ENGINEERING THERMODYNAMICS

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: Nil	Practical Classes: Nil				Total Classes: 45		

I. COURSE OVERVIEW:

Thermodynamics is the science that deals with the relationship between heat and work and those properties of systems that bear relation to heat and work. General laws of energy transformations concerning all types of systems, mechanical, electrical and chemical may fall within the purview of this science. It is a science based on a number of empirical laws formed by experimentation from which all predictions concerning the physical behavior of the system may be deduced by logical reasoning. The findings have been formalized into certain basic laws, which are known as Zeroth, First, Second and third laws of thermodynamics. Power cycles and refrigeration cycle based on thermodynamic system is studied along with applications of power cycles.

II. OBJECTIVES:

The course should enable the students to:

I. Understand the laws of thermodynamics and determine thermodynamic properties and gas laws.
II. Apply Knowledge of properties of pure substances, mixtures, usage of steam tables and Mollier chart, psychometric charts.
III. Understand the direction law and concept of increase of entropy of the 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.

III. COURSE OUTCOMES (COs):

COs	Course Outcome
CO 1	Understand basics of thermodynamics along with basic laws of thermodynamics.
CO 2	Understand the limitations of first law of thermodynamics and different forms of second law of thermodynamics.
CO 3	Describe the properties of pure substances with help of phase diagrams and also understand the psychrometric properties.
CO 4	Understand different processes in different standard cycles and calculate efficiencies of each cycle.
CO 5	Understand working of heat exchangers, different types of heat exchangers and working of them.

IV. SYLLABUS:

MODULE-I	BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS	Classes : 09

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	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, Third Law of thermodynamics.

MODULE- III	PURE SUBSTANCES AND MIXTURES OF PERFECT GASES	Classes: 09

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, 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, Psychometric chart.

MODULE-IV	POWER CYCLES	Classes: 09

Power cycles: 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.

MODULE- V	ELEMENTS OF HEAT TRANSFER AND GAS COMPRESSORS	Classes : 09

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.

V. 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.

VI. 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, 2011.
4. Holman. J.P, “Thermodynamics”, Tata McGraw-Hill, 4th Edition, 2013.

VII. 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

VIII. E-Text Book:

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