COURSE TITLE : APPLIED THERMODYNAMICS
COURSE CODE : 3045
PERIODS/WEEK : 5
PERIODS/SEMESTER : 90
CREDITS : 5

TIME SCHEDULE

MODULE	TOPICS	PERIODS
1	Thermodynamic Processes	22
2	Air Standard Cycles	23
3	Power Developed in I.C. Engines Air Compressors	23
4	Principles of Heat Transfer Principles of Heat Exchanger	22
	Total	**90**

OBJECTIVES

Upon completion of the study of this subject the student should be able to: -

1.1.0 Understand terms associated with Thermodynamics and different process
- 1.1.1 Distinguish between specific heat at constant volume and at constant pressure
- 1.1.2 Derive the relation between specific heats and gas constant
- 1.1.3 Explain pressure- volume diagram
- 1.1.4 Derive formulae for work, change in internal energy, heat transfer, relation between P, V and T etc, during Isochoric, Isobaric, Isothermal, Isentropic and Polytropic processes.

2.1.0 Comprehend cycles of operation of I.C. Engines
- 2.1.1 Distinguish between reversible and irreversible cycles
- 2.1.2 Describe available work of a cycle
- 2.1.3 Express air standard efficiency of a cycle
- 2.1.4 Explain Carnot cycle, Otto cycle, Diesel cycle,Dual combustion cycle and Joule Cycle with the help of P-V diagrams.
- 2.1.5 Derive formulae for air standard efficiency of Carnot cycle, Otto cycle and diesel cycle.
- 2.1.6 Compute the air standard efficiencies of Carnot cycle, Otto cycle and diesel cycle from the given data.

3.1.0 Compute power developed in I.C. Engines
- 3.1.1 Explain indicator diagrams
- 3.1.2 Find brake power, indicated power, friction power, mean effective pressure, specific fuel consumption, mechanical efficiency, thermal efficiencies and volumetric efficiency
- 3.1.3 Demonstrate Morse test
- 3.1.4 Prepare heat balance sheet

3.2.0 Understand working of various types of air compressors and its safety devices
- 3.2.1 Outline the function of air compressor
- 3.2.2 List the uses of compressed air
- 3.2.3 Classify compressors

3.2.4 Explain the working of single stage and multi stage air compressors
3.2.5 Defend the advantages of multistage compression
3.2.6 Describe roots blower, vane type, centrifugal and axial flow compressors
3.2.7 Indicate the necessity of safety devices in compressor
3.2.8 Explain pressure relief valve and automatic cut off

4.1.0 Comprehend the principles of Heat Transfer
4.1.1 Explain the three modes of heat transfer
4.1.2 Name the fields of application of heat transfer
4.1.3 State and explain Fourier's law of thermal conduction
4.1.4 Define thermal conductivity
4.1.5 Analyse conduction through plain wall and composite plain wall
4.1.6 Estimate heat loss/square meter/hour
4.1.7 Explain thermal radiation, reflection, absorption and transmission of radiation
4.1.8 Define absorptivity, reflectivity and transmitivity
4.1.9 Explain the concept of a black body
4.1.10 State and explain Stefan - Boltzman law of total radiation
4.1.11 Explain the concept of a Grey body
4.1.12 Explain Newton's Law of cooling.
4.1.13 Explain free convection and forced convection

4.2.0 Understand principles of heat exchangers
4.2.1 Classify heat exchangers – Recuperator type and Regenerative type,
4.2.2 Parallel flow and counter flow type
4.2.3 Define overall heat transfer coefficient
4.2.4 Define LMTD
4.2.5 Write equations for LMTD for various flow types
4.2.6 Solve problems to calculate surface area of heat exchanger tubes
4.2.7 Distinguish between evaporators and condensers

CONTENT OUTLINE

MODULE I: Thermodynamic Processes

Revision of topics like, thermodynamic system, thermodynamic properties, boundary, state, process, internal energy, flow of work, enthalpy, entropy, first and second law of thermodynamics.

Specific heats at constant volume and at constant pressure. Establish the relation between specific heats and gas constant. Derivation of formulae for work, heat, change in internal energy, relation between pressure, volume and temperature during constant volume, constant pressure, constant temperature, adiabatic and polytropic processes – problems.

MODULE – II

Air standard cycles – Reversible and irreversible cycle. Available work and energy of a cycle.

Theoretical thermal efficiency and air standard efficiency. Pressure- volume diagram and temperature – entropy diagram. Derivation of formulae for air standard efficiency of Carnot cycle, Otto cycle, Diesel cycle- problems to find air standard efficiency.

MODULE– III

Power developed in I.C. Engines – Indicator diagram and measurement of mean effective pressure. Engine indicators. Indicated power, brake power, friction power, indicated thermal efficiency, brake thermal efficiency, volumetric efficiency, specific fuel consumption, Morse test and preparation of heat balance sheet.

Air compressors – uses of compressed air, classification of air compressors – working of single stage and multistage air compressors. Intercooler.

MODULE– IV

Principles of heat transfer – introduction to heat transfer. Modes of heat transfer and fields of application of heat transfer. Thermal conduction, Fourier's law of thermal conduction, thermal conductivity. Conduction through plain wall and composite plain wall – simple problems. Thermal radiation, reflection, absorption and transmission of radiation. Absorptivity, reflectivity and transmitivity. Concept of a black body, Stefan – Boltzman law of total radiation. Concept of gray body. Newton's law of cooling. Free convection and forced convection. Basic principles of heat exchangers. Classifications of heat exchangers. Evaporator and condenser.

TEXT BOOKS

1.Thermal Engineering _ R. S. Kurumi
2.. Heat and Mass transfer - S.K.Suchdev and S.Kothanda Raman

REFERENCE BOOKS

1.Elements of Heat engines - R.C.Patel and Karan Chandani
2.Thermal engineering Vol.-I - Lakshminarayana
3. Automobile mechanics - N.K.Giri
4.Heat and Mass transfer - R. Rudra Moorthy and K.Mayil Samy
5. Vehicle operations and testing - J G Giles
6. Intenal combustion engines - V.Ganesan
7. Intenal combustion engines theory and practice - S.P.Sen
8. Internal combustion engines - Mathur and Sharma
9. IC Engines - Maleeve
10. IC Engines - P.M.Heldt
11. Thermal engineering - Ramalingam