CBCS SCHEME

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21MT71

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2025
Thermal Engineering

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define the following use diagram and equations of necessary.
i) Thermodynamics ii) System iii) Boundary iv) Work v) Energy. **(10 Marks)**

b. State Zeroth law of thermodynamics and explain thermodynamics equilibrium. **(05 Marks)**

c. Explain quasistatic process with neat sketch. **(05 Marks)**

OR

2 a. Explain the following types of work transfer
i) Shaft work ii) Electrical work iii) Stirring work. **(06 Marks)**

b. Derive an expression for displacement work with P.V diagram for the following process.
i) Isobaric process ii) Isochoric process. **(04 Marks)**

c. A spherical ballon has a diameter of 25 cm and contains air at a pressure of 1.5 bar the diameter of the ballon increases to 30 cm due to heating and during this process, the pressure is directly proportional to diameter. Calculate the work done by air. **(10 Marks)**

Module-2

3 a. Explain energy is a property of system. **(10 Marks)**

b. Derive an expression for Steady Flow Energy Equation (SFEE) with suitable assumptions. **(10 Marks)**

OR

4 a. State Kelvin Plank and Claussius statement and explain equations of two statements. **(08 Marks)**

b. Prove that $(COP)_{HP} = 1 + (COP)_{ref}$ **(04 Marks)**

c. Define :
i) Heat pump ii) Refrigerator iii) Thermal efficiency iv) Co-efficient of performance. **(08 Marks)**

Module-3

5 a. Compare Otto, diesel and dual cycles. **(10 Marks)**

b. Explain diesel cycle with P-V and T-S diagram. Derive an expression for its mean effective pressure. **(10 Marks)**

OR

6 a. Define heat transfer and explain different modes of heat transfer. **(10 Marks)**

b. Describe boundary conditions of 1st, 2nd and 3rd kind with figures. **(10 Marks)**

Module-4

7 a. Derive an expression for general of 3–D dimensional conduction equation in Cartesian coordinate. **(10 Marks)**

b. A slab of 40 mm thick (K = 20 W/m°C) is placed between 2 fluids having temperature 120°C and 25°C respectively. If the corresponding heat transfer coefficients are 250 W/m^2°C and 500 W/m^2°C respectively, find the heat flow rate. **(10 Marks)**

OR

8 a. Using Buckingham's π theorem method for natural convection show that $N_u = f(Gr, Pr)$. **(10 Marks)**

b. Explain the following :
   i) Natural convection
   ii) Local heat transfer coefficient
   iii) Grashoff Number
   iv) Drag force
   v) Nusselt Number. **(10 Marks)**

Module-5

9 a. Air at 25°C and atmospheric pressure is flowing over a flate plate at a velocity of 4m/sec. If the plate is 20cm wide and 65°C, calculate the following quantities at a distance of 40 cm from the leading edge.
   i) Thermal boundary layer thickness
   ii) Local shear stress
   iii) Local heat transfer co effective
   iv) Total drag force and heat transfer. **(12 Marks)**

b. Explain the physical signature of
i) Raynolds Number ii) Staton Number iii) Prandtl Number iv) Nusselt number. **(08 Marks)**

OR

10 a. State and explain the following laws with equations
   i) Stefan – Boltzman law
   ii) Planck's law
   iii) Kirchoff's law
   iv) Wein displacement law **(12 Marks)**

b. Define Emissivity. Explain grey body and black body emissivity. **(08 Marks)**

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