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

(An Autonomous Institution affiliated to VTU, Belagavi)

Seventh Semester, B.E. - Civil Engineering

Semester End Examination; February - 2022

Open Channel Hydraulics

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Apply the knowledge of fluid mechanics, conservation equations for mass, momentum, and energy to develop a strong knowledge of open channel flow.

CO2: Analyze and compute flow profiles using various methods.

CO3: Develop and apply mathematical relationships for hydraulic jumps, critical, uniform, gradually-varying flow and rapidly varied flow.

CO4: Knowledge of open channel flow in future to work effectively either as an individual or as a team member to satisfy the changing professional and societal needs.

***Note**: I) **PART - A** is compulsory. **Two** marks for each question.*

*II) **PART - B**: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
1 a.	Differentiate between Energy correction factor and Momentum correction factor.	2	L1	CO1	PO1
b.	Define Critical flow and Section factor for Critical flow.	2	L1	CO2	PO1
c.	List the methods of computing GVF profiles.	2	L1	CO2	PO1
d.	Give the condition for Repelled jump and Submerged jump.	2	L1	CO3	PO1
e.	List the different types of spillways.	2	L1	CO3	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
1 a.	Briefly explain the various types of flow in case of open channels.	9	L2	CO1	PO1
b.	Show that the hydraulic exponent '*N*' for Uniform flow is, $N = \frac{2y}{3A}\left[5T - 2R\frac{dp}{dy}\right]$ and hence, determine hydraulic exponent values for rectangular channel section.	9	L2	CO1	PO1
c.	Water flows at a uniform depth of 2 m in a trapezoidal channel having bottom width 6 m and side slopes 2H:1V. Compute the normal critical slope and the discharge corresponds to this depth of flow and slope. Take $\eta = 0.025$.	9	L2	CO1	PO1
	UNIT - II	**18**			
2 a.	Define specific energy and specific energy curve. Also, derive an expression for critical depth and critical velocity.	9	L2	CO1	PO1,2

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b.	List the assumptions made in deriving GVFE and hence derive the equation $\frac{dy}{dx} = \frac{S_0 - S_f}{1 - \frac{Q^2 T}{gA^3}}$.	9	L2	CO3	PO2,3
c.	A rectangular channel 8 m wide has a uniform depth of flow 2.5 m and has a bed slope of 1 in 3500. If the water surface at a section is raised by 0.8 m due to weir constructed at the downstream end of the channel, determine the water surface slope with respect to horizontal at this section. Assume Manning's $N = 0.02$.	9	L3	CO3	PO2,3
	UNIT - III	18			
3 a.	Briefly explain the direct step method in solving GVF equation.	9	L2	CO2	PO1,2
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 depth is 1.75 m. Use Bresse's method. Take C = 45 and Manning's $N = 0.025$.	9	L3	CO2	PO2,3
c.	A rectangular channel 2 m wide carries a discharge of 2 m^3/s. The bed slope is 0.004. At a certain section the depth of flow is 1 m. Calculate the distance of section downstream where the depth of flow is 0.9 m. Solve by single step method. Assume manning's $N = 0.014$.	9	L3	CO2	PO2,3
	UNIT - IV	**18**			
4 a	Define the term hydraulic jump. Classify hydraulic jump based on initial Froude's number. Also mention the uses of hydraulic jump.	9	L2	CO3	PO2
b.	Derive the relation between Initial depth (y_1) and sequent depth (y_2) for a hydraulic jump in a horizontal rectangular channel in terms of Froude number of flow before jump.	9	L2	CO3	PO2
c.	A sluice gate discharges water into a horizontal rectangular channel with a velocity of 6 m/s and depth of flow is 0.4 m The width of the channel is 8 m. Determine whether a hydraulic jump will occur and if so, find its height and loss of energy per kg of water. Also determine the power lost in the hydraulic jump.	9	L3	CO3,4	PO5

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UNIT - V **18**

5 a.	Define the following terms: i) Stilling Basin ii) Chute blocks iii) End sill iv) Baffle piers v) Ogee Spillway vi) Syphon Spillway	9	L2	CO3	PO2
b.	Define stilling basin. Briefly explain the type-II and type-IV with neat sketches.	9	L2	CO3	PO2
c.	Design a suitable section (only D/S profile) for the overflow portion of a concrete gravity dam having the downstream face sloping at a slope of 0.7H:1V. The design discharge for spillway is 6,000 cumecs. The height of the spillway above the river bed is 60 m. The effective length of the spillway may be taken as 50 m. Take C = 2.2.	9	L3	CO3,4	PO5

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