

UNIVERSITY OF SWAZILAND

DEPARTMENT OF GEORAPHY, ENVIRONMENTAL SCIENCE AND PLANNING

MAIN EXAMINATION: DECEMBER 2011

B.Sc. II

TITLE OF PAPER : WATER RESOURCES

COURSE NUMBER : GEP 228

TIME ALLOWED : THREE (3) HOURS

**INSTRUCTIONS : ANSWER TWO QUESTIONS FROM EACH
SECTION. ILLUSTRATE YOUR ANSWERS WITH
APPROPRIATE DIAGRAMS**

MARKS ALLOCATED : EACH QUESTION CARRIES 25 MARKS

**THIS PAPER IS NOT TO BE OPENED UNTIL PERMISSION HAS BEEN GRANTED
BY THE INVIGILATOR**

SECTION A: ANSWER ANY TWO QUESTIONS

Question 1

- (a) Distinguish between weather and climate. (5 marks)
- (b) Explain the factors that affect the amount of solar energy received on the earth's surface. (10 marks)
- (c) Discuss the importance of climate classification. (5 marks)
- (d) Explain one method of climate classification. (5 marks)
- (25 marks)**

Question 2

- (a) On the basis of global pressure systems, explain the global atmospheric circulation system. (15 marks)
- (b) Discuss the fact that the polar regions do not get extremely cold and the tropics extremely hot. (10 marks)
- (25 Marks)**

Question 3

Discuss how climate affects the agricultural activities in Swaziland. **(25 Marks)**

SECTION B: ANSWER ANY TWO QUESTIONS

Question 4

- (a) Explain the role of hydrology in socio-economic development. (10 marks)
- (b) Compute the net solar radiation at Kwaluseni (26° South), for the month of October given the following information and Tables 1 to 3.
- Actual sunshine hours for October is 11.2
 - Actual air temperature is 21.6° C
 - Actual vapour pressure is 18.2 mm of Hg
- (15 marks)
- (25 Marks)**

Table1 Values of σT^4 as a function of air temperature.

(Ministry of Agriculture, Fisheries and Food (1967) *Potential Transpiration*.
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| °F | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----|------|------|------|------|------|------|------|------|------|------|
| 30 | 11.0 | 11.1 | 11.2 | 11.3 | 11.4 | 11.5 | 11.6 | 11.6 | 11.7 | 11.8 |
| 40 | 11.9 | 12.0 | 12.1 | 12.2 | 12.3 | 12.4 | 12.5 | 12.6 | 12.7 | 12.8 |
| 50 | 12.9 | 13.0 | 13.1 | 13.2 | 13.3 | 13.4 | 13.5 | 13.6 | 13.7 | 13.9 |
| 60 | 14.0 | 14.1 | 14.2 | 14.3 | 14.4 | 14.5 | 14.6 | 14.7 | 14.8 | 14.9 |
| °C | | | | | | | | | | |
| -0 | 11.2 | 11.0 | | | | | | | | |
| 0 | 11.2 | 11.4 | 11.5 | 11.7 | 11.9 | 12.0 | 12.2 | 12.3 | 12.5 | 12.7 |
| 10 | 12.9 | 13.1 | 13.3 | 13.5 | 13.7 | 13.9 | 14.0 | 14.2 | 14.4 | 14.6 |
| 20 | 14.8 | 15.0 | | | | | | | | |

