PVP 20

Code: 20ME3301

II B.Tech - I Semester – Regular Examinations - FEBRUARY 2022

FLUID MECHANICS AND HYDRAULIC MACHINES
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

Note: 1. This paper contains questions from 5 units of Syllabus. Each unit carries 14 marks and have an internal choice of Questions.
2. All parts of Question must be answered in one place.

UNIT – I

1. a) $3.2\ m^3$ of a certain oil weighs 27.5 kN. Calculate its specific weight, mass density, specific volume and specific gravity. If kinematic viscosity of oil is 7×10^{-3} stokes, what would be its dynamic viscosity in centipoise? 8 M

   b) Describe the principle employed in manometers for measurement of pressure. Explain the difference between a simple and differential manometer. 6 M

OR

2. a) What is meant by intensity of pressure? How it varies with the depth of fluid? 4 M

   b) A simple U-tube manometer containing mercury is connected to a pipe in which a fluid of specific gravity 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 40 cm and the height of fluid in the left from the centre of pipe is 15 cm below. 10 M

UNIT – II

3. a) Deduce the general three-dimensional equation of continuity and derive from it the continuity equation for one-dimensional frictionless flow. 8 M

   b) Water flows through a 10 cm diameter pipe with velocity 8 m/s. compute the discharge rate. If the same flow now takes place through a 20 cm diameter pipe, evaluate the new velocity. 6 M

OR

4. a) Water flows through a 4.5 m high conical vertical pipe whose diameter changes from 40 cm at the top end to 120 cm at the bottom end. Measurements indicate that when velocity at the smaller section is 9 m/s, the friction head loss is 2 m for flow in either direction. For a pressure indication of 1.6 m of water at the smaller section, make calculation for the pressure at the larger section when the flow is in the (i) downward direction (ii) upward direction. 8 M

   b) Derive an expression for the head loss due to sudden enlargement in pipe flow. 6 M

UNIT-III

5. a) Determine the diameter of throat of a venturimeter to be introduced in a horizontal section of a 10 cm diameter main so that reading of a differential U-tube manometer is 60 cm when the discharge is 20 litres per second. Assume the discharge coefficient of the meter as 0.95. If the meter had been placed vertically with flow upwards, what would have been the gauge reading for the same rate of flow? Assume that the inlet and throat sections are 20 cm apart. 8 M

b) The discharge through a venturimeter depends upon '*dp*' only and is independent of the orientation of the meter. Discuss the correctness of this statement. 6 M

OR

6. a) Deduce the expression for the force exerted by a jet of water on an inclined fixed plate in the direction of jet. 7 M

b) A 50 mm diameter jet having a velocity of 18 m/s impinges without shock on a flat plate inclined at an angle of 30^0 to the axis of the jet. If the plate is moving at 5 m/s in the direction of jet, make calculations for the normal force exerted on the plate, work done and the efficiency. 7 M

UNIT – IV

7. a) Differentiate between impulse and reaction type of hydraulic turbines. 5 M

b) Explain the terms unit speed, unit power, and specific speed as used in connection with the operation of a hydraulic turbine. 6 M

c) Give the classification of hydraulic turbines based on specific speed. 3 M

OR

8. a) Explain the factors which decide the choice for a particular hydraulic turbine for a hydro-power project. 6 M

b) The following data relates to a Pelton turbine that generates 4000 kW under a net head of 300 m: 8 M

Speed ratio = 0.45; coefficient of velocity for nozzle = 0.97; jet ratio = 12; angle of jet deflection = 165^0; generator efficiency = 96 %; overall efficiency = 86 %; frictional loss of buckets = 10 %.

Determine (i) diameter of jet (ii) mean runner diameter (iii) force exerted on runner buckets (iv) synchronous speed.

UNIT – V

9. a) Give the complete classification of hydraulic pumps. 4 M

   b) Explain the terms manometric efficiency, mechanical efficiency and overall efficiency as applied to centrifugal pumps. 6 M

   c) Explain the term negative slip as used in connection with the working of a reciprocating pump. Why and when negative slip occurs? 4 M

OR

10. a) A centrifugal pump with an impeller diameter 30 cm runs at 1450 rpm and delivers 2.3 m^3/min against a head of 16 m. Estimate the head and size of a geometrically similar pump which would deliver half the quantity while running at the same speed. 7 M

    b) A single acting reciprocating pump has the plunger diameter of 20 cm and stroke of 30 cm. The pump discharges 0.53 m^3 of water per minute at 60 rpm. Find the theoretical discharge, coefficient of discharge and percentage slip of pump. Further, if suction and delivery heads are 4 m and 12 m respectively, work out for power required to run the pump. 7 M