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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. - 2015

Fluid Mechanics and Machinery

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting at least **ONE** full question from each **unit**.*
ii) Missing data may suitably be assumed.

UNIT - I

1 a. Define the following fluid properties indicating their units in SI system,
i) Mass density ii) Specific weight
iii) Kinematic viscosity iv) Surface tension. 6

b. Derive an expression for capillary rise in a glass tube of diameter 'd' immersed in water. 6

c. The dynamic viscosity of an oil, used for lubrication between a shaft and sleeve is 6 poise the shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of oil film is 1.5 mm. 8

2 a. State and prove 'Pascal's law'. 10

b. Establish a relation amongst absolute, gauge and atmospheric pressure with a simple sketch and explain. 5

c. The right limb of a simple U - tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of sp. gr. 0.9 is flowing. The centre of the pipe is 12 cm below the level of mercury in the left limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm. 5

UNIT - II

3 a. Obtain an expression for the total pressure and centre of pressure on a vertical plane when it is submerged in the liquid. 10

b. A solid cylinder of diameter 4.0 m has a height of 1.0 m. Find the meta - centric heights of the cylinder, if the specific gravity of the material of cylinder = 0.6 and it is floating in water with its axis vertical. State whether the equilibrium is stable or unstable. 5

c. A uniform body of size 3 m long x 2 m wide x 1 m deep floats in water. What is the weight of the body if depth of immersion is 0.8 m? Determine the meta - centric height also. 5

4 a. Differentiate between :
i) Steady and unsteady flow
ii) Uniform flow and non - uniform flow.
iii) Laminar and turbulent flow. 9

b. Obtain an expression for continuity equation for a three - dimensional flow. 11

Contd…2

UNIT - III

5 a. State the Buckingham's theorem. The efficiency η of a fan depends on density 'ρ' dynamic viscosity μ of the fluid, angular velocity w, diameter D of the rotor and the discharge Q. Express η is terms of dimensionless parameter. 10

b. Define the following dimensionless number and their significance, 10

i) Froude number ii) Euler's number iii) Mach number.

6. a. State Bernoulli's theorem for steady flow of an incompressible fluid. Derive an expression for Bernoulli's equation from first principle and state the assumptions made for such a derivation. 12

b. Water is flowing through a pipe having diameters 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm^2 and the pressure at the upper end 9.81 N/m^2. Determine the difference in datum head if the rate of flow through pipe is 40 lit./s. 8

UNIT - IV

7 a. Derive the Darcy - Weisbach equation for the loss of head due to friction in a pipe. 10

b. Sketch a Pitot - tube arrangement for finding the velocity of flow of fluid. Derive an expression for the velocity of flow measured by the same. 10

8 a. Prove that the work per second per unit weight of water in a reaction turbine is given at $\frac{1}{g}\left[V_{w1}U_1 \pm V_{w2}U_2\right]$. 10

b. A pelton wheel is revolving at a speed of 190 rpm and develops 2150.25 kW when working under a head of 220 m with an overall efficiency of 80%. Determine unit speed, unit discharge and unit power. The speed ratio for the turbine is given as 0.47. Find the speed, discharge and power when this turbine is working under a head of 140 m. 10

UNIT - V

9 a. Give the classification of reciprocating pumps explain with a simple sketch the working principle of reciprocating pump. 10

b. A single acting reciprocating pump, running at 50 rpm, delivers 0.01 m^3/s of water. The diameter of the piston is 200 mm and stroke length 400 mm. Determine : 10

i) The theoretical discharge of the pump ii) Coefficient of discharge

iii) Slip and the percentage slip of the pump.

10 a. Derive an expression for work done by the impeller on water in a centrifugal pump with usual notation. 10

b. A centrifugal pump delivers water against a net head of 14.5 m and a design speed of 1000 rpm. The vanes are curved back to an angle of 30^o with periphery. The impeller diameter is 300 mm and outlet width is 50 mm. Determine the discharge of the pump if manometric efficiency is 95%. 10

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