Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, JANUARY 2017

ME 203: MECHANICS OF FLUIDS (ME)

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer any three questions)

1. Explain the characteristic fluid properties to which the following phenomenon are attributable:
   a. Rise of sap in a tree; (2)
   b. Spherical shape of a drop of a liquid; (2)
   c. Cavitation ; (2)
   d. Flow of a jet of oil in an unbroken stream; (2)
   e. Water hammer (2)

2. a. A rectangular plane surface 2 m wide and 3 m deep lies in water in such a way that its plane makes an angle of 30^0 with the free surface of water. Determine the total pressure and position of centre of pressure when the upper edge is 1.5 m below the free water surface. (5)

   b. Write the conditions for the equilibrium of floating and submerged bodies. (5)

3. (a). Define the following:
   (i) Steady flow: (1)
   (ii) Laminar flow: (1)
   (iii) Turbulent flow: (1)
   (iv) Uniform flow and (1)
   (v) Compressible flow (1)

   (b). The velocity vector in a fluid flow is given by $V= 4x^3i- 10x^2yj+2tk$. Find the acceleration of fluid particle at (2,1,3) at time t=1 (5)

4. In a 2D incompressible flow, the fluid velocity components are given by u = x-4y and v= -y-4x. Show that velocity potential exists and determine its form. Find also the stream function. (10)

PART B

(Answer any three questions)

5. (a) Derive Euler's equation of motion. How will you obtain Bernoulli's equation from Euler's equation (6)

   (b) What are the assumptions made in deriving Bernoulli's equation? (4)

6. (a) What is a Venturimeter? Derive an expression for the discharge through a venturimeter. (6)

(b) An oil of specific gravity 0.8 is flowing through a venturimeter having inlet diameter 20 cm and throat diameter 10 cm. The oil-mercury differential manometer shows a reading of 15 cm. Calculate the discharge of oil through the horizontal venturimeter. Take Cd=0.98 (4)

7. (a) What are minor losses? (4)

(b) Derive Darcy-Weisbach equation (6)

8. (a) Define hydraulic gradient line and total energy line. (4)

(b) A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and of length 15 m. Calculate the difference of pressure at the two ends of the pipe, if 100kg of oil is collected in a tank in 25 seconds. (6)

PART C

(Answer any four questions)

9 With a neat sketch explain the development of boundary layer over a horizontal flat plate which is kept in a flow field. (10)

10 For the velocity profile in a laminar flow $\frac{u}{U} = \sin\left(\frac{\pi}{2}\frac{y}{\delta}\right)$. Obtain the expression for boundary layer thickness, shear stress, drag force on one side of the plate and coefficient of drag in terms of Reynolds number. (10)

11 Describe the methods of preventing the separation of boundary layer. (10)

12 The pressure drop ΔP in flow of incompressible fluid through rough pipes is found to depend on the length L, average velocity u, fluid density ρ, dynamic viscosity μ, diameter D and average roughness height e. Obtain a dimensionless expression using π - theorem (10)

13. Explain similarity requirements between the model and prototype (10)

14. Water tunnel operates with a velocity of 3 m/s at the test section and power required was 3.75 kW. If the tunnel is to operate with air, determine for similitude the flow velocity and the power required. (10)