

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

Conjugate Heat Transfer

Time: 3 hrs.

Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.**2. Assume missing data suitably.**3. Use of databook is permitted.***Module-1**

- 1 a. What is meant by Fluid domain? What are its key aspects? (10 Marks)
 b. What are different modes of heat transfer? Explain. (10 Marks)

OR

- 2 a. State and explain Body domain in Conjugate heat transfer. (10 Marks)
 b. What are different applications of conjugate heat transfer? (10 Marks)

Module-2

- 3 a. Explain Fourier law of heat conduction. (10 Marks)
 b. A 1 m long, 5 cm diameter cylinder placed in an atmosphere of 40°C is provided with 12 longitudinal straight fins ($K = 75 \text{ W/m-K}$) 0.75 mm thick. The fins protrude 2.5 cm from cylinder surface. The heat transfer co-efficient from the cylinder and fins to the ambient air is $23.3 \text{ W/m}^2\text{-K}$. Calculate
 (i) Rate of heat transfer if the surface temperature of cylinder is 150°C
 (ii) The temperature at the center of the fin. (10 Marks)

OR

- 4 a. What is meant by Fin effectiveness and fin efficiency? Derive them for long insulated tip fin. (10 Marks)
 b. A very thin glass walled 0.3 cm diameter mercury thermometer is placed in a stream of air where heat transfer coefficient is $57 \text{ W/m}^2\text{K}$ for measuring unsteady temperature of air. Consider cylindrical thermometer bulb to consist of mercury only for which $K = 8.9 \text{ W/m-K}$ and $\alpha = 0.0166 \text{ m}^2/\text{hr}$. Calculate the time required for the temperature change to reach half its final value. (10 Marks)

Module-3

- 5 a. What is multiphase flow and multiphase heat transfer? What is phase change heat transfer? Explain. (10 Marks)
 b. Explain (i) Free convection (ii) Forced convection. (10 Marks)

OR

- 6 a. Write down the empirical relations for forced convection, for flow through pipes. (10 Marks)
 b. The water is heated in a tank by dipping a plate ($30\text{cm} \times 30\text{cm}$) size. The temperature of plate surface is maintained at 140°C . Assuming the temperature of surrounding water is 20°C . Find out heat lost from the plate per hour. (10 Marks)

Module-4

- 7 a. What is thermal boundary layer for flow through pipe? How Turbulent boundary layers improves convective heat transfer? Explain. (10 Marks)
- b. State and explain,
- (i) Planck's Distribution law.
 - (ii) Weins displacement law.
 - (iii) Stefan-Boltzmann law. (10 Marks)

OR

- 8 a. Obtain the expression for LMTD for,
- (i) Parallel flow heat exchanger (10 Marks)
 - (ii) Counter flow heat exchanger. (10 Marks)
- b. How heat exchangers are classified? Explain. (10 Marks)

Module-5

- 9 a. What is Factor of conjugation? Explain. (10 Marks)
- b. State and Explain Harmonic law of oscillation. (10 Marks)

OR

- 10 a. Differentiate between, (i) Filmwise condensation (ii) Dropwise condensation (10 Marks)
- b. Explain : (i) Nucleate boiling (ii) Film boiling (10 Marks)
