INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech V Semester End Examinations(Regular) - November, 2019

Regulation: IARE – R16

HYDRAULICS AND HYDRAULIC MACHINERY

Time: 3 Hours   **(CE)**   Max Marks: **70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Write Bazin's formula for uniform flow by explaining the terms and Derive the relation between chezy's and Bazin's formula. **[7M]**

   (b) The depth of flow of water at a certain section of a rectangular channel of 2 m wide is 0.3 m. The discharge through the channel is 1.5 m^3/s. Determine whether a hydraulic jump will occur and if so find its height and loss of energy per kg of water. **[7M]**

2. (a) Explain the velocity distribution diagram of an open channel with a neat sketch and write the condition for maximum velocity. **[7M]**

   (b) A power canal of trapezoidal section has to be excavated through hard clay at the least cost. Determine the dimensions of the channel given, discharge equal to 14 m^3/s, bed slope 1/2500, Manning's n = 0.02. (For trapezoidal channel side slope m = $1\sqrt{3}$). **[7M]**

UNIT – II

3. (a) Define scale ratio and explain the different types of hydraulic similarities that must exist between a proto type and it's model? **[7M]**

   (b) The pressure difference ΔP in a pipe diameter of D and a length of L due to flow turbulent flow depends on the velocity V, viscosity 'μ', density 'ρ', roughness K. Using Buckingham's π theorem obtain an expression for ΔP. **[7M]**

4. (a) Explain in detail the various types of dimensionless numbers. Enumerate significance of the non-dimensional numbers: Reynold's number, Froude number and mach number in the theory of similarity? **[7M]**

   (b) In a 1 in 20 model of stilling basin, the height of the hydraulic jump in the model is observed to be 0.2m. What is the height of the hydraulic jump in the prototype? If the energy dissipated in the model is 1/10 kW, what is the corresponding value in prototype? **[7M]**

UNIT – III

5. (a) Explain the layout of hydro electric power plant with a neat sketch. **[7M]**

   (b) A jet of water of diameter 7.5 cm strikes a curved plate at its center with a velocity of 20 m/s. The curved plate is moving with velocity of 8 m/s in the direction of the jet. The jet is deflected through an angle of 165^0. Assuming the plate to be smooth, find

   i) Force exacted on the plate in the direction of the jet.

   ii) Power of the jet, and

   iii) Efficiency of the jet **[7M]**

6. (a) Define the term impact of jets and explain in detail stationary and movable jets with neat sketch.
[7M]

(b) Find the force exerted by a jet of water of diameter 7.5 cm on a stationary flat plate with a velocity of 20 m/sec
i) Normally
ii) At an angle θ **[7M]**

UNIT – IV

7. (a) Explain the importance of draft tube in reaction turbines and enumerate different types of draft tubes with a neat sketch. **[7M]**

(b) A Kaplan turbine develops 11772 kW shaft power at a head of 20 m. The outer diameter is 3.5 m and hub diameter 1.75 m. The guide blade angle at the extreme edge of the runner is 35°. The hydraulic efficiency of the turbine is 88 % and overall efficiency is 84 %. If the velocity of wheel is zero at outlet, determine
i) Runner vane angles at inlet and outlet
ii) Speed of the turbine **[7M]**

8. (a) Explain in detail about the working principle of Pelton wheel with a neat sketch. **[7M]**

(b) A pelton wheel has a mean bucket speed of 10 m/s with a jet of water flowing at the rate of 700 litres/sec. Under a head of 30 m the buckets deflects through an angle of 160°. Calculate the power developed of the turbine. Assume $C_V = 0.98$. **[7M]**

UNIT – V

9. (a) Define a centrifugal pump. Explain the working of a single –stage centrifugal pump with sketches.
[7M]

(b) It is required to deliver 0.048 m^3/s of water to a height of 24 m through a 150 mm diameter and 120 m long, by a centrifugal pump. If the overall efficiency of the pump is 75 % and co-efficient of friction, f = 0.01 for pipe line, find the power required to drive the pump. **[7M]**

10. (a) Describe in detail about the working principle of single acting reciprocating pumps and double acting reciprocating pump with a neat sketch. **[7M]**

(b) A single acting reciprocating water pump of 180 mm bore and 240 mm stroke operates at 40 rpm. Determine the discharge if the slip is 8%. What is the value of coefficient of discharge. If the suction and delivery heads are 6 m and 20 m respectively determine the theoretical power. If the overall efficiency was 80%, what is the power requirement? **[7M]**