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

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2141406 **Date: 03/06/2017**

Subject Name: Food Engineering Transport Phenomenon

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 Short Questions **14**

1 Draw velocity distribution for viscous fluid flowing through a pipe.

2 What is the value of C_d for an orifice meter?

3 What is the application of stream function?

4 Write the assumptions of Bernoulli's equation.

5 Define momentum thickness.

6 What is boundry layer?

7 ……is variable area meter.

8 A manometer connected to a pipe indicates a negative gauge pressure of 100 mm of mercury. What is the absolute pressure in the pipe in Pa?

9 Define angle of contact.

10 What is Bourdon gauge?

11 Calculate the capillary rise of water kept in a vertical capillary tube of 1.5 mm diameter and 30 cm height. [σ = 0.0725 Nm].

12 Calculate the volumetric change in water at 22 ^oC if 1.5 m^3 of water is subjected to a compressive stress of 0.27 MPa. [K for water at 22 ^oC = 2.5 G Pa]

13 What is surface tension?

14 Explain cavitation. How can it be prevented?

Q.2 **(a)** The diameters of two glass limbs of a differential U-tube manometer are 6 mm and 7 mm respectively. During an experiment, the manometer indicates a differential pressure of 160 mm WC. Calculate the percent error caused by the capillary effect. **03**

[Take $\theta = 0^o$, $\sigma = 0.0725$ Nm].

(b) A rectangular iron plate having 6 meter width and 9 meter depth is vertically immersed in oil (Specific gravity = 0.9) such that its upper edge is horizontal and coincides with the free surface of the oil. Calculate the pressure force and locate its position. **04**

(c) Define relative equilibrium. A fluid contained in vessel is moving horizontally on a road with an acceleration of 'a' m/s^2. Show that the angle of inclination of the fluid free surface with the horizontal is given by $\theta = \tan^{-}\left(\frac{a}{g}\right)$, where g is the acceleration due to gravity. **07**

OR

(c) Define velocity potential function and derive equation for the same which indicates possible case of irrotational and rotational flow. Also derive equation of velocity component in any one direction. **07**

Q.3 **(a)** Explain buoyant force and its cause. A solid cylinder (ρ = 600 kg/m^3) of 5m diameter and 10 m height is floating partially submerged in water with its axis vertical. Calculate the force of buoyancy and determine the location of center of buoyancy if the block is in stable equilibrium state. **03**

(b) Explain the conditions of stability of floating bodies with neat diagrammatic representations. **04**

(c) What do you understand by dimensional similitude? It is known that the efficiency η of a fluid pump depends on the fluid density ρ, dynamic viscosity of the fluid μ , RPM of the pump rotor N, diameter of the pump rotor D and fluid discharge rate Q in m^3/s. Using Buckingham π-theorem, show that, $\eta = f\left[\left(\frac{Q}{D^3 N}\right), \left(\frac{\mu}{D^2 \omega \rho}\right)\right]$ **07**

OR

Q.3 **(a)** Explain Archimedes principle. A polymer block (ρ = 750 kg/m^3) of size 3 m x 2 m x 6 m floats horizontally in water. Calculate the buoyant force and the location of center of buoyancy if the block is in stable equilibrium state. **03**

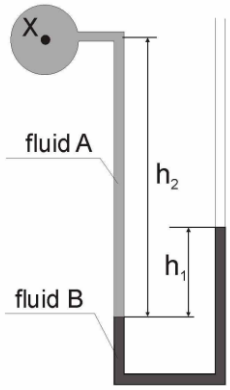
(b) Explain the conditions of stability of submerged bodies with neat diagrammatic representations. **04**

(c) State Buckingham π-Theorem. It is given that the flow through a pipe depends on pressure drop per unit length, the pipe diameter and viscosity of the fluid flowing through it. Develop a functional relationship between these variables using Buckingham π-Theorem. **07**

Q.4 **(a)** Define diffusion and explain it's mechanism by taking one example. **03**

(b) **04**

Explain how a U-tube manometer can be used for measurement of vacuum. The figure shows a U-tube manometer connected to the Point X. Fluid A is water and fluid B is mercury. The pressure at point X is 140 kPa. Calculate h_1 if h_2 is 1.5m.
Specific gravity of mercury is = 13.66



(c) Derive equation of discharge for viscous fluid flowing through parallel plates. **07**

OR

Q.4 **(a)** Differentiate between orifice meter and venturi meter. **03**

(b) What are differential manometers? With the help of a neat diagram describe the construction and working of a 'Well type U-tube differential manometer". Write down the mathematical expression for pressure difference between two points. **04**

(c) Derive Euler's equation and also prove that the total head of a fluid system remains constant. **07**

Q.5 **(a)** Write a short note on a Rota meter. **03**

	(b)	Derive an equation of velocity through venturi meter, considering inlet converging cone and throat section of the venturimeter.	**04**
	(c)	What is laminar boundary layer? Derive an expression for a displacement thickness.	**07**

OR

Q.5	**(a)**	Enumerate types of mouthpiece and orifice.	**03**
	(b)	Derive an expression of discharge over rectangular weir.	**04**
	(c)	State law of conservation of mass and Derive continuity equation for rectangular co-ordinate.	**07**

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