THERMODYNAMICS

IV Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AME003	Core	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	1	-	4	30	70	100
Contact Classes: 45	**Tutorial Classes: 15**	**Practical Classes: Nil**				**Total Classes: 60**		

OBJECTIVES:

The course should enable the students to:

I. Understand the laws of thermodynamics and determine thermodynamic properties, gas laws.
II. Apply Knowledge of properties during various phases of pure substances, mixtures, usage of steam tables and Mollier chart, psychometric charts.
III. Understand the direction law and concept of increase in entropy of universe.
IV. Understand the working of ideal air standard, vapor cycles and evaluate their performance in open systems like steam power plants, internal combustion engines, gas turbines and refrigeration systems.

COURSE LEARNING OUTCOMES (CLOs):

1. Understand various forms of energy, mechanisms of energy transfer, the concept of energy transfer, the concept of temperature, energy balance, energy conservation and conversion efficiency using familiar processes that involver mostly mechanical forms of energy
2. Demonstrate knowledge of ability to identify & apply fundamentals to solve problems like system properties, amount of work transfer and heat during various processes.
3. Explore knowledge & ability to design the thermal related components in various fields of energy transfer equipment.
4. Derive the first law of Thermodynamics from the concept of conservation of energy.
5. Discuss the nature of steady and unsteady processes under the influence of time.
6. Develop the second law of thermodynamics from the limitations of first law.
7. Determine entropy changes in a wide range of processes and determine the reversibility or irreversibility of a process from such calculations based on Carnot Cycle.
8. Understand the inter relationship between thermodynamic functions and an ability to use such relationships to solve practical problems.
9. Knowledge of the Gibbs and Helmholtz free energies as equilibrium criteria, and the statement of the equilibrium condition for closed and open systems
10. Determine the equilibrium states of a wide range of systems, ranging from mixtures of gases, liquids, solids and pure condensed phases that can each include multiple components.
11. Discuss pressure-temperature, volume-temperature, pressure-volume phase diagrams and the steam tables in the analysis of engineering devices and systems.
12. Develop the Third Law of Thermodynamics from the concept of absolute thermodynamic scale and describe its significance.
13. Understand the process of psychrometry that are used in the analysis of engineering devices like air conditioning systems.
14. Introduction to concepts of power and refrigeration cycles. Their efficiency and coefficients of performance.
15. Ability to use modern engineering tools, software and equipment to analyze energy transfer in required air-condition application.

16. Explore the use of modern engineering tools, software and equipment to prepare for competitive exams, higher studies etc.

Unit-I	BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS	Classes: 10

Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle, Reversibility, Quasi static Process, Irreversible Process, Causes of Irreversibility, Various flow and non-flow processes ,Energy in State and in Transition, Types-Work and Heat, Point and Path function., Zeroth Law of Thermodynamics, Concept of quality of Temperature, Principles of Thermometry, Reference Points, Constant Volume gas Thermometer, Ideal Gas Scale, PMMI - Joule's Experiments, First law of Thermodynamics, Corollaries First law applied to a Process, Applied to a flow system, Steady Flow Energy Equation.

Unit-II	SECOND LAW OF THERMODYNAMICS	Classes: 09

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, Availability and Irreversibility, Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations, Elementary Treatment of the Third Law of Thermodynamics.

Unit-III	PURE SUBSTANCES	Classes: 10

Phase Transformations, T-S and h-s diagrams, P-V-T- surfaces, Triple point at critical state properties during change of phase, Dryness Fraction, Mollier charts, Various Thermodynamic processes and energy Transfer, Steam Calorimeter.

Perfect Gas Laws: Equation of State, Specific and Universal Gas constants, Throttling and Free Expansion Processes, Deviations from perfect Gas Model, Vander Waals Equation of State.

Unit -IV	MIXTURE OF PERFECT GASES	Classes: 08

Mole Fraction, Mass friction, Gravimetric and volumetric Analysis, Volume fraction, Dalton's Law of partial pressure, Avogadro's Laws of additive volumes, and partial pressure, Equivalent Gas constant, Internal Energy, Enthalpy, sp. Heats and Entropy of Mixture of perfect Gases . Psychrometric properties-Dry bulb temperature, wet bulb temperature, specific humidity, Relative humidity, saturated air, Degree of saturation-adiabatic saturation, carrier equation, psychrometric chart.

Unit -V	POWER CYCLES	Classes: 08

Otto, Diesel, Dual Combustion cycles, Description and representation on P-V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis, comparison of Cycles, Introduction to Brayton cycle and Bell Coleman cycle.

Text Books:

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publishers, 5th Edition, 2013.
2. 2. Yunus Cengel, Michael A. Boles, "Thermodynamics-An Engineering Approach", Tata McGraw Hill publishers, 8th Edition, 2014.

Reference Books:

1. J. B. Jones, R. E. Dugan, "Engineering Thermodynamics", Prentice Hall of India Learning.
2. Y. V. C. Rao, "An Introduction to Thermodynamics", Universities Press.
3. K. Ramakrishna, "Engineering Thermodynamics", Anuradha Publishers.
4. J.P Holman, "Thermodynamics" Tata McGraw Hill Publishers.

Web References:

1. https://en.wikipedia.org/wiki/Thermodynamics
2. https://en.wikipedia.org/wiki/Laws_of_thermodynamics
3. http://www.livescience.com/50776-thermodynamics.html
4. https://www3.nd.edu/~powers/ame.20231/planckdover.pdf

E-Text Books:

1. https://www3.nd.edu/~powers/ame.20231/planckdover.pdf
2. http://www.ebookdownloadz.net/2014/08/engineering-thermodynamics-by-pknag.html