CBCS SCHEME

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17MT72

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
Thermal Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Thermal Data Hand Books are permitted.

Module-1

1 a. Define:
i) Thermodyanamics
ii) Zeroth law of thermodynamic
iii) Temperature
iv) Enthalpy
v) Intensive property
vi) Path
vii) Process
viii) Cycle
ix) Specific heat at constant volume
x) Specific heat at constant pressure. **(10 Marks)**

b. Explain thermodynamic equillibrium in detail. **(04 Marks)**

c. Distinguish between:
i) Microscopic and macroscopic approaches
ii) Diathermic and adiabatic wall. **(06 Marks)**

OR

2 a. Define thermodynamic work. Explain displacement work with an example. **(04 Marks)**

b. Explain the following types of work transfer i) Shaft work ii) Work done in stretching a wire. **(08 Marks)**

c. The properties of a closed system change following the relation between pressure and volume as $PV = 3.0$. Where P is in bar V is in m^3. Calculate the work done when the pressure increases from 1.5 bar to 7.5 bar. **(08 Marks)**

Module-2

3 a. State the 1st law of thermodynamics for cyclic process and show that internal energy is a property of a system. **(10 Marks)**

b. How can be 1st law applied to open system? With usual notations deduce the steady flow energy equation for an open system. **(10 Marks)**

OR

4 a. Two carnot engines work in series between the source and sink temperature of 550K and 350K respectively. If both engines develop equal power determine the intermediate temperature. **(04 Marks)**

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? **(08 Marks)**

c. Explain the concept of heat engine, heat pump and thermal reservoir. **(08 Marks)**

Module-3

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

b. Compare among Otto, Diesel and dual cycles. **(12 Marks)**

OR

6 a. Explain the modes of heat transfer with governing law and equation. **(08 Marks)**

b. Explain the combined heat transfer mechanism. **(04 Marks)**

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

Module-4

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

b. The temperature distribution across a large concrete slab 50cm thick heated from one side as measured by thermo couples approximate to the relation.

$T = 60 - 50x + 12x^2 + 20x^3 - 15x^4$

Where T is in °C and x is in meter. Considering area of $5m^2$ compute:

i) Heat entering and leaving the slab

ii) Heat energy stored in unit time for concrete K = 1.2 W/mK. **(10 Marks)**

OR

8 a. A square plate 40cm × 40cm maintained at 400K is suspended vertically in atmospheric air at 300K

i) Determine the boundary layer thickness at trailing edge of the plate.

ii) Calculate the average heat transfer coefficient using a relation $N_u = 0.516\ (Gr_L.Pr)^{0.25}$. Take the following properties of air $V = 20.75 \times 10^{-6} m^2/s$, K = 0.03W/m.K, $\beta = 2.86 \times 10^{-3} K^{-1}$, Pr = 0.7. **(10 Marks)**

b. A hot square plate 50cm × 50cm at 100°C is exposed to atmosphere air at 20°C. Find the heat loss from both surfaces of the plate if i) plate is kept vertical ii) plate is kept horizontal.

Use the following relation:

$Nu = 0.13\ (Gr\ Pr)^{1/3}$ vertical position

$Nu = 0.71\ (Gr\ Pr)^{1/4}$ for upper surface

$Nu = 0.35\ (Gr\ Pr)^{1/4}$ for lower surface. **(10 Marks)**

Module-5

9 a. Explain the physical significance of Reynolds number, Prandtl number, Stanton number, Eckert number and Peclet number. **(10 Marks)**

b. Assuming that a man can be represented by a cylinder 30cm in diameter and 1.7m high with a surface temperature of 30°C. Calculate the heat he would lose while standing in a 36 km/h wind at 10°C. **(10 Marks)**

OR

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

b. The radiation shape factor of the circular surfaces of a thin hollow cylinder of 10cm diameter and 10cm length is 0.1716. What is the shape factor of the curved surface of the cylinder with respect to itself? **(10 Marks)**

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