

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER– IV (New) EXAMINATION – WINTER 2019****Subject Code: 2142105****Date: 12/12/2019****Subject Name: Heat and Mass Transfer in Metallurgy****Time: 10:30 AM TO 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) Define and classify fluids. **03**
 (b) Explain Fick's first law of diffusion and derive unit for diffusivity. **04**
 (c) Derive differential equation of momentum balance (Equation of motion) in rectangular coordinate system. **07**
- Q.2** (a) Explain mass concentration, molar concentration, mass fraction & molar fraction. **03**
 (b) Derive differential mass balance (Continuity Equation). **04**
 (c) Derive differential equation for heat conduction in rectangular coordinate system. **07**
- OR**
- (c) What are different type of fluid flows? Explain them. **07**
- Q.3** (a) If max. velocity of fluid flowing through pipe of diameter 20cm is 5m/sec & shear stress required to create flow is 20 N/m². Calculate dynamic viscosity of fluid. Consider velocity of fluid at wall is zero. **03**
 (b) State Fourier law of heat conduction and derive units of thermal conductivity (k). **04**
 (c) Derive Hagen-Poiseuille Equation for fluid flowing through pipe. **07**
- OR**
- Q.3** (a) Calculate discharge of fluid flowing through pipe of 20 cm radius and 5 m/sec velocity. **03**
 (b) For temperature difference of 200 °C for refractory thickness of 400 mm having thermal conductivity of 0.2 W/mK. Calculate heat flux. **04**
 (c) What is convective heat transfer? Discuss different modes of convective heat transfer. **07**
- Q.4** (a) Determine temperature inside of furnace refractory wall of thickness 2000 mm having k= 0.15W/mK if outside temperature is 75 °C for heat flux of 100 W/m². **03**
 (b) Explain lambert's law for radiative heat transfer. **04**
 (c) From Euler's equation, derive Bernoulli's equation by integration. **07**
- OR**
- Q.4** (a) What is mass transfer? Briefly explain different modes of mass transfer. **03**
 (b) State Newton's law of cooling and derive unit for coefficient of convective heat transfer (h). **04**
 (c) Write note on Kirkindall effect. **07**
- Q.5** (a) For convective heat transfer condition if heat flux of 1500 W/m² and temperature difference of 30 °C. Calculate co-efficient of convective heat transfer (h). **03**
 (b) A sphere of diameter 10 mm and emissivity 0.9 is maintained at 80 °C inside oven with wall temperature of 400 °C. Calculate net heat transfer rate from oven wall to object. **04**
 (c) What is emissive power, emissivity, black body, white body and gray body? **07**
- OR**
- Q.5** (a) Briefly explain pseudo steady diffusion. **03**
 (b) What is radiative heat transfer? How it is different than conductive & convective heat transfer? **04**
 (c) State and explain plank's law, wein's law, **07**
