B. E. Third Semester (Civil Engineering)/ SoE – 2014-15 Examination

Course Code : CV 1205/ CV 205 **Course Name : Fluid Mechanics - I**

Time : 3 Hours] [Max. Marks : 60

Instructions to Candidates :—

(1) All questions are compulsory.
(2) All questions carry marks as indicated.
(3) Assume suitable data wherever necessary.
(4) Illustrate your answers wherever necessary with the help of neat sketches.
(5) Use of Logarithmic tables, non programmable calculator, Steam tables, Mollier's chart, Drawing instruments, Thermodynamic tables for moist air, Psychrometric charts and Refrigeration charts is permitted.

1. (A) Solve any **One** :

(A1) Define - (i) Vapour pressure (ii) Cavitation

(A2) Define - (i) Compressibility, (ii) Specific Volume 2 (CO 1)

(B) Solve any **One** :

(B1) A piston 99.5 mm diameter works in a cylinder 100 mm diameter, 120 mm long. The space between the two is filled with a lubricating oil of viscosity 0.05 poise. Calculate the speed of the piston through the cylinder under the action of axial force of 5 N.

(B2) Calculate capillary rise in glass tube 2.5 mm diameter when immersed in water. Take surface tension of water as 7.5×10^{-2} N/m. What will be the rise when the same tube is dipped in mercury having surface tension of 0.51 N/m ? 4 (CO 1)

(C) Solve any **One** :

(C1) A liquid at 20^{0}C has a relative density of 0.8 and a kinematic viscosity of 2.3 centistoke. Determine its (i) unit weight and (ii) dynamic viscosity.

(C2) A liquid at 20^0C has a relative density of 0.80 and a kinematic viscosity of 2.3 centistoke. Determine its (i) unit weight and (ii) dynamic viscosity in Pas. 4 (CO 1)

2. (A) Solve any **One** :

(A1) Define–Absolute pressure and Suction pressure.

(A2) Give classification of pressure measuring devices. 2 (CO 3)

(B) Solve any **One** :

(B1) State and prove Pascal's Law along with neat sketches.

(B2) Derive hydrostatic law of fluid pressure. 4 (CO 3)

(C) Solve any **One** :

(C1) An open tank contains water to a depth of 2.5 m and oil of relative density 1.25 to a depth of 1.5 m. Determine the pressure at (a) the water surface, (b) at the oil-water interface, (c) at a depth of 3.5 m below the free surface and (d) at the bottom of the tank.

(C2) An inverted differential manometer containing an oil of specific gravity 0.9 is connected to find the difference of pressure at two points of a pipe containing water. If the manometer reading is 400 mm, find the difference of pressure. 4 (CO 3)

3. (A) Solve any **One** :

(A1) What are the methods of describing fluid motion ? Explain each briefly.

(A2) Distinguish between-Stream line and Streak line. 2 (CO 2)

(B) Solve any **One** :

(B1) The stream function $\psi = x^3 - 3xy^2$ Find ϕ = ?

(B2) The velocity potential function $\phi = 4x(3y - 4)$ Find ψ = ?
4 (CO 2)

(C) Solve any **One** :

(C1) For a Flow Field the Stream Function is given by $\psi = 3x^3y + 8xy - 3xy^3$. Show that the flow is irrotational. Also determine velocity at a point (3, 4)

(C2) Show that Streamlines and Equipotential lines intersect each other orthogonally. 4 (CO 2)

4. (A) Solve any **One** :

(A1) Write a note on Kinetic energy correction factor.

(A2) Write a note on Momentum correction factor. 2 (CO 3)

(B) Solve any **One** :

(B1) Sketch Pitot tube when used in : (a) Open channel, (b) Pipe.

(B2) Explain with sketch Prandtl Pitot tube. 4 (CO 3)

(C) Solve any **One** :

(C1) Derive expression for flow rate through Venturimeter.

(C2) A pipe line having a length of 6 m between section A (diameter 100 mm) and section B (diameter 300 mm) is inclined at an angle of 20^0 upwards with horizontal with section A at lower level. If the velocity of flow of water is 1·8 m/s at section A upwards and head loss between two sections is 5 cm, determine the difference of pressures between the two sections. 4 (CO 3)

5. (A) Solve any **One** :

(A1) Define 'vena – contracta', write a note on it.

(A2) Define Mouthpiece. Also give classification. 2 (CO 3)

(B) Solve any **One** :

(B1) Explain experimental procedure for determination of Coefficient of Contraction for an Orifice.

(B2) Derive an expression for time of emptying a tank through an orifice at its bottom. 4 (CO 3)

(C) Solve any **One** :

(C1) What is a convergent – divergent mouthpiece ? Obtain an expression for the ratio of diameters at out at vena – contracta for a convergent – divergent 'mouthpiece' in terms of absolute pressure head at contracta, head of liquid above mouthpiece and atmospheric pressure head.

(C2) A tank has two identical orifices, one vertically above the other and 1 m apart, in one of its vertical sides. The water surface is 1·22 m above the higher orifice and is maintained at a constant level. It is found that the jets intercept each other at a horizontal distance of 2·65 m from the vena – contracta. Determine the C_v for the orifices. 4 (CO 3)

6. (A) Solve any **One** :

(A1) Explain the selection procedure for repeating variables.

(A2) Define dimensionless numbers and derive expression for Reynold's number and Froude's number. 2 (CO 4)

(B) Solve any **One** :

(B1) What do you mean by dimensional homogeneity ? Illustrate your answer by a suitable example.

(B2) Efficiency (η) of a faxdepends on density (ρ), dynamic viscosity (μ) angular velocity (ω), diameter (D) of rotor and discharge (Q). Express 'η' in terms of dimensionless parameters using Rayleigh's method. 4 (CO 4)

(C) Solve any **One** :

(C1) If pressure rise $\triangle p$ generated by a pump is a function of the impeller dia 'D', the rotational speed 'N', the fluid density 'Q'. Viscosity 'u', and rate of discharge 'Q', show that

$$\triangle P = \varrho N^2 D^2 \ \phi \left[\frac{Q}{D^3 N} \ , \ \frac{\mu}{\varrho N D^2} \right]$$

(C2) Show that the resistance 'R' to the motion of the sphere of diameter 'D' moving with a uniform velocity 'V' through a real fluid of density 'ρ' and viscosity 'μ' is given by

$$R = \rho V^2 D^2 \ f \left(\frac{\mu}{V D \rho} \right).$$

4 (CO 4)