DU – 006

III Semester B.E. (Civil) Degree Examination, Dec. 2017/Jan. 2018
(2K11) (Semester Scheme)
CE 304 : FLUID MECHANICS AND HYDRAULIC MACHINERY

Time : 3 Hours Max. Marks : 100

Instructions *: 1) Part – **A** is **compulsory**.*
*2) Answer **any five full** questions, selecting atleast **one** from **each** Part – **B** and Part – **C**.*
*3) Assume **any** missing data **suitably**.*

PART – A

1. a) Explain why the viscosity does not contribute to hydrostatic law.
   b) Density of liquid is 850 kg/m^3. Determine relative density and weight density of the liquid, with reason, state whether the liquid will float on water or not.
   c) Express pressure in two different ways with examples.
   d) How do you measure negative gauge pressure using Piezometer ?
   e) When is the flow in a pipe (i) unsteady and (ii) non-uniform.
   f) List the various forces acting on a fluid in motion.
   g) Express each term of Bernoulli's equation in terms of (i) Energy per unit mass of liquid and (ii) Energy per unit volume of liquid.
   h) Why is the length of the convergent cone of a venturimeter shorter than the length of the divergent cone ?
   i) State Buckingham's π-theorem.
   j) What is the significance of the study of impact of jet on vanes ? **(2×10=20)**

PART – B

2. a) Explain the phenomenon of capillarity. Obtain an expression for capillary rise in liquids. **8**
   b) A fluid of viscosity 8 poise flows past a flat plate and has a velocity of 1 m/s at the vertex, which is at 0.2 m from the plate surface. Determine the velocity gradients and shear stresses at points 0.05 m, 0.10 m and 0.15 m from the boundary. Assume a parabolic velocity distribution. **8**

P.T.O.

3. a) Derive an expression for the variation of pressure in a static mass of liquid and hence derive an expression for the pressure intensity at a point in a liquid. **8**

   b) A U-tube mercury manometer is used to measure pressure of oil (s = 0.85) in a pipeline. The difference shown by manometer is 450 mm. The mercury – oil interface is 1.50 m above the centre line of the pipe. Find the pressure of oil in the pipeline. **8**

4. a) Derive general form of continuity equation for three dimensional flow. **8**

   b) Given the velocity field :

   $V = (6 + 2xy + t^2)\, i - (xy^2 + 10t)\, j = 25\, k$. What is the acceleration of a particle at (3, 0, 2) at time t = 1 ? **8**

PART – C

5. a) Derive Bernoulli's equation from first principle. State the assumptions made. **8**

   b) A vertical pipe carrying oil of S = 0.80 tapers uniformly from 20 cm diameter at the lower section to 10 cm diameter at the upper section. The vertical distance between the sections is 1 m. The pressures at lower and upper sections are 6 N/cm^2 and 5 N/cm^2 respectively when the discharge of oil is 30 litres/sec. Calculate the loss of head between the two sections. Determine the direction of flow also. **8**

6. a) Derive an expression for the rate of flow of fluid through a horizontal venturimeter. **8**

   b) Oil of specific gravity 0.95 flows through a 30 cm diameter by 10 cm diameter venturimeter. The pressures of fluid at inlet and throat sections are 1.45 bars (gauge) and 30 cm of mercury (vacuum) respectively. The head lost in the venturimeter is equal to 3% of the differential head of the meter. Determine the coefficient of discharge and the discharge of the fluid through the venturimeter. **8**

7. a) Derive an expression for discharge over a right angled triangular notch. **8**

   b) A tank has two identical orifices one vertically above the other and 3 m apart in one of its vertical sides. The water surface is 4 m above the upper orifice. It is found that the jets issuing from the two orifices intersect each other at a horizontal distance of 8.7 m from the vena-contracta. Determine the coefficient of velocity of orifices. **8**

8. a) Derive an expression for the force exerted by a jet striking a moving curved unsymmetrical vane tangentially at one of the tips. Draw velocity triangles at inlet and outlet. **8**

   b) A jet of water with a velocity of 40 m/s strikes without shock a series of vanes moving at 10 m/s. The jet is inclined at an angle of 20° to the direction of motion of vanes. The relative velocity of jet at outlet is 0.90 times of the value at inlet and the absolute velocity of water at exit is to be normal to the motion of vanes. Determine

   i) Vane angle at entrance and exit

   ii) Workdone on vanes per second per unit weight of water, and

   iii) Hydraulic efficiency. **8**

9. a) Fluid of density ρ and viscosity μ flows at an average velocity V through a circular pipe of diameter 'd'. Using dimensional analysis, show that the shear stress at the pipe wall $\tau_0 = \rho V^2 \, f\left[\frac{\rho V d}{\mu}\right]$. Use Buckingham's π-theorem. **8**

   b) A 1 : 64 model is constructed of an open channel in concrete which has Manning's n = 0.014. Find the value of Manning's n for the model. **8**
