ENGINEERING THERMODYAMICS

III Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEB02	Core	3	-	-	3	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

COURSE OBJECTIVES:

The student will try to learn:

I. The concepts of thermodynamics, gas properties and the thermodynamic disorderness in the real time physical systems in heat engines, heat pumps and refrigeators for measure of their performance

II. The characteristics of pure substances, mixtures, usage of steam tables, mollier' chart and psychometric charts for solving thermal problems.

III. The characteristics and performance of open and closed systems of thermodynamic cycles for effective delineation of real time applications

IV. The methods of heat transfer and the suitability of heat exchangers and gas compressors in power plants and aircraft propulsion system.

COURSE OUTCOMES:

CO1 **Demonstrate** the ideal gas laws, the properties of pure substance and path and point functions through exact differentials for describing the thermodynamic process.

CO2 **Summarize** working principles of energy conversions in physical systems by the fundamental laws of thermodynamics for identifying the significance of energy.

CO3 **Classify** the thermodynamics processes and energy transfer mechanisms which lead to the ascertaining of properties involving thermodynamic cycles

CO4 **Illustrate** the statements of heat to work conversion and thermodynamic direction laws involved heat engines, heat pumps and refrigerators for classification of their efficiencies.

CO5 **Apply** thermodynamics laws and entropy changes for describing the properties of pure substances and mixtures of perfect gases.

CO6 **Illustrate** the characteristics of pure substances in various thermal processes while undergoing the changes from one state to another..

CO7 **Demonstrate** the knowledge of steam and gas tables, in solving problems of steam power plants..

CO8 **Choose** the properties of air conditioning systems and practicing psychometric charts in solving the complex problems of refrigeration and air conditioning.

CO9 **Illustrate** the concept of entropy and its changes in various thermal processes for determining performance of air standard cycles.

CO10 **Identify** the working of various air standard cycles and its performance characteristics useful in aeronautical and automobile engineering, power plants and refrigeration systems

CO11 **Demonstrate** the modes of heat transfer and suitability of heat exchangers in various engineering fields including aerospace applications.

CO12 **Summarize** the working principle of gas compressors based on thermodynamics cycles as well as compression stages and their significance in real world systems.

Module-I BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS

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.

Module-II	**SECOND LAW OF THERMODYNAMICS**

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, Third Law of thermodynamics.

Module-III	**PURE SUBSTANCES AND MIXTURES OF PERFECT GASES**

Pure substances: 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:

Psychrometric 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.

Module-IV	**POWER CYCLES**

Columns, types of columns, Euler's formula instability of columns, Rakine's and Jonson's formula, Eigen values and Eigen modes, concept of beam-column.

Module-V	**ELEMENTS OF HEAT TRANSFER AND GAS COMPRESSORS**

Basic concepts of Heat Transfer: Conduction, Convection and Radiation, Heat Exchangers, Types of Heat Exchangers. Basic concepts of: Gas Compressors, Air Compressors, Single-Stage Reciprocating Air Compressor, Multi-Stage Compression, Volumetric Efficiency, Air Motors, Rotary Compressors.

Text Books:

1. P. K. Nag, -Engineering Thermodynamics‖, Tata McGraw-Hill, 4th Edition, 2008
2. Yunus Cengel, Michael A. Boles, Thermodynamics-An Engineering Approach, Tata McGraw-Hill, 7th Edition, 2011.

Reference Books:

1. J. B. Jones, R. E. Dugan, Engineering Thermodynamics, Prentice Hall of India Learning, 1st Edition, 2009..
2 Y. V. C. Rao, - An Introduction to Thermodynamics, Universities Press, 3rd Edition, 2013
3 K. Ramakrishna, - Engineering Thermodynamics, Anuradha Publishers, 2nd Edition, 2011Timoshenko, S, Young, D. H. "Elements of Strength of Materials", T. Van Nostrand Co. Inc., Princeton N.J, 4th Edition, 1977.
4. Holman. J.P, - "Thermodynamics", Tata McGraw-Hill, 4th Edition, 2013

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