CBCS SCHEME

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15MT72

Seventh Semester B.E. Degree Examination, Aug./Sept.2020
Thermal Engineering

Time: 3 hrs. Max. Marks: 80

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of thermodynamics and heat transfer data books are permitted.***

Module-1

1 a. Define:
(i) State postulate
(ii) Quasi-static process
(iii) Control volume
(iv) Adiabatic wall **(08 Marks)**

b. Explain thermodynamic equilibrium in detail. **(08 Marks)**

OR

2 a. Distinguish between heat and work. **(06 Marks)**

b. Explain: (i) Shaft work (ii) Electrical work **(06 Marks)**

c. Gas from a bottle of compressed helium is used to inflat an inelastic flexible balloon, originally folded completely flat to a volume of 0.5 m^3. If barometer reads 760 mm Hg, what is the amount of work done upon the atmosphere by the balloon? Sketch the system before and after the process. **(04 Marks)**

Module-2

3 a. State the first law of thermodynamics for cyclic process. Show that internal energy is a property of a system with suitable diagram. **(08 Marks)**

b. Explain and illustrate conservation of energy principle to:
(i) Nozzle and diffuser
(ii) Turbine and compressors **(08 Marks)**

OR

4 a. Explain the following: (i) Carnot principle (ii) Concept of heat engine. **(06 Marks)**

b. A reversible engine operates between temperatures T_1 and T ($T_1 > T$). The energy rejected from this engine is received by a second reversible engine at the same temperature T. The second engine rejects energy at temperature T_2 ($T_2 < T$). Show that:
(i) Temperature T is the arithmetic mean of temperature T_1 and T_2 if the engine produces the same amount of work output.
(ii) Temperature T is the geometric mean of temperatures T_1 and T_2 if the engines have the same cycle efficiencies. **(10 Marks)**

Module-3

5 a. Distinguish among Otto, diesel and dual cycles. **(08 Marks)**

b. In an air standard diesel cycle, the compression ratio is 16, and at the beginning of isentropic compression, the temperature is 15°C and the pressure is 0.1 MPa. Heat is added until the temperature at the end of the constant pressure process is 1480°C. Calculate:
(i) The cut-off ratio
(ii) The heat supplied per kg of air
(iii) The cycle efficiency **(08 Marks)**

OR

6 a. Explain basic laws governing different modes of heat transfer. **(10 Marks)**

b. Explain combined heat transfer mechanism in detail. **(06 Marks)**

Module-4

7 a. Explain the concept of thermal contact resistance. **(06 Marks)**

b. Heat is transferred from hot fluid to cold fluid through a slab of thickness 4 cm with K = 20 W/mK. The dimension of the surface perpendicular to the heat transfer is 0.5 m × 2 m. The hot fluid and cold fluid temperature are 150°C and 40°C. The hot side and cold side connective coefficient are 300 W/m^2K and 500 W/m^2K respectively. Calculate:

(i) The rate of heat transfer

(ii) Overall heat transfer coefficient

(iii) The total thermal resistance **(10 Marks)**

OR

8 a. Explain the physical significance of following non-dimensional number:

(i) Grasoff number

(ii) Nussett number

(iii) Prandtl number **(06 Marks)**

b. Water is heated by a 15 cm by 15 cm vertical flat plate, which is maintained at 60°C. Calculate heat transfer rate when the water is at 20°C. **(10 Marks)**

Module-5

9 Using dimensional analysis, show that $N_u = cR_e^a P_r^b$ for forced convection with their usual notations. **(16 Marks)**

OR

10 a. Define the following terms used in radiation heat transfer:

(i) Absorptivity (ii) Black body (iii) White body

(iv) Gray body (v) Diffused reflection (vi) View factor **(06 Marks)**

b. Define:

(i) Kirchoff's law

(ii) Wein's displacement law **(06 Marks)**

c. Two very large parallel plates are maintained at uniform temperatures T_1 = 800 K and T_2 = 500 K and have emissivities $\in_1 = 0.2$ and $\in_2 = 0.7$ respectively. Determine the net rate of radiation heat transfers between the two surfaces per unit surface area of the plates. **(04 Marks)**

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