GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–IV • EXAMINATION – SUMMER • 2014

Subject Code: 142101   **Date: 16-06-2014**
Subject Name: Transport Phenomenon in Materials Processing
Time: 10:30 am - 01:00 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)** What is heat transfer? Write types of heat transfer. Why study of heat transfer is useful in metallurgical processes? **07**

(b) What do you mean by mass transfer? Explain different modes of mass transfer **07**

Q.2 **(a)** What is Fourier law of heat conduction? Derive one dimensional heat conduction equation through a large plane wall **07**

(b) Define fluid and viscosity. State Newton's law of viscosity, explain dynamic and kinematic viscosity and classify fluids **07**

OR

(b) Derive Bernoulli's equation by using Euler's equation **07**

Q.3 **(a)** Derive continuity equation for overall mass balance **07**
(b) Derive Euler's Stokes equation. **07**

OR

Q.3 **(a)** Explain steady state heat conduction through composite walls **07**
(b) A special thermo-box is made of 20 mm thick Stainless Steel plate (K = 60 W/mK), insulated with 20 mm thick asbestos layer (K= 0.1 W/mK). If the inner wall of the plate is exposed to hot gas at 525°C with a heat transfer coefficient of 100 W / m^2 K and the outer surface of the asbestos is in contact with cool air at 25 °C with a heat transfer coefficient of 25 W / m^2 K, calculate **07**
  (i) The heat flux across the layer
  (ii) The interfacial temperature between layers.

Q.4 **(a)** What do you mean by convective heat transfer? Explain mechanism of convective heat transfer **07**

(b) Air stream at 30 °C moving at 0.3 m/s flows across a 100 W electric bulb, glowing at 124 °C. If the bulb is approximated by a 60 mm diameter sphere, calculate the heat transfer rate by convection. Use Nu = 0.37 Re$^{0.6}$
For air at 77°C , $v = 2.08 \times 10^{-5}$ m^2 / s, K = 0.031 W/mK, Pr = 0.697 **07**

OR

Q.4 **(a)** Define heat transfer by radiation. Explain Absorptivity, Reflectivity and Transmissivity **07**
(b) Explain Plank's Law, Kirchoff's and Stefan Boltzman Law. **07**

Q.5 **(a)** What is newton's law of cooling ? Give correlations of dimensionless numbers which play important role in natural & forced convections **07**
(b) Derive equation for viscosity measurement by stokes' method. **07**

OR

Q.5 **(a)** Discuss Black body radiation & lambert's law **07**
(b) Find out the heat transfer rate per unit area due to radiation between two infinitely long parallel planes. The first plane has an emissivity = 0.4 and I is maintained at 200°C. the emissivity of second plane is 0.2 and it is maintained at 30°C. Take $\sigma = 5.67 \times 10^{-8}$ **07**

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