

- (b) A centrifugal pump is to discharge $0.118 \text{ m}^3/\text{s}$ at a speed of 1450 r.p.m. against a head of 25 m. The impeller diameter is 250 mm, its width at outlet is 50 mm and manometric efficiency is 75 %. Determine the vane angle at the periphery of the impeller. 10

SECTION - D

8. (a) A single-acting reciprocating pump has a plunger diameter of 25 cm and stroke of 45 cm and it is driven with S.H.M. at 60 r.p.m. The length and diameter of delivery pipe are 60 m and 100 m respectively. Determine the power saved in overcoming friction in the delivery pipe by fitting an air vessel on the delivery side of the pump. Assume friction factor = 0.01. 10
- (b) Explain with neat sketch, the principle and working of gear-wheel pump. 10
9. (a) What is an air-vessel? Describe the function of air-vessel for reciprocating pump. 10
- (b) The total weight (including the self-weight of ram) placed on the sliding ram of a hydraulic accumulator is 40 kN. The diameter of the ram is 50 cm. If the frictional resistance against the movement of the ram is 5% of the total weight, determine the intensity of pressure of water when :
- (i) The ram is moving up with a uniform velocity, and
- (ii) The ram is moving down with uniform velocity.

Roll No. _____

24259

B. Tech. 5th Semester (ME) Examination – February, 2022

FLUID MACHINE

Paper : ME-305-F

Time : Three Hours]

[Maximum Marks : 100

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt five questions in all, selecting one question from each Section. Question No. 1 is compulsory. All questions carry equal marks.

1. Explain following : 4 × 5 = 20
- (a) Jet propulsion of ships.
- (b) Cavitation in a turbine.
- (c) Specific speed of a turbine.
- (d) Torque converter.

SECTION - A

2. (a) A nozzle of 50 mm diameter delivers a stream of water at 20 m/s perpendicular to a plate that moves away from the jet at 5 m/s. Find : 10

(i) force on the plate, (ii) the work done, and (iii) the efficiency of jet

- (b) A Pelton wheel is to be designed for the following specifications: 10

Shaft power = 11, 772 kW; Head = 400 meters, Speed = 750 r.p.m.; Overall efficiency = 86%, jet diameter is not to exceed one-sixth of the wheel diameter. Determine:

- (i) The wheel diameter,
(ii) The number of jets required, and
(iii) Diameter of the jet.

Assume co-efficient of velocity as 0.985 and speed ratio = 0.45

3. (a) A jet of water of diameter 50 mm moving with a velocity of 40 m/s, strikes a curved fixed symmetric plate at the centre. Find the force exerted by the jet of water in the direction of jet, if the jet is deflected through an angle of 135 degree at the outlet of curved plate. 10
- (b) What is governing of turbine? Explain governing of Pelton turbine. 10

SECTION - B

4. The following data is given for a Francis turbine, Net head = 60 m; Speed $N = 700$ r.p.m.; shaft power = 294.3 kW; $\eta_{10} = 84\%$; $\eta_h = 93\%$; flow ratio = 0.20; breadth ratio $n = 0.1$; Outer diameter of the runner = 2 x inner diameter of the runner. The thicknesses of vanes occupy 5% of circumference area of the runner,

velocity of flow is constant at inlet and outlet and discharge is radial at outlet. Determine 20

- (i) Guide blade angle,
(ii) Runner vane angles at the inlet and outlet,
(iii) Diameter of runner at inlet and outlet, and
(iv) Width of the wheel at inlet.
5. (a) Differentiate between Kaplan and Propeller turbine. 10
- (b) The external and internal diameters of an inward flow reaction turbine are 1.20 m and 0.6 m respectively. The head on the turbine is 20 m and velocity of flow through the runner is constant and equal to 2.5 m/s. The guide blade angle is given as 10° and the runner vanes are radial at inlet. If the discharge at outlet is radial, determine: 10
- (i) The speed of turbine
(ii) The vane angle at outlet of the runner, and
(iii) Hydraulic efficiency.

SECTION - C

6. (a) State Buckingham's π -theorem. What do you mean by repeating variables? How are the repeating variables selected in dimensional analysis? 12
- (b) How does a volute casing differ from a vortex casing for the centrifugal pump? 8
7. (a) What is the significance of the non-dimensional numbers? Define Reynolds number, Froude number and Mach number. 10