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 – JUNE 2010

HYDROLOGY – TCW 2202

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

QUESTION 1
    a. Why is the study of statistics important in hydrology and what are the objectives?
            (6 marks)
    b. i.   A dam is to be constructed to withstand a 1 in 10,000 year flood. It is anticipated that the dam will have a 100 year life. What is the probability that a flood that exceeds the design flood will occur during the lifetime of the dam?
       ii.   What is the significance of the answer in i above   **(6 marks)**

    b. Derive the basic hydrologic equation for a region. Provide a sketch and explain the basic terms in the equation   **(8 marks)**
    c. During the year 2000 the water budget terms for Insiza Dam included precipitation of 430 mm/year, evaporation of 530 mm/year, surface water inflow of 10 mm/year, surface outflow of 1730 mm/year and a change in dam volume of –20mm/year. Determine the groundwater flow.   **(5 marks)**

QUESTION 2
a. Explain 5 important factors that affect runoff.   **(5 marks)**
b. Determine the optimum number of rain-gauge stations to be established in a basin with data shown in Table Q2. The desired limit of error in the mean value of rainfall is 10%. What is the percentage accuracy of the existing network in the estimation of average depth of rainfall?   **(8 marks)**

Table Q2b

Station	A	B	C	D	E
Rainfall (mm)	88	104	138	78	56

    c. A rain gauge installation (A) has been upgraded by replacing a conventional manually read gauge with a tipping bucket type. At the same time a new protective fence has been built around the site.
    i.   Examine the homogeneity (consistency) of the record of gauge A in column 2 Table Q2c compared to the average of five near-by gauges. Determine whether or not a change in conditions occurred.

ii.   If a change occurred, adjust the pre-change data to be homogeneous with that currently being recorded.

iii.   The rain gauge record at A during 1999 has been lost as a result of a computer virus, so estimate the missing annual value.   **(12 marks)**

Table Q2c

Year 19	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Gauge A	690	852	780	842	878	801	899	710	801	750	822	718	801	728	700	-
5 gauge average x 10^2	88	104	979	1033	1060	1008	1105	1018	1099	1066	1134	1037	1108	1022	980	1161

QUESTION 3

a.   Describe the following: i) aquifer; ii) aquitard; iii) aquifuge; iv) aquiclude and v) piezometric surface   **(5 marks)**

b.   With the aid of diagram, describe a flowing artesian well.   **(5 marks)**

c.   3 wells in a confined aquifer are equally spaced a distance of 150 m on a straight line and have a diameter of 225 mm. The aquifer thickness is 65 m and at steady state a discharge of 346 m3/s was recorded in the middle well. If the drawdown is 5 m in all wells, determine:

i.   the transmissivity of the aquifer if the radius of influence of each well is 800 m

ii.   the discharge of the first and third wells   **(15 marks)**

QUESTION 4

a.   Discuss the advantages and disadvantages of the Horton' model for determining the infiltration capacity   **(5 marks)**

b.   The diameter of the inside ring of a double ring infiltrometer is 0.30 m. The soil under test is a silty clay. Table Q4 show the volume of water added during each of the time intervals.

i.   Determine the infiltration capacity of the soil (f mm/h) during each time interval.

ii.   Plot a graph of f against time

iii.   What is the initial and final infiltration capacity?

iv.   What is the average infiltration capacity during the first 10 min and 60 min?

Table Q4

	1	2	3	4	5	6	7	8	9	10
Time since start of test (mins)	0	2	5	10	20	30	60	90	120	180
Volume of water added during time interval (m^3 x 10^3)	-	0.330	0.455	0.719	1.232	0.985	1.526	0.639	0.427	0.779

(20 marks)

QUESTION 5

    a.   What is a hydrograph? Explain the surface-flow phenomenon

    b.   Explain the watershed characteristics which affect the nature of streamflow

    c.   Discuss the hydrograph concept. How is the hydrograph shape affected by various factors? Explain these factors.

    d.   What is a unit hydrograph? How does it permit the conversion of rainfall to runoff?

    e.   What is an S-hydrograph? Explain the use of the S-hydrograph in hydrologic analysis. **(25 marks)**