Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-III Examination-Dec.-2011

Subject code: 131403 **Date: 15/12/2011**

Subject Name: Food Engineering Transport Phenomenon

Time: 2.30 pm -5.00 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)**	Define following term: Fluid density; Specific weight; Specific volume; Specific gravity; Vapour pressure; Surface tension; Kinematic viscosity	**07**
	(b)	An open tank contains water up to depth of 2 m and above it an oil of specific gravity 0.9 for a depth of 1 m. Find the pressure intensity (i) At the interface of the two liquids. (ii) At the bottom of the tank.	**04**
	(c)	Calculate the capillary fall in a glass tube of 2.5 mm diameter when immersed vertically in mercury. σ for mercury = 0.52 N/m in contact with air. The specific gravity of mercury is given as 13.6 and angle of contact $=130^0$.	**03**
Q.2	**(a)**	Derive the hydrostatic law for determination of pressure variation in a fluid at rest. Calculate the pressure due to a column of 0.3 m of (a) water (b) an oil of specific gravity 0.8 & (c) mercury of specific gravity 13.6. Take density of water (ρ) = 1000 kg/m^3.	**07**
	(b)	What is the difference between U tube differential manometers and inverted U tube manometers? The right limb of a simple U tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of liquid in the pipe if the difference of mercury level in the two limbs is 20 cm.	**07**
		OR	
	(b)	Develop the equation of pressure difference in U tube differential manometer. A pipe contains an oil of specific gravity 0.9. A differential manometer connected at the two points A & B shows a difference in mercury level as 15 cm. Find the difference of pressure at the two points.	**07**
Q.3	**(a)**	Define of Buoyant force; Centre buoyancy Find the volume of water displaced and position of centre of buoyancy for a wooden block of width 2.5 m and of depth 1.5 m, when it floats horizontally in water. The density of wooden block is 650 kg/m^3 and its length 6 m.	**06**
	(b)	What are Stable equilibrium; Unstable equilibrium & Neutral equilibrium for submerged bodies?	**03**
	(c)	Derive expression for the discharge through orifice meter.	**05**
		OR	

Q.3 **(a)** Derive Euler's equation of motion & derive Bernoulli's equation from it. Write assumptions of Bernoulli's equation. **07**

(b) Derive expression of velocity for flow of fluid through an external cylindrical mouthpiece. **07**

Q.4 **(a)** A fluid of density ρ, viscosity μ flows at an average velocity ν through a circular pipe of diameter D. Show by dimensional analysis that shear stress at pipe wall is given as **05**

$$\tau_o = \rho v^2 \phi \left[\frac{\rho v D}{\mu} \right]$$ (Use Buckingham π Theorem)

(b) What is model & prototype? What are the advantages of dimensional and model analysis? **05**

(c) Give significance of Reynold's Number; Froude's Number; Euler's Number and Weber Number **04**

OR

Q.4 **(a)** A pipe of diameter 1.5 m is required to transport an oil of specific gravity 0.9 and viscosity 0.03 poise at the rate of 3000 lit/s. Test were conducted on a 15 cm diameter pipe using water at 20 ^{0}C. Find the velocity and rate of flow in model. Viscosity of water at 0^0C = 0.01 poise. **05**

(b) Prove that $V = \sqrt{2.g.H}$ is dimensionally homogeneous equation. Derive an expression for time period (t) for a pendulum which depends on length (L) & gravity acceleration (g). **05**

(c) Describe Reynold's experiment to determine types of flow. **04**

Q.5 **(a)** Show that ratio of maximum velocity (U_{max}) to average velocity of liquid for circular pipe for incompressible one dimensional laminar flow is 2**.** **05**

(b) A fluid of viscosity 0.7 N.s/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at pipe wall is given as 196.2 N/m^2. Find **05**

(i) The pressure gradient
(ii) The average velocity
(iii) Reynold Number of the flow

(c) Define Laminar boundary layer & Turbulent boundary layer. **04**

OR

Q.5 **(a)** Develop equation of velocity distribution for viscous flow. **06**

(b) Determine the wall shearing stress in a pipe of diameter 100 mm which carries water. The velocities at the pipe centre and 30 mm from the pipe centre are 2 m/s & 1.5 m/s respectively. The flow in pipe is given as turbulent. **04**

(c) What is Fick's law of diffusion? Define mass transfer & diffusivity. **04**

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