Reg. No. : | | | | | | | | | | | |

B 2088

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

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 supercritical and sub critical flow.

2. State the various regimes of flow.

3. Define roughness in case of open channel flow. How does it influence the flow?

4. What are non-erodible channels?

5. Distinguish between a draw down curve and a back water curve.

6. What is the cause of a surge to occur in a flow?

7. Define Thoma's cavitation factor. How is it related to specific speed and overall efficiency of a turbine?

8. What is governing of a turbine?

9. Define NPSH.

10. What is an indicator diagram?

PART B — (5 × 16 = 80 marks)

11. (a) (i) The rate of flow of water through a circular channel of diameter of 60 cms is 150 litres/second. Find the slope of the bed of the channel for maximum velocity. (8)

(ii) A rectangular channel 1.5m wide and depth 2.25m, discharges 10 m^3/sec. Calculate the specific energy and the depth alternate to the given depth. (8)

Or

(b) (i) Derive the condition for maximum discharge for a given value of specific energy. (8)

(ii) For a constant specific energy of 3.0m, what maximum flow may occur in a rectangular of 4.5m bed width? (8)

12. (a) (i) A trapezoidal channel has side slopes 1 : 2 and a bed slope 1 in 1500. The area of the section is 40 m^2. Find the dimensions of the most economical section. Determine the discharge of the most economical section if C = 50. (8)

(ii) A canal is formed with side slopes 2 :1 and a bottom width of 3.0m. The bed slope is 1 in 4500. Using Manning's formula and assuming Manning's 'n' as 0.025, calculate the depth of water for a discharge of 3.0 m^3/sec for a uniform flow. (8)

Or

(b) (i) Obtain an expression for the depth of flow in a circular channel which gives maximum velocity for a given longitudinal slope. The resistance to flow can be expresses by Manning's equation. (8)

(ii) Calculate the possible depths of flow at which a discharge of 25 cumec may be carried in a rectangular channel 4m wide with a specific energy equal to 2.5m. (8)

13. (a) A rectangular channel having bottom width 4.0m, Manning's n = 0.025, bottom slope 0.0005. The normal depth of flow in the channel is 2.0m. If the channel empties into a pool at the downstream end and the pool elevation is 0.60m higher than the canal bed elevation at the downstream end, calculate the coordinates of the resulting gradually varied flow profile.

Or

(b) A trapezoidal channel having bottom width 5m, side slope 2 : 1, Manning's n = 0.025, bottom slope 0.0015, carries a discharge of 10 cumecs. Compute the back water profile created by a dam which backs up the water to a depth of 2m immediately behind the dam. Use direct step method.

14. (a) A propeller turbine runner has outer diameter of 4m and the diameter of the hub is 2.25m. It is required to develop 20000 kW power when running at 150 rpm under a head of 20m. Assuming a hydraulic efficiency of 95% and overall efficiency of 85% determine the runner vane angles at inlet and exit at the mean diameter of the vanes. Also determine the vane angles at inlet and exit at two sections, one near the hub and the other at the outer periphery.

Or

(b) A single jet Pelton wheel develops 2 MW power under a gross head of 360m while running at 560 rpm. The water is supplied through a penstock which is 1200m long. Take $C_v = 0.98$ and friction factor 'f' for the penstock = 0.03, Hydraulic efficiency of the turbine $\eta_h = 85\%$. He head lost in the penstock is 12m of water. Find out the quantity of water supplied to the turbine, the diameter of the nozzle and the diameter of the penstock.

15. (a) A centrifugal pump operates against a manometric head of 30m with a manometric efficiency of 75%. The pressure rise through the impeller is 65% of 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 400mm and the width at outlet is 15mm. The blades at in let are curved backwards at 60° to the wheel of the tangent. Calculate the discharge in litres per minute, speed, blade angle at outlet and the diameter of the impeller at the inlet.

Or

(b) A single acting reciprocating pump having a plunger of 12cm diameter and a stoke of 25 cm draws water from a sump 2m below its centre and delivers to a tank 10m above its centre. The diameter of the pipes is 8cm and the suction pipe is 3m long and the delivery pipe is 12m long. An air vessel is fitted to the delivery pipe alone very near to the pump axis. The separation pressure is $8\,kN/m^2$ below atmospheric pressure. The density of the liquid pumped is $1200\,kg/m^3$ and the friction factor for the pipes is 0.01. Find the maximum speed of the pump to run without separation to occur. Also determine the power required to run the pump at this speed.
