CBCS SCHEME

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18MT72

Seventh Semester B.E. Degree Examination, June/July 2023
Thermal Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Heat transfer handbook is permitted.
2. Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following: i) Thermodynamic ii) System iii) Boundary iv) Surrounding v) Universe. **(10 Marks)**

b. Explain difference between Micro and Macroscopic approach. **(05 Marks)**

c. Explain difference between heat and work. **(05 Marks)**

OR

2 a. Explain following types of work transfer: i) Shaft work ii) Electrical work iii) Stirring work iv) Work done is stretching a wire. **(10 Marks)**

b. The reading t_A and t_B two Celsius thermometers A and B agree at the Ice point and steam point and are related by the equation $t_A = L + M.t_B + N.t_B^2$ between these two points L,M,N are constants. When both are immersed in an oil bath thermometer. 'A' Indicates 55°C and thermometer 'B' indicates 50°C. Determine the values of L, M, N and also find the reading on 'A' if 'B' reads 25°C. **(10 Marks)**

Module-2

3 a. Explain energy is a property of system. **(10 Marks)**

b. Derive the expression for heat transfer per unit mass for reversible polytropic process taking place in closed system. **(10 Marks)**

OR

4 a. Define the following: i) Heat pump ii) Refrigerator iii) Thermal efficiency iv) Co-efficient of performance. **(06 Marks)**

b. Prove that $(COP)_{HP} = 1 + (COP)_{ref}$. **(06 Marks)**

c. A heat engine working on carnot cycle converts one-fifth of the heat input into work. When the sink temperature is reduced by 70°C, the heat engine efficiency gets doubled. Determine temperature of source and sink. **(08 Marks)**

Module-3

5 a. Explain carnot cycle with P-V and T-S diagram. Derive an expression for its efficiency. **(10 Marks)**

b. Explain diesel cycle with P-V and T-S diagram. Derive an expression for its mean effective pressure. **(10 Marks)**

OR

6 a. Define heat transfer and explain modes of heat transfer. **(10 Marks)**

b. A surface having an area of $1.5m^2$ and maintained at 300°C exchanges heat by radiation with another surface at 40°C. The value of factor due to the geometric location and emissivity is 0.52. Determine:
i) Heat lost by radiation.
ii) The value of thermal resistance
iii) The value of equivalent convection coefficient. **(10 Marks)**

Module-4

7 a. Derive the 3-D conduction equation in Cartesian coordinates and reduce the equation to Fourier's and Laplace equivalent. **(10 Marks)**

b. A reactors wall 320mm thick is made up of an Inner layer of five brick (K = 0.84w/mic) covered with a layer of Insulation (K = 0.16W/mic). The reactor operates at a temperature of 1325°C and the ambient temperature is 25°C.

i) Determine the thickness of fire brick and insulation which gives minimum heat loss.

ii) Calculate the heat loss pressuring that the insulating material has a maximum temperature of 1200°C. **(10 Marks)**

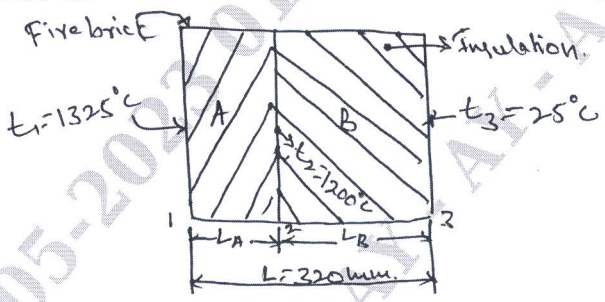

Fig.Q.7(b)

OR

8 a. Using dimensional analysis for free convection heat transfer show that $N_u = C\left(G_r^n . P_r^m\right)$ with usual notations. **(10 Marks)**

b. Explain with neat sketch heat transfer in vertical and horizontal flat plates. **(10 Marks)**

Module-5

9 a. Using Buckingham π - theorem for forced convection heat transfer show that, $N_u = C\left(R_e^n . P_r^m\right)$ with usual notations. **(10 Marks)**

b. Explain physical significance of following:

i) Reynolds number

ii) Prandtl number

iii) Nussult number

iv) Stanton number. **(10 Marks)**

OR

10 a. State and explain the following radiation laws

i) Planks law

ii) Wien's displacement law

iii) Stefan-Boltzman law

iv) Kirchoff's law. **(10 Marks)**

b. An industrial furnace in the form of black body emits radiation at 3000K. Calculate the following:

i) Monochromatic Emissive power at 1μm wave length.

ii) Maximum emissive power.

iii) Total emissive power.

iv) Compare the total emissive power of the furnace. If it is assumed as a real surface having emissivity 0.8

v) Wave length at which emission is maximum. **(10 Marks)**

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