

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2015**

**Subject Code: 2141406****Date: 03/06/2015****Subject Name: Food Engineering Transport Phenomenon****Time: 10.30 am - 1.00 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 resisting force  $R$  of a supersonic plane during flight can be considered as dependent upon the length of aircraft  $l$ , velocity  $v$ , air viscosity  $\mu$ , air density  $\rho$  and bulk modulus of air  $K$ . Express the fundamental relationship between these variables and the resisting force  $R$  by using Buckingham's  $\pi$  – Theorem. **07**
- (b) Write assumptions of Bernoulli's equation. Derive Bernoulli's equation. **07**
- Q.2** (a) What is diffusion? Explain Fick's law of diffusion in details. **07**
- (b) Derive an expression for velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across the section of pipe. **07**
- OR**
- (b) Draw a velocity distribution curve for flow of viscous fluid between two parallel fixed plates and derive an equation for same. **07**
- Q.3** (a) What is absolute pressure? Derive Pascal's law. **07**
- (b) Derive an equation for hydrostatic pressure for fluid at rest. Explain Newton's law of viscosity. **04**
- (c) Draw the figures of different conditions for submerged body. **03**
- OR**
- Q.3** (a) Write a short note on types of pressure measuring device. Derive an equation of pressure difference for inverted U-tube manometer. **07**
- (b) Derive equation of continuity for Cartesian co-ordinates. **07**
- Q.4** (a) A fluid of viscosity  $0.5 \text{ Ns/m}^2$  and specific gravity 1.20 is flowing through a circular pipe of diameter 100 mm. the maximum shear stress at the pipe wall is given as  $147.15 \text{ N/m}^2$ . Find (i) Pressure gradient; (ii) Average Velocity; (iii) Reynolds number of the flow. **07**
- (b) Define the term displacement thickness and derive an expression for the same. **07**
- OR**
- Q.4** (a) Write a short note on followings: **07**
- (1) Orifice meter
- (2) Notches
- (b) (1) Describe in brief about weirs. **03**
- (2) Write a short note on rotameter. **04**
- Q.5** (a) What do you mean by the dimensional homogeneity equation? Prove that  $t = 2\pi (L/g)^{1/2}$  is dimensionally homogeneous equation where  $t$  = time,  $l$  = length of pendulum and  $g$  = gravity acceleration. **07**
- (b)1 Define the following terms. **04**
- i). Model    ii). Similitude    iii). Euler's Number    iv). Boundary layer
- (b)2 Give the dimensions for the following Quantities. **03**
- i). Specific Weight    ii). Power    iii). Discharge

**OR**

- Q.5**    **(a)**    Water flows through a horizontal pipe. At a particular cross-section X the velocity of the water is  $1.5 \text{ m s}^{-1}$  and the pressure is 175 kPa. The pipe tapers gradually from 150 mm at X to 75 mm at a section Y. Determine the pressure at Y, assuming that the frictional losses are negligible. What must be the diameter at Y for the pressure there to be reduced to 55 kPa? **07**
- (b)**    (1) Calculate the Reynolds number for a vegetable oil of viscosity  $0.03 \text{ Pa s}$  and density  $850 \text{ kg m}^{-3}$  flowing in a 50 mm bore pipe at a mean velocity of  $0.75 \text{ m s}^{-1}$ . **03**
- (2) Define followings **04**
- a. Meta center
  - b. Buoyant force
  - c. Specific volume
  - d. Kinematic viscosity

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