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

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code: 2141906 **Date: 03/06/2017**

Subject Name: Fluid Mechanics

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.**

MARKS

Q.1 **Short Questions** **14**

1 Fluid which do not follow the linear relationship between shear stress and rate of deformation are termed as ……..fluids.
(a) Newtonian fluid (b) Non Newtonian fluid (c) dialent (d) ideal

2 The simplest form of manometer which can be used for measuring moderate pressures of liquid is
(a) Piezometer (b) differential manometer (c) U-tube manometer (d) none of the above

3 The term…….mean the study of pressure exerted by a fluid at rest.
(a) hydrostatic (b) fluid mechanics (c) continuum (d) kinetics

4 The motion of the fluid particles may be described by which of the following methods?
(a) Lagrangian method (b) Eulerian method
(c) neutral equilibrium (d) any of the above

5 The flow in a river during the period of heavy rainfall is
(a) steady, non-uniform and three dimensional (b) steady, uniform, three dimensional (c) unsteady, uniform, three dimensional (d) unsteady, non-uniform and three dimensional

6 A……. is an imaginary line within the flow so that the tangent at any point on it indicates the velocity at that point.
(a) streak line (b) stream line (c) path line (d) none of the above

7 In fluid mechanics, the continuity equation is a mathematical statement embodying the principle of
(a) conservation of momentum (b) conservation of mass
(c) conservation of energy (d) none of the above

8 Which of the following equation is known as momentum principle?
(a) $F = d(m^2V)/dt$ (b) $F = dV/dt$ (c) $F = d(mV)/dt$ (d) $F = d(mV)/dt^2$

9 Dynamic similarity between model and prototype is
(a) similarity of motion (b) similarity of lengths
(c) similarity of forces (d) none of the above

10 Mach number is defined as the square root of the ratio of the (a) inertia force to pressure force (b) inertia force to surface tension force (c) inertia force to elastic force (d) none of the above

11 Which of the following may be used for measuring the rate of flow of water in rivers or streams?
(a) Notches (b) Orifices (c) Weir (d) any of these

12 In case of viscous flow through circular pipes,
(a) $\bar{u} = 2u_{(max)}$(b) $\bar{u} = u_{(max)}/2$
(c) $\bar{u} = 3/2 * u_{(max)}$ (d) none of the above

13 In turbulent flow, which of the following gives the exact velocity distribution
(a) Logarithmic distribution (b) Blasius equation
(c) power law with index varying (d) Prandtl's one-seventh power

14 The region outside the Mach cone is called
(a) zone of action (b) zone of silence (c) control volume (d) none of the above

Q.2 **(a)** Differentiate between (i) absolute and gauge pressure (ii) simple and differential manometer (iii) piezometer and pressure gauge **03**

(b) Prove the compressibility is reciprocal of bulk modulus. Also derive relation between bulk modulus and pressure for a gas for isothermal and adiabatic process. **04**

(c) Two large plane surfaces are 2.4 cm apart. The space between the surfaces is filled with glycerin. What force is required to drag a very thin plate of surface area 0.5 m^2 between two large plane surfaces at a speed of 0.6 m/s, if **07**

(i) The thin plate is in the middle of the two plane surfaces and,

(ii) The thin plate is at a distance of 0.8 cm from one of the plane surface.

Take the dynamic viscosity of glycerin= 8.10 x 10^{-1} Ns/m^2

OR

(c) Find out the differential reading "h" of an inverted U-tube manometer containing oil of sp.gr. 0.7 as the manometric fluid, when connected across pipes A and B as shown in figure.1, conveying liquid of sp.gr.1.2 and 1.0 and immiscible with manometer fluid. Pipes A and B are located at the same level and assume the pressure at A and B to be equal. **07**

