



CBCS SCHEME

21AE/AS71

Seventh Semester B.E./B.Tech. Degree Examination, June/July 2026 Conjugate Heat Transfer

Time: 3 hrs.

Max. Marks: 100

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

Module-1

- 1 a. Describe conjugate problem and computational domains with neat sketch. (10 Marks)
- b. Explain any two conjugate heat transfer problem in engineering. (10 Marks)

OR

- 2 a. Illustrate the boundary conditions of a 2D thermal problem and explain the problem statement. (10 Marks)
- b. Explain the heat transfer by solids and fluids interaction with neat sketch and one example. (10 Marks)

Module-2

- 3 a. Derive the expression for the heat conduction in differential form. (10 Marks)
- b. A steel tube of 50 mm interior data and 80 mm outer dia is covered by 30 mm thick of asbestos. The thermal conductivity of steel and asbestos are 45 W/mK, 0.2 W/mK, the tube receives heat from hot gases at 400°C with heat transfer co-efficient of 15 W/m²K. Determine :
 - i) Heat loss per unit length
 - ii) Interface temperature and surface temperature. (10 Marks)

OR

- 4 a. Explain the thermal systems with negligible internal resistance with neat sketch. (10 Marks)
- b. In a quenching process, a copper plate of 3 mm thick is heated upto 350°C and then suddenly, it is dropped into a water bath at 25°C. Calculate the time required for the plate to reach the temperature of 50°C. The heat transfer co-efficient on the surface of the plate is 28 W/m²K. The plate dimensions taken as length 40 cm and width 30 cm. Also calculate the time required for infinite long plate to cool to 50°C. Other parameters remain same. Take properties of copper as $c = 380 \text{ J/kg.K}$, density $\rho = 8800 \text{ kg/m}^3$, $k = 385 \text{ W/m.K}$. (10 Marks)

Module-3

- 5 a. Describe the sequence of steps in subsonic analysis in heat transfer. (10 Marks)
- b. Explain about multiphase fluid flow analysis and illustrate the problem with one example. (10 Marks)

OR

- 6 a. A flat plate 1m wide and 1m long is placed in a wind tunnel. The temperature and velocity of the air are 10°C and 80 m/s respectively. The flow over the whole length of the plate is made turbulent with the help of turbulizing grid placed upstream of the plate. Determine the thickness of the boundary layer at the trailing edge of the plate. Also calculate the mean value of the heat transfer coefficient from the surface of the plate. (10 Marks)
- b. An airstream at 0°C is flowing along a heated plate at 90°C at a speed of 75 m/s. The plate is 45 cm long and 60 cm wide. Assuming the transition of boundary layer to take place at $Re = 5 \times 10^5$. Calculate the average values of friction co-efficient and heat transfer for the full length of the plate. Hence calculate rate of energy dissipation from the plate. (10 Marks)

Module-4

- 7 a. Describe about boundary layer and its classifications with neat sketch. (10 Marks)
- b. Explain Stefan Boltzmann law and the concept of total emissive power of a surface. (10 Marks)

OR

- 8 a. Assuming the sun (diameter = $1.4 \times 10^9\text{m}$) as a black body having a surface temperature of 5750 K and at a mean distance of $15 \times 10^{10}\text{m}$ from the earth (diameter = $12.8 \times 10^6\text{m}$), estimate the following :
- The total energy emitted by the sun
 - The emission received by the earth if no radiation is blocked by the atmosphere of the earth.
 - The emission received per m^2 just outside the atmosphere of the earth. (10 Marks)
- b. Describe in detail about the various types of heat exchangers with neat sketch. (10 Marks)

Module-5

- 9 a. Derive the basic equations for steady one dimensional conduction. (10 Marks)
- b. Describe in detail about the harmonic law of oscillation. (10 Marks)

OR

- 10 a. Explain the algorithm of computing the conjugate heat transfer problem with one example. (10 Marks)
- b. Describe about turbulent heat transfer in engineering applications. (10 Marks)

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