ME

BTS 117(D)

B.Tech. Degree III Semester (Supplementary) Examination in Mechanical Engineering , June 2001

ME 303 THERMAL ENGINEERING - I

(1998 admissions)

Time: 3 Hours *Max. Marks: 100*

(All questions carry equal marks)

b) Saturated water at 20° C flows through a pipe of inside diameter 10mm at a rate of 5 cm^3/sec. Determine the type of flow and its entrance length.

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MODULE - I

I a) State and explain the second law of thermodynamics.

b) Calculate the decrease in available energy when 25 kg. of water at 95° C mix with 35 kg. of water at 35° C, the pressure being taken as constant and the temperature of the surroundings being 15° C. Assume specific heat of water at constant pressure as 4.2 KJ/kg-k.

OR

II a) Determine the heat transfer per kg. mol of fuel for the following reaction

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O \quad (1)$$

The reactants and products are each at a total pressure of 100 kPa and 25° C.

b) A cyclic heat engine operates between a source temperature of 800° C and a sink temperature of 30° C. What is the least rate of heat rejection per KW net output of the engine?

MODULE - II

III a) What are the characteristics of an ideal working fluid in vapour power cycles?

b) Following are the details of a steam power plant operating on a Rankine cycle:
Pressure limits : 0.08 bar and 20 bar
Maximum temperature : 360° C
Find the work output and cycle efficiency.

OR

IV a) With a neat sketch explain the working of a binary vapour cycle.

b) A steam power station uses the following cycle:
Steam at boiler - outlet - 150 bar, 550° C
Reheat at 40 bar to 550° C
Condenser at 0.1 bar.

Find the (i) quality of steam at the exit,
(ii) cycle efficiency, and
(iii) steam rate

MODULE - III

V a) Compare petrol and diesel engines.

b) A four stroke petrol engine 80mm bore, 100mm stroke, is tested at full throttle at constant speed. The fuel supply is fixed at 4.08 kg/hr. and the plugs of the four cyclinders are successively short circuited without change of speed. The brake power measurements are the following:
With all cylinders firing = 12.5 KW
With cylinder No.1 cut off = 9 KW
With cylinder No.2 cut off = 9.15 KW
With cylinder No.3 cut off = 9.2 KW
With cylinder No.4 cut off = 9.1 KW

Determine (1) Indicated power of the engine.
(2) Indicated thermal efficiency.

OR

VI a) What is a heat balance sheet ? How will you draw the heat balance sheet for an IC engine ?

b) A petrol engine has a cylinder diameter of 60mm and stroke 100mm. If the mass of the charge admitted per cycle is 0.0002 kg, find the volumetric efficiency of the engine. Assume characteristic constant for the charge as 287 J/Kg.K.

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MODULE - IV

VII a) Determine the heat lost by radiation per metre length of 7.5cm diameter oxidized steel pipe at 300° C if (i) located in a large room with red brick walls at a temperature of 25° C and (ii) enclosed in a 25cm x 25 cm red brick conduit at a temperature of 25° C. The emissivity of oxidized steel is 0.79 and that of red brick is 0.93.

b) Derive an expression for the critical thickness of pipe insulation.

OR

VIII a) A steam pipe having an outside diameter of 2cm is to be covered with two layers of insulation, each having thickness of 1 cm. The average conductivity of one material is 5 times that of the other. Assuming that the inner and outer surface temperatures of the composite insulation are fixed, calculate by how much percentage the heat transfer will be reduced when the better insulating material is next to the pipe than when it is away from the pipe.

b) Explain the concept of a black body.

MODULE - V

IX a) How heat exchangers are classified? Explain with neat sketches.

b) Water flows inside a tube 5cm in diameter and 3 m long at a velocity 0.8 m/sec. Determine the heat transfer coefficient and the rate of heat transfer if the mean water temperature is 50° C and the wall is isothermal at 70° C.

OR

X a) Water is evaporated continuously at 100° C in an evaporator by cooling 500 kg/hour of air from 260°C to 150° C. Calculate the heat transfer surface area required and the steam evaporation rate per hour if water enters at 100° C. Take the overall heat transfer coefficient as 46 W/m^2k and C_p of air as 1.005 KJ/Kgk

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