Hall Ticket No | | | | | | | | | | | Question Paper Code: ACEC08

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech IV SEMESTER END EXAMINATIONS (REGULAR / SUPPLEMENTARY) - AUGUST 2023
Regulation: UG-20
HYDRAULICS AND HYDRAULIC MACHINERY

Time: 3 Hours **(CIVIL ENGINEERING)** **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) For a trapezoidal channel of most economical section, prove that:
   i) Half of top width=Length of one of the sloping sides
   ii) Hydraulic mean depth=1/2 × depth of flow. [BL: Understand| CO: 1|Marks: 7]

   (b) An open channel 3 m wide rectangular in shape carries the discharge at normaldepth of 1.2 m. What should be the slope of channel if the Manning's "n" is 0.014. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Summarize about displacement thickness and momentum thickness. Determine an expression for the momentum thickness. [BL: Understand| CO: 2|Marks: 7]

   (b) A free stream of water has a velocity of 4 m/s and a smooth flat plate with a sharp leading is placed in it. Find the distance from the leading edge where the boundary layer transition from laminar to turbulent flow occurs. Find also the thickness of the boundary layer at that point. The density and viscosity of water are $1000 kg/m^3$ and 1 centipoise, respectively.
   [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Show that the force exerted by a jet of water on an inclined fixed plate in the direction of the jet is given by $F = \rho a V^2 sin^2\theta$. Where a=area of the jet, V = velocity of the jet, θ is inclination of the plate with the jet. [BL: Understand| CO: 3|Marks: 7]

   (b) A jet of water having a velocity of 40 m/s strikes a curved vane, which is moving with a velocity of 20 m/s. The jet makes an angle of 30^0 with the direction of motion of vane at inlet and leaves at an angle of 90^0 to the direction of motion of vane at outlet. Draw the velocity triangles at inlet and outlet and determine the vane angles at inlet and outlet so that the water enters and leaves the vane without shock. [BL: Apply| CO: 3|Marks: 7]

4. (a) Differentiate between
   i) The impulse and reaction turbine
   ii) Radial and axial flow turbine
   iii) Inward and outward radial flow turbine

   [BL: Understand| CO: 4|Marks: 7]

(b) Determine the overall efficiency of a Kaplan turbine developing 2850 kW under a head of 5.2 m. It is provided with a draft tube with its inlet (diameter 3 m) set 1.8 m above e tail race level. A vacuum gauge connected to the draft tube indicates a reading of 5.2 m of water. Assume draft tube efficiency as 75 percent. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Differentiate between
   i) Reciprocating pumps and centrifugal pumps.
   ii) Single stage and multistage centrifugal pump [BL: Understand| CO: 5|Marks: 7]

   (b) A centrifugal pump delivers water against a net head of 14.5m and design speed of 1000 rpm. The vanes are curved back to an angle of 30^0 with periphery. The impeller diameter is 300 mm and outlet width 50 mm. Determine the discharge of the pump if the manometric efficiency is 95%. [BL: Apply| CO: 5|Marks: 7]

6. (a) Determine an expression for the work done by the impeller of a centrifugal pump on liquid per second per unit weight of liquid. [BL: Understand| CO: 5|Marks: 7]

   (b) The internal and external diameter of the impeller of a centrifugal pump are 300 mm and 600 mm respectively. The pump is running at 1000rpm. The vane angles of the impeller at inlet and outlet are 20^0 and 30^0 respectively. The water enters the impeller radially and velocity of flow is constant. Determine the work done by impeller per unit weight of water .
   [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Outline geometric, kinematic and dynamic similarities. Are these similarities truly attainable? If not why? [BL: Understand| CO: 6|Marks: 7]

   (b) In the model test of a spillway the discharge and velocity of flow over the model were $2.5m^3/s$ and 1.5 m/s respectively. Calculate the velocity and discharge over the prototype which is 36 times the model size [BL: Apply| CO: 6|Marks: 7]

8. (a) State Buckingham π theorem. What do you mean by repeating variables? How are the repeating cariables selected in dimenssional analysis. [BL: Understand| CO: 6|Marks: 7]

   (b) A ship 500 m long moves in a sea water whose density is $1030kg/m^3$. 1:100 Ratio of model is to be tested in a wind tunnel .The velocity of air in the wind Tunnel around the model is 25m/sec and resistance of the model is 80N. Determine the velocity of ship in sea water and also the resistance of ship in sea water .The density of air is $1.24kg/m^3$. Kinematic viscosity of seawater and air Are 0.010 stokes and 0.015 stokes respectively. [BL: Apply| CO: 6|Marks: 7]

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