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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Mechanical Engineering

Semester End Examination; June - 2017

Fluid Mechanics

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Any missing data may be suitably assumed.

UNIT - I

1 a. Define the terms density, specific volume, weight density and specific gravity, vapour pressure, vacuum pressure. 6

b. Derive an expression for the capillary rise or depression, given the value of the contact angle β and the density and surface tension of the liquid. 6

c. A shaft of 145 mm diameter runs in journals with a uniform oil film thickness of 0.5 mm, bearings of 20 cm width is used. The viscosity of the oil is 19 cP. Determine the speed, if the power absorbed is 15 W. 8

2 a. Define and discuss the term viscosity and capillarity effect. 6

b. Derive an expression for the pressure difference caused by surface tension on a soap bubble. 6

c. In a closed end single tube manometer, the height of mercury column above the mercury well shows 757 mm against the atmospheric pressure. The ID of the tube is 2 mm. The contact angle is 135°. Determine the actual height representing the atmospheric pressure, if surface tension is 0.48 N/m. The space above the column may be considered as vacuum. 8

UNIT - II

3 a. Explain with the help of sketch, inverted U tube differential manometer. 6

b. Derive an expression for total pressure force and centre of pressure for an inclined plane surface submerged in a liquid. 6

c. The Canal shown in the cross section in Fig Q.3c. runs 40 m in to the paper. Calculate the horizontal and vertical components of the hydrostatic force against the quarter circle wall and the centre of pressure, also find where the resultant strikes the wall? 8

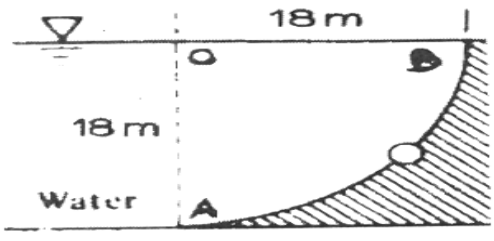

Fig.Q.3c

4 a. Explain the conditions of equilibrium of a floating body in terms of metacentric height. 6

b. Differentiate between the following :

i) Simple manometer and Differential manometer 6

ii) Centre of buoyancy and Metacentric height

Contd….2

c. A differential manometer is connected to two pipes whose centers are at 3 m difference in height. Higher level pipe is carrying liquid of specific gravity 0.9 at a pressure of 1.8 bar and another pipe is carrying liquid of specific gravity 1.5 at a pressure of 1 bar. The centre of pipe carrying low pressure liquid is 2 m above the higher level of the mercury in the manometer. Find out the difference in level of mercury in the manometer 8

UNIT - III

5 a. Distinguish between the following :
i) Laminar flow and Turbulent flow ii) Compressible and Incompressible flow. 6

b. Develop Eulers's equation of motion and then derive Bernoullis equation. 6

c. Determine the stream function given, $u = 2x+y$, $v = x-2y$. 8

6 a. Distinguish Stream lines, Path lines and Streak lines. 6

b. Derive the expression for the continuity equations for three dimensional flow in Cartesian coordinate. 6

c. A vertical pipe of diameter of 30 cm carrying water is reduced to a diameter of 15 cm. The transition piece length is 6 m. The pressure at the bottom is 200 kPa and at the top it is 80 kPa. If frictional drop is 2 m of water head, determine rate of flow. 8

UNIT - IV

7 a. Define the following :
i) Boundary layer thickness ii) Critical Reynold's number iii) Momentum thickness iv) Drag coefficient and Lift coefficient v) Drag force and Lift force. 10

b. Derive Darcy-Weisbatch formula to calculate the frictional head loss in pipe in terms of friction factor 10

8 a. State and explain the necessary frictional losses that should be taken into account in a pipe system design. 10

b. Three pipes 400 mm, 200 mm and 300 mm diameter and having length of 400 m, 200 m, and 300 m are connected in series to make a compound pipe. The ends of this pipe are connected with two tanks whose difference in water level is 16 m. If a friction factor for all pipes is 0.02, determine the discharge through compound pipe. Neglecting first minor losses and then including them. Take coefficient of contraction as 0.6. 10

UNIT - V

9 a. Derive Hagen Poiseuille equation for head loss due to friction in a pipe. 10

b. 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. using dimensionless analysis show that. 10

$$\frac{\Delta P}{\rho u^2} = f\left[\frac{L}{D}, \frac{e}{D}, \frac{\rho u D}{\mu}\right]$$

10 a. Define Buckingham's theorem and mention the advantages of dimensional analysis. 6

b. Explain the method of Selecting Repeating Variables. 4

c. Show that the power P, developed by a hydraulic turbine can be correlated by the dimensionless parameters $P/\rho N^3D^5 = f(h/D, g/DN^2)$, where ρ is the density of water and N is the rotational speed, D is the runner diameter, h is the head and g is acceleration due to gravity. 10

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