BME-052

IPLOMA IN MECHANICAL ENGINEERING (DME)

Term-End Examination

June, 2011

IE-052 : BASICS OF THERMAL ENGINEERING

e : 2 hours | Maximum Marks : 70

e : *All questions are compulsory.*
Use of scientific calculator is permitted.
Use of steam table, Mollier diagram are permitted.

Answer *any two* of the following : 2x7 =14

(a) A piston - cylinder device with air at an initial temperature of 30°C undergoes an expansion process for which pressure and volume are related as given below:

P(KPa)	100	37.9	14.4
V(m^3)	0.1	0.2	0.4

Calculate the work done by the system.

(b) State the following laws

(i) Boyle's law

(ii) Charle's law

(iii) Zeroth law of thermodynamics

(iv) First law of thermodynamics

(c) Water flows through a turbine in which friction causes the water temperature to raise from 35°C to 37°C. If there is no heat transfer, how much does the entropy of the water change in passing through the turbine ? (Water is in compressible and the process can be taken to at constant volume)

2. Explain the working principle with neat sketch, *any two* of the following **2x7 =14**

(a) Lancashire boiler

(b) Cochran boiler

(c) Babcock and Wilcox boiler

3. Answer *any two* of the following : **2x7 =14**

(a) Dry steam expands through a nozzle from a pressure of 15 bar to a pressure of 10 bar. Assuming the flow to be frictionless and adiabatic, estimate the velocity of the steam jet.

(b) Explain the construction and working of an impulse (steam) turbine with a neat sketch.

(c) Describe, with a line diagram, the various elements of a steam power plant.

Answer *any two* of the following. 2x7 = 14

(a) A furnace wall comprises three layer : 13.5 cm thick inside layer of fire brick, 7.5 cm thick middle layer of insulating brick and 11.5 cm thick outside layer of red brick. The furnace operates at 870°C and it is anticipated that the outside of this composite wall can be maintained at 40°C by the circulation of air. Assuming close bonding of layers at their interfaces, find the rate of heat loss from the furnace and wall interface temperatures. The wall measures 5m x 2m and thermal conductivities of Fire brick = 1.2 W/mK ; insulating brick = 0.14 W/mK; Red brick = 0.85 W/mK.

(b) A black body of total area 0.045 m^2 is completely enclosed in a space bounded by 5 cm thick walls. The walls have a surface area 0.5 m^2 and thermal conductivity 1.07 W/mK. If the inner surface of the enveloping wall is to be maintained at 215°C and the outer wall surface is at 30°C, Calculate the temperature of the black body. Neglect the difference between inner and outer surface areas of enveloping material.

(c) The exhaust steam 0.975 dry enters a surface condenser at 0.12 bar. The condensate leaves at 44°C. If the temperature rise of circulating water is 14°C, determine the amount of cooling water required per kg of steam condensed.

5. Write short notes on *any two* of the followig : **2x7 =14**

(a) Solar energy

(b) Wind power energy

(c) Geothermal energy.
