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

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, B.E. - Mechanical Engineering

Semester End Examination; Dec. - 2019

Fluid Mechanics

Time: 3 hrs *Max. Marks: 100*

Note: **i) PART - A** is compulsory. **Two** marks for each question.
ii) PART - B: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.

Q. No.	Questions	Marks
	I : PART - A	**10**
I a.	A reservoir of glycerin has a mass of 1200 kg and a volume of 0.952 m^3.What is the glycerin's specific weight and specific gravity?	2
b.	The gravity at a location is 5 m/s^2. The density of fluid was 2000 kg/m^3. What is the pressure exerted by a column of 1 m of the fluid?	2
c.	Define steady flow and non-uniform flow.	2
d.	Differentiate between friction drag and pressure drag.	2
e.	Determine the dimensions of angular velocity and power.	2
	II : PART - B	**90**
	UNIT - I	**18**
1 a.	Distinguish between; i) Gas and Liquid ii) Specific weight and Specific volume iii) Newtonian and Non-Newtonian Fluids iv) Cohesion and Adhesion force	9
b.	Define capillarity and compressibility. A cylindrical tank of 0.8 m diameter and weights 40 N is slides down an inclined ramp with constant speed of 0.1 m/s. If the 2 mm thickness oil layer on the ramp has viscosity 0.2 Pas. Determine the angle θ of the ramp making with horizontal.	9
c.	Derive the relation between surface tension and pressure inside a droplet of liquid in excess of outside pressure. Determine the diameter of a glass tube necessary to keep the capillarity height change of water less than 2 mm. Take $\sigma = 0.0712$.	9
	UNIT - II	**18**
2 a.	With neat sketch explain the following: i) Inverted U tube differential manometer ii) Stability criteria of floating bodies	9
b.	A square 3 m x 3 m gate is located in 45° sloping side of a dam. Some measurements indicate that the resultant force of the water on the gate is 500 kN. Determine the position of center of pressure and also determine pressure at the bottom of the gate.	9

Contd…2

c. A closed cylindrical tank filled with water has a hemispherical dome and is connected to an inverted piping system as shown in Fig. Q 2c. The liquid in the top part of the piping system has specific gravity of 0.8, and the remaining parts of the system are filled with water. If the pressure gauge reading at A is 60 kPa, determine; 9

i) The pressure in pipe B

ii) The pressure head, in millimeters of mercury, at the top of the dome (point C).

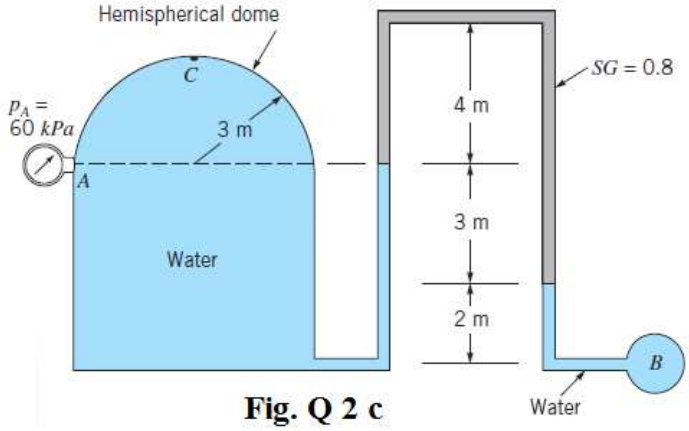

Fig. Q 2 c

UNIT - III

18

3 a. Distinguish between the following :

i) Laminar flow and Turbulent flow ii) Compressible and Incompressible flow 9

iii) Rotational and Irrotational flow

b. Check whether the following relations satisfy the requirements for steady and irrotational flow: i) $U = xt^2 + 2y$, $v = x^2 - yt^2$ ii) $\psi = 4(x^2 - y^2)$ 9

c. A liquid with specific gravity 0.8 flows at the rate of 3 liters per second through a venturimeter of diameters 6 cm and 4 cm. If the manometer fluid is mercury (sp.gr = 13.6), determine the value of manometer reading. 9

UNIT - IV

18

4 a. Determine the following:

i) Drag force and Lift force

ii) Displacement thickness and Momentum thickness 9

iii) Hydraulic gradient and Total energy line

b. Air at a pressure of 83.4 kPa and 25°C flows with a velocity of 6 m/s over a 2.5 m and 8 m flat plate. Determine the drag force acting on the top surface of the plate, if the air flows parallel to the (i) 8 m long side and (ii) the 2.5 m long side. Take friction coefficient as 0.003189 and 0.002691 when air flows parallel to 8 m and 2.5 m side respectively. 9

c. Water at 10°C (ρ = 999.7 kg/m^3) and μ = 1.307x10^{-3} Pa.s is flowing steadily in a 2 mm diameter, 15 m long pipe at an average velocity of 1.2 m/s. Determine; 9

i) The pressure drop ii) The head loss

iii) The pumping power requirement to overcome this pressure drop

Contd…3

UNIT - V **18**

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

b. The resisting force of a supersonic plane during flight can be considered as dependent on the length of the aircraft L, velocity V, viscosity μ, mass density ρ, Bulk modulus K. Express the fundamental relationship between resisting force and these variables using Buckingham's Π theorem method, $R = (L^2\ V^2\ \rho)\phi\left|\frac{k}{v^2\rho}, \frac{\mu}{\rho VL}\right|$ 9

c. An oil is flowing between two parallel plates kept at 10 cm apart with maximum velocity of 1.5 m/s. Find velocity at 2 cm from the plate surface, the pressure difference 20 m apart along the flow direction. Take μ for oil as 25 poise. 9

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