CBCS SCHEME

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15MT72

Seventh Semester B.E. Degree Examination, July/August 2021
Thermal Engineering

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions.

1 a. Define the following with examples:
(i) Open system
(ii) Closed system
(iii) Path function
(iv) Point function **(08 Marks)**

b. Distinguish between:
(i) Microscopic and macroscopic view points
(ii) Thermal equilibrium and mechanical equilibrium **(08 Marks)**

2 a. Explain the following types of work transfer:
(i) Electrical work
(ii) Paddle-wheel work **(08 Marks)**

b. State the similarities between heat and work and explain with example to illustrate the difference between heat and work. **(08 Marks)**

3 a. State the 1st law of thermodynamics for cyclic process and show that internal energy is a property of a system. **(08 Marks)**

b. How can be 1st law applied to open system? With usual notations, deduce the steady flow energy equation for an open system. **(08 Marks)**

4 a. 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? **(08 Marks)**

b. A domestic food freezer maintains a temperature of –15°C. The ambient air temperature is 30°C. If heat leaks into the freezer at the continuous rate of 1.75 kJ/s, what is the least power necessary to pump this heat out continuously? **(08 Marks)**

5 a. Explain Carnot cycle and derive an expression for its efficiency. **(08 Marks)**

b. Compare among Otto, Diesel and dual cycles. **(08 Marks)**

6 a. Differentiate between thermal conductivity and heat transfer coefficient. **(04 Marks)**

b. Describe boundary conditions of 1st, 2nd and 3rd kind with figures. **(08 Marks)**

c. The heat flow rate through a 4 cm thick wood board for a temperature difference of 25°C between the inner outer surfaces is 75 W/m^2. What is the thermal conductivity of wood? **(04 Marks)**

7 a. Explain the overall heat transfer coefficient. **(08 Marks)**

b. A brick wall of thickness 250 mm has thermal conductivity 0.8 W/m°C is maintained at 20°C at one surface and 10°C from the other surface. Determine the heat flow rate across a 5 m^2 surface area of the wall. And also find heat flux. **(08 Marks)**

8 a. A horizontal pipe 0.3 m diameter is maintained at a temperature of 250°C in a room where the ambient air is at 15°C. Calculate the free convection heat loss per meter of length. **(08 Marks)**

b. A wall 4m high by 5m wide is at 60°C and the surrounding air is at 20°C. Calculate the heat lost by natural convection neglecting end effects using the relation. $Nu = 0.51(Pr)^{1/2}(Pr+1)^{1/4}(Gr)^{1/4}$ Take $\rho = 1.09$ kg/m^3; $\mu = 1.91 \times 10^{-5}$ Ns/m^2; K = 0.063 kJ/m.hr.K; Pr = 0.714. **(08 Marks)**

9 a. Water flows with a velocity of 0.6 m/s through a tube of inside diameter 60 mm and length 3.5 m. Find the heat transfer rate by forced convection if mean water temperature is 50°C and tube wall surface temperature is 70°C. Using empirical correlation $Nu = 0.023(Re)^{0.8}(Pr)^{0.4}$ **(08 Marks)**

b. Air at 27°C is moving at 0.3 m/s across a 100 W electric bulb at 127°C. If the bulb is approximated by a 10 cm diameter and 1 m high cylinder, estimate the heat transfer rate and percentage of power lost due to convection. **(08 Marks)**

10 a. For a hemispherical furnace, the flat floor is at 700 K and has an emissivity of 0.5. The hemispherical roof is at 1000 K and has an emissivity of 0.25. Find the net radiate heat transfer from roof to floor. **(08 Marks)**

b. Two concentric cylinders having diameters of 10 cm and 20 cm have a length of 20 cm. Calculate the radiation shape factor between the open ends of the cylinders. **(08 Marks)**

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