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Question Paper Code : 20261

B.E/B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Fourth Semester

Civil Engineering

CE 6403 — APPLIED HYDRAULIC ENGINEERING

(Regulations 2013)

(Common to : PTCE 6403 – Applied Hydraulic Engineering – for B.E. (Part-Time) – Fourth Semester – Civil Engineering – Regulations – 2014)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Mention the classification of flow in an open channel.
2. Enlist the factors affecting Manning's roughness coefficient.
3. Define varied flow and states its classification.
4. List the methods used to determine the length of surface profile.
5. Define sub critical flow and supercritical flow.
6. Enlist the classification of hydraulic jumps.
7. State the difference between inward flow and outward flow radial turbine.
8. Define specific speed and unit quantities of the turbine.
9. Mention the main parts of centrifugal pump.
10. State the purpose of an air vessel fitted in the pump.

PART B — (5 × 13 = 65 marks)

11. (a) A most efficient trapezoidal section is required to give a maximum discharge of 21.5 m^3/s of water. The slope of the channel bottom is 1 in 2500. Take C = 70 $m^{1/2}/s$ in Chezy's equation, determine the dimensions of the channel. Also determine the value of Manning's n, taking the value of velocity of flow as obtained for the channel by Chezy's equation. (13)

Or

(b) An unlined irrigation canal has its bed and side composed of cohensionless material having mean diameter 6 mm. Angle of repose of the material is 40°. The bed width of the canal is 5 m and the side slope 1.5(H):1(V). Determine the minimum discharge that can be admitted into the canal without any sediment movement. Longitudinal slope of the canal is 1 in 5000, Manning's n = 0.025 and specify gravity of the material s = 2.65. (13)

12. (a) State and discuss the assumptions made in the derivation of the dynamic equation for gradually varied flow. Starting from first principles derive equations for the slope of the water surface in gradually varied flow with respect to wide rectangular Channel. (13)

Or

(b) A trapezoidal channel having bottom width 6 m, side slope 2 horizontal to 1 vertical, Manning's roughness coefficient 0.025 and bottom slope 0.0016, carries a discharge of 10 m^3/s. Compute the back water profile created by a dam which backs up the water to a depth of 2.0 m immediately behind the dam. Use the direct step method for computation. (13)

13. (a) Show that the head loss in a hydraulic jump formed in a rectangular channel may be expressed as $\Delta E = \frac{(V_1 - V_2)^3}{2g(V_1 + V_2)}$. (13)

Or

(b) The depth and velocity of flow in a rectangular channel are 1 m and 1.5 m/s respectively. If the rate of inflow at the upstream end is suddenly doubled, what will be the height and absolute velocity of the resulting surge and the celerity of the wave? (13)

14. (a) Design a Francis turbine runner with the following data : Net Head H = 68 m ; Speed N = 750 r.p.m ; output power P = 330 kW; hydraulic efficiency η_h = 85%; flow ratio ψ = 0.15; Breadth ratio n = 0.1 ; inner diameter of runner is (1/2) outer diameter. Also assume 6% of circumferential area of the runner to be occupied by the thickness of the vanes. Velocity of flow remains constant throughout and flow is radial at exit. (13)

Or

(b) (i) A Kaplan turbine produces 60,000 kW under a net head of 25 m with an overall efficiency of 90%. Taking the value of speed ratio Ku as 1.6, flow rate ψ as 0.5 and the hub diameter as 0.35 times the outer diameter, find the diameter and speed of the turbine. (6)

(ii) A reaction turbine works at 450 r.p.m under a head of 120 m. Its diameter at inlet is 1.2 m and the flow area is 0.4 m^2. The angles made by the absolute and relative velocities at inlet are 20° and 60° respectively with the tangential velocity. Determine the volume flow rate, power developed and the hydraulic efficiency. Assume whirl at outlet to be zero. (7)

15. (a) A centrifugal pump has the following characteristics: outer diameter of impeller = 800 mm; width of impeller vanes at outlet = 100 mm; angle of impeller vanes at outlet = 40°. The impeller runs at 550 r.p.m and delivers 0.98 cubic meters of water per second under an effective head of 35 m. A 500 kW motor is used to drive the pump. Determine the manometric, mechanical and overall efficiencies of the pump. Assume water enters the impeller vanes radially at inlet. (13)

Or

(b) A double acting pump has a bore of 0.2 m and stroke of 0.4 m. The suction pipe has a diameter of 0.1 m and is fitted with an air vessel. Find the rate of flow into or from the air vessel when the crank makes angles of 30°, 90° and 120° with inner dead centre. Determine also the crank angles at which there is no flow to or from the air vessel. Take the speed as 120 r.p.m., and assume that the plunger has simple harmonic motion. Determine the net force due to fluid pressure on the piston when it has moved through a distance of 10 cm from the inner dead center. (13)

PART C — (1 × 15 = 15 marks)

16. (a) A propeller turbine runner has outer diameter of 4.5 m and the diameter of the hub 2 m. It is required to develop 20,600 kW when running at 150 r.p.m under a head of 21 m. Assuming hydraulic efficiency of 94% and overall efficiency of 88%, determine the runner vane angles at inlet and exit at the mean diameter of the vanes. Also determine the runner vane angles at inlet and exit at two sections-neat the hub and the outer periphery. (15)

Or

(b) In a pumping station, 18000 cubic meter water is to be raised per day from an intake well to a sedimentation tank under a static head of 21 m. Lengths of suction pipe and rising main are 40 m and 150 m respectively. Diameters of pipes is 50 cm. There are two shifts of working of pumps each of 8 hours. Take coefficient of friction as 0.01 and combined efficiency of motor and pump as 80%. Recommend the number of units of pump each having B.H.P of 30. (15)