1	Identify the basic terminology used in thermodynamics and explain the concept of thermodynamics	**10**
CO-2	State and apply the First law of thermodynamics for closed and change of state condition for a system and evaluate the feasibility of thermodynamic processes and cycles with the help of second law of thermodynamics.	**25**
CO-3	Conceptualize of entropy and exergy analysis in different thermodynamic processes and cycles	**20**
CO-4	Analyze the Gas power and Vapor Power Cycle	**30**
CO-5	Differentiate the ideal and real gas equation for pure substance through compressibility factor/charts and also elementary analysis of Combustion	**15**

Curriculum Revision:

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