Table 2 Mean Monthly Solar Radiation at the top of Atmosphere R_a in mm per day produced from McCullon (1995)

| Latitude | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| Northern Hemisphere | | | | | | | | | | | | |
| 60 | 1.4 | 3.6 | 7.0 | 11.1 | 14.6 | 16.4 | 15.6 | 12.6 | 8.5 | 4.7 | 2.0 | 0.9 |
| 50 | 3.7 | 6.0 | 9.2 | 12.7 | 15.5 | 16.6 | 16.1 | 13.7 | 10.4 | 7.1 | 4.4 | 3.1 |
| 40 | 6.2 | 8.4 | 11.1 | 13.8 | 15.9 | 16.7 | 16.3 | 14.7 | 12.1 | 9.3 | 6.8 | 5.6 |
| 30 | 8.1 | 10.5 | 12.8 | 14.7 | 16.1 | 16.5 | 16.2 | 15.2 | 13.5 | 11.2 | 9.1 | 7.9 |
| 20 | 10.8 | 12.4 | 14.0 | 15.2 | 15.7 | 15.8 | 15.8 | 15.4 | 14.4 | 12.9 | 11.3 | 10.4 |
| 10 | 12.8 | 13.9 | 14.8 | 15.2 | 15.0 | 14.8 | 14.9 | 15.0 | 14.8 | 14.2 | 13.1 | 12.5 |
| 0 | 14.6 | 15.0 | 15.2 | 14.7 | 13.9 | 13.4 | 13.6 | 14.3 | 14.9 | 15.0 | 14.6 | 14.3 |
| 10 | 15.9 | 15.7 | 15.1 | 13.9 | 12.5 | 11.7 | 12.0 | 13.1 | 14.4 | 15.4 | 15.7 | 15.8 |
| 20 | 16.8 | 16.0 | 14.5 | 12.5 | 10.7 | 9.7 | 10.1 | 11.6 | 13.6 | 15.3 | 16.4 | 16.9 |
| 30 | 17.2 | 15.8 | 13.5 | 10.9 | 8.6 | 7.5 | 7.9 | 9.7 | 12.3 | 14.8 | 16.7 | 17.5 |
| 40 | 17.3 | 15.1 | 12.2 | 8.9 | 6.4 | 5.2 | 5.6 | 7.6 | 10.7 | 13.8 | 16.5 | 17.8 |
| 50 | 16.9 | 14.1 | 10.4 | 6.7 | 4.1 | 2.9 | 3.4 | 5.4 | 8.7 | 12.5 | 16.0 | 17.6 |
| 60 | 16.5 | 12.6 | 8.3 | 4.3 | 1.8 | 0.9 | 1.3 | 3.1 | 6.5 | 10.8 | 15.1 | 17.5 |
| Southern Hemisphere | | | | | | | | | | | | |

Table 3 Mean monthly values of possible sunshine hours (N), obtained from United Nations (FAO, 1977)

