NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF SCIENCE AND TECHNOLOGY EDUCATION

DEPARTMENT OF TECHNICAL AND ENGINEERING EDUCATION AND TRAINING

SURFACEWATER MODELING

PTE 6257

Examination Paper

May 2019

This examination paper consists of 3 pages

Time Allowed:	**3 hours**
Total Marks:	**100**
Special Requirements:	**Graph paper**
Examiner's Name:	**DR. E. MAKAYA**

INSTRUCTIONS

1. Answer any four (4) questions
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	**25**
2.	**25**
3.	**25**
4.	**25**
5.	**25**
TOTAL	**100**

QUESTION 1

(a) What is evapotranspiration. Describe the parameters that affect it. (4 marks)

(b) Define the following terms as used in engineering hydrology

(i) time of concentration

(ii) catchment

(iii) hydrological cycle (6 marks)

(c) Describe the 3 phases of hydrologic cycle? (10 marks)

(d) Explain 3 key steps in calibrating a rainfall-runoff model (5 marks)

QUESTION 2

(a) Briefly explain the use of the double mass curve in preparation of hydrologic data. (5 marks)

(b) Provide a labeled schematic of a unit hydrograph, explain its derivation and use in an engineering application. (10 marks)

(c) A 6 hour unit hydrograph of a catchment is triangular in shape with a base of width of 64 hours and a peak ordinate of 30 m^3/s. Calculate the equilibrium discharge obtainable from this catchment for an effective rainfall intensity of 1/6 cm/hr. (5 marks)

(d) Describe what a runoff hydrograph is and give 2 main properties of a catchment that influence a runoff hydrograph significantly. (5 marks)

QUESTION 3

(a) Explain the Muskingum and the Linear Channel methods used for river routing a flood hydrograph. In your explanations, provide the fundamental equations and assumptions of these methods. (10 marks)

(b) Explain the process of reservoir routing and lake routing and how it is used in predicting reservoir levels. In your explanation you may consider a flood wave passing through a storage reservoir. (15 marks)

QUESTION 4

(a) What is the importance of infiltration in hydrologic cycle? Explain the typical shape of an infiltration curve and discuss the practical importance of the ϕ-index (10 marks)

(b) The infiltration rates for different time intervals are given in Table Q4. Determine f_0 and derive an equation for the infiltration capacity (I.C) curve

Table Q4

Time since start of test (mins)	5	10	20	30	40	50	60
f_t (cm/hr)	6.1	4.0	2.0	1.0	0.5	0.3	0.3
f_t-f_c	5.8	3.7	1.7	0.7	0.2	0	0

(15 marks)

QUESTION 5

(a) For a certain catchment the depletion curve of the hydrograph at the outlet may be described. The flood hydrograph Q (mm/d) at the outlet, as given below, was produced by a rainstorm of 50 mm.

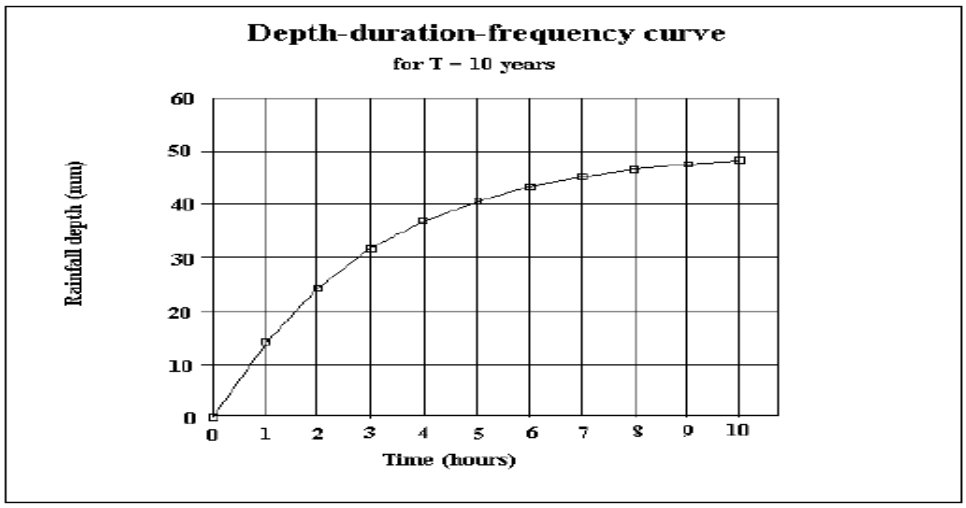
Day	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Q (mm/d)	1.72	1.50	1.31	1.14	1.00	6.00	10.0	6.00	4.00	3.00	2.62	2.29	2.00	1.75

(i) Plot the hydrograph and separate direct runoff from base flow by a straight line. (For the construction of this line semi-log paper may be used, but this is not required). (8 marks)

(ii) Estimate the direct runoff in mm. (5 marks)

(iii) Estimate the total base flow contribution from this rain storm. (5 marks)

(b) Consider a rainstorm with a constant intensity falling uniformly over a catchment of 6 km. The time of concentration of the catchment is 3 hours. The runoff coefficient is 0.4. The Depth-Duration-Frequency curve for the T = 10 years that applies to this catchment is given below. Use the Rational Method to compute the maximum peak runoff in m^3/s with a return period of 10 years.



(7 marks)

END OF EXAMINATION