Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-III Regular / Remedial Examination December 2010

Subject code: 131403
Subject Name: FOOD ENGINEERING TRANSPORT PHENOMENON

Date: 15 /12 /2010 **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)** Describe the following properties of fluids in detail: **08**
Vapour pressure, viscosity, surface tension, capillary.

(b) The space between two square parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5mm. The upper plate, which moves at 2.5 meter per sec requires a force of 98.1N to maintain the speed. **06**

Determine:

1) The dynamic viscosity of the oil in poise and

2) The kinematic viscosity of the oil if the specific gravity of the oil is 0.95.

Q.2 **(a)** Derive an expression to state the Hydrostatic law for fluids and define pressure head. **03**

(b) Calculate the pressure due to a column of 0.3m of **04**

a) water
b) an oil of specific gravity 0.8
c) mercury specific gravity 13.6

Take density of water, $\rho=1000 kg/m^3$

(c) A U-tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, If the difference in level of mercury in the limbs of u-tube is 10cm and the free surface of mercury is in the level with centre of the pipe. Give a sketch of the arrangement. **07**

OR

(c) Derive equations for total pressure force and centre of pressure for a vertical plane surface immersed in liquid. **07**

Q.3 **(a)** Define buoyancy, meta centre and the necessary condition for stability for a floating object in fluid. **04**

(b) Derive the Euler's equation of motion of fluid flow, Explain how Bernoulli's equation is derived form Eulers' equation **05**

(c) Water is flowing through a pipe of 5cm diameter under a pressure of $29.43 N/cm^2$ and with mean velocity of 2.0m/s. Find total head or total energy per unit weight of the water at the cross section using Euler's equation, which is 5m above the datum line. **05**

OR

Q.3	**(a)**	Derive an expression for C_d, the co-efficient for a venturi meter used in horizontal pipes through which fluid is flowing.	**05**
	(b)	Write a short note on momentum equations and how it is used in pipes with bends. How moment of momentum is determined?	**04**
	(c)	Describe about Notches and weirs. Derive an expression for a rectangular weir for the equation for flow rate.	**05**
Q.4	**(a)**	An Orifice meter diameter 10cm is inserted in a pipe of 20cm diameter. The pressure gauges fitted upstream and down stream of the orifice meter gives readings of 19.62N/cm^2 and 9.81 N/cm^2. Co-efficient of discharge for the meter is given as 0.6. Find the discharge of water through the pipe.	**04**
	(b)	Differentiate between orifices and mouth pieces used in flow systems How Coffs. of discharge C_d is determined in case of a mouth piece?	**05**
	(c)	State Buckingham 's π Theorem.	**05**
		OR	
Q.4	**(a)**	The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the air craft l, velocity V, air viscosity μ, air density and bulk modulus of air K. Express the functional relationship between these variables and resisting force.	**05**
	(b)	Derive an expression for drop of pressure for a given length of pipe, Hagen Poiseuille formula.	**05**
	(c)	Explain the turbulent flow through a pipe using a using Reynolds's experiment.	**04**
Q.5	**(a)**	A oil of viscosity 0.1Ns/m^2 and relative density 0.9 is flowing through a horizontal circular pipe of diameter 50mm and a length of 300m. The rate of flow of fluid through the pipe is 3.55m/sec. Find the pressure drop in a length of 300m and also the shear stress at the pipe wall.	**05**
	(b)	Explain the drag force on a flat plate due to boundary layer and derive an expression Von Karman momentum integral equation for boundary layer.	**05**
	(c)	Describe the forces exerted on a stationary body immersed in flowing fluid.	**04**
		OR	
Q.5	**(a)**	Write in detail the loss of head caused by friction in pipes with flowing liquids. Derive an expression for loss of head due to friction in pipes.	**04**
	(b)	For turbulent flow in a pipe of diameter 300mm, find the discharge when the centre line velocity is 2.0 m/s and the velocity at a point 100mm from the centre as measured as by Pitot- tube is 1.5m/s.	**05**
	(c)	Write a short note on of Diffusivity Theory and Fick's law.	**05**

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