THERMODYNAMICS

III Semester: ME

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AMEB04	Core	3	1	-	4	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 fundamental knowledge on concepts of physics and chemistry for obtaining the axiomatic principles using thermodynamic co-ordinates.

II The thermodynamic disorderness in the real time physical systems like external/internal heat engines, heat pumps to get the measure of performance characteristics.

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

IV The thermodynamic cycles such as power and refrigerant cycles yields to alternative solutions to conserve the environment.

COURSE OUTCOMES:

At the end of the course students are able to:

CO 1 **Recall** the thermodynamic properties and discern the path and point functions through exact differentials.

CO 2 **Summarize** working principles of energy conversions in physical systems by fundamental laws of thermodynamics.

CO 3 **Explain** the various energy transfer mechanisms which leads to the ascertaining of properties involving thermodynamic cycles.

CO 4 **Identify** the laws of conservation of energy to yield the relationship between heat, work and change in internal energy.

CO 5 **Contrast** between various statements of purpose in heat to work conversion and notice that thermodynamic direction laws defining them are mutually complementary.

CO 6 **Relate** various relations involving pressure, temperature and volume to discern the change in entropy generation in universe.

CO 7 **Interpre**t the properties of pure substances and steam to emit relevant inlet and exit conditions of thermodynamic work bearing systems.

CO 8 **Describe** fundamental relationship between intensive properties in form of partial derivatives implemented for perfect gases.

CO 9 **Show** the significance of partial pressure and temperature to table the performance parameters of gaseous mixtures.

CO 10 **List** the properties of air-conditioning systems by practicing psychrometry chart and gas property tables.

CO 11 **Illustrate** the working of various air standard cycles and work out the performance characteristics.

CO 12 **Infer** the performance of power and refrigerant cycles, and their significance in real world systems.

MODULE-I	BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS	Classes: 12

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..

MODUL -II	**SECOND LAW OF THERMODYNAMICS**	**Classes: 12**

Thermal reservoir, heat engine, heat pump, parameters of performance, second Law of thermodynamics, Kelvin Planck and Claussius 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.

MODULE-III	**PURE SUBSTANCES &GAS LAWS**	**Classes: 12**

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.
Equation of state, specific and universal gas constants, throttling and free expansion processes, deviations from perfect gas model, Vander Waals equation of state.

MODULE-IV	**MIXTURES OF PERFECT GASES**	**Classes: 12**

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, specific heats and entropy of mixture of perfect gases; psychometric properties, dry bulb temperature, wet bulb temperature, dew point temperature, thermodynamic wet bulb temperature, specific humidity, relative humidity, saturated air, vapor pressure, degree of saturation, adiabatic saturation, Carrier's equation, Psychometric chart.

MODULE-V	**POWER CYCLES**	**Classes: 12**

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, 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, 2011.
4. Holman. J.P, "Thermodynamics", Tata McGraw Hill, 4th Edition, 2013.

Web References:

1. https://nptel.ac.in/courses/112/105/112105123/