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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.	What is the density of one litre of a liquid which weighs 7N?	2
	b.	A stone weighs 392.4 N in air and 196.2 N in water, compute the volume of stone.	2
	c.	Distinguish between compressible flow and incompressible flow.	2
	d.	Define drag force and lift force.	2
	e.	Define Reynold's number and Mach number.	2
		II : PART - B	**90**
		UNIT - I	**18**
1	a.	Define the following and write SI units for the same : i) Dynamic viscosity and Kinematic viscosity ii) Surface tension and Capillarity iii) Vapour pressure and Cavitation	9
	b.	State and prove Pascal's law.	9
	c.	A vertical cylinder of diameter 180 mm rotates concentrically inside another cylinder of diameter 181.2 mm. Both the cylinders are 300 mm high. The space between the cylinders is filled with a liquid whose viscosity is unknown. Determine the viscosity of the fluid, if a torque of 20 N-m is required to rotate the inner cylinder at 120 rpm.	9
		UNIT - II	**18**
2	a.	Develop an expression for total pressure force and position of centre of pressure for an inclined plane surface submerged in a liquid.	9
	b.	A simple U–tube manometer containing mercury is connected to a pipe in which a fluid of sp. Gr. 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 400 mm and the height of fluid in the left from the centre of pipe is 150 mm below. Sketch the arrangement.	9

Contd…2

c. A solid cylinder of diameter 4 m has a height of 4 m. Find the meta-centric height of the cylinder, if the sp. Gr. of the material of cylinder is 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. 9

UNIT - III **18**

3 a. Develop an expression for Bernoulli's theorem from Euler's equation. Also state the assumptions made. 9

b. In a 2D flow, the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine its form. Find also the stream function. 9

c. A 20 cm × 10 cm horizontal venturimeter is used to measure the flow of water. The pressure at inlet is 17.658 N/cm^2 and the vacuum pressure at the throat is 30 cm of mercury. Find the discharge of water through venturimeter. Take $C_d = 0.98$. 9

UNIT - IV **18**

4 a. Distinguish between:

i) Pressure drag and Friction drag ii) Displacement thickness and Momentum thickness iii) Hydraulic gradient line and Total energy line 9

b. Water is to be supplied to the inhabitants of a college hostel through a supply main. The following data are given:

The distance of the reservoir from the hostel = 4000 m, number of inhabitants = 3000, consumption of water per day of each inhabitants =180 litres, loss of head due to friction = 18m. Coefficient of friction for the pipe $f = 0.007$. If the half of the daily supply is pumped in 8 hours. Determine the size of the supply main. 9

c. Experiments were conducted in a wind tunnel with a wind speed of 50 km/hour on a flat plate of size 2 m long and 1 m wide. The density of air is 1.15 kg/m^3. The coefficient of lift and drag are 0.75 and 0.15 respectively. Determine; 9

(i) Lift force (ii) Drag force (iii) Resultant force

(iv) Direction of resultant force (v) Power exerted by air on the plate

UNIT - V **18**

5 a. Derive Hagen-Poiseuille equation with usual notations. 9

b. Using Buckingham's π Theorem, show that the velocity through a circular orifice is given by $V = \sqrt{2gh}\phi\left[\frac{D}{H}, \frac{\mu}{\rho VH}\right]$ where H is the head causing flow, D is the diameter of the orifice, μ is coefficient of viscosity, ρ is the mass density and g is the acceleration due to gravity. 9

c. A crude oil of viscosity 0.97 poise and relative density 0.9 is flowing through a horizontal circular pipe of diameter 100 mm and length 10 m. Calculate the difference of pressure at the two ends of the pipe, if 100 kg of the oil is collected in a tank in 30 seconds. Assume laminar flow. 9

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