GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–IV(New) EXAMINATION – SUMMER 2016

Subject Code:2141906　　　　　　　　　　　　　　**Date:10/06/2016**
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.**

Q.1　　　**Choose the correct answer:**　　　　　　　　　　　　　　**14**

  1　Kinematic viscosity is defined as
     (a) dynamic viscosity × density　　　(b) dynamic viscosity / density
     (c) dynamic viscosity × pressure　　(d) pressure × density

  2　Newton's law of viscosity states that
     (a) shear stress is directly proportional to the velocity
     (b) shear stress is directly proportional to the velocity gradient
     (c) shear stress is directly proportional to shear strain
     (d) shear stress is directly proportional to the viscosity

  3　Fluid static deals with
     (a) viscous and pressure forces　　(b) viscous and gravity forces
     (c) gravity and pressure forces　　(d) surface tension and gravity forces

  4　For a submerged curved surface, the vertical component of the hydrostatic force is
     (a) mass of the liquid supported by the curved surface
     (b) weight of the liquid supported by the curved surface
     (c) the force on the projected area of the curved surface on vertical plane
     (d) none of the above

  5　An orifice is known as large orifice when the head of liquid from the centre of orifice is
     (a) more than 10 times the depth of orifice
     (b) less than 10 times the depth of orifice
     (c) less than 5 times the depth of orifice
     (d) none of the above

  6　Hydraulic gradient line (H.G.L.) represents the sum of
     (a) pressure head and kinetic head　　　(b) Kinetic head and datum head
     (c) pressure head, kinetic head and datum head
     (d) pressure head and datum head

  7　Froude's number is defined as the square root of the ratio of
     (a) inertia force to viscous force　　(b) inertia force to gravity force
     (c) inertia force to elastic force　　(d) inertia force to pressure force

  8　For a sub-merged body, if the centre of buoyancy is below the centre of gravity, the equilibrium is called
     (a) stable　　　(b) unstable　　　(c) neutral　　　(d) none of the above

  9　Pitot-tube is used to measure
     (a) discharge　　(b) temperature　　(c) velocity at a point　　(d) pressure at a point

  10　The flow is said to be supersonic if
     (a) M = 1　　(b) M < 1　　(c) M >1　　(d) none of above

11 Models are known as undistorted model if
(a) the prototype and model are having different scale ratios
(b) the prototype and model are having same scale ratio
(c) model and prototype are kinematically similar
(d) none of the above

12 An ideal fluid is one which
(a) is compressible   (b) has no viscosity
(c) is elastic and viscous   (d) is non-viscous and incompressible

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

14 The value of bulk modulus of elasticity ……………. with increase of pressure.
(a) increases   (b) decreases   (c) either of the above   (d) none of above

Q.2 **(a)** Define: Stream line, Streak line and Path line. **03**

(b) State and prove Pascal's law with usual notations. **04**

(c) A circular plate 1.5 m diameter is submerged in water, with its greatest and least depths below the surface being 2 m and 0.75 m respectively. Determine: **07**
　　(i) Total pressure on one of the face of the plate
　　(ii) The position of centre of pressure.

OR

(c) Derive expressions for total pressure and centre of pressure for vertically immersed surface. **07**

Q.3 **(a)** A horizontal venturimeter with inlet diameter 150 mm and throat diameter 75 mm is used to measure discharge. The differential manometer gives reading of 150 mm of mercury. Determine the rate of flow if C_d is 0.98. **03**

(b) Derive Euler's equation of motion along a stream line. **04**

(c) The stream function of a two dimensional flow is given by $\psi = 2xy + 25$. Calculate the velocity at the point (1, 2). Also find the velocity potential function Ø. **07**

OR

Q.3 **(a)** Explain the term Vorticity. **03**

(b) Deduce the expression of discharge over a rectangular notch. **04**

(c) Derive continuity equation in three dimensional Cartesian coordinate system. **07**

Q.4 **(a)** Explain the procedure for selection of repeated variables in dimensional analysis. **03**

(b) Obtain Bernoulli's equation for compressible flow considering adiabatic process. **04**

(c) A solid cylinder 2 m in diameter and 2 m high is floating in water with its axis vertical. If the specific gravity of the material of cylinder is 0.65 find its metacentric height. State whether the equilibrium is stable or unstable. **07**

OR

Q.4 **(a)** A projectile is travelling in air having pressure 8.83 N/Cm^2 and temperature -2^{0}C. If the mach angle is 40^0, find the velocity of projectile. Take k = 1.4 and R = 287 J/kgK **03**

(b) Explain stability of a floating body. **04**

(c) The resistance R to the motion of completely submerged body depends on length of body, velocity of flow, mass density and kinematic viscosity. Find the relation between R and other variables using suitable method. **07**

2

Q.5 **(a)** Find the expression of velocity of sound in terms of Bulk Modulus. **03**

(b) Explain propagation of sound waves for Sub sonic and Sonic flow. **04**

(c) Derive an expression for Hagen-Poiseuille's formula for viscous flow. **07**

OR

Q.5 **(a)** In a pipe of 200 mm diameter water is flowing, there is a shear stress of 0.12 **03** kN/m^2 at a point distant 30 mm from the pipe axis. If the coefficient of friction between the pipe and fluid is 0.04, calculate the shear stress at the pipe wall.

(b) Obtain Darcy-Weisbach formula for head loss due to friction. **04**

(c) An oil of specific gravity 0.9 and viscosity 0.06 poise is flowing through a **07** pipe of diameter 200 mm at the rate of 60 liters/s. Find the head lost due to friction for a 500 mm length of pipe. Also find the power required to maintain the flow. Take $f = 0.079/(R_e)^{1/4}$

****