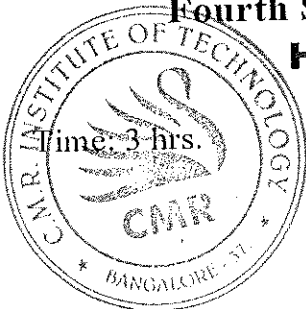


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10CV45

**Fourth Semester B.E. Degree Examination, June/July 2016**  
**Hydraulics and Hydraulic Machines**



Max. Marks:100

*Note: Answer FIVE full questions, selecting  
at least TWO questions from each part.*

**PART – A**

- 1 a. Define repeating variable. What are the guidelines for selection of repeating variables? (05 Marks)
- b. The resistance due to wind on a tall vertical Chimney is dependent on the density  $\rho$ , viscosity  $\mu$  of air, wind velocity  $V$ , diameter  $D$  and height  $H$  of the Chimney. By means of  $\pi$ -theorem develop an expression for the resistance of the building in terms of these quantities. (09 Marks)
- c. A spillway model is constructed in the laboratory such that velocity and discharge in the model are respectively  $2\text{m/s}$  and  $2.5\text{m}^3/\text{s}$ . If the velocity in the prototype is  $20\text{m/s}$ , what is the scale ratio of the model and the discharge in the prototype? (06 Marks)
- 2 a. Distinguish between open channel flow and pipe flow. (06 Marks)
- b. Show that for most efficient triangular channel section, the crest angle will be  $90^\circ$ . (06 Marks)
- c. A trapezoidal channel with side slopes 1:1 has to be designed to convey  $10\text{m}^3/\text{s}$  of water so that the amount of lining is minimum. Find the dimensions of channel. Take  $n = 0.015$  and channel bed slope is  $0.00056$ . (08 Marks)
- 3 a. Derive the dynamic equation for non uniform flow in open channel: (08 Marks)
 
$$\frac{dy}{dx} = \frac{s_o - s_f}{1 - \frac{Q^2 T}{g A^3}}$$
- b. In a horizontal jump on a horizontal floor, the Froude number before jump is  $\sqrt{6}$ , find Froude number after jump. (04 Marks)
- c. A  $3\text{m}$  wide rectangular channel carries  $2.4\text{m}^3/\text{s}$  discharge at a depth of  $0.7\text{m}$ . Determine: i) Specific energy at  $0.7\text{m}$  depth; ii) Determine critical depth; iii) Determine alternate depth to  $0.7\text{m}$ . (08 Marks)
- 4 a. A jet of water with velocity ' $v$ ' strikes a series of flat vanes moving with velocity ' $u$ ' in the direction of jet. The vanes are held normal to the jet. Show that the maximum efficiency of jet is  $50\%$ . (10 Marks)
- b. A square plate weighing  $100\text{N}$  and of uniform thickness has side  $20\text{cm}$  and it can swing freely about the top edge. A horizontal jet  $2\text{cm}$  diameter and velocity  $12.5\text{ m/s}$  impinges on the plate. The center of the jet is  $15\text{cm}$  below the hinge. The jet strikes normal to the plate. Calculate:
  - i) What horizontal force must be applied to the bottom of plate to hold the plate vertical?
  - ii) If the plate is allowed to swing freely, what is the angle of inclination made by the plate with vertical with the force removed? (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 eg, 42+8 = 50, will be treated as malpractice.

**PART – B**

- 5 a. Show that the maximum efficiency for the jet striking a single semicircular vane symmetrical about the axis of the jet moving in the direction of jet is  $16/27$ . (10 Marks)
- b. A jet of water moving at 30m/s impinges on a series of vanes moving with a velocity of 15m/s. The jet makes an angle of  $30^\circ$  to the direction of motion of vanes when entering and leaves at an angle of  $120^\circ$  to the direction of motion of the vanes. Draw the velocity triangle at inlet and outlet and find: i) the angle of vane tips at inlet and outlet, ii) the work done per N of water and iii) hydraulic efficiency. (10 Marks)
- 6 a. Give the list of classification of turbines with example. (10 Marks)
- b. Design a Pelton wheel turbine required to develop a power of 1500 kW working under a head of 160m at a speed of 400rpm. The overall efficiency may be taken as 85%. Take  $C_v = 0.98$  and  $C_u = 0.46$ . Jet ratio = 12. (10 Marks)
- 7 a. Explain cavitation in turbines. How to prevent it? (06 Marks)
- b. Define draft tube and explain its function. (06 Marks)
- c. A Kaplan turbine runner is to be designed to develop 7350 kW power under a head of 5.5 m. Determine: i) Diameter of runner and boss; ii) Speed; iii) Specific speed. Take diameter of boss =  $\frac{1}{3}$  of runner, speed ratio = 2.09 and flow ratio = 0.68,  $\eta_o = 85\%$ . (08 Marks)
- 8 a. Define: i) Manometric head; ii) Static head; iii) Suction head; iv) Delivery head. (04 Marks)
- b. What is the minimum starting speed of a centrifugal pump? Derive an expression for the same. (08 Marks)
- c. A centrifugal pump is to deliver  $0.12 \text{ m}^3/\text{s}$  at a speed of 1450 rpm against a head of 25 m. The impeller diameter is 250 mm, width at outlet is 50 mm. The manometric efficiency is 75%. Determine the vane angle at the outer periphery of the impeller. (08 Marks)

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