Seat No.: ________ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – WINTER 2018

Subject Code: 2141406 **Date:01/12/2018**

Subject Name: Food Engineering Transport Phenomenon

Time: 02:30 PM TO 05:00 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)** What are dimensionless numbers? Derive the expression for Reynold's number. **03**

(b) An open tank contains water upto a depth of 2m and above it an oil of specific gravity 0.9 for a depth of 1 m. Find the pressure intensity at interface of two liquid as well as at the bottom of the tank. **04**

(c) What are real and ideal fluids? Explain with diagram the properties of Newtonian and non-Newtonian fluid. **07**

Q.2 **(a)** Prove that maximum velocity in a circular pipe for viscous flow is equal to two times the average velocity of the flow **03**

(b) Explain with diagram the concept of guage pressure, vacuum pressure and absolute pressure. **04**

(c) (i) Describe the phenomena of capillarity rise and fall. **07**

(ii) A 0.6-mm-diameter glass tube is inserted into water at 20°C in a cup. Determine the capillary rise of water in the tube. Given the surface tension of water at 20°C is 0.073 N/m and the contact angle of water with glass is 0°.

OR

(c) State and prove Hydrostatic law **07**

Q.3 **(a)** Differentiate between simple manometer and differential manometer. **03**

(b) Derive an expression for the force exerted on a submerged vertical plane surface by the static liquid and locate the position of centre of pressure **04**

(c) Define metacentric height. A rectangular pontoon is 6 m long 4 m wide and 1.8 m high. The depth of immersion of pontoon is 1.2 m in sea water. If the centre of gravity is 0.9 m above the bottom of the pontoon, determine the metacentric height. Density of sea water = 1025 kgm^{-3} **07**

OR

Q.3 **(a)** Define the terms (i) Velocity potential function (ii) Stream function **03**

(b) Water is flowing through a pipe of 5 cm diameter under a pressure of 29.43 Ncm^{-2} (guage) and with a mean velocity of 2.0 ms^{-1}. Find the total head per unit weight of the water at a cross-section, which is 5 m above the datum line **04**

(c) Derive an equation for difference of pressure head of viscous fluid flowing through two fixed parallel plates **07**

Q.4 **(a)** Discuss the conditions of equilibrium of submerged bodies **03**

(b) Give one practical example of each **04**

1) Laminar flow

2) Turbulent flow
3) Steady flow
4) Uniform flow

(c) Explain laminar boundary layer, turbulent boundary layer and laminar sub layer with suitable diagram. **07**

OR

Q.4 (a) Define the term: (a) Dynamic viscosity (b) Kinematic viscosity. Give their dimensions. **03**

(b) The diameters of a pipe at the section 1 and 2 are 10 cm and 15 cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at the section 1 is 5 m/s. Determine also the velocity at section 2. **04**

(c) A horizontal venturimeter with inlet and outlet throat diameter 30 cm and 15 cm respectively is used to measure the flow of water. The reading of differential manometer connected to the inlet and the throat is 20 cm of mercury. Determine the rate of flow. Take C_d=0.98, Specific gravity of mercury =13.6 **07**

Q.5 (a) The velocity potential function is given by $\varphi = 5(x^2 - y^2)$. Calculate the velocity components at the point (4,5). **03**

(b) Derive an equation for pressure inside a water droplet. **04**

(c) Derive an equation for displacement thickness. **07**

OR

Q.5 (a) Explain with diagram the concept of guage pressure, vacuum pressure and absolute pressure. **03**

(b) Define similitude. Explain different types of similarities that must exist between the model and the prototype. **04**

(c) 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**