CBCS SCHEME

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15MR46

Fourth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Fluid Mechanics

Time: 3 hrs. Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

Module-1

1 a. Derive the expression for capillary rise of liquid by explaining phenomenon of capillarity. **(06 Marks)**

b. A 90 N rectangular solid block slides down a 30° inclined plane. The plane is lubricated by 3 mm thick film of oil relative density 0.9 and viscosity 8 poise. If the contact area is 0.3 m^2, estimate the terminal velocity of the block. **(05 Marks)**

c. A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 0.8 and having vacuum pressure is flowing. The other end of the manometer is open to atmosphere. Find the vacuum pressure in pipe, if the difference of mercury level in the two limbs is 40 cm and the height of fluid in the left from the center of pipe is 15 cm below. **(05 Marks)**

OR

2 a. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(08 Marks)**

b. State and prove hydrostatic law. **(04 Marks)**

c. Define the following:
i) Specific weight ii) Density
iii) Specific gravity iv) Specific volume. **(04 Marks)**

Module-2

3 a. Explain stability of unconstrained submerged bodies in fluid. **(05 Marks)**

b. A solid cylinder of diameter 4 m has a height of 3 meters. Find the meta-centric height of the cylinder when it is floating in water with its axis vertical. The specific gravity of the cylinder is 0.6. **(05 Marks)**

c. Derive the continuity equation in Cartesian coordinates with respect to fluid flow. **(06 Marks)**

OR

4 a. Explain the following:
i) Steady and unsteady flow
ii) Uniform and non-uniform flow **(04 Marks)**

b. State the assumptions made for driving the Bernoulli's equation and derive the same. **(06 Marks)**

c. The water is flowing through a taper pipe of length 100 m having diameter 600 mm at the upper end and 300 mm at the lower end, at the rate of 50 liters/sec. the pipe has a slope of 1 in 30. Find the pressure at the lower end if the pressure at the higher level is 19.62 N/cm^2. **(06 Marks)**

Module-3

5 a. Derive the expression for flow through orfice meter. **(08 Marks)**

b. Water flows over a rectangular weir. 1 m wide at a depth of 150 mm and afterwards passes through a triangular right angled weir. Taking C_d for the rectangular and triangular weir as 0.62 and 0.59 respectively. Find the depth over the triangular weir. **(08 Marks)**

OR

6 a. The variables controlling the motion of a floating vessel in water are the drag force F, which depends on speed V, length L, mass density ρ, dynamic viscosity μ and acceleration due to gravity g. Derive the expression for F using Buckingham's π theorem. **(10 Marks)**

b. Explain: i) Geometric similarity
ii) Kinematic similarity
iii) Dynamic similarity. **(06 Marks)**

Module-4

7 a. Derive Parcy-Weisbach expression for head loss due to friction in a pipe flow and obtain Chazy's equation. **(10 Marks)**

b. The rate of flow of water through a horizontal pipe is 0.25 m^3/sec. The diameter of the pipe which is 200 mm is suddenly enlarged to 400 mm. the pressure intensity in the smaller pipe is 11.772 N/cm^2, determine loss of head due to sudden enlargement, pressure intensity in the large pipe and power lost due to enlargement. **(06 Marks)**

OR

8 a. The flow between two parallel stationary plates show that maximum velocity is 1.5 times average velocity. **(10 Marks)**

b. A fluid of viscosity 0.7 N-Sec/m^2 and specific gravity 1.3 is flowing through a circular pipe of diameter 100 mm. The maximum shear stress at the pipe wall is given as 196.2 N/m^2. Find:
(i) The pressure gradient
(ii) The average velocity
(iii)Reynold's number of the flow. **(06 Marks)**

Module-5

9 a. Derive an expression for drag and lift with usual notations. **(08 Marks)**

b. A metallic ball with diameter of 2 mm is dropped in a liquid of mass density 950 kg/m^3 and velocity 15 poise. Specific gravity of ball is 12. Find:
i) Drag force on ball
ii) The pressure drag
iii) Terminal velocity of the ball **(08 Marks)**

OR

10 a. Explain the following terms:
i) Mach number
ii) Subsonic flow
iii) Sonic flow
iv) Supersonic flow **(06 Marks)**

b. Explain the terms:
i) Boundry layer thickness
ii) Displacement thickness **(06 Marks)**

c. Calculate the Mach number at a point on a jet propelled aircraft, which is flying at 1100 km/hr at sea-level where air temperature is 20°C. Take K = 1.4 and R = 287 J/kg°K. **(04 Marks)**

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