S 9071

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2006.

Fourth Semester

Civil Engineering

CE 238 – APPLIED HYDRAULIC ENGINEERING

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define super critical flow, critical flow and sub critical flow.
2. What is the significance of channels of most efficient sections?
3. What is a draw down curve?
4. Define surge.
5. What is the use of a draft tube? Why it is not required in case of a Pelton turbine?
6. Define unit quantities.
7. What is priming?
8. What is Cavitation?
9. Define negative slip in a reciprocating pump. When does it occur?
10. What is meant by a two throw pump?

PART B — (5 × 16 = 80 marks)

11. (a) Water flows at a velocity of 1 m/s and a depth of 2m in an open channel of rectangular cross section 3 m wide. At a certain section the width is reduced to 1.8 m and the bed is raised by 0.65 m. Will the upstream depth be affected? If so to what extent?

Or

(b) A flow of 100 litres per second takes place down a rectangular laboratory channel of width 0.6 m and having an adjustable bottom slope. If Chezy's C is 56 determine the bottom slope necessary for uniform flow with a depth of 0.3 m. Also find whether the flow is rapid or tranquil.

12. (a) Show that the head loss in a hydraulic jump formed in a rectan channel may be

expressed as $\Delta E = \frac{(V_1 - V_2)^3}{2g(V_1 + V_2)}$.

Or

(b) A trapezoidal channel having bottom width 8m and side slope 1: a discharge of 80 cumec. Find the depth conjugate to initial depth of 0.7 before the jump. Also determine the loss of energy in the jump.

13. (a) Design a Francis turbine runner with the following data: Net head H = 70 m. Speed N = 750 rpm. Output Power P = 330 kW. Hydraulic effi $\eta_h = 0.94$, Overall efficiency $\eta_o = 0.85$, flow ratio $\psi = 0.15$, breadth ratio n inner diameter is half of outer diameter. Assume blade ratio k = 0.94. Ve of flow remains constant through out and the flow is radial at exit.

Or

(b) A straight conical draft tube attached to Francis turbine has an inle diameter 3m and its outlet area is 20 m^2. The velocity of water at inlet is 5 The inlet is set 5 m above the tail race level. Assuming the head loss in th draft tube equal to half the velocity head at its outlet determine the press head at the top of the draft tube, total head at the top taking tail race level datum, the power of water ate outlet of runner, the power of water at the e of the draft tube.

14. (a) (i) Derive an expression for specific speed of a centrifugal pump.

(ii) Find the power required to drive a centrifugal pump which deliv 40 litres of water per second to a height of 20 m through a 150 mm diameter 100 m long pipeline. The overall efficiency of the pump is 70% and Darcy's friction factor is 0.006 for the pipe line. Assume inlet losses in suction pipe a 0.3 m.

Or

(b) A centrifugal pump operates against a manometric head of 30 m with a manometric efficiency of 75%. The pressure rise through the impeller is 65 % the total head developed by the pump. The radial velocity of flow which is constant is 3 m/s. The outer diameter of the impeller is 400 mm and the width

at the outlet is 15 mm. The blades at inlet are curved backwards at 60^0 to the wheel tangent. Calculate the discharge in litres per minute, speed of the impeller, blade angle at outlet and diameter of impeller at inlet.

(a) A single acting reciprocating pump has a plunger diameter of 80 mm and a stroke length of 150 mm. It takes supply from a sump 3 m below the pump through a pipe of 4.5m long and 30mm diameter. It delivers water to a tank 12 m above the pump through a pipe of 25 mm diameter and 15 m long. If separation occurs at 78.48 kN/m^2 below atmospheric pressure, find the maximum speed at which the pump can be operated without separation to occur. Assume the plunger to have a simple harmonic motion.

Or

(b) A single acting reciprocating pump has a plunger diameter of 75 mm and a stroke length of 150 mm. It takes supply from a sump 2 m below the pump through a pipe of 3.5m long and 20mm diameter. It delivers water to a tank 10 m above the pump through a pipe of 25 mm diameter and 15 m long. Take friction factor for both pipes as 0.02. Find the absolute pressure head in the cylinder at the beginning, middle and end of the suction stroke. Also find the power required to drive the pump.
