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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Eighth Semester, B.E. - Civil Engineering

Semester End Examination; July - 2021

Open Channel Hydraulics

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer any **FIVE** full questions.*

1 a. Differentiate between;

i) Prismatic channels and Non-prismatic channels — 4

ii) Energy coefficient and Momentum coefficient

b. Explain the various types of flow. — 6

c. Explain with sketches, variation of velocity and pressure in open channel flow sections. — 10

2 a. Define the following terms: — 6

i) Conveyance

ii) Section factor for uniform flow

iii) Critical slope

b. Find the discharge through a rectangular channel of width 3 m, having a depth of water 2 m and bed slope 1 in 2000. Take $K = 2.36$ in Bazin's formula. — 6

c. Water flows at a uniform depth of 1.5 m in a trapezoidal channel having bottom width 5 m and side slopes 2H:1V. Compute the normal critical slope and the discharge corresponds to this depth of flow and slope. Take $\eta = 0.025$. — 8

3 a. Derive an expression for the hydraulic exponent for the critical flow as, — 12

$M = \frac{y}{A}\left[3T - \frac{A}{T}\frac{dT}{dy}\right]$ and hence determine the values of M for

i) Rectangular channel

ii) Triangular channel

b. Compute the critical depth and velocity over trapezoidal channel of base width 4 m and side slope 2H:1V carrying a discharge of 8 cumecs. — 8

4 a. List the assumptions made in deriving GVFE and hence derive the equation, — 10

$$\frac{dy}{dx} = \frac{S_o - S_f}{1 - \frac{Q^2 T}{gA^3}}.$$

b. Explain with neat sketch, possible water surface profile on mild slope. — 4

c. Find the slope of the free water surface in a rectangular channel of width 20 m having depth of flow 5 m. The discharge through the channel is 50 m^3/s. The bed of the channel is having a slope of 1 in 4000. Take Chezy's constant $C = 60$. — 6

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5 a. List the different methods of computing Gradual varied flow profiles. Explain direct step method in detail. 10

b. A rectangular channel with a bottom width 4 m and bed slope 8×10^{-4} has a discharge of 1.5 cumecs. Depth at certain location in the GVF profile is 0.3 m. Determine the type of profile. Take $\eta = 0.016$. 10

6 a. Briefly explain the direct integration method of solving GVF equation. 10

b. A wide rectangular channel carries a discharge of 3 cumecs/m width on a slope of 1 in 1000, A weir is constructed across the channel which increases the depth to 2 m. Calculate the distance from the weir to a point where the depth is 1.75 m. Use Bresse's method. 10
Take $C = 45$ and Manning's $N = 0.025$.

7 a. Define hydraulic jump. Derive an expression for depth of hydraulic jump in terms of the upstream Froude number. 10

b. State the importance of TWC and JWC for different possible condition with neat sketches. 10

8 a. With neat sketches, briefly explain the various classification of hydraulic jump based on initial Froude's number. 8

b. A spillway discharges a flood at a rate of 7.75 m^3/s per *m* width. At the downstream horizontal apron, the depth of flow was found to be 0.5 m. What tail water depth is needed to form a hydraulic jump? If a jump is formed find its; 12

i) Type ii) Length
iii) Head loss iv) Energy loss as a percentage of initial energy

9 a. Discuss the provision of stilling basin that helps in energy dissipation. Also write a short note on USBR stilling basin Type-II and Type-IV. 10

b. After flowing over a spillway, a discharge per *m* width of 4.2 m^3/s passes over a level concrete apron. The velocity at the foot of spillway is 12.5 m/s and the tail water depth is 3 m. In order that the jump be contained on the apron, how long should it be built? How much energy is lost from the foot of spillway to the down stream end of the jump? 10

10 a. Briefly explain the design principles involved in the design of stilling basins. 12

b. Compute the discharge over an Ogee weir with $C_d = 2.4$ at a head of 2 m. The length of spillway is 100 m. The weir crest is 8 m above the bottom of the approach channel having the same width as that of the spillway (consider velocity of approach). 8

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