

UNIVERSITY OF SWAZILAND
Faculty of Health Sciences
Department of Environmental Health Sciences

BSc Environmental Health

MAIN EXAMINATION PAPER DECEMBER 2012

TITLE OF PAPER : HYDROLOGY

COURSE CODE : EHS:545

DURATION : 2 HOURS

MARKS : 100

INSTRUCTIONS : THERE ARE FIVE QUESTIONS IN THIS EXAM
: ANSWER ANY FOUR OF THE FIVE QUESTIONS
: EACH QUESTION CARRIES 25 MARKS
: NO PAPER SHOULD BE BROUGHT INTO OR OUT OF THE
EXAMINATION ROOM

QUESTION ONE (25 Marks)

The catchment area shown in Figure Q1 below is provided with 17 rainfall gauging stations. The average annual precipitation for each gauging station is also indicated in the figure.

- I. Draw the isohyetal lines starting from 8 cm rain fall and continuing at contour intervals of 2cm rainfall.[12 Marks]
- II. Draw the Thiessen polygons and indicate the areas within the catchment boundary represented by each of the rainfall gauging stations.[13 Marks]

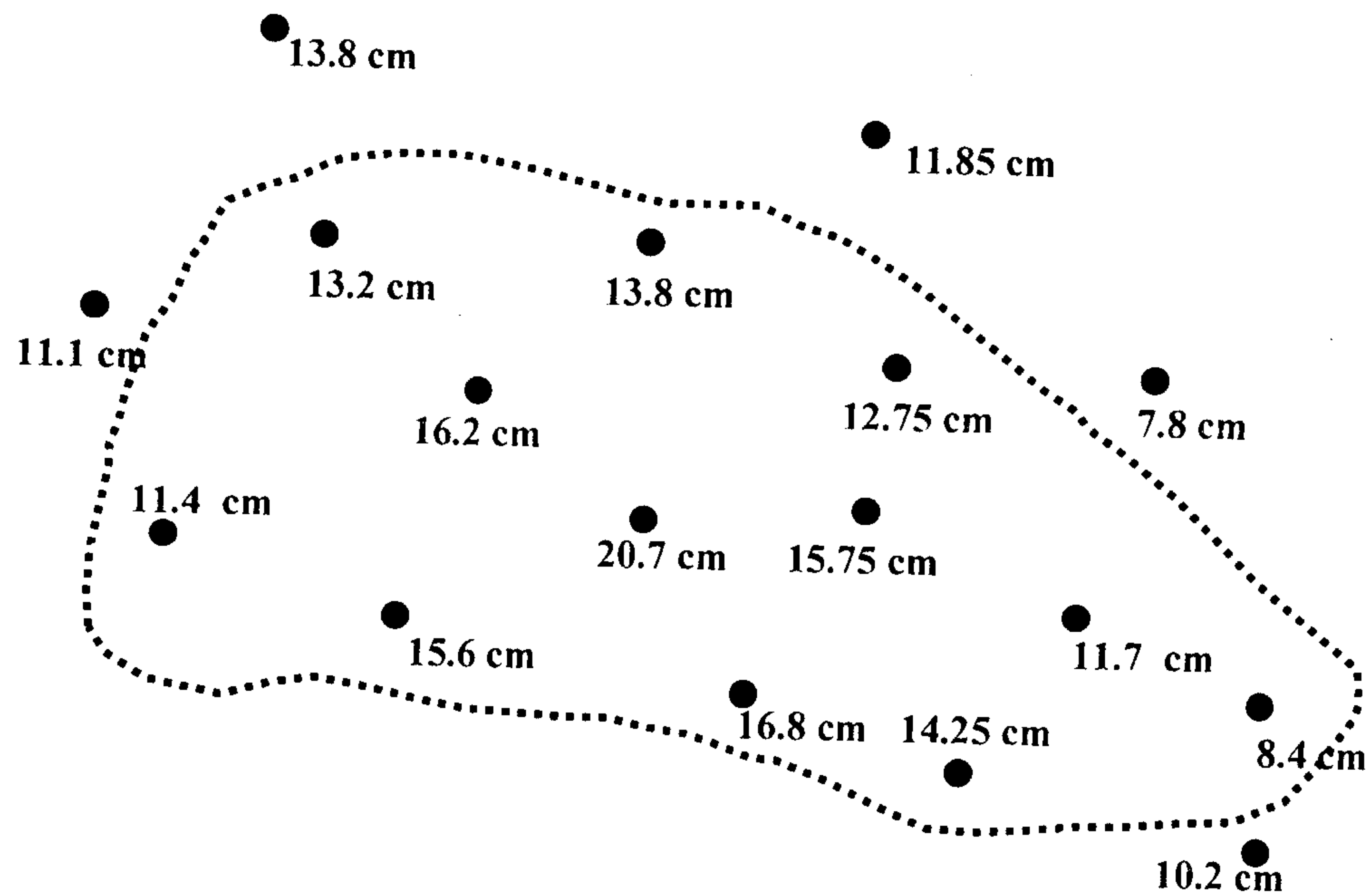


Figure Q1

QUESTION TWO (25 Marks)

