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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; March - 2021

Fluid Mechanics

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Explain fluid properties like density, weight density, specific volume, specific gravity, viscosity and surface tension. Solve problems on viscosity and surface tension.

CO2: Derive Pascal's law and fundamental law of hydrostatics and Explain buoyancy and centre of buoyancy.

CO3: Describe the types of fluid flow and solve problems on continuity equation, Euler's equation of motion and Bernoulli's equation.

CO4: Explain boundary layer concept and define hydraulic gradient line and total energy line.

CO5: Derive Hagen-Poiseuille equation and apply dimensional analysis technique to obtain dimensionless relations.

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	BL	COs	POs
	I : PART - A	**10**			
I a.	What is specific gravity? How is related to density?	2	L1	CO1	PO1
b.	What is atmospheric pressure at a location where the barometric reading is 750 mmHg. Take the density of mercury to be 13,600 kg/m^3.	2	L1	CO2	PO1
c.	Define velocity potential function and stream function.	2	L1	CO3	PO1
d.	Define drag coefficient and lift coefficient.	2	L1	CO4	PO1
e.	Write the dimensions of dynamic viscosity and energy.	2	L1	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	Distinguish between; i) Gauge pressure and Absolute pressure ii) Kinematic viscosity and Dynamic viscosity iii) Newtonian and Non-Newtonian fluids	9	L1	CO1	PO1
b.	Define surface tension and vapour pressure. A shaft 70 mm in diameter is being pushed at a speed of 400 mm/s through a bearing sleeve of 70.2 mm in diameter and 250 mm long. The clearance, assumed uniform is filled with oil of kinematic viscosity 0.005 m^3/s and specific gravity 0.9. Find the force exerted by the oil on the shaft.	9	L3	CO1	PO2
c.	Derive an expression for the change in height '*h*' in a circular tube of a liquid with surface tension 'σ' and contact angle 'θ'. Determine the gauge pressure inside a soap bubble of diameter, i) 0.2 cm and ii) 5 cm. The surface tension of soap water is 0.025 N/m.	9	L3	CO1	PO2

Contd… 2

UNIT - II — 18

2 a. With neat sketch, explain the following:

i) Measurement of negative pressure using U-tube manometer — 9 L2 CO2 PO2

ii) Stability criteria of immersed bodies

b. State the basic principle involved in measuring pressure and pressure difference using manometers and also calculate the pressure difference between *A* and *B* for the setup shown in Fig. Q.2.b. — 9 L3 CO2 PO1

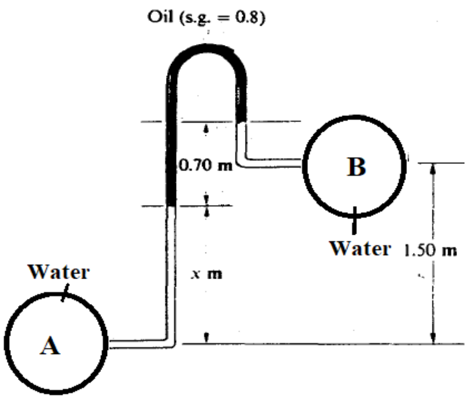

Fig.Q.2.b

c. Calculate the resultant force on triangular window ABC as shown in Fig. Q.2.C and also locate its centre of pressure. — 9 L3 CO2 PO2

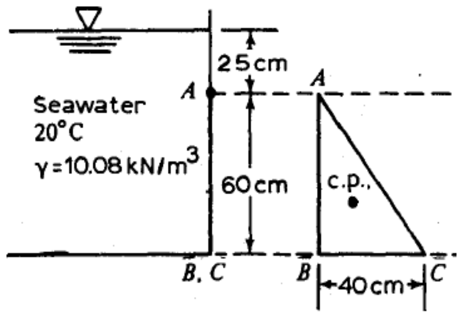

Fig.Q.2.c

UNIT - III — 18

3 a. Distinguish between the following: — 9 L2 CO3 PO1

i) Uniform and Non-uniform flow

ii) Stream line and Path line

iii) Rotational and Irrational flow

b. Check whether the following relations satisfy the requirements for steady and irrotational flow: — 9 L3 CO3 PO1

i) $u = 2x + y, v = x - 2y$ ii) $\phi = (y^2 - x^2)$

c. A Venturimeter having throat diameter of 150 mm is installed in a horizontal 300 mm diameter water main. The coefficient of discharge is 0.982. Determine the difference in level of the mercury columns of the differential manometer attached to the venturimeter if the discharge is 0.142 m^3/s. — 9 L3 CO3 PO1

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		Marks	Level	CO	PO
	UNIT - IV	**18**			
4 a.	Explain the concept of boundary layer and also derive an expression for displacement thickness.	9	L1	CO4	PO1
b.	An advertise board of 6 m^2 is mounted on a pole 5 m height. The wind is blowing with velocity of 36 km/hr. Find the wind force on the board and the bending moment at the base of the pole. Take C_d = 1.35 and ρ = 1.2 kg/m^3.	9	L3	CO4	PO1
c.	Lubricating oil at a velocity of 1 m/s flow through a pipe of 100 mm diameter. Determine whether the flow is laminar or turbulent. Also determine the friction factor and the pressure drop over 10 m length. What should be the velocity for the flow to turn turbulent? Take density as 930 kg/m^3 and dynamic viscosity as 0.1 Pa.s.	9	L3	CO4	PO1
	UNIT - V	**18**			
5 a.	Show that for fully developed laminar flow of a fluid with viscosity 'μ' flowing between horizontal fixed parallel plates kept at distance 'h' m apart, the mean velocity $\overline{U}$ is related to the pressure gradient $\frac{\partial p}{\partial x}$ by the relation $\overline{U} = -\frac{1}{12\mu}\frac{\partial p}{\partial x}h^2$.	9	L2	CO5	PO1
b.	Prove that the frictional torque T of a disc of diameter D rotating at a speed N in a fluid of viscosity μ and density ρ in a turbulent flow is given by $T = (D^5 N^2 \rho) f\left[\frac{\mu}{D^2 N \rho}\right]$.	9	L2	CO5	PO1
c.	A laminar flow is taking place in a pipe of diameter 200 mm. The maximum velocity is 1.5 m/s. Find the mean velocity and the radius at which this occurs. Also calculate the velocity at 4 cm from the wall of pipe.	9	L3	CO5	PO1

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