UNIVERSITY OF BOLTON

SCHOOL OF ENGINEERING

BENG (HONS) CIVIL ENGINEERING

SEMESTER ONE EXAMINATION 2019/2020

WATER ENGINEERING AND THE ENVIRONMENT

MODULE NO: CIE6012

Date: Friday 17th January 2020   **Time: 10:00am – 1:00pm**

INSTRUCTIONS TO CANDIDATES: **Open Book Exam**
There are FOUR questions.

Answer ALL questions.

Marks for parts of questions are shown in brackets.

This examination paper carries a total of 100 marks.

All working must be shown. A numerical solution to a question obtained by programming an electronic calculator will not be accepted.

School of Engineering
BEng (Hons) Civil Engineering
Semester One Examination 2019/2020
Water Engineering And The Environment
Module No. CIE6012

Q1.
   a) Please indicate the correct answer in your answer booklet

   1. Steady uniform flow in an open channel occurs when the:
      a. Slope of the channel is mild.
      b. Flow depth remains unchanged with distance
      c. Flow depth remains unchanged with time and distance.
      d. Flow depth remains unchanged with time.

                                                                    (2 marks)

   2. The flow velocity in a 2.5 m wide rectangular channel is 3.0 m/s at a flow
      depth of 1.25m. The flow in the channel is:
      a. Supercritical flow
      b. Critical flow
      c. Subcritical flow
      d. Transition from subcritical to supercritical flow condition.

                                                                    (2 marks)

   3. The unit hydrograph for a drainage basin is used to:
      a. Determine the ordinates of the direct runoff hydrograph
         corresponding to a particular storm event.
      b. Obtain the lag time between the peak of the rainfall and the peak of
         the direct runoff hydrograph.
      c. Obtain the contribution of groundwater flow to the total flood
         hydrograph.

                                                                    (2 marks)

   4. What is the Froud's number for an open channel having mean flow velocity
      4.24 m/s and mean hydraulic depth of 3m?
      a. 0.4 m
      b. 0.6 m
      c. 0.7 m
      d. 0.8 m

                                                                    (2 marks)

   5. In a prismatic open channel, assume that the slope and the hydraulic radius
      remain unchanged, an increase in roughness coefficient (n) would decrease
      the flow velocity and the discharge.
      a. True
      b. False

                                                                    (2 marks)

School of Engineering
BEng (Hons) Civil Engineering
Semester One Examination 2019/2020
Water Engineering And The Environment
Module No. CIE6012

Q1 continued…

6. The critical depth in a rectangular open channel is a function of both discharge per unit width and slope:
    a. True
    b. False

(2 marks)

7. The gradually varied flow in an open channel occurs when the depth of water gradually changes over a short distance.
    a. True
    b. False

(2 marks)

8. The rapidly varied flow in an open channel occurs when the depth of water suddenly changes over a long distance.
    a. True
    b. false

(2 marks)

b) 8.5 m^3/s of steady uniform flow in an open channel of rectangular cross section 6 m wide with a slope of 1 in 2000 and a water depth of 1.0 m. Calculate (1) the value of C in the Chezy's formula and (2) the roughness coefficient (n) in Manning's formula.

(14 marks)

Total 30 marks

Q2.
a) Obtain the critical depth and the corresponding specific energy for a rectangular channel whose bottom width is 2 m at a discharge of 4 m^3/s. What would be the flow regime (Subcritical or supercritical) if the:
(1) normal water depth is 1.2 m.
(2) normal water depth is 0.6 m.

(10 marks)

b) A concrete lined trapezoidal channel has a normal depth of 2.5 m. The base width of the channel is 4 m and the side slope (H:V) is 2:1. The manning's roughness coefficient (n) is 0.015 and the bed slope of the channel (S) is 0.0015. Calculate the discharge and the mean velocity.

(10 marks)
Total 20 marks

PLEASE TURN THE PAGE…..

School of Engineering
BEng (Hons) Civil Engineering
Semester One Examination 2019/2020
Water Engineering And The Environment
Module No. CIE6012

Q3.
a) Derive a Unit Hydrograph for a drainage basin of 282.6 km^2 of area using the direct runoff hydrograph (DRH) tabulated below. Plot on the same graph the direct runoff hydrograph and the derived unit hydrograph.

Time (hr)	0	1	2	3	4	5	6	7	8	9
Direct runoff hydrograph (m^3/s)	0	200	650	1050	750	600	400	200	75	0

(20 marks)

b) For the same drainage basin, use the derived unit hydrograph to

(i)   determine the direct runoff hydrograph (DRH) that would be observed as a result of a storm event whose the hyetograph of the effective rainfall is tabulated below.

(ii)   Plot on the same graph the UH and the generated DRH.

Time (hr)	0-1	1-2	2-3	3-4	4-5
Effective Rainfall (cm)	1.0	2.0	1.5	1.8	2.5

(20 marks)
Total 40 marks

Q4.
a) Determine the coefficient of discharge (c$_d$) of a triangular weir (V-notch) of θ=60^0 when the discharge over the weir equals 26.4 l/s and a depth of water over the notch is 0.25m.

(5 marks)

b) A rectangular weir of 2.5m notch width extends across part of the channel has 0.5 m water depth above the crest. Determine the discharge over the weir. Assume the coefficient of discharge (c$_d$) = 0.60.

(5 marks)
Total 10 marks

END OF QUESTIONS