Menoufiya University
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Civil Engineering Department

Diploma Exam 3 / 01 / 2018
Open channel flow (CVE558)
Time allowed 3 hrs
Max. Degree : 100

Answer the following questions . Any missing data can be reasonably assumed . Illustrates you answer with neat sketches . answers should be organized , concise and readable.

Question (1) .....(20 MARKS)

a) Find the best hydraulic section for each of the circular section .....**(5 marks)**

b) Estimate the normal depth in circular channel if Q=40 m^3/s , S=10 cm /km , n= 0.025 , 10 m diameter.....**(5 marks)**

c) A sewer running half full is to be laid of a slope of 1:1000 to serve 2000000 persons at the rate of 250 lit / person /day. Considering n = 0.016, find the sewer diameter if the maximum rate of flow according to which the sewer should be designed can be found by assuming that the total daily discharge flows uniformly in the sewer during 6 hours. .....**(5 marks)**

d) If the velocity distribution for turbulent flow over rough channel surface is expressed by:
$U / U^* = 5.75 \text{ Log } \frac{3\ y}{k}$, deduce the relationship between chezy's © and the relative roughness (y_0/k), in which y_0 is the total water depth. Compile this relationship graphically.....**(5 marks)**

Question (2) .....(18 MARKS)

a) Show that the maximum velocity in a circular open channel of certain diameter taken place when the water depth is 0.81 times the channel diameter. Also show that the maximum discharge occurs when the water depth is 0.95 the diameter .....**(9 marks)**

b) If the velocity distribution for turbulent flow over rough open channel surfaces is represented by :
$u = 5.75\ u^* \text{ Log} \frac{3\ y}{k}$ **(9 marks)**
It is required to:

1- Prove that $E = \frac{1}{c}^{.2} = 0.883\sqrt{f} = 9.5 \frac{9.5\ n}{R^{1/6}}$

2- Derive an expression for the mean velocity at a vertical section (V_m) and give the height above the bed of which it occurs .

3- Compare the expression you get in (2) with the mean of the velocities at 0.2 and 0.8 of the water depth.

4- Show that $E = \frac{U_m}{V_m - 1}$

Question (3) ..... (18 MARKS)

a) A special sewer consists of a semicircular top and bottom of radius (r) joined by parallel vertical sides of length ® so that the total height is (3r). **(9 marks)**

1- Show that for max discharge the angle subtended by the water surface at the centre of curvature of the upper semicircle is approximately 64^0.

2- if the upper surface is raised until it reached the top of the sewer , find the percentage decrease in flow.

b) For uniform laminar flow in wide open channels that: **(9 marks)**

1- The velocity distribution at a vertical section is parabolic,

2- The average velocity: $V = \frac{g.s}{3v} {y_0}^2$

3- The unit discharge: $q = \frac{g.s}{3v} {y_0}^3$

and then evaluate the values of the velocity coefficient α and the momentum coefficient β.

Question (4) .....(18 MARKS)

a) In a river of bed width of 600 m and bed slope of 7.50 cm / km. it is found that the bed material just begin to move when the discharge is 120 million.m^3/day. Assuming the mean velocity to vary with the water depth and slope according to the relation: $V=120\ YS^{2/3}$, find the bed slope at which the same tractive force on the bed would be produced with a discharge of 365 million m^3 /day.
(6 marks)

b) Derive expression for: critical depth, critical specific energy and critical velocity for: **(6 marks)**
1- rectangular channel,
2- non rectangular channel

c) A horizontal rectangular channel is contracted laterally from width b1 to b2 causing the water depth to change y1 to y2. Show that the discharge through the channel may be expressed as:

$$Q = c_d b_2 y_2 \sqrt{\frac{2g(y1-y2)}{1-\left(\frac{b2}{b1}\right)^2\left(\frac{y2}{y1}\right)^2}}$$ .....**(6 marks)**

Question (5) .....(26 MARKS)

a) Show that the discharge through a venture-flume is expressed by: **(8 marks)**
$Q= 1.705\ C_d\ b_t\ (E\ )^{1.5}\ m^3/sec$ in which :
b_t = throat width,
E =u.s. specific energy.
Estimate the discharge passing through a horizontal venture-flume if the width of both channel and throat are 2.25 m and 1.5m respectively. The water depth u.s. the flume is 2 m and c_d = 0.98.

b) A uniform flow of depth 1.5m occurs in a long rectangular channel of 20m width, having a manning n of 0.012 and laid on a slope of 0.0016. calculate the following: **(8 marks)**
1- The min height of a hump which can be built in the floor of this channel across the flow to produce min specific energy there. Evaluate E_{min}.
2- The max contraction which can produce by itself min. specific force. Evaluate F_{min}.
3- Compare between the two cases (1), (2) by stating two main differences.

c) Considering the formation of a hydraulic jump over a horizontal frictionless rectangular channel, derive the relationship between the conjugate depths: **(10 marks)**
1- As function of the critical depth,
2- As function of Froude number.
Derive similar relationship in case of steep frictionless bed slope.

This exam measures the following ILOs											
Question Number	Q1	Q2	Q4	Q2	Q3	Q5	Q1	Q2	Q3	Q4	Q5
	A2	A5	A2	B1	B5	B2	C2	C1	C3	C6	C4
	Knowledge & Understanding Skills			Intellectual Skills			Professional Skills				