Seat No.: ________

Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV (New) EXAMINATION – WINTER 2019

Subject Code: 2141406 **Date: 12/12/2019**

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 **(a)** Define fluids. Differentiate between Newtonian and Non-Newtonian fluids. Give examples. **03**

(b) At a certain point in oil layer, the shear stress is 0.22 Pa and the velocity gradient is 0.21/s. If density of the oil is 960 kg/m^3, calculate kinematic viscosity. **04**

(c) State law of conservation of mass and energy. Derive continuity equation in rectangular co-ordinates for a three dimensional flow. **07**

Q.2 **(a)** A solid cylinder of diameter 6 m has a height 4 m. Calculate the meta-centric height of the cylinder if the specific gravity of the material of the cylinder is 0.65 and it is floating in water with its axis vertical. State whether the equilibrium will be stable or unstable. **03**

(b) Define surface tension and capillarity. Derive the equation for capillary rise in a glass column. **04**

(c) What are manometers? A U-tube differential manometer contains two pipes at A and B. The pipe A contains a liquid of specific gravity 1.6 under pressure of 110 kPa. The pipe B contains oil of specific gravity 0.82 under a pressure of 180 kPa. Pipe A is 3.2 m above pipe B. The height of liquid in left limb is 6 m below point A. Calculate the difference in mercury level in the differential manometer. **07**

OR

(c) What is Archimedes Principle? Explain the conditions of equilibrium of floating and submerged bodies with neat diagrams. **07**

Q.3 **(a)** Explain the operation rotameter with a diagram. **03**

(b) Write short notes on (i) Orifice-meter (ii) Venturi-meter **04**

(c) Answer the following: **07**

(i) Prove that $t = 2\pi\sqrt{\frac{L}{g}}$ is dimensionally homogeneous equation.

(ii) A manometer connected to a pipe indicates a negative gauge pressure of 90 mm of mercury. What is the absolute pressure in the pipe in Pa?

(iii) What is Relative equilibrium?

(iv) Calculate the volumetric change in water at 27 °C if 3m^3 of water is subjected to a compressive stress of 0.3 MPa. [K for water at 27 °C = 2.85 G Pa]

OR

Q.3 **(a)** Explain the terms laminar boundary layer, turbulent boundary layer, laminar sub-layer and represent them graphically. **03**

	(b)	Classify weirs and notches. Derive an equation for fluid discharge through a rectangular weir.	**04**
	(c)	Derive an expression for the force exerted on a submerged vertical plane surface.	**07**
Q.4	**(a)**	What is diffusion? Explain Fick's law of unsteady state diffusion.	**03**
	(b)	Define the terms: i. Centre of pressure ii. Centre of buoyancy iii. Define Angle of contact. iv. Laminar and turbulent flow	**04**
	(c)	(i) Explain vena contracta with neat sketch. (ii) Derive the equation representing Bernoulli's theorem.	**07**
		OR	
Q.4	**(a)**	State (i) Pascal,s law (ii) Hydrostatic law.	**03**
	(b)	Differentiate between (i) Simple and differential manometer (ii) Absolute and guage pressure	**04**
	(c)	Determine displacement thickness, momentum thickness and energy thickness for the velocity distribution in boundary layer given by, $u/U = (y/\delta) - (y/\delta)^2$	**07**
Q.5	**(a)**	Write a short note on velocity potential function.	**03**
	(b)	An oil of viscosity 0.01 Ns/m^2 is flowing between two stationary parallel plates 1.5m wide maintained 20 mm apart. The velocity midway between the plates is 1.5m/s. Calculate : (i) Pressure gradient along the flow (ii) Average velocity (iii) Discharge	**04**
	(c)	State Buckingham's π-theorem. The resisting force R of a supersonic plane during flight can be considered as dependent upon the length of the aircraft l, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables and the resisting force using Buckingham's π-theorem.	**07**
		OR	
Q.5	**(a)**	Prove that the velocity distribution for viscous flow through a circular pipe is parabolic in nature.	**03**
	(b)	What are dimensionless numbers? Name any four dimensionless numbers. Derive Reynold's equation.	**04**
	(c)	Define similitude. Discuss the types of similarity must exist between the model and prototype. Explain the procedure for selecting repeating variables for solving the problems by using Buckingham's π-theorem.	**07**

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