CBCS SCHEME

USN

17CV43

Fourth Semester B.E. Degree Examination, Aug./Sept.2020

Applied Hydraulics

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Assume any missing data if any suitably.

Module-1

1 a. Differentiate between dimensionally homogeneous and non-homogeneous with an example each. **(06 Marks)**

b. What is dimensional analysis? Mention its uses. **(06 Marks)**

c. Capillary rise 'h' depends upon density 'ρ', acceleration due to gravity, 'g', surface tension, 'σ' and radius of tube, 'r'. Show by Buckingham π – theorem that,

$$\frac{h}{r} = \phi\left[\frac{\sigma}{\rho g r^2}\right]$$ **(08 Marks)**

OR

2 a. Explain Reynold's model law and give the areas where it is applied. **(06 Marks)**

b. What are distorted and undistorted models? **(04 Marks)**

c. The discharge and velocity of flow over the model of a spillway of a dam were measured to be 2.0 m^3/s and 2.5 m/s respectively. If the model is built to a scale of 1:36, compute the velocity and discharge over its prototype. **(10 Marks)**

Module-2

3 a. Derive Chezy's equation for uniform flow in open channel and thereby deduce Manning's formula for velocity in open channel. **(08 Marks)**

b. A circular open channel laid to a gradient of 1:9000 carries a discharge of 0.40 m^3/s. If the depth of flow is 1.25 times the radius of channel, find the diameter of the channel. Assume rugosity coefficient for channel surface as 0.015. **(12 Marks)**

OR

4 a. How do you define specific energy of a flowing? Draw specific energy curve and explain various parameters. **(06 Marks)**

b. Enumerate the characteristics of critical flow through open channels. **(04 Marks)**

c. The discharge in a 4.0 m wide rectangular channel at 1.0m depth of flow is 4.0 m^3/s. Compute (i) Specific energy for 1.0m depth of flow (ii) Critical depth (iii) Alternate depth to 1.0m. **(10 Marks)**

Module-3

5 a. Define hydraulic jump in an open channel flow. Give its applications. **(06 Marks)**

b. Prove that the critical depth (y_c) and the alternate depths y_1 and y_2 are related by the expression, $y_c^3 = \frac{2y_1^2 y_2^2}{(y_1 + y_2)}$, in a rectangular open channel. **(06 Marks)**

c. In a rectangular channel of width 6.0m, the sluice gate discharges with a velocity of 5.0 m/s at a depth of 0.40m. Determine whether a hydraulic jump will occur. Also find (i) Jump height (ii) Energy lost per kg of water and (iii) Power lost in the hydraulic jump. **(08 Marks)**

OR

6 a. Explain classification of surface profiles with neat sketches. **(10 Marks)**

b. A rectangular channel 10m wide carries a discharge of 40 m^3/s. If at a section in this channel, the depth of flow is 1.50m, how far upstream or downstream from this section will the depth be 2.0m. Take channel bedslope as 0.00009 and Manning's N = 0.017. **(10 Marks)**

Module-4

7 a. Derive an expression for the force exerted by a jet striking a moving symmetrical curved vane striking at the center and hence how that the maximum efficiency of this jet-vane system is limited to 16/27. **(10 Marks)**

b. A jet water moving at 20 m/s impinges on a symmetrical curved vane so shaped to deflect the jet through 120°. If the vane is moving at 5.0 m/s, find the angle of jet so that there is no shock at the inlet. Also determine the absolute velocity at the exit in magnitude and direction and the work done per unit weight of water. **(10 Marks)**

OR

8 a. Draw a general layout of a hydro-electric power plant and give the function of each of the components in brief. **(10 Marks)**

b. A Pelton wheel running at a speed of 600 rpm under a head of 820 m develops 13200 kW power. If the coefficient of jet $C_v = 0.98$, Speed ratio, $\phi = 0.46$ and jet diameter is 1/16 of wheel diameter, calculate (i) Pitch circle diameter (ii) Diameter of the jet (iii) Quantity of water supplied to the wheel and (iv) the number of jets required. Assume overall efficiency as 85%. **(10 Marks)**

Module-5

9 a. Draw a neat sketch of a Francis turbine and explain its components. **(04 Marks)**

b. What is a draft tube? Explain its function in a reaction turbine. **(06 Marks)**

c. A Kaplan turbine runner is to be designed to develop 9100 kW power. The net available head is 5.6m. If the speed ratio = 2, flow ratio = 0.68, overall efficiency = 86% and the diameter of boss is equal to $1/3^{rd}$ the diameter of runner, find the diameter of runner, the speed and specific speed of turbine. **(10 Marks)**

OR

10 a. Explain various heads and efficiencies of centrifugal pumps. **(10 Marks)**

b. A centrifugal pump with radial inflow delivers 0.08 cumecs of water against a total head of 40m. If the outer diameter of the impeller is 30cm and its width at the outer periphery is 1.25 cm, find the blade angle at exit. The speed of the pump is 1500 rpm and its manometric efficiency is 80%. **(10 Marks)**

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