

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-IV • EXAMINATION – WINTER 2013****Subject Code: 142101****Date: 19-12-2013****Subject Name: Transport Phenomenon in Materials Processing****Time: 02:30 pm to 05:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Derive differential mass transfer equation in rectangular co-ordinates. **07**
(b) State Fourier's Law of heat conduction. Define its terms and derive equation to determine thermal conductivity of hollow sphere. **07**

- Q.2** (a) What is fluid? Discuss different fluid properties and classify fluids. **07**
(b) Get Euler's equation from Navier stoke's equation and derive Bernoulli's equation from it. **07**

OR

- (b) Derive general equation of mass diffusion in stationary media. **07**

- Q.3** (a) Explain following terms: **07**
i) Mass Density ii) Molar concentration iii) Mass Fraction iv) Mole Fraction
(b) What are different modes of heat transfer? Differentiate between them. **07**

OR

- Q.3** (a) A furnace wall is made up of M.S. plate of thickness 12 mm and $k=12\text{ W/m-K}$. Inside gas is at 900°C while outside air is at 30°C . the inside and outside heat transfer co-efficient are $100\text{ W/m}^2\text{ K}$ and $20\text{ W/m}^2\text{ K}$ respectively. The wall is to be insulated using refractory brick lining having $k\ 1.2\text{ W/m-K}$. Determine the thickness of insulation required so that the outer surface of insulation will be at 80°C . **07**
(b) A fluid having specific gravity of 0.7 is flowing through a pipe of diameter 50 cm and length 6 m, pressure difference of 60 N/m^2 and dynamic viscosity 0.14 N sec/ m^2 , calculate density, specific weight, specific volume, weight and calculate volumetric flow rate. **07**

- Q.4** (a) What is dimensionless analysis? Discuss its requirements and physical significance of Nusselt Number, Prandtl Number, Reynolds Number. **07**
(b) Derive equation for viscosity measurement by stokes' method. **07**

OR

- Q.4** (a) Binary mixture of oxygen and nitrogen have partial pressure of 0.21 and 0.79 is at 27°C at mixture pressure of $1 \times 10^5\text{ N/m}^2$. Calculate molar concentration, mass concentration, molar fraction and mass fraction for each. ($C_i = p_i/RT$, $R = 8314\text{ Nm/ kg-mol-K}$) **07**
(b) Radiation strikes an object with transmissivity of 0.03 and reflectivity of 0.5, the absorbed flux is indirectly measured as 94 W/m^2 . Calculate incident flux. **07**

- Q.5** (a) In terms of radiation explain absorptivity, reflectivity, transmissivity, emissive power, emissivity, planck's distribution law and gray surface. **07**
(b) State Newton's second law of motion and derive equation of motion. **07**

OR

- Q.5** (a) Air at 30 °C moving at 0.3 m/sec is flowing around a sphere which is at 124 °C having 60 mm diameter, calculate the convective heat transfer rate by Newton's Law of cooling. $Nu = 0.37 Re^{0.6}$ for air at 77 °C $\nu = 2.08 \times 10^{-5} \text{ m}^2/\text{sec}$, $k = 0.031 \text{ W/m K}$, $Pr = 0.697$ **07**
- (b) Discuss the different types of fluid flows. **07**
