

**6E3053**

Roll No. \_\_\_\_\_

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**6E3053****B.Tech VI Sem. (Main/Back) Exam., April-May, 2012****Mechanical Engg.****6ME5 Hydraulic Machines & Hydroelectric****Power Plant****Time : 3 Hours****Maximum Marks : 80****Min. Passing Marks : 24***Instructions to Candidates:*

*Attempt any five questions, selecting one question from each unit. All Question carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

*Units of quantities used/ calculated must be stated clerly.*

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. \_\_\_\_\_ Nil \_\_\_\_\_

2. \_\_\_\_\_ Nil \_\_\_\_\_

### **Unit - I**

1. (a) The power developed by a turbine is a function of density  $e$  of the fluid, the speed  $N$  of the turbine, the diameter  $D$  of turbine, and the pressure intensity  $p$  under which it operates. Show that

$$P = e N^3 D^5 f \left[ \frac{N^2 D^2}{g H} \right]$$

Hence obtain an expression for the specific speed of such a turbine.

8

- (b) The nozzle of a pelton wheel is 38 mm in diameter, the head at the nozzle is 152 meters,  $C_v = 0.97$ , wheel diameter = 380mm, relative velocity at discharge = 0.85 times the relative velocity at inlet, discharge edge of blading is at  $15^\circ$  to the plane of motion of the blading. Calculate unit power and unit speed if the blade speed is 0.46 of the jet speed.

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Or

- 1 (a) A jet has direct impact on series of flat vanes mounted over the periphery of a large wheel. Determine the force of impact and the work done per second? 8
- (b) A jet of water moving with a velocity of 30 m/s impinges on a series of vanes moving at 15 m/s. The jet makes an angle of  $30^\circ$  to the direction of motion of vanes at entry and leaves the vanes at  $120^\circ$ . Draw the inlet and outlet velocity diagram and find (i) vane angles at inlet and outlet. (ii) work done per sec Newton of water and (iii) The efficiency. 8

## Unit - II

- 2 (a) Explain the construction and working of pelton wheel with help of neat sketch. 8
- (b) The head at the base of nozzle of a pelton wheel is 650 cm. The outlet vane angle of the bucket is  $15^\circ$  the relative velocity at outlet is reduced by 15% due to friction along the vanes. If the discharge at outlet is without whirl, find the ratio of the bucket speed to the jet speed. If the jet diameter is 100 mm while the wheel diameter is 1.2 m, find the speed of the turbine in rpm, the force exerted by the jet on the wheel, the power developed and the hydraulic efficiency. Take  $\eta = 0.97$  8

Or

- 2 (a) Explain the principle of Governing of impulse turbine with a neat sketch. 8
- (b) Show that for the maximum efficiency the bucket speed of a pelton wheel should be equal to one half the jet speed. 8

## Unit - III

- 3 (a) Draw a schematic diagram of a Kaplan turbine and explain briefly its construction and working. 8

- (b) The particulars of a reaction turbine are given below: Type of turbine : Inward flow turbine, External diameter = 625 mm, Internal diameter = 405 mm, width at inlet = 55mm, Inlet vane angle =  $95^\circ$ , outlet vane angle =  $14^\circ$ , Head on turbine = 56 m, Hydraulic efficiency = 88%, overall efficiency = 81%, Velocity of flow through the runner is constant. Discharge at outlet is entirely radial. Determine (i) The guide vane angle, (ii) The speed of turbine (iii) The shaft power. 8

Or

3. (a) In a vertical Francis turbine the runner speed is 380 rpm and available head across the turbine is 49m. The inlet to the runner is 1.8 m above the tail race level and the area and diameter of the runner at inlet are  $0.234 \text{ m}^2$  and 0.90 m respectively. The guide and the runner vane angles at inlet are  $15^\circ$  and  $70^\circ$  respectively. The water enters a draft tube without whirl at 1.575 m above the tail race level and the draft tube diameter is 0.55 m. At the outlet the draft tube is 0.70 m in diameter. If the frictional losses in the runner amount to 2.70 m and that in draft tube is 1.5 m and overall efficiency is 0.90x hydraulic efficiency, find (i) Shaft power (ii) hydraulic efficiency (iii) pressure head at inlet to the runner (iv) pressure head at entry to draft tube. 8
- (b) What do you mean by characteristic curves of a turbine? What are main and operating characteristic curves of a turbine? 8

### Unit - IV

4. (a) Obtain expression for the pressure head due to friction on the suction and delivery pipe for a reciprocating pump. 8
- (b) A simple acting reciprocating pump has a plunger of diameter 150mm and a stroke 300mm. The length of the suction and delivery pipes are 5 m and 20m respectively, and their diameter is 75mm. The suction and delivery heads are 3.5m and 8m respectively. Find the heads in the cylinder at the beginning, middle and end of the suction and delivery strokes. Take  $f = 0.0075$  and speed of the pump = 30 rpm. Also find the power required to drive the pump. Assume atmospheric pressure head = 10.30 meter of water. 8

Or

4. Explain any two of following :

- (a) Hydraulic Intensifier
- (b) Hydraulic Press
- (c) Hydraulic coupling

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### Unit - V

5. (a) Explain following:

- (i) Hydrograph
- (ii) Hydrological cycle
- (iii) Flow duration curve
- (iv) Run off

4x2=8

(b) Explain Surge Tank with sketch

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Or

5. (a) Write a note on Hydro Power development in Rajasthan.

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(b) Write note on Selection of turbine.

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