The table below presents runoff data in m^3/sec measured at a gauging station of a river after a rainfall event in which the effective precipitation was 3.5cm. The duration of rainfall was 20 min. The base flow component of the river is given in the table below corresponding to each runoff measured. Derive the unit hydrograph of 20 min duration.

Time (min)	0	20	40	60	80	100	120	140	160	180	200	220	240	260
Total runoff (m^3/sec)	11	12.2	23	57.8	66.6	64.5	43.4	29.3	20.2	16	11.7	10.5	9	8
Base flow component (m^3/sec)	11	12.2	12	11.8	11.6	11.5	11.4	11.3	11.2	11	10.5	10.5	9	8

QUESTION 3 (25 Marks) (Note: each question carries 2.5 marks)

- 3A.** Describe the variation of temperature and pressure with increasing altitude in the
i) Troposphere ii) Stratosphere and iii) Mesosphere.
- 3B.** Describe the effect of atmosphere on the net solar radiation received by earth.
- 3C.** How do you explain the variation of water vapor content of air with altitude? What factors are responsible for the variation?
- 3D.** Describe with the help of a diagram the variation of relative humidity with temperature.
- 3E.** Compare the variation of the albedo α of i) white cloud ii) earth iii) snow and iv) oceans.
- 3F.** Give an estimate of the contribution of the long wave (diffuse) radiation to the overall net radiation from the sun i) under clear sky condition ii) in cloudy conditions iii) at night.
- 3G.** Explain the weather patterns of monsoon climates and the factors that influence the climate variation in monsoon regions.
- 3H.** Explain the adiabatic process by which air cools as it rises to a higher altitude. How could the temperature of the air decrease as air rises to higher altitude and why is such process characterized as adiabatic process?
- 3I.** Describe the weather patterns leading to the production of precipitation in the temperate regions.
- 3J.** Describe the theory of raindrop growth as explained by i) the Bergeron process ii) growth by collision and iii) growth by accretion.

QUESTION FOUR (25 Marks)

4A. Define the following terms: i) overland flow ii) under flow iii) detention storage
iv) isochrone.[5 marks]

4B. Describe how the following factors affect the runoff process: i) intensity ii) duration iii)
antecedent precipitation iv) basin shape v) land slope.[5 marks]

4C. Compare the following runoff estimation methods and state the conditions under which
each of the methods may be used:

- i. Empirical formulae (curves and tables)
- ii. Rational method
- iii. SCS Method
- iv. Unit hydrograph method

.....[5 marks]

4D. Stream flow data for two stations are given in the Table below. Using double mass curve
plot, determine the annual flow for 1997 and 1998 at station 2.

.....[10 marks]

Year	Runoff Station 1	Runoff Station 2
1980	30	14
1981	191	88
1982	155	73
1983	35	16
1984	261	122
1985	378	181
1986	48	21
1987	58	30
1988	108	55
1989	251	113

Year	Runoff Station 1	Runoff Station 2
1990	316	139
1991	274	134
1992	311	137
1993	339	159
1994	313	147
1995	275	143
1996	213	113
1997	308	??
1998	51	??

QUESTION FIVE (25 Marks)

5A. Order the following aquifers in increasing order of abundance of ground water:

- i. Slates
- ii. Vescicular basalts
- iii. Lake sediments, glacial deposits
- iv. Sand stones
- v. Granites and marble with fissures and cracks
- vi. Lime stones with cavities
- vii. Heavily shettered quartzites
- viii. Unconsolidated gravels, sands, alluvium

.....[5 marks]

5B. Define the following terms: i) Aquiclude ii) Aquifuge iii) Aquitard

iv) Transmissibility v) Storage coefficient.[5 marks]

5C. A tube well taps an artesian aquifer. Find its yield in liters per hour for a drawdown of 3 m when the diameter of the well is 20 cm and the thickness of the aquifer is 30 m. Assume that the coefficient of permeability is 35 m/day. If the diameter of the well is doubled find the percentage increase in the yield, the other conditions remaining the same. Assume the radius of influence as 300 m in both cases.[15 marks]