

GUJARAT TECHNOLOGICAL UNIVERSITY
B. E. - SEMESTER – IV • EXAMINATION – WINTER 2012

Subject code: 140403**Date: 29/12/2012****Subject Name: Principles of process Engineering-I****Time: 02.30 pm - 05.00 pm****Total Marks: 70****Instructions:**

1. Attempt any five questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Notations used have their conventional meanings.

- Q.1** (a) Differentiate between Conduction, convection and radiation with examples, mechanisms and laws of each in detail. **07**
- (b) Derive the equation for heat transfer rate per unit length of composite cylinder of three different materials using Fourier's law for heat conduction. **07**

- Q.2** (a) State different types of manometers used for measurement of pressure Difference. Describe differential manometer with neat sketch in detail. **07**
- (b) A small capillary with inside diameter of 2.22×10^{-3} m and a length 0.317 m is being used to continuously measure the flow rate of a liquid having a Density of 875 kg/m^3 and viscosity of $1.13 \times 10^{-3} \text{ Pa-s}$. The pressure drop reading across the capillary during laminar flow is 0.0655 m water (density 996 kg/m^3). What is flow rate if end effects are neglected? **07**

OR

- (b) Discuss boundary layer formation and separation in detail. **07**
- Q.3** (a) Explain the construction and working of Shell and Tube heat exchanger with neat sketch. **07**
- (b) Define NPSH and state its importance. **04**
- (c) Define the terms: i) Manometric Head ii) Suction Head iii) Manometric Efficiency **03**

OR

- Q.3** (a) Classify different types of pumps. Also, explain Centrifugal pump with neat sketch in detail. **07**
- (b) A three stage centrifugal pump has impeller diameter 40 cm and 2 cm wide at outlet. The vanes are curved back at outlet at 45 degree and reduce the Circumferential area by 10%. The manometric efficiency is 90% and the overall efficiency is 80%. Determine the head generated by the pump when running at 1000 rpm delivering 50 liters per second what should be the shaft horse power? **07**

- Q.4** (a) Write a detail note on Double pipe heat exchanger with neat sketch. **07**
- (b) What are the different methods of dimensional analysis? Explain Rayleigh method of dimensional analysis in detail. **07**

OR

- Q.4** (a) Derive Hagen-Poiseuille equation for laminar flow of Newtonian fluids through pipes. **07**
- (b) Explain the concept of critical thickness of insulation and derive the expression for critical radius in case of pipes. **07**

- Q.5** (a) Discuss different theories explaining the mechanism of thermal radiation. **05**
(b) Define the terms: i) Potential flow ii) Viscosity. **02**
(c) An oil pipeline $d_i / d_o = 44 / 51$ mm in the diameter is covered with a layer of concrete, 80 mm thick. The thermal conductivity of pipe-line material is $43 \text{ kcal/hr-m}^{-1} \text{ } ^\circ\text{C}$ and that of concrete is $1.1 \text{ kcal/hr-m}^{-1} \text{ } ^\circ\text{C}$. The mean temperature of oil is 120°C and the ambient air temperature 25°C . The local coefficient of heat transfer from oil to the wall is $86 \text{ kcal/hr-m}^2 \text{ } ^\circ\text{C}$ and that from the concrete surface to the air is $8.6 \text{ kcal/hr-m}^2 \text{ } ^\circ\text{C}$. Calculate the loss of heat from length of 1 meter of a bare pipeline and from the same length of the pipeline covered with concrete. **07**

OR

- Q.5** (a) State different laws of black body radiation and derive the expression of Wein's displacement law using Planck's law. **08**
(b) What is rheology of fluids? Explain Newtonian and non-newtonian fluids with relevant graphs and model equations. **06**
