NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF INDUSTRIAL TECHNOLOGY
BACHELOR OF ENGINEERING (HONS) DEGREE
DEPARTMENT OF CIVIL AND WATER ENGINEERING
PART II SECOND SEMESTER EXAM INATIONS – MAY 2011

ENGINEERING HYDROLOGY – TCW 2202

Instructions: Total marks: 100
Answer any 4 questions Time: 3Hours

QUESTION 1

a. The normal annual rainfall depths for a basin are recorded and isohyetats drawn as shown in Fig. 1a. Determine the optimum number of rain gauge stations to be established in the basin, if the desired limit of error in the mean value of rainfall is not to exceed. Suggest how you propose to distribute the additional rain gauge stations required if any. What is the percentage accuracy of the existing network in the estimation of the average depth of rainfall over the basin? The area between the isohyetats are as follows:

Table 1b

Zone	I	II	III	IV	V	VI
Area (km^2)	85	290	395	230	65	35

(15 marks)

b. i. Enumerate the factors affecting runoff. **(4 marks)**
ii. Explain the effect of any 3 factors on the runoff of a catchment with the help of a neat sketch **(6 marks)**

QUESTION 2

a. What is a unit hydrograph? Discuss its importance. **(5 marks)**

b. A 6-hr unit hydrograph for a catchment area of 600 km^2 is given in Table Q2.
In the same catchment area, there was a storm consisting of three consecutive 3-hr periods of rainfall of intensities of 15 mm/hr; 10 mm/hr and 6 mm/hr respectively. The storm loss is 4 mm/hr for all the storms and the baseflow rises from 15 m^3/s to 20 m^3/s during the total period of runoff. Compute the peak discharge. Make any checks possible on the validity of the unit graph.

Table 2Q

Time, hr	0	1	2	3	4	5	6	7	8	9	10	11
6-Hr unit graph, m^3/s	0	22	120	198	153	107	76	51	31	16	6	0

(20 marks)

QUESTION 3

a. A 1-m diameter well penetrates vertically through a confined aquifer 30 m thick. When the well is pumped at 113m^3/h, the drawdown in a well 15 m away is 1.8 m, in another well 50 m away, it is 0. 5 m.

i. What is the approximate head in the pumped well for steady state conditions and what is the approximate drawdown in the well.

ii. Calculate the transmissivity of the aquifer and the radius of influence of the pumping well. Take the initial piezometric level as 40 m above the datum. **(15 marks)**

b. 0.5 m diameter penetrates 33 m below the static water table. After a long pumping period at a rate of 80 m3/h, the drawdowns in the wells 18 m and 45 m from the pumped well were found to be 1.8 m and 1.1 m respectively.

i. What is the transmissivity of the aquifer

ii. What is the approximate drawdown in the pumped well

(10 marks)

QUESTION 4

a. Define infiltration capacity, percolation capacity and percolation rate.

(5 marks)

b. A double ring infiltrometer was used to measure the infiltration rates of a soil. An initial infiltration rate of *98.5mm/hr* was recorded. After 5 hours, an infiltration rate of *6.3mm/hr* was also recorded and a cumulative depth of 507mm. Estimate the Horton's recession constant, k.

(10 marks)

c. If there was a rainfall of intensity of *75mm/hr* during the 5 hours of the experiment, determine the excess rainfall and distinguish it by shading on a graph.

(6 marks)

d. Discuss the disadvantages of Horton's model for determining the infiltration capacity.

(4 marks)

QUESTION 5

a. i. A bridge has an intended design life of 120 years and is designed for a 1 in 100 year flood. What is the probability that something bigger will be experienced? **(3 marks)**

ii. A bridge pier is to be constructed inside a temporary cofferdam. If the cofferdam is designed for a 1 in 20 year flood and will be in the river for 2 winters, what is the probability that a larger flood will occur? **(4 marks)**

b. The annual maxima for a series of water years is shown in Table Q5b

i. Determine the magnitude of a 1 in 5,1 in 20 and 1 in 100 year flood.

ii. The catchment is 25.3 km2 and is almost entirely rural in character. There is a proposal for a urban housing development. Investigate the effect of the development on catchment flood magnitude and frequency. **(18 marks)**

Table 5b

Water year	1981	1982	1983	1984	1985	1986	1987	1988
Discharge Q	17.914	10.085	4.651	5.673	12.973	9.813	9.543	8.629
Water year	1989	1990	1991	1992	1993	1994		
Discharge Q	6.239	4.936	3.807	13.843	7.074	7.525		

Fig 1a