COURSE TITLE : APPLIED THERMODYNAMICS
COURSE CODE : 4051
COURSE CATEGORY : B
PERIODS/WEEK : 5
PERIODS/SEMESTER : 70
CREDITS : 5

TIME SCHEDULE

Module	Topic	Periods
1	Thermodynamic processes	17
2	Air standard cycles	17
3	Power developed in i.c engines Air compressors	17
4	Principles of heat transfer Principles of heat exchanger	19
TOTAL		**70**

GENERAL COURSE OUTCOME

Module	G.O	Student will be able to
1	1	Understand the thermodynamic processes
	2	Distinguish between specific heats and gas constant.
	3	Formulate the equations of work, internal energy relations between P,V, and T during various process
2	1	Comprehend various processes in different cycles of I.C. engines.
	2	Derive air standard efficiency of Carnot cycle, Ottocycle and diesel Cycles
	3	Calculate efficiencies of different air standard cycles.
3	1	Explain indicator diagrams
	2	Calculate B.P, I.P, F.P, M.e.p, S.F.C and various efficiencies of an engine.
	3	Prepare heat balance sheet of I.C. engine.
	4	Describe the working of air compressor and its safety devices
4	1	Understand different modes of heat Transfer.
	2	State Fourier's Law of thermal conduction
	3	Define absorptivily, reflectively and transmitivily
	4	Understand the principles of heat exchangers.

SPECIFIC COURSE OUTCOME

MODULE I

1.1.0 Understand the terms associated with Thermodynamics and different processes

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.

MODULE II

2.1.0 Comprehend the 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.

MODULE III

3.1.0 Analyse 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 Describe the 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 List 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 a compressor

3.2.8 Explain the pressure relief valve and automatic cut off

MODULE IV

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 the principles of heat exchangers
4.2.1 Classify heat exchangers – Recuperative 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

CONTENTDETAILS

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. R. S. Khurmi - Thermal Engineering - S.Chand
2. S.K.Suchdev and S.Kothanda Raman - Heat and Mass transfer - New age international

REFERENCE BOOKS

1. R.C.Patel and Karmchandani.C.J. - Elements of Heat engines – Acharya book
2. Lakshminarayana - Thermal engineering Vol.-I
3. N.K.Giri - Automobile mechanics – Khanna publishers
4. R. Rudra Moorthy and K.Mayil Swamy - Heat and Mass transfer- pearson education india
5. J G Giles-Vehicle operations and testing - life
6. V.Ganesan - Internal combustion engines – Tata McGraw-Hill
7. S.P.Sen - Internal combustion engines theory and practice – Khanna publishers
8. Mathur and Sharma - Internal combustion engines – Dhanpat Rai
9. V.L. Malaev - IC Engines – McGraw-Hill
10. P.M.Heldt - IC Engines
11. Ramalingam - Thermal engineering - New age international
12. B B Ghosh - A Text book of Engineering Thermodynamics – Vikas publishing