Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) EXAMINATION – SUMMER 2019

Subject Code: 2151903 Date: 31/05/2019

Subject Name: Fluid Power Engineering

Time: 02:30 PM TO 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain the impulse-momentum principle. **03**

(b) State the functions of following components of hydro power plant: Trash rack, surge tank, dam and power house. **04**

(c) How ships are propelled ? Derive an expression for propulsive work and propulsive efficiency if the water is drawn from an orifice at right angles to the motion of ship. **07**

Q.2 **(a)** State major applications of hydro power plant. **03**

(b) Show that the force exerted by a jet of water on an inclined fixed plate in the direction of jet is given by $F_x = \rho a V^2 \sin^2\theta$ **04**
Where a = Area of the jet, V = Velocity of the jet and θ = Inclination of the plate with the jet.

(c) A 80 mm diameter jet having a velocity of 25 m/sec strikes a flat plate, the normal of which is inclined at 45° to the axis of the jet. Find the normal pressure on the plate **07**
(i) When the plate is stationary
(ii) When the plate is moving with a velocity of 12 m/sec in the direction of jet and away from the jet.
Also determine the power and efficiency of the jet when the plate is moving.

OR

(c) A jet of water strikes at the centre of a single curved vane moving in the direction of jet with velocity u so that jet velocity relative to vane is (V – u). If the outgoing jet makes an angle θ with the entering jet prove that **07**
(i) For maximum efficiency V = 3u and
(ii) Maximum efficiency = $\frac{8}{27}(1 + \cos\theta)$

Q.3 **(a)** Differentiate between Francis and Kaplan turbine. **03**

(b) A Pelton wheel has a mean bucket speed of 10 m/sec with a jet of water flowing at the rate of 800 litres/sec under a head of 32 metres. The bucket deflects the jet through an angle of 165°. Calculate the power given by water to the runner and hydraulic efficiency of the turbine. Assume co-efficient of velocity as 0.98. **04**

(c) What is draft tube ? State its functions. With neat diagrams explain salient features of different types of draft tube. **07**

OR

Q.3 **(a)** Compare inward flow and outward flow reaction turbine. **03**

(b) Define the term specific speed and derive an expression for specific speed of hydraulic turbine. **04**

(c) What do you mean by characteristic curves for hydraulic turbines ? Discuss the main characteristic curves. **07**

Q.4 **(a)** What do you mean by an air vessel ? Explain the function of an air vessel for reciprocating pump. **03**

(b) Discuss the criteria for selection of pumps. **04**

(c) Show that the pressure rise in impeller of a centrifugal pump is given by **07**

$$\frac{1}{2g}\left[V_{f_1}^2 - V_{f_2}^2 \operatorname{cosec}^2 \beta_2 + u_2^2 \right]$$

where β_2 is the blade angle at outlet . Neglect the friction losses.

OR

Q.4 **(a)** Compare screw and scroll compressor. **03**

(b) What is pre-whirl ? State its advantages and disadvantages. Draw velocity diagrams with and without pre-whirl. **04**

(c) A single acting two stage air compressor deals with 4.2 m^3/min of air under atmospheric conditions of 1 bar and 17°C with a speed of 250 rpm. The delivery pressure is 80 bar. Assume complete intercooling, find the minimum power required by the compressor and bore and stroke of the compressor. Assume a piston speed of 210 m/min, mechanical efficiency of 76 % and volumetric efficiency of 82 % per stage. Assume polytropic index of compression in both stages to be n = 1.3 and neglect clearance. **07**

Q.5 **(a)** Explain construction and working of direct acting hydraulic lift. **03**

(b) Differentiate between fluid coupling and fluid torque converter. **04**

(c) Explain the phenomenon of stalling in axial flow compressor. **07**

OR

Q.5 **(a)** With a neat sketch explain working of centrifugal compressor. **03**

(b) Explain construction and working of simple hydraulic accumulator. **04**

(c) Explain function, working principle, construction and working of hydraulic jack. **07**

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