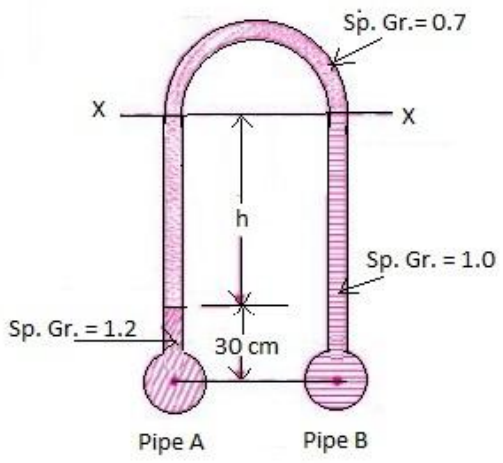

Figure.1

Q.3 **(a)** Define different types of fluid flow. **03**

(b) A rectangular gate that is 2 m wide is located in the vertical wall of a tank containing water as shown in figure.2. It is desired to have **04**

the gate open automatically when the depth of water above the top of the gate reaches 10 m. (a) At what distance "d" should the frictionless horizontal shaft be located? (b) What is the magnitude of the force on the gate when it opens?

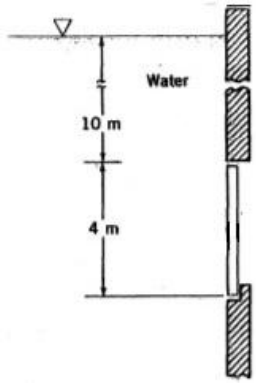

Figure. 2

(c) Define metacenter and metacentric height. Derive expression to find metacentric height using analytical method for floating body. **07**

OR

Q.3 **(a)** Describe stability condition of floating bodies. **03**

(b) The velocity components in a two- dimensional flow are $u = y^3/3 + 2x - x^2y$ and $v = xy^2 - 2y - x^3/3$. Show that these functions represent a possible case of an irrotational flow. **04**

(c) Define total pressure and centre of pressure. Derive expression of total pressure force and center of pressure for vertical plane surface remains submerged in liquid. **07**

Q.4 **(a)** What do you understand by stream function, velocity potential function and flownet. Give the relation between stream function and velocity potential function. **03**

(b) A horizontal venturimeter with inlet diameter 20 cm and throat diameter 10 cm is used to measure the flow of water. The pressure at inlet is 17.658 N/cm^2 and the vacuum pressure at throat is 30 cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$. **04**

(c) Derive the expression for the loss of head due to friction in pipes. **07**

OR

Q.4 **(a)** Derive expression for discharge over a rectangular notch or weir. **03**

(b) Prove the velocity of sound wave in compressible fluid is given by $C = \sqrt{\frac{k}{\rho}}$ where k = bulk modulus of fluid and ρ = density of fluid. **04**

(c) 200 liters/s of water is flowing in a pipe having a diameter of 250 mm through which the water is flowing having pressure 38 N/cm^2. If the pipe is bent by 125^o (that is change from initial to final direction 125^o). Find the magnitude and direction of the resultant force on the bend. **07**

Q.5 **(a)** Derive the expression for rate of flow through venturimeter. **03**

(b) A syphon of diameter 200 mm connects two reservoirs having a difference in elevation of 20 m. The length of the syphon is 500 m and the summit is 3.0 m above the water level in the upper reservoir. The length of the pipe from upper reservoir to the summit is 110 m. Determine the discharge through the syphon and also pressure at the summit. Neglect minor losses. The co-efficient of friction f= 0.005 **04**

(c) Using Buckingham's π- theorem show that the velocity through a circular orifice is given by, **07**

$$V = \sqrt{2gH}\ \emptyset[\frac{D}{H}, \frac{\mu}{\rho VH}]$$

Where H is head causing flow, D is the diameter of the orifice, μ is the coefficient of viscosity, ρ is mass density and g is the acceleration due to gravity.

OR

Q.5 **(a)** Calculate (i) the pressure gradient along flow (ii) the average velocity and (iii) the discharge for an oil of viscosity 0.02 Ns/m^2 flowing between two stationary parallel plates 1 m wide maintained 10 mm apart. The velocity midway between the plates is 2 m/s. **03**

(b) The rate of flow of water through a horizontal pipe is 0.25 m^3/s. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. The pressure intensity in the smaller pipe is 11.772 N/cm^2. Determine (i) loss of head due to sudden enlargement (ii) pressure intensity in large pipe. **04**

(c) Derive an expression for the velocity distribution for viscous flow through a circular pipe. Also sketch the velocity distribution and shear stress distribution across a section of the pipe. **07**

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