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

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Industrial and Production Engineering

Semester End Examination; Dec - 2016/Jan - 2017

Fluid Mechanics and Hydraulic Machinery

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Distinguish between:

i) Absolute viscosity and Kinematic viscosity ii) Ideal fluid and Real fluid

iii) Newtonian and Non Newtonian fluid iv) Ideal plastic and Elastic Solid. 10

b. A 400 mm diameter shaft is rotating at 200 rpm in a bearing of length 120 mm. If the thickness of oil film is 1.5 mm and the dynamic viscosity of the oil is 0.7 N-s/m^2. Determine; 6

i) Torque required to overcome friction in bearing

ii) Power utilized in overcoming viscous resistance.

c. When the pressure of liquid is increased from 3.5 MN/m^2 to 6.5 MN/m^2 its volume is found to decrease by 0.08 percent. Find the bulk modulus of elasticity of the liquid. 4

2 a. State and prove the following laws : 10

i) Pascal's law ii) Hydrostatic law.

b. Explain the following : 6

i) Piezometer ii) U-tube manometer.

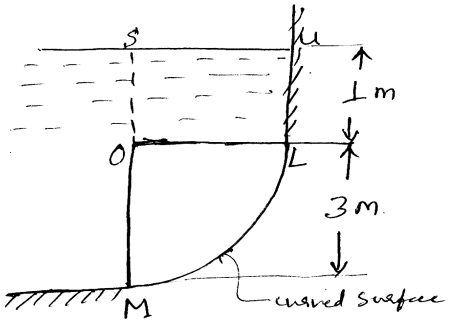
c. Distinguish between : 4

i) Atmospheric pressure and Gauge pressure ii) Absolute pressure and Vacuum pressure.

UNIT - II

3 a. Find the expression for the total and centre of pressure for a vertically immersed surface. 10

b. Figure (a) shows a curved surface LM, which is in the form of a quadrant of a circle of radius 3 m, immersed in the water. If the width of the gate is unity, calculate the horizontal and vertical components of the total force acting on the curved surface. 10



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4 a. Find an expression for metacentric height for floating body (analytical method). 10

b. A body has the cylindridcal upper portion of 4 m diameter and 2.4 m deep. The lower portion, which is curved displaces a volume of 800 litres of water and its centre of buoyabcy is situated 2.6 m below the top of the cylinder. The centre of gravity of the whole body is 1.6 m below the top fo the cylinder and the total displacement of waer is 52 kN. Find the metacentric height of the body. 10

UNIT - III

5 a. Distinguish between :

i) Steady and unsteady flow ii) Uniform and non-uniform flow 10

iii) Laminar and turbulent flow iv) Rotational and irrotational flow.

b. Find an expression for continuity equation for a three dimensional flow. 6

c. Given $V = (xy + 2zt)t + (2y^2 + xyt)\,j + (12xy)\,k$ where x, y *and* z are in meters and 't' in seconds. Determine *ax*, the *x* component of the acceleration of the fluid particle at (1, 1, 1) at t = 1 sec. 4

6 a. Derive the Euler's equation of motion for ideal fluids and hence deduce Bernoulli's equation of motion. Mention the assumptions made. 10

b. Name the various forces present in a fluid flow. 2

c. A 300 mm x 150 mm venturimeter is provided in a vertical pipeline carrying oil of specific gravity 0.9, flow being upward. The difference in elevation of the throat section and entrance section of the Venturimeter is 300 mm. the differential U-tube manometer shows a gauge deflection of 250 mm. Find; 8

i) The discharge of oil

ii) The pressure difference between the entrance and throat section.

Take coefficient of meter as 0.98 and specific gravity of mercury as 13.6.

UNIT - IV

7 a. Derive Chezy's formula for loss of head due to friction in a pipe. 10

b. How the turbines are classified explain with example. 4

c. The mean bucket speed of a Pelton turbine is 15 m/s. The rate of flow of water is supplied 6

by the jet under a head of 42 m is 1 m^3/s. If the jet is deflected by the buckets at an angle of 165º. Find the power and efficiency of the turbine. Take $C_V = 0.985$.

8 a. Prove that the work done/sec/unit weight of water in a reaction turbine is given as $\frac{1}{g}(V_{w1}u_1 + V_{w2}u_2)$. 6

b. Define the terms major energy losses and minor energy losses in pipes. 4

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c. A square plate weighing 115 N and of uniform thickness and 30 cm edge is hung so that horizontal jet 2 cm diameter and having a velocity of 15 m/s impinges on the plate. The centre line of the jet is 15 cm below the upper edge of the plate, and when the plate is vertical the jet strikes the plate normally and at its centre. Find what force must be applied at the lower edge of the plate in order to keep the plate vertical? If the plate is allowed to swing freely. Find the inclination to the vertical which the plate will assume under the action of jet. 10

UNIT - V

9 a. What is a reciprocating pump? Describe the principle and working of a reciprocating pump with neat sketch. 8

b. Explain why a reciprocating pump is called a positive displacement pump? 4

c. A single acting reciprocating pump has the plunger diameter of 20 cm and stroke of 30 cm. The pump discharges of 0.53 m^3 of water per minute at 60 rpm. Find the theoretical discharge, co-efficient of discharge and percentage slip of pump. If suction and delivery heads are 4 m and 12 m respectively. Workout power organized to run the pump. 8

10 a. Explain the terms manometric efficiency, mechanical efficiency and overall efficiency as applied to centrifugal pumps. 6

b. Draw a neat sketch of centrifugal pump and explain how does it operate? 8

c. A centrifugal pump having an overall efficiency of 72% delivers 0.03 m^3/s of water to a height of 20 m through a 10 cm diameter pipe 80 m long. Take $f = 0.01$, calculate the power required to run the pump. 6

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