| North Lats South Lats | Jan Jul | Feb Aug | Mar Sep | Apr Oct | May Nov | Jun Dec | Jul Jan | Aug Feb | Sep Mar | Oct Apr | Nov May | Dec Jun |
|--------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 60 | 6.7 | 9.0 | 11.7 | 14.5 | 17.1 | 18.6 | 17.9 | 15.5 | 12.9 | 10.1 | 7.5 | 5.9 |
| 58 | 7.2 | 9.3 | 11.7 | 14.3 | 16.6 | 17.9 | 17.3 | 15.3 | 12.8 | 10.3 | 7.9 | 6.5 |
| 56 | 7.6 | 9.5 | 11.7 | 14.1 | 16.2 | 17.4 | 16.9 | 15.0 | 12.7 | 10.4 | 8.3 | 7.0 |
| 54 | 7.9 | 9.7 | 11.7 | 13.9 | 15.9 | 16.9 | 16.5 | 14.8 | 12.7 | 10.5 | 8.5 | 7.4 |
| 52 | 8.3 | 9.9 | 11.8 | 13.8 | 15.6 | 16.5 | 16.1 | 14.6 | 12.7 | 10.6 | 8.8 | 7.8 |
| 50 | 8.5 | 10.0 | 11.8 | 13.7 | 15.3 | 16.3 | 15.9 | 14.4 | 12.6 | 10.7 | 9.0 | 8.1 |
| 48 | 8.8 | 10.2 | 11.8 | 13.6 | 15.2 | 16.0 | 15.6 | 14.3 | 12.6 | 10.9 | 9.3 | 8.3 |
| 46 | 9.1 | 10.4 | 11.9 | 13.5 | 14.9 | 15.7 | 15.4 | 14.2 | 12.6 | 10.9 | 9.5 | 8.7 |
| 44 | 9.3 | 10.5 | 11.9 | 13.4 | 14.7 | 15.4 | 15.2 | 14.0 | 12.6 | 11.0 | 9.7 | 8.9 |
| 42 | 9.4 | 10.6 | 11.9 | 13.4 | 14.6 | 15.2 | 14.9 | 13.9 | 12.6 | 11.1 | 9.8 | 9.1 |
| 40 | 9.6 | 10.7 | 11.9 | 13.3 | 14.4 | 15.0 | 14.7 | 13.7 | 12.5 | 11.2 | 10.0 | 9.3 |
| 35 | 10.1 | 11.0 | 11.9 | 13.1 | 14.0 | 14.5 | 14.3 | 13.5 | 12.4 | 11.3 | 10.3 | 9.8 |
| 30 | 10.4 | 11.1 | 12.0 | 12.9 | 13.6 | 14.0 | 13.9 | 13.2 | 12.4 | 11.5 | 10.6 | 10.2 |
| 25 | 10.7 | 11.3 | 12.0 | 12.7 | 13.3 | 13.7 | 13.5 | 13.0 | 12.3 | 11.6 | 10.9 | 10.6 |
| 20 | 11.0 | 11.5 | 12.0 | 12.6 | 13.1 | 13.3 | 13.2 | 12.8 | 12.3 | 11.7 | 11.2 | 10.9 |
| 15 | 11.3 | 11.6 | 12.0 | 12.5 | 12.8 | 13.0 | 12.9 | 12.6 | 12.2 | 11.8 | 11.4 | 11.2 |
| 10 | 11.6 | 11.8 | 12.0 | 12.3 | 12.6 | 12.7 | 12.6 | 12.4 | 12.1 | 11.8 | 11.6 | 11.5 |
| 5 | 11.8 | 11.9 | 12.0 | 12.2 | 12.3 | 12.4 | 12.3 | 12.3 | 12.1 | 12.0 | 11.9 | 11.8 |
| Equator 0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 | 12.0 |

Question 5

- (a) Explain the factors that affect runoff of a drainage basin. (10 marks)
- (b) Table 4 presents the current meter discharge measurement data for a hypothetical River on December 20, 2009. Compute the discharge of the river on that day. (15 marks)
- (25 Marks)**

Table 4 Current meter flow velocity measurements for a hypothetical River on December 20, 2009

| Vertical number | Distance from bank (m) | Depth (m) | $V_{0.6}$ (m/s) |
|-----------------|------------------------|-----------|-----------------|
| 0 | 0 | 0 | 0 |
| 1 | 1.22 | 0.29 | 0.095 |
| 2 | 2.134 | 0.43 | 0.122 |
| 3 | 3.049 | 0.61 | 0.101 |
| 4 | 3.963 | 0.64 | 0.128 |
| 5 | 4.878 | 0.70 | 0.134 |
| 6 | 5.793 | 0.69 | 0.140 |
| 7 | 6.707 | 0.67 | 0.152 |
| 8 | 7.317 | 0.56 | 0.125 |
| 9 | 8.00 | 0.48 | 0.120 |
| 10 | 8.8 | 0.0 | 0.00 |

Question 6

- (a) Explain the methods used to estimate the available water resources of river basin. (10marks)
- (b) Using Figure 1 estimate the preliminary reservoir storage capacity (in m^3) for a water demand of 100,000.00 acre-ft per year. (15 marks)
- (25 marks)

