ENGINEERING THERMODYNAMICS

III Semester: AE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AAEC02	Core	3	0	0	3	30	70	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil				Total Classes: 45		

Prerequisite: Basic principles of waves

I. COURSE OVERVIEW:

Engineering Thermodynamics is the field of physics which deals with the relationship between heat and mechanical work, and the 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 law, First, Second and third laws of thermodynamics. Power cycles and refrigeration cycle based on thermodynamic system are analyzed for determination of their efficiencies and applications. This course emphasis on the groundwork for subsequent studies in the fields of fluid mechanics, heat transfer and to prepare the cohorts for effective use of thermodynamics in the real-world applications..

II. COURSE OBJECTIVES:

The students 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 refrigerators 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.

III. COURSE OUTCOMES:

After successful completion of the course, students should be able to:

CO 1	**Interpret** the thermodynamic processes and energy conversions in physical systems based on fundamental laws of thermodynamics for identifying the significance of energy.	Understand
CO 2	**Make use of** heat to work conversion and thermodynamic directionlaws involved in heat engines and heat pumps for deriving their efficiency and coefficient of performance.	Apply
CO 3	**Utilize** thermodynamic laws and entropy to describe the properties of pure substances and mixtures of perfect gases for examining the unavailability in any given system.	Apply
CO 4	**Choose** the properties of refrigernats and practicing of psychrometric charts for solving the complex problems of refrigeration and air conditioning.	Apply
CO 5	**Illustrate** the working principles of air standard cycles and its performance characteristics for recognizing the suitable engines in aeronautical and automobile applications.	Understand
CO 6	**Summarize** the basics of heat transfer, working principle of gas compressors and heat exchangers for relating their applications inaerospace engineering.	Understand

IV. SYLLABUS:

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

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

V. TEXT BOOKS:

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw-Hill, 4th Edition, 2008.
2. YunusCengel, Michael A. Boles, "Thermodynamics-An Engineering Approach", Tata McGraw-Hill, 7th Edition, 2011.
3. R.K.Rajput, "Engineering Thermodynamics", Laxmi Publications (P) Ltd, Third Edition, 2007.

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 BOOKS:

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