INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

THERMODYNAMICS AND HEAT TRANSFER								
III Semester: AE								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
AAED02	**Core**	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	-	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Nil								

I.COURSE OVERVIEW:
Engineering thermodynamics deals with the study of energy and heat transfer in various engineering applications. This course will delve into several key areas, including the principles of mass and energy conservation, the application of the first law to both closed and open systems, a comprehensive grasp of the second law of thermodynamics and its relation to entropy, an exploration of pure substance properties, a thorough examination of power generation and refrigeration. It forms an essential cornerstone for mechanical, chemical and aerospace engineers and plays a pivotal role in the study of energy systems.

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 such as heat engines, heat pumps
II. The characteristics of pure substances, mixtures, usage of steam tables, Mollier' chart and psychometric charts for solving thermal problems.
III. The principles of various power cycles, gas compressors and their real-world applications.
IV. The various modes of heat transfer, types of heat exchangers

III.COURSE OUTCOMES:
After successful completion of the course, students will 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.
CO 2 Make use of heat to work conversion and thermodynamic direction laws involved in heat engines and heat pumps for deriving their efficiency and coefficient of performance
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.
CO 4 Choose the properties of refrigerants and practicing of psychrometric charts for solving the complex problems in refrigeration and air conditioning.
CO 5 Illustrate the working principles of air standard cycles and its performance characteristics for recognizing the suitable engines in aeronautical and automobile applications
CO 6 Summarize the basics of heat transfer, working principle of heat exchangers for relating their applications in aerospace engineering.

IV. COURSE CONTENT:
MODULE-I: BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS (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, 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 (10)

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 AND GAS COMPRESSORS (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, Basic concepts of: Gas Compressors, Types of Air Compressors, Single-Stage compression, Multistage Compression, Volumetric Efficiency, Rotary Compressors.

MODULE –V: BASIC CONCEPTS IN HEAT TRANSFER (10)

Modes of Heat Transfer, Heat Transmission by Conduction, Fourier's law of conduction Thermal conductivity of materials Thermal resistance, General heat conduction equation in cartesian coordinates, Heat conduction through plane and composite walls, Heat Transfer by Convection, Heat Exchangers, Types of heat exchangers Heat exchanger analysis Logarithmic temperature difference (LMTD), Heat Transfer by Radiation, Surface emission properties, Absorptivity, reflectivity and transmittivity, Concept of a black body, The Stefan-Boltzmann law, Kirchhoff's law.

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, 3 rd 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. ELECTRONICS RESOURCES:

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

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end 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)
11. Power point presentation