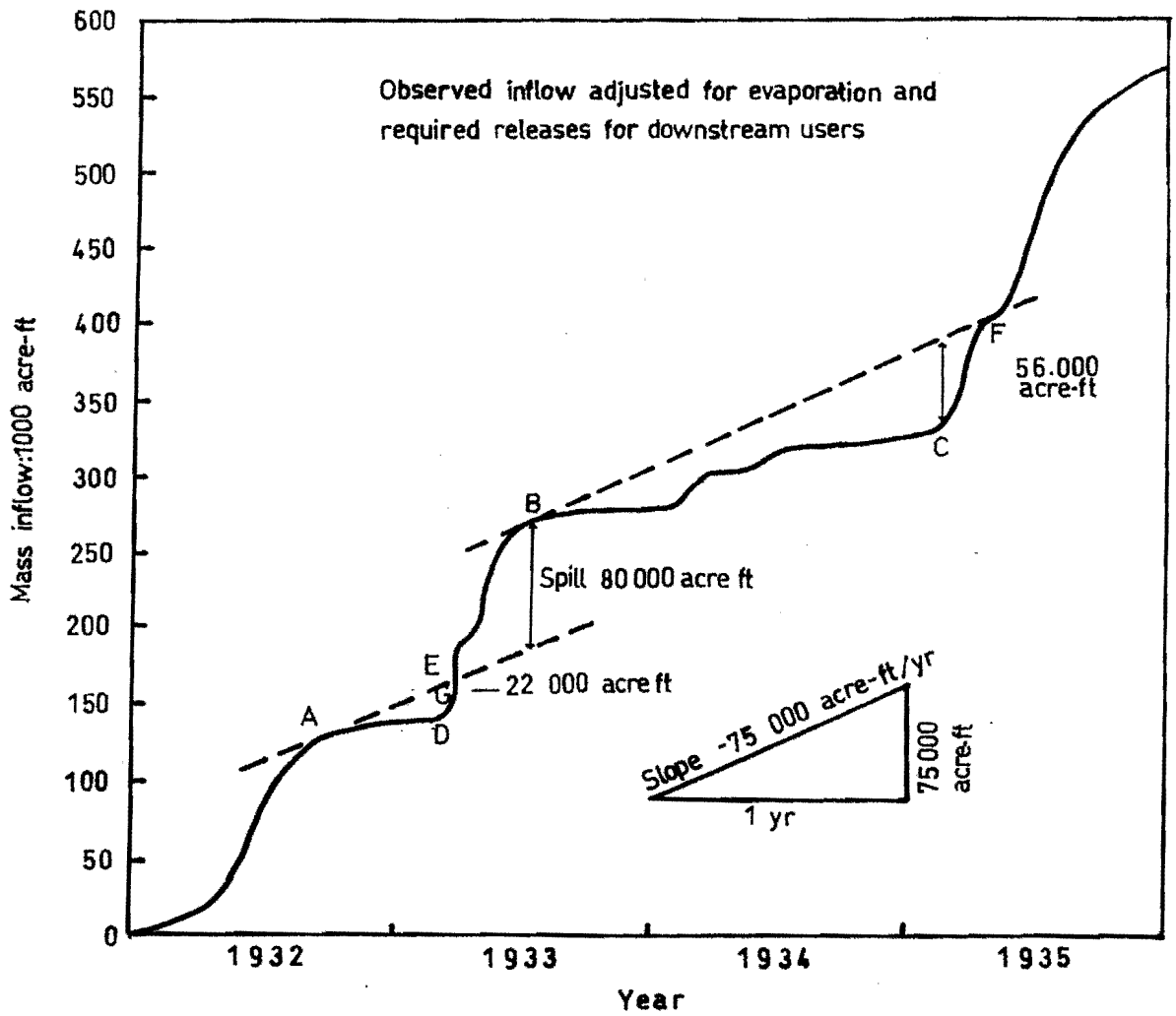


Figure 1: Mass curve for a four year period.