

**Fourth Semester B.E. Degree Examination, June/July 2015**  
**Hydraulics and Hydraulic Machines**

Time: 3 hrs.

Max. Marks:100

- Note: 1. Answer any FIVE full questions, selecting at least TWO questions from each part.**  
**2. Assume missing data suitably.**

**PART – A**

- Explain the terms: distorted models and undistorted models. (04 Marks)
  - Explain Froude's model law. List its application in fluid flow problems. (06 Marks)
  - The resisting torque  $T$  against the motion of a shaft in a lubricated bearing depends on the viscosity  $\mu$ , the rotational speed  $N$ , the diameter  $D$  and bearing pressure intensity  $P$ , show that  $T = \mu ND^3 \phi \left[ \frac{P}{\mu N} \right]$ . (10 Marks)
- What do you understand best hydraulic channel section? Derive the conditions for best hydraulic triangular channel section. (10 Marks)
  - A trapezoidal channel with side sloper of 3 horizontal to 2 vertical has to be designed to convey  $10 \text{ m}^3/\text{s}$  at a velocity of  $1.5 \text{ m/s}$ , so that the amount of concrete lining for the bed and sides is minimum. Find: i) The wetted perimeter; ii) Slope of the bed if Manning's  $n = 0.014$ . (10 Marks)
- Derive the differential equation for gradually varied flow and list all the assumptions. (10 Marks)
  - A discharge of  $18 \text{ m}^3/\text{s}$  flows through a rectangular channel  $6 \text{ m}$  wide at a depth of  $1.6 \text{ m}$ . Find:
    - Specific energy head
    - Critical depth
    - State whether the flow is subcritical or supercritical
    - What is the depth alternate to the given above? (10 Marks)
- Derive the expressions for force exerted by a jet on an inclined plate in the direction of the jet. i) When the plate is stationary? and ii) When the plate is moving in the direction of jet? (10 Marks)
  - A jet of water of diameter  $25 \text{ mm}$  strikes a  $200 \text{ mm} \times 200 \text{ mm}$  square plate of uniform thickness with a velocity of  $10 \text{ m/s}$  at the centre of the plate which is suspended vertically by a hinge on its top horizontal edge. The weight of the plate is  $98.1 \text{ N}$ . The jet strikes normal to the plate. What force must be applied at the lower edge of the plate so that plate is kept vertical? If the plate is allowed to deflect freely, what will be the inclination of the plate with vertical due to the force exerted by the jet of water? (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. Any revealing of identification, appeal to evaluator and/or equations written e.g. 42+8 = 50, will be treated as malpractice.

## PART - B

- 5 a. Show that for a free jet of water striking at the centre of a symmetrical curved vane the maximum efficiency is slightly less than 60%. (10 Marks)
- b. A jet of water having velocity 45m/s impinges without shock on a series of vanes moving at 15 m/s, the direction of motion of vanes being inclined at  $20^\circ$  to that of the jet. The relative velocity at the outlet is 0.9 of that at inlet, and the absolute velocity of the water at the exit is to be normal to the motion of vanes. Find: i) Vane angles at entrance and exit and ii) Hydraulic efficiency. (10 Marks)
- 6 a. Classify and explain different types of turbines. (10 Marks)
- b. A penstock supplies water from a reservoir to the Pelton Wheel with a gross head of 500m. One third of the gross head lost in friction in the penstock. The rate of flow of water through the nozzle fitted at the end of the penstock is  $2 \text{ m}^3/\text{s}$ . The angle of deflection of jet is  $165^\circ$  when the vanes are stationary. Determine the power given by the water to the runner and also hydraulic efficiency. Take speed ratio = 0.45 and  $C_v = 1.0$ . (10 Marks)
- 7 a. What is draft tube? What are the functions of draft tube? (06 Marks)
- b. With the help of a neat sketch, explain the component parts of Kalpan turbine. (06 Marks)
- c. A Kalpan turbine produces 60000 kW under a net head of 25m with an overall efficiency of 90%. Taking the value of speed ratio as 1.6 and flow ratio as 0.5 and hub diameter as 0.35 times the outer diameter, find the diameter and speed of the turbine. (08 Marks)
- 8 a. Explain manometric efficiency, mechanical efficiency and overall efficiency of a centrifugal pump. (06 Marks)
- b. Describe with sketches pumps in series and pumps in parallel. (06 Marks)
- c. A centrifugal pump running at 1450 rpm discharges 710 litres per second against a head of 23 metres. If the diameter of the impeller is 250mm and its width is 50mm find the vane angle at the outer periphery. The manometric efficiency of the pump is 75%. (08 Marks)

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