TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering & Technology

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN CIVIL ENGINEERING
(BSCEY4 – PT & REG)

ECE 2403: HDYROLOGY I

END OF SEMESTER EXAMINATION
SERIES: APRIL 2014
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Answer booklet*
- *Scientific Calculator*

This paper consists of **FIVE** questions.
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
All questions carry equal marks
Maximum marks for each part of a question are as shown
This paper consists of **FOUR** printed pages

Question One (COMPULSORY)

a) Describe with the aid of a neat sketch the hydrologic cycle. **(5 marks)**

b) Describe with the aid of a neat sketch the principle of working of Symon's non-recording rain gauge. **(4 marks)**

c) A storm commenced at 8.00 hours. The ordinates of the rainfall mass curve of this storm in mm as recorded by a recording rain guage at 15 minutes intervals are 0, 11.5, 19.0, 29.0, 42.5, 51.0, 65.0, 86.0, 97.0, 104.0, 112.0, 114.0 and 114.0

(i) Construct the hyetograph of this storm for a uniform interval of 15 minutes

(ii) Compute maximum rainfall instensitites for duration of 15, 30, 45, 60, 90, 120 and 180 minutes and;

(iii) Plot intensity duration graph. **(15 marks)**

d) Describe THREE climatic and THREE physiographic factors affecting runoff from a cateherent area. **(6 marks)**

Question Two

a) Describe THREE metrological and THREE factors affecting evaporation. **(6 marks)**

b) Describe how evaporation can be reduced from water surface. **(5 marks)**

c) The average water spread areas in the reservoirs and pan evaporation at the reservoir site for twelve …. are given below:

Months	Average Water Spread in Hectares	Pan Evaporation in mm
January	681	11.5
February	623	17.2
March	590	28.5
April	578	34.3
May	567	31.5
June	560	20.0
July	574	17.2
August	598	15.7
September	630	15.7
October	664	17.2
November	696	14.3
December	716	11.5

If the pan coefficient is 0.8 compute:

(i) The annual evaporation for the reservoir

(ii) The additional revenue realized if water in the reservoir is sold at the rate of $0.75 per cubic meter and the evaporation is reduced by 25 percent. **(6 marks)**

d) Describe water balance method for estimating evaporation from the reservoir. **(3 marks)**

Question Three

a) With the aid of a sketch, describe weighting bucket raingauge. **(5 marks)**

b) Describe a procedure of finding average rainfall using isohyetal method. **(4 marks)**

c) Thiessen polygon constructed to a network of 10 raingauges in a river basin yielded Thiessen weights of 0.10, 0.16, 0.12, 0.11, 0.09, 0.08, 0.08, 0.07, 0.11, 0.06 and 0.10. If the rainfall recorded at these gauges during a cyclonic storm arc 132, 114, 162, 138, 207, 156, 135, 158, 168, and 150mm respectively. Determine:

(i) The average depth of rainfall by Thiessen mean and arithmetic mean methods.

(ii) The volume of surface runoff at the basin outlet if 45 percent of rainfall is lost as infiltration. Take the area of the basin as 6500km2 and express your answer in cubic metres. **(8 marks)**

d) Describe the formation of conventional rainfall. **(3 marks)**

Question Four

a) The data given below is obtained during the gauging of a stream:

Distance from left water edge	**Depth**	**Velocities at 0.2 depth**	**Velocities at 0.8 depth**
(m)	(m)	(m/s)	(m/s)
0	0.00	0.00	0.00
1	1.25	0.50	0.30
2	2.00	0.75	0.50
3	3.00	1.00	0.60
4	2.50	0.85	0.50
5	2.00	0.80	0.50
6	1.50	0.70	0.40
7	0.00	0.00	0.00

Compute the discharge in the stream

b) (i) What is a unit hydrograph
(ii) Outline the assumptions of unit hydrograph theory. **(6 marks)**

c) Describe measurement of velocity of a stream using surface, ….and road floats. **(3 marks)**

d) Establish a stage-discharge rating curve from the following data obtained at a stream gauging site:

State (m)	**Discharge**	**Stage (m^3/s)**	**Discharge m^3/s**
2.96	26.99	4.64	83.08
4.46	74.93	3.55	44.54
5.70	126.57	3.00	26.51
6.91	179.40	2.93	23.95
9.59	218.33	2.83	21.82
7.02	184.34	2.76	20.11
5.86	133.68	2.63	17.16

Determine the discharge when the stage is 8.5m, 6.0m and 4m **(5 marks)**

Question Five

a) The total observed runoff volume during a 6 hour storm with uniform intensity of 1.5cm/hr is 21.6 x $10^6 m^3$. If the area of basin is $360 km^2$, find the average infiltration rate for the basin. **(5 marks)**

b) Describe measurement of infiltration capacity using a double ring infiltrometer. **(5 marks)**

c) Describe Dalton's law used for estimating evaporation loss. **(3 marks)**

d) An annual rainfall in mm recorded at a rainfall station for a period of 12 years from 1980 – 1992 are given below:

520, 615, 420, 270, 305, 308, 705, 600, 350, 550, 560, 400

(i) Find the average and standard deviation of the annual rainfall
(ii) Plot the rainfall data as a chronological chart
(iii) Construct a 3-year moving average curve **(8 marks)**