CBCS SCHEME

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21MT71

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Thermal Engineering

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of heat transfer data hand book is permitted.

Module-1

1 a. Explain the following:
i) Open system
ii) Closed system
iii) Intensive property
iv) Extensive property
v) Thermodynamic state point
vi) Thermodynamic process. **(12 Marks)**

b. State the Zeroth law of thermodynamics. Explain thermodynamic equilibrium. **(08 Marks)**

OR

2 a. Derive an expression for displacement work of polytropic process with P-V diagram. **(10 Marks)**

b. Explain the following types of work transfer :
i) Electrical work
ii) Shaft work
iii) Flow work. **(10 Marks)**

Module-2

3 a. Apply steady flow energy equation to each of the following, using schematic diagram:
i) Turbine
ii) Heat exchanger. **(10 Marks)**

b. With P-V diagram, explain the first law of thermodynamics under cyclic process. **(10 Marks)**

OR

4 a. State Kelvin Planck's and Classius statement and explain the equivalence of two statement. **(10 Marks)**

b. Define heat engine and heat pump. And also derive an expression for COP of refrigerator and heat pump. **(10 Marks)**

Module-3

5 a. Derive an expression for thermal efficiency of Otto cycle. **(10 Marks)**

b. Compare Otto, Diesel and dual cycles based on:
i) Same compression and same max temperature
ii) Same heat rejection. **(10 Marks)**

OR

6 a. Explain the modes of heat transfer with governing laws and equations. **(10 Marks)**

b. Explain the overall heat transfer coefficient and thermal contact resistance. **(04 Marks)**

c. Explain the three kinds of boundary condition. **(06 Marks)**

Module-4

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

b. Derive the one dimensional heat conduction equation for plane wall, with necessary assumptions. **(10 Marks)**

OR

8 a. Using Buckingham's – II theorem for free convection heat transfer, show that $N_u = C\ R_a^{\ m}$ with usual notations. **(10 Marks)**

b. Define the following:

i) Natural convection

ii) Grashoff number

iii) Drag force

iv) Drag coefficient

v) Prandtl's number. **(10 Marks)**

Module-5

9 a. Using Buckingham's – II theorem for forced convection heat transfer show that $N_u = C(R_e^{\ m}\ P_r^{\ n})$ with usual notations. **(10 Marks)**

b. Describe the physical significance of following:

i) Reynolds number

ii) Nusselt number

iii) Stanton number. **(06 Marks)**

c. Distinguish between forced and free convection heat transfer. **(04 Marks)**

OR

10 a. Illustrate the following:

i) Stefan Boltzman law

ii) Kirchoff's law

iii) Planck's law

iv) Wein's displacement law

v) Radiation shield. **(10 Marks)**

b. Two large parallel plates having emissivities of 0.3 and 0.5 are maintained at temperature of 800°C and 300°C respectively. A radiation shield having an emissivity of 0.05 on both sides is placed between the two plates. Calculate:

i) Heat transfer per unit area without shield.

ii) Find the temperature of the shield and heat transfer per unit area with shield.

(10 Marks)

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