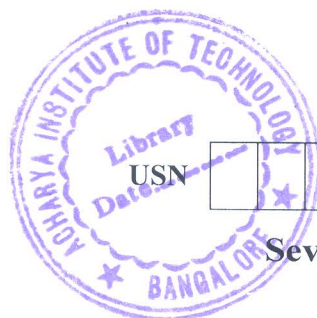


CBCS SCHEME



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
- b. Explain thermodynamic equilibrium in detail.

(08 Marks)

(08 Marks)

OR

- 2 a. Distinguish between heat and work.
- b. Explain: (i) Shaft work (ii) Electrical work
- c. Gas from a bottle of compressed helium is used to inflate 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.

(06 Marks)

(06 Marks)

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

(08 Marks)

(08 Marks)

OR

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

(06 Marks)

(10 Marks)

Module-3

- 5 a. Distinguish among Otto, diesel and dual cycles.
- 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)

(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 $K = 20 \text{ W/mK}$. The dimension of the surface perpendicular to the heat transfer is $0.5 \text{ m} \times 2 \text{ m}$. The hot fluid and cold fluid temperature are 150°C and 40°C . The hot side and cold side connective coefficient are $300 \text{ W/m}^2\text{K}$ and $500 \text{ W/m}^2\text{K}$ 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 $N_u = cR_c^a P_r^b$ 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 $T_1 = 800 \text{ K}$ and $T_2 = 500 \text{ K}$ and have emissivities $\epsilon_1 = 0.2$ and $\epsilon_2 = 0.7$ 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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