COURSE CONTENT

THERMODYNAMICS

III Semester: CE / CSD / CSE / CSM / ECE / EEE / ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
2530303	Foundation	3	0	0	3	40	60	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Prerequisites: There are no prerequisites to take this course.

Course Overview:

Thermodynamics is the science that deals with the relationship between heat and work, as well as the properties of systems associated with them. It encompasses the general laws governing energy transformations in various types of systems, including mechanical, electrical, and chemical. These laws, derived from empirical evidence and experimentation, enable predictions about the physical behavior of systems through logical reasoning. The findings have been formalized as the laws of thermodynamics. Power cycles and refrigeration cycles, which are based on thermodynamic principles, are also studied. In this process, students become familiar with standard charts and tables

Course Objectives:

1. To introduce the basic concepts and laws of thermodynamics.
2. To apply the first and second laws to closed and open systems.
3. To understand the properties of pure substances and their use in thermodynamic processes.
4. To study the working principles and performance of thermodynamic cycles.
5. To prepare students for applications in engines, power plants and refrigeration

Course Outcomes: After Completion of the Course, Students should be able to

1. Understand the basic thermodynamic concepts, systems, and properties.
2. Apply the first law to both closed and open systems.
3. Analyze thermodynamic processes using property diagrams and tables.
4. Apply the second law and evaluate entropy changes and efficiency.
5. Examine the performance of power and refrigeration cycles

UNIT - I: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium State, Property, Process, Exact and Inexact Differentials, Cycle, Reversibility, Quasi – static Process, Irreversible Process, Causes of Irreversibility, Energy in State and in Transition, Types, Displacement and Other forms of Work Heat Point and Path functions, Zeroth Law of Thermodynamics, Concept of Temperature, Principles of Thermometry, Reference Points, Constant Volume gas Thermometer, Scales of Temperature, Ideal Gas Scale, PMM - I, Joule's Experiments, First law of Thermodynamics, Corollaries, First law applied to a Process, applied to a flow system, Steady Flow Energy Equations.

UNIT - II: Limitations of the First Law, Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin, Planck and Clausius Statements and their Equivalence, Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics..

UNIT - III: Pure Substances, P - V- T surfaces, T- S and h- s diagrams, Mollier Charts, Phase Transformations: Triple point at critical state properties during change of phase, Dryness Fraction, Clausius - Clapeyron Equation, Property tables and application of these concepts in various thermodynamic processes, including steam calorimetry. Perfect Gas Laws, Equation of State, Specific and Universal Gas constants, various Nonflow processes, Properties, end states, Heat and Work Transfer, changes in Internal Energy, Throttling and Free Expansion Processes, Flow processes.

UNIT - IV: Deviations from perfect Gas Model, Vader Waals Equation of State, and Compressibility charts, variable specific Heats, Gas Tables.
Mixtures of perfect Gases: Mole Fraction, Mass friction Gravimetric and volumetric Analysis. Dalton's Law of partial pressure, Avogadro's Laws of additive volumes. Mole fraction, Volume fraction and partial pressure, Equivalent Gas constant and Molecular Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases and Vapour.

UNIT - V: Atmospheric air, Psychometric Properties, Dry bulb Temperature, Wet Bulb Temperature, Dew point Temperature, Thermodynamic Wet Bulb Temperature, Specific Humidity, Relative Humidity, Saturated Air, Vapour pressure, Degree of saturation, Adiabatic Saturation, Carrier's Equation, Psychrometric chart.
Thermodynamic Cycles: Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle, Description and representation on P–V and T- S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis, Comparison of Cycles.
Refrigeration Cycles: Bell Coleman cycle, Vapour compression cycle, Ammonia, Water Vapor Absorption Cycle.

TEXT BOOKS:

1. Engineering Thermodynamics, P.K. Nag, Mc Graw Hill, 7th Edition, 2020.
2. Thermodynamics, Yunus A Cengel, Michael A Boles, Mehmet Kanoglu, McGraw-Hill, 9th Edition, 2019

REFERENCE BOOKS:

1. Thermodynamics, Yunus A Cengel, Michael A Boles, Mehmet Kanoglu, McGraw-Hill, 9th Edition, 2019
2. Thermodynamics, J.P. Holman, McGraw Hill Education, 10th Edition, 2010
3. Engineering Thermodynamics, Chattopadhyay, Oxford, 2nd Edition, 2015.
4. Engineering Thermodynamics, Rogers, Pearson, 4th Edition, 1996.
   Engineering Thermodynamics, M Achuthan, PHI, 2nd Edition, 2009

ELECTRONIC RESOURCES:

1. **https://www.thermopedia.com/**
2. **https://heattransferbooks.com/**
3. **https://www.cheresources.com/mass_transfer.asp**
4. **https://engineeringtutorials.net/thermodynamics/**

MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Tech talk and Concept Video topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. E-Learning Readiness Videos (ELRV)