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

Subj Subi	ect (	code: 140403 Date: 29/12/2012 Name: Principles of process Engineering-I	
Time	e: 02	2.30 pm - 05.00 pm Total Marks: 70	
Insti	cuct	ions:	
	1. 2.	Attempt any five questions. Make suitable assumptions wherever necessary.	
	3. 4.	Figures to the right indicate full marks. 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 x $10^{-3}$ m and a length 0.317 m	07
		is being used to continuously measure the flow rate of a liquid having a Density of 875 kg/m <sup>3</sup> and viscosity of $1.13 \times 10^{-3}$ Pa- s. The pressure drop reading across the capillary during laminar flow is 0.0655 m water (density 996 kg/m <sup>3</sup> ). What is flow rate if end effects are neglected?	
	( <b>b</b> )	<b>UR</b> Discuss boundary layor formation and constantion in datail	07
	(0)	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
0.2	(a)	<b>UR</b> Classify different types of pumps Also explain Contrifugal pump with	07
Q.3	(a)	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) (b)	Write a detail note on Double pipe heat exchanger with neat sketch. What are the different methods of dimensional analysis? Explain Rayleigh method of dimensional analysis in detail.	07 07
Q.4	(a)	Derive Hagen-Poiseuille equation for laminar flow of Newtonian fluids through pipes.	07

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- Q.5 (a) Discuss different theories explaining the mechanism of thermal radiation. 05
  - (b) Define the terms: i) Potential flow ii) Viscosity.
  - (c) An oil pipeline  $d_i / d_o = 44 / 51$  mm in the diameter is covered with a layer 07 of concrete, 80 mm thick. The thermal conductivity of pipe-line material is 43kcal/hr-m-° C and that of concrete is 1.1 kcal/hr-m-°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 kcal/hr-m<sup>2</sup>-°C and that from the concrete surface to the air is 8.6 kcal/hr-m<sup>2</sup>-°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.

## OR

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

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