Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-III Remedial Examination May 2011

Subject code: 131403

Subject Name: Food Engineering Transport Phenomenon

Date: 27-05-2011 **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)**	The drag force exerted by a flowing fluid on a solid body depends up on the length of the body (L); velocity (V); density of fluid (ρ) and viscosity (μ). Find an expression for drag force using Buckingham's theorem.	**05**
	(b)	Write significance of Reynold's Number; Froude number. What is difference between model & prototype explains with example.	**05**
	(c)	Define term: Vapour pressure; Specific gravity; Dynamic viscosity & Capillarity	**04**
Q.2	**(a)**	Define Laminar & Turbulent flow of fluid. What is compressible & incompressible flow? Write the continuity equation for incompressible flow & solve following problem. The diameter of a pipe at section 1 & 2 are 10 cm & 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 5 m/s. Determine velocity at section 2.	**07**
	(b)	Define surface tension. Prove that the relationship between surface tension and Pressure inside a droplet of liquid is excess of outside pressure is given by $P = 4\sigma/d$. The surface tension of water in contact with air at 20 ^{0}C is 0.0725 N/m. The pressure inside a droplet of water is to be 0.02 N /cm^2 greater than outside pressure. Calculate the diameter of the droplet of water.	**07**
		OR	
	(b)	Develop Bernoulli's equation by developing Euler's equation of motion.	**07**
Q.3	**(a)**	Derive an expression for discharge through Venturi meter with neat sketch.	**06**
	(b)	Name of equipments used for measurement of flow rate. Develop the equation for velocity measurement for pitot tube using application of Bernoulli's equation.	**05**
	(c)	Define Buoyant force; Meta centre & Meta centric height.	**03**
		OR	
Q.3	**(a)**	Derive an expression for discharge through the orifice meter with neat sketch.	**06**
	(b)	Describe about Notches & Weirs. Derive an expression for discharge through rectangular weir.	**05**
	(c)	Explain the turbulent flow through a pipe using Reynold's experiment.	**03**

Q.4 **(a)** Show that shear stress distribution in circular pipe for viscous flow is linear. Develop the equation for point velocity in circular pipe from it. **07**

(b) A crude oil of viscosity 0.97 poise & relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 10 m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. **04**

(c) Water is flowing through a 200 mm diameter pipe with coefficient of friction f=0.04.The shear stress at a point 40 mm from the pipe axis is 0.00981 N/cm^2. Calculate the shear stress at the pipe wall. **03**

OR

Q.4 **(a)** 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 **06**

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

(b) Determine the wall shearing stress in a pipe of diameter 100 mm which carries water. The velocities at the pipe centre & 30 mm from the pipe centre are 2 m/s. and 1.5 m/s respectively. The flow is given as turbulent. **05**

(c) Derive an expression for time period (t) which depends on length (L) of pendulum & gravity acceleration (g). **03**

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) Describe π theorem for dimensional analysis **05**

(c) Define Laminar sub layer; boundary layer thickness; displacement thickness & momentum thickness. **04**

OR

Q.5 **(a)** Develop Hagen Poiseuille's formula for pressure drop. **05**

(b) A laminar flow is taking place in a pipe of diameter of 200 mm. The maximum velocity is 1.5 m/s. Find the mean velocity and the radius at which this occurs. Also calculate the velocity at 4 cm from the wall of the pipe. **05**

(c) Define Mass transfer, Diffusivity, Fick's law of diffusion & Concentration. **04**

****