Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER VI– • EXAMINATION – SUMMER 2015

Subject Code: 163503 Date: 08/05/2015

Subject Name: Fluid Flow & Heat Transfer

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)**	i)	Explain Newton's law of viscosity with stress strain relationship for Non-Newtonian fluids?	**04**
		ii)	Determine the vacuum pressure in meter of water when the absolute pressure is 0.5434 bar. Assume atmospheric pressure of water as 10.33 meter of water	**03**
	(b)	i)	What is significance of Critical and Economic thickness of Insulation?	**04**
		ii)	Hot air at 150 °C flows over a flat plate maintained at 50 °C. If the forced convection heat transfer coefficient is 75 W/(m^2 °C). Calculate the heat transfer rate into the plate through an area of 2 m^2.	**03**
Q.2	**(a)**		Derive Hagen Poiseuilli's equation for the laminar flow of an incompressible fluid through a pipe.	**07**
	(b)		Find the density of a metallic body which floats at the interface of mercury of specific gravity 13.6 and water such that 40% of its volume is submerged in mercury and 60% in water.	**07**
			OR	
	(b)		Explain the following terms	
		i)	Steady and Unsteady flow	**02**
		ii)	Uniform and non-uniform flow	**02**
		iii)	Laminar and turbulent flow	**02**
		iv)	Compressible and Incompressible flow	**01**
Q .3	**(a)**		With the help of a suitable diagram explain the various head in a centrifugal pump.	**07**
	(b)		A venturimeter having an inlet diameter of 20cm and throat diameter 10cm is used to measure flow of oil of specific gravity 0.8. The discharge of oil through venturimeter is 60 litre/sec. Find the reading of oil mercury differential manometer. Take C_d = 0.98	**07**
			OR	
Q.3	**(a)**		A pipeline carrying oil of specific gravity 0.8 changes in diameter from 300 mm at a position A to 500 mm diameter at position B, which is 5 m at a higher level. If the pressures at A and B are 200 kPa and 152 kPa respectively and the discharge is 150 liters /sec. Determine the loss of head and direction of flow.	**07**
	(b)		Explain	**07**
		i)	Flow pattern in agitated vessels	
		ii)	Prevention of Swirling	
		iii)	Draft tubes	
Q.4	**(a)**		Define i) Drag ii) Cavitation iii) NPSH iv) Terminal Settling velocity v) Surface Tension vi) Wall drag vii) Transition length	**07**

(b) Determine the head lost due to friction for the flow of water through a pipe of 30 cm diameter and 60m long. The volumetric flow rate of water is 0.15 m^3/s. Density of water is 1000 kg/m^3 and viscosity of water is 1cp. **07**

OR

Q.4 **(a)** What is minimum fluidization velocity? Explain various types of fluidization practiced in industries with relevant applications? **07**

(b) A fermentation broth with a viscosity 10^{-2} Pa s and density 1000 kg/m^3 is agitated in a $50m^3$ baffled tank using a marine propeller 1.3m in diameter. Calculate the power required for a stirring speed of $4s^{-1}$. Assume the value of N_p as 0.35 at the corresponding Reynolds number. **07**

Q.5 **(a)** i) What do you mean by Boundary Conditions? Explain various boundary conditions used in the analysis of heat transfer studies. **04**

ii) Prove that average heat transfer area in the case of hollow sphere of inner and outer radius r_i and r_o is the geometric mean of inner and outer radius. **03**

(b) A heat exchanger is designed to cool 8.7 kg/s of ethyl alcohol solution (C_p = 3840 J/kg °C from 75 °C to 45 °C with cooling water entering the tube side at temperature of 15 °C at a rate of 9.6 kg/s If the overall heat transfer coefficient based on the outer tube surface is 500 W/m^2 °C. Calculate the heat transfer area required for (i) counter flow arrangement (ii) parallel flow arrangement.

OR

Q.5 **(a)** i) Explain Leidenfrost Phenomenon and mention its relationship with pool boiling. **04**

ii) Explain the various flow regimes for forced convection boiling of liquid in a vertical tube. **03**

(b) An evaporator operating at atmospheric pressure is used to concentrate a feed from 5% solute to 20% solute by weight at a rate of 5000kg/h. Dry saturated steam at a pressure corresponding tom saturation temperature of 399 K is used. The feed is at 298 K and the boiling point rise is 5 K. The overall heat transfer coefficient is 2350 W/m^2 K. Calculate the economy of the evaporator and the area of heat transfer to be provided. **07**

Data: Latent heat of condensation of steam at 399 K = 2185 kJ/kg

Latent heat of vaporization of water at 101.325 kPa and 373 K = 2257 kJ/kg

Specific heat of the feed = 4.187 kJ/kg K

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