Exam.		**Regular**	
Level	BE	Full Marks	80
Programme	BCE, B.Agri.	Pass Marks	32
Year / Part	II / II	Time	3 hrs.

Subject: - Hydraulics (CE555)

✓ Candidates are required to give their answers in their own words as far as practicable.
✓ Attempt **All** questions.
✓ The figures in the margin indicate **Full Marks**.
✓ **Necessary figures are attached herewith.**
✓ Assume suitable data if necessary.

1. a) One meter diameter pipe is to carry a water discharge of 1.0 m³/s at the minimum loss of energy. What will be the permissible height of surface roughness? [8]

   b) Derive an expression for ratio of length of inlet to outlet leg for typical siphon as follows: [8]

   $$\frac{l_1}{l_2} \leq \frac{P_a - (Z_B - Z_A)}{(Z_B - Z_C) - P_a}$$

   Where P_a is atmospheric pressure, Z_A, Z_B, Z_C are elevation of inlet, summit and outlet of syphon.

2. a) A pump draws water from a reservoir and delivers it through a pipe 150 mm diameter, 90 m long, to a tank in which the free surface level is 8 m higher than that in the reservoir. The flow rate is steady at 0.05 m³/s until a power failure causes the pump to stop. Neglecting minor losses in the pipe and in the pump and assuming that the pump stops instantaneously, determine for how long flow into bank continues after the power failure. The friction factor f may be taken as constant at 0.028 and elastic effects in the water or pipe material may be disregarded. [8]

   b) Using Hardy-cross method, find the rate of flow in every pipe lines as given below. The constant factor for AB, BC, CD, DA and BD are 1,2,1,2 and 3 respectively. [8]
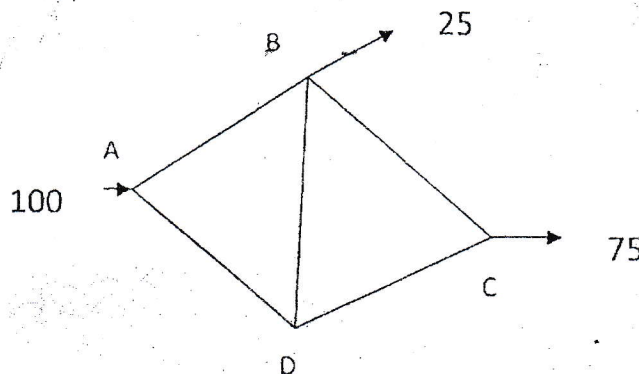
3. a) A 900 mm diameter conduit 3600 m long is laid at a uniform slope of 1 in 1500 and connects two reservoirs. When the levels in the reservoirs are low, the conduit runs partly full and it is found that a normal depth of 600 mm gives a rate of flow of 0.322 m^3/s. The Chezy coefficient C is given by KR^n where K is a constant, R is the hydraulic radius and n = 1/6.

Neglecting losses of head at entry and exit, obtain (i) the value of K, (ii) the discharge when the conduit is flowing full and the difference in level between the two reservoirs is 4.5 m. [8]

b) A 3.5 m wide rectangular channel section carries 4 m^3/s of water at a depth of 1 m. If the width is to be reduced to 2.5 m and bed raised by 10 cm, what would be the depth of flow in the contracted section? What maximum rise in the bed level of the contracted section is possible without affecting the depth of flow upstream of the transition? [8]

4. a) A hydraulic jump is formed in a 4 m wide outlet just downstream of the control gate, which is located at the upstream end of the outlet. The flow depth upstream of the gate is 20 m. If the outlet discharge is 100 m^3/s, determine: [8]

   i) Flow depth downstream of the jump
   ii) Trust on the gate; and
   iii) Energy losses in the jump

   Assume the losses through the gate is 5% of velocity head of flow gate.

b) Derive the expression for most economical rectangular section. [3]

c) A trapezoidal channel has side slope 1:2 (H:V) and the slope of the bed is 1 in 1500. The area of the section is 40 m^2. Find the dimensions if it is most economical. Determine the discharge of the most economical section if Chezy's constant (C) = 50. [5]

5. a) Sketch the water-surface profile in along rectangular channel (n=0.014), f the channel is 3 m wide; the flow rate is 9.6 m^3/s; and there is an abrupt change in slope from 0.0016 to 0.0150. [8]

b) What do you mean by incipient motion condition? Derive an expression for the shear stress reduction factor or tractive force ratio in the case of mobile boundary channel in terms of side slope angle and angle of repose of the sediment. [2+6]

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