U.S.N [ ][ ][ ][ ][ ][ ][ ][ ][ ]

P.E.S. College of Engineering, Mandya - 571 401
(An Autonomous Institution affiliated to VTU, Belagavi)
Third Semester, B.E. - Industrial and Production Engineering
Semester End Examination; March - 2021
Fluid Mechanics and Hydraulic Machines

Time: 3 hrs   *Max. Marks: 100*

Course Outcomes
The Students will be able to:
CO1: Explain the properties of fluid like density, specific weight, specific gravity, viscosity etc; estimate the variations of pressure in a static mass of fluid, and Applying Pascal's Law.
CO2: Explain the principles of fluid kinematics involving different types of flows, velocity and acceleration, continuity equation.
CO3: Derive the equations of motion and explain fluid flow measurement devices like Venturimeter, orifice meter etc.; evaluate the energy losses in pipe flow.
CO4: Explain the operation of energy producing devices like turbines through velocity triangles knowing fully the principles of impact of jets on vanes.
CO5: Draw the velocity triangles to explain the working of energy absorbing device like centrifugal pump and the working principle of reciprocating pum.

<u>*Note:*</u> *I) PART - A is compulsory. **Two** marks for each question.*
    *II) PART - B: Answer any <u>**Two**</u> sub questions (from a, b, c) for Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
I a.	Specific gravity of a given fluid is 0.8. Find its mass density in kg/m^3.	2			
b.	Explain the principle of floatation.	2			
c.	Differentiate between Steady and Uniform flow.	2			
d.	List two important differences between inward and outward radial flow reactions turbines.	2			
e.	Define specific speed for a centrifugal pump.	2			
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	Define the following fluid properties mentioning their units in SI system: i) Specific Weight ii) Absolute viscosity iii) Surface tension	9			
b.	A simple manometer is used to measure the pressure of oil (specific gravity = 0.8) flowing in a pipe line. The centre of pipe is 9 cm below the level of mercury in the right limb. If the difference of mercury levels in the two limbs of the manometer is 15 cm, determine the absolute pressure of the oil in the pipe in N/cm^2. Sketch the arrangement.	9			
c.	Fig Q(1c) shows a flat plate 1 m^2 area and mass 10 kg sliding down a 30° inclined plane over a 0.1 cm uniform. Layer of oil of viscosity $\mu = 0.5$ poise. Determine the steady state velocity of the plate.	9			

U= ?
30°
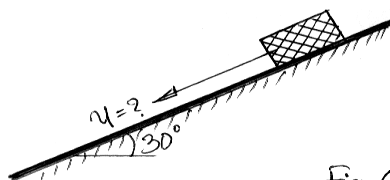
Fig. Q 1(c)

## UNIT - II   **18**

2 a. Briefly explain how the total pressure force and centre of pressure is determined for a curved plane surface and mention clearly what P_X and P_Y stand for?   9

b. A pipeline which is 4 m in diameter contains a gate valve. The pressure at the centre of the pipe is 19.6 N/cm^2. If the pipe is filled with oil of specific gravity of 0.87, find the force exerted by the oil upon the gate in and the position of centre of pressure from the centerline of the pipe.   9

c. A closed cylindrical tank of diameter 2.0 m, height 1.2 m, weighing 20 kN is floating with its axis vertical in sea water whose specific gravity is 1.025. Find the depth of the cylinder of immersion, if an additional load of 5 kN is added at the top.   9

UNIT - III   **18**

3 a. Write the expression for the following and explain the terms:

i) Continuity equations in three dimensions

ii) Bernoulli's equation for real fluids   9

iii) Venturi head for an inclined venturimeter

b. I) Identify the combinations of flow types occurring in the closed conditions (a) and (b) shown in Fig. Q3(b).

fig. Q3(b)
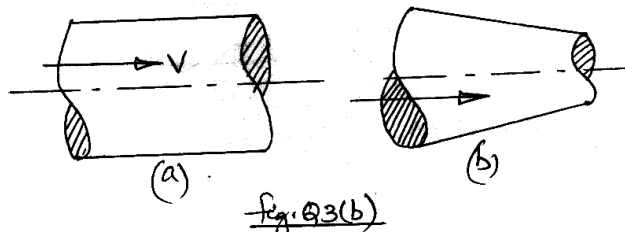
II) Sketch a pitot tube and briefly explain its functioning. Write an expression for velocity of flow of fluid as measured by it.   9

c. A venturi meter 40 cm × 20 cm is provided in a vertical pipe to measure the flow of oil of specific gravity 0.80. The difference in elevation of the throat section and the entrance section is 1 m, the direction of flow of oil being vertically upwards. The oil mercury differential gauge shows deflection of mercury equal to 40 cm. Determine the quantity of oil flowing in pipe in *lt/s*. Assume 0.98 as the value of C_d. Sketch the arrangement.   9

UNIT - IV   **18**

4 a. Differentiate between;

i) Major and Minor energy losses

ii) Impulse and Reaction turbines   9

iii) Kaplan and Propeller turbines

b. Explain the hydraulic function of the following elements of a reaction turbine:

9

 i) Spiral casing ii) Draft tube iii) Guide wheel

c. Draw inlet and outlet velocity triangles for a pelton wheel when (angle made by the absolute velocity V_2 with the direction of motion of vane at outlet) is, i) Acute ii) 90° iii) Obtuse

9

Write expressions for work done per second per unit weight of water striking and hydraulic efficiency in each case.

UNIT - V

18

5 a. Derive an expression for the work done by the centrifugal pump on water with usual notations by drawing the velocity triangles at inlet and outlet.

9

b. A double acting reciprocating Pump running at 50 rpm is discharging 900 litres of water per minute. The pump has a stroke of 400 mm and the diameter of the piston is 250 m. The delivery and section heads are 25 m and 4 m respectively. Find the slip of the pump and the power required to drive the pump.

9

c. Explain in brief, the functions of the following elements of the pumps:

 i) Air vessels of reciprocating pumps

 ii) Vortex casing of a centrifugal pump

9

 iii) Casing with guide blades of a centrifugal pump

✳ ✳ ✳