

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI • EXAMINATION – SUMMER • 2014****Subject Code: 163503****Date: 23-05-2014****Subject Name: Fluid Flow & Heat Transfer****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) i) Explain Newtonian and Non-Newtonian fluids with their corresponding stress strain curves and examples? **04**
ii) Convert intensity of pressure of 4 MPa into equivalent pressure head of oil of specific gravity 0.82 **03**
(b) i) Write any three dimensionless numbers used in heat transfer studies with their physical significance. **03**
ii) Water is flowing through a tube of 5 mm diameter at a velocity of 0.2m/sec. Predict the kind flow pattern existing in the tube and estimate the transition length of the tube. **04**
- Q.2** (a) Derive an expression for shear stress distribution for flow of an incompressible steady state fluid in steady flow in a cylindrical tube. Also give the relation between skin friction and wall shear **07**
(b) A body weighs 8000N in air and 6000N in water. Find its volume and specific gravity **07**
- OR**
- (b) Calculate the dynamic viscosity of an oil which is used for lubrication between a square plate of size 700mm × 700 mm sliding in an inclined plane which is fixed at an angle of 25° with horizontal. The weight of the square plate is 250 N and if it slides down the plane with a velocity of 0.35 m/s and thickness of the oil film is 1.4mm **07**
- Q.3** (a) With a neat sketch explain the main parts, construction and working principle of Centrifugal pump **07**
(b) A venturimeter having an inlet diameter of 200mm and throat diameter 120mm is installed in a pipe line carrying water. If the differential manometers installed shows a reading of 200 mm. Find the discharge through the pipe in liters/sec. Take coefficient of discharge for venturimeter as 0.98 **07**
- OR**
- Q.3** (a) A pipe of 300 mm diameter carries an oil of specific gravity 0.85 at a rate of 140 litres/sec and under a pressure of 4 kPa. Find the total energy per unit weight at a point which is 4m above the datum line. Find also the total energies per unit mass and unit volume. **07**
(b) Detail the various kinds of impellers used in process industries with kind of flow patterns produced in them during agitation. **07**
- Q.4** (a) Write about i) drag coefficient ii) Cavitation iii) NPSH **07**
iv) Stagnation point v) Stream line vi) Form drag vii) Re-dispersion point
vii) Re-dispersion point
(b) An oil of density 1500 kg/m³ and viscosity 2.5 cp is pumped from a storage tank to the top of a column at a rate of 1000 kg/min through a pipe of diameter 10 cm and length 50m. Calculate the pumping power required to maintain flow rate. **07**

OR

- Q.4 (a)** Explain the concept of “Fluidization” with various types involved and its application in industry. **07**
- (b)** A disk turbine with six flat blades is installed centrally in a vertical baffled tank of 2 m in diameter. The turbine is 0.67m in diameter and positioned 0.67m above the bottom of the tank. The turbine blades are 134 mm wide. The tank is filled to a depth of 2 m with an aqueous solution of 50% NaOH at 65 °C which has a viscosity of 12 cp and a density of 1,500 kg/m³. The turbine impeller turns at 90r/min. What will be the power required? (Take value of $K_T = 5.8$) **07**
- Q.5 (a)** i) What is velocity boundary layer and thermal boundary layer? How can you relate both of them? **03**
- ii) A hollow cylinder of having inside and outside radius r_i and r_o of length L have their inner and outer surfaces maintained at T_i and T_o . Develop an expression for radial heat flow and temperature distribution across the hollow cylinder. **04**
- (b)** A shell and tube heat exchanger is used to heat water at the rate of 0.8 kg/sec from $T_i = 30^\circ\text{C}$ to $T_o = 80^\circ\text{C}$ with hot oil entering at 120°C and leaving at 85°C . The overall heat transfer coefficient is $125 \text{ W}/(\text{m}^2 \text{ }^\circ\text{C})$. Calculate the heat transfer area required in (i) counter flow arrangement (ii) parallel flow arrangement. **07**

OR

- Q.5 (a)** What is pool boiling? Explain various regimes involved in pool boiling with the sketch of boiling curve. **07**
- (b)** A single effect evaporator is required to concentrate a solution from 10% solids to 30% solids at the rate of 250 kg of feed per hour. If the pressure in the evaporator is 77 kPa absolute, and if steam is available at 200 kPa gauge, calculate the quantity of steam required per hour and the area of heat transfer surface if the overall heat transfer coefficient is $1700 \text{ J m}^{-2} \text{ s}^{-1} \text{ }^\circ\text{C}^{-1}$. Assume that the temperature of the feed is 18°C and that the boiling point of the solution under the pressure of 77 kPa absolute is 91°C . The specific heat of the solution is the same as for water, that is $4.186 \times 10^3 \text{ J kg}^{-1} \text{ }^\circ\text{C}^{-1}$, and the latent heat of vaporization of the solution is the same as that for water under the same conditions. **07**
- From steam tables, the condensing temperature of steam at 200 kPa (gauge)[300 kPa absolute] is 134°C and latent heat 2164 kJ kg^{-1} ; the condensing temperature at 77 kPa (abs.) is 91°C and latent heat is 2281 kJ kg^{-1} .
