B.E. (Civil Engineering) Seventh Semester (C.B.S.)

Elective – I : Advanced Hydraulics

P. Pages : 3 **TKN/KS/16/7524**

Time : Three Hours Max. Marks : 80

Notes : 1. All questions carry marks as indicated.
2. Answer **all** questions.
3. Due credit will be given to neatness and adequate dimensions.
4. Assume suitable data whenever necessary.
5. Retain the construction lines.
6. Illustrate your answers whenever necessary with the help of neat sketches.
7. Use of non programmable calculator is permitted.

1. a) Define normal depth and critical depth of flow through an open channel. What is their importance in open channel flow? **7**

b) Flow of $30\,m^3/sec$ is carried in a 5.0 m wide rectangular channel at a depth of 1.0 m. Find the slope necessary to sustain uniform flow at this depth, if manning N = 0.012. What change in roughness would produce critical flow at this depth on the same slope? **7**

OR

2. a) Derive the dynamic equation for gradually varried flow in the form : **7**

$$\frac{dy}{dx} = S_0 \frac{\left[1-\left(\frac{y_n}{y}\right)^3\right]}{\left[1-\left(\frac{y_c}{y}\right)^3\right]}$$

where

y_n = normal depth of flow.

y_c = critical depth.

y = depth of flow.

S_o = bed slope.

b) Show that for a wide rectangular channel, the slope is mild or steep according to S_o being less than or greater than **7**

$$\left[\frac{n^2 g^{10/9}}{q^{2/9}}\right]$$

where

n = manning constant.

g = acceleration due to gravity.

q = discharge per unit width.

3. a) Draw the possible water surface profile when flow taken place below a sluice gate located on a horizontal bed which is turn ends in a free overfall. **6**

b) Explain direct step method of computing GVF in a rectangular channel. **7**

OR

4. a) A rectangular channel 6 m wide has a uniform slope of 1 in 2000. Normal flow occurs when there is a constant depth of 0.90 m and discharge is 8.5 cumecs. **9**
A dam placed across the channel raise the depth just U/S of the dam to 1.8 m. Find how far the depth will be 1.5 m. Use four steps for the solution.

b) Differentiate Bresse's method and Chow's method of computation of GVF. **4**

5. a) Define hydraulic jump. Under which conditions it is created. Give some practical examples. **5**

b) A hydraulic jump in rectangular channel show that **8**

$$F_{r_2}^2 = \frac{8F_{r_1}^2}{\left[\sqrt{1+8F_{r_1}^2}-1\right]^3}$$

where

F_{r_1} = Froude's number before the jump.

F_{r_2} = Froude's number after the jump.

OR

6. a) Derive an expression for loss of energy in hydraulic jump. **6**

b) A rectangular channel carrying a super critical stream is to be provided with a hydraulic jump type energy dissipater. If it is desired to have an energy loss of 5.0m in the jump when the inlet the inlet Froude's number is 8.5, determine the sequent depth. **7**

7. a) Explain clearly, the difference between elastic water column theory and rigid water column theory. **6**

b) Explain with the help of a sketch, the variation of pressure with time due to sudden closure of valve fitted at the end of horizontal pipe supplied from a reservoir at the following location. **8**

i) At a point just U/S of the valve.

ii) At a point located at a distance x from the valve on the U/S side.

OR

8. a) Explain the phenomenon of pressure wave reflection at a reservoir end and at a the dead end in a single horizontal pipe. **6**

b) A 3000 m long pipe line consists of 200 mm dia 2000 m long and 150 mm dia, 1000 mm long pipes connected in series and is supplied from a large reservoir. The outlet of the pipeline is 20 m below the water level in the reservoir. If the valve at the pipe. Outlet is suddenly opened from closed position estimate the time required to reach 95% of the steady state discharge. **8**
Assume f = 0.02 for both the pipes.

9. A 10 km long pipe of 1200 mm diameter carries water at the rate of $2\,m^3/sec$, when a head of 20 m is acting. The velocity of pressure wave in the pipe is 1000 m/sec. Assuming the pipe line as horizontal and frictional losses as negligible. Calculate the maximum pressure rise in the pipe due to closing of valve fitted at the end of the pipe. The valve closer in sixty seconds according to the law – **13**

$$A = A_0 \cos\left(\frac{\pi.t}{120}\right)$$

OR

10. A 800 mm pipe of 1000 m length supplies water due to gravity from a reservoir having water surface elevation 10.0 m above the valve fitted at the other end. The maximum discharge through the pipe, when the valve is fully open, is $1.0\,m^3/sec$. The valve closes in 10 seconds such that the area of opening of valve decreases linearly. Calculate the maximum pressure rise using Allieve's interlocked equations. **13**

Assume modulus of elasticity for steel $E = 2{,}00{,}000\,N/mm^2$ and bulk modulus of water $K = 2100\,N/mm^2$. Neglect friction losses.

11. a) Derive the expression for time flow establishment for unsteady flow. **7**

b) Derive the continuity equation for flow through pipe when elasticity of pipe is considered. **7**

OR

12. a) How water hammer pressure is controlled? Enlist the devices used for this purpose. **7**

b) Explain the phenomenon of development of water hammer pressure in a pump systems. How is it controlled. **7**

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