

### Unit III

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Roll No. ....

5. (a) A model having scale ratio  $1/10$  is constructed to determine the best design of Kaplan turbine to develop 7355 kW under a net head of 10 m at a speed of 100 rpm. If the head available at the laboratory is 6 m and the model efficiency is 88%, find : (i) running speed of the model, (ii) the flow required in the laboratory, (iii) the output power of the model; and (iv) the specific speed in each case. Assume efficiency of the prototype turbine is 4% better than that of the model turbine. **12**
- (b) An impulse turbine at best speed produced 92 kW under a head of 63 m. By what per cent should the speed be increased for a head of 87 m ? **3**
6. (a) Explain with the help of neat sketch, the principle and working of Hydraulic Coupling. **8**

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### B. Tech. EXAMINATION, May 2019

(Fourth Semester)

(B. Scheme) (Main & Re-appear)

(ME)

ME208B

FLUID MACHINES

*Time : 3 Hours]*

*[Maximum Marks : 75*

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

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**Note :** Attempt *Five* questions in all, selecting at least *one* question from each Unit.

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P.T.O.

## Unit I

1. A 20 mm diameter jet having a velocity of 60 m/s impinges without shock on a series of vanes which move in the same direction as the jet. The shape of each vane is such that, if stationary, it would deflect the jet through an angle of  $150^\circ$ . Friction reduces the relative velocity by 10% as water flows across the vanes and there is a further windage loss given as  $(0.4 u^2/2g)$  Nm per N of water, where  $u$  is velocity of vanes. Find the velocity of vanes corresponding to an hydraulic efficiency of 80%. Also determine the force on the vanes in, and at right angles, to the direction of their motion. **15**
2. (a) Explain the characteristic features of the bucket of a Pelton Turbine. **4**  
(b) Draw main characteristic curves of a Pelton wheel. **3**  
(c) Describe with neat sketch the working of governing mechanism of Pelton wheel. **8**

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## Unit II

3. (a) Derive an expression for degree of reaction for medium flow Francis turbine. **9**  
(b) State briefly the functions of spiral casing, guide vanes and draft tube. **6**
4. (a) A reaction turbine works under a head of 6 m. The guide blades are inclined at  $30^\circ$  to the tangent at periphery and the runner vanes make  $110^\circ$  to the forward tangent at the periphery at inlet. If the discharge is radial and if all the exit velocity is wasted, find the hydraulic efficiency of the turbine. Assume velocity of flow to be constant. Find also the velocity of flow. **8**  
(b) A Kalpan turbine produced 44000 kW under a head of 25 m with an overall efficiency of 90%. Taking the value of speed ratio  $K_u$  as 1.6, flow ratio  $\psi$  as 0.5 and the hub diameter as 0.35 times the outer diameter, find the diameter and speed of the turbine. **7**

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P.T.O.

8. A single acting-reciprocating pump is to raise a liquid of specific weight  $11.77 \text{ kN/m}^3$  through a vertical height of  $11.5 \text{ m}$ , from  $2.5 \text{ m}$  below the pump axis to  $9 \text{ m}$  above it. The plunger moves with SHM, and has a diameter  $125 \text{ mm}$  and stroke length  $225 \text{ mm}$ . The suction and delivery pipes are  $75 \text{ mm}$  diameter, and  $3.5 \text{ m}$  and  $13.5 \text{ m}$  long respectively. There is a large air vessel placed on the delivery pipe near the pump axis but there is no air vessel on the suction pipe. If separation takes places at  $88.3 \text{ kN/m}^2$  below the atmospheric pressure, find (a) the maximum speed at which the pump can run without separation taking place (b) the power required to drive the pump if  $f = 0.02$ . Neglect slip for the pump. **15**

- (b) Define cavitation. Why does it occur and what are its effects ? Explain the significance of Thoma's cavitation factor.

**7**

#### Unit IV

7. Assuming that the radial component of flow of fluid through a centrifugal pump remains constant and that the fluid enters radially, prove that the ratio of pressure head  $H_p$  to velocity head  $H_v$  created by an impeller neglecting the losses is given by an equation :

$$\frac{H_p}{H_v} = \frac{U_2 - Vf_2 \cot \phi}{U_2 + Vf_2 \cot \phi}$$

where  $U_2$  is rim speed of impeller at outlet,  $Vf_2$  is the velocity of flow and  $\phi$  is the exit angle of impeller blades. Hence show that ideal efficiency of the impeller is : **15**

$$\eta = (U_2 + Vf_2 \cot \phi) / 2U_2.$$