



UNIVERSITY EXAMINATIONS
NJORO CAMPUS

FIRST SEMESTER 2012/2013

FIFTH YEAR EXAMINATIONS FOR THE DEGREE OF BACHELOR OF SCIENCE IN
AGRICULTURAL ENGINEERING

AGEN 556: SOIL AND WATER CONSERVATION ENGINEERING

STREAM: 2008 (Y5) B. SC. AGEN

TIME: 2 hours

DAY/TIME: TUESDAY, 08.30 – 11.30 am

DATE: 22/01/2013

INSTRUCTIONS:

1. The paper contains **SIX (6)** questions
2. Attempt **any FIVE (5)** questions
3. All questions carry equal marks.
4. Marks for each question are shown in parenthesis.
5. Tables and other aid material are provided at the back of the paper.
6. **EACH QUESTION SHOULD BE STARTED ON A NEW PAGE.**

QUESTION ONE

- (a) Give an outline of at least 5 of the most common visual indicators of water erosion. **(5 marks)**
- (b) Give an outline of at least 4 of the most common visual indicators of wind erosion. **(4 marks)**
- (c) Give an outline of the three mechanics of soil erosion by either wind or water. **(3 marks)**
- (d) Explain how knowledge of soil erosion mechanics referred to in part (c) above is used in formulating mitigation measures for water and wind erosion. **(3 marks)**

QUESTION TWO

- (a) Briefly discuss the concept of soil loss tolerance **(4 marks)**
- (b) Define the term “Iso-erodent” **(1 mark)**
- (c) Explain why it has not been possible to prepare iso-erodents for Kenya. **(1 mark)**
- (d) Describe in detail, the procedure for creating iso-erodents in a given country **(9 marks)**

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QUESTION THREE

- (a) Briefly discuss the concept of "Cultural or Biological" soil conservation measures. (4 marks)
- (b) Briefly discuss the concept of "Physical" soil conservation measures. (4 marks)
- (c) Outline any seven basic factors which are considered in the selection and design of physical soil conservation structures. (7 marks)

QUESTION FOUR

- (a) Outline the basic land use rules (Agriculture Act CAP 318) governing the cultivation of steep slopes and watercourses for agricultural purposes in Kenya. (5 marks)
- (b) A piece of forest land in East Mau area has a uniform slope gradient of 16 % and is 180 m in length. The land was estimated to lose 0.5 Mg/ha/yr before it was cleared and replanted with maize. No conservation measures have been instituted and ploughing has been going on up and down the slope. Assume the crop management factor (C) for maize is 0.76, for forest is 0.01, and the conservation practice factor (P) for terracing is 0.16, and for forest conditions is 0.10.
 - (i) Estimate the amount of soil lost from the piece of land (5 marks)
 - (ii) The amount of soil loss if the piece of land is terraced (5 marks)

QUESTION FIVE

- (a) Explain the difference between a windbreak and a shelterbelt (2 marks)
- (b) Briefly discuss the two major types of wind erosion control measures under the headings surface wind velocity and soil factors (4 marks)
- (c) Define the terms in the following equation:
$$d = 17h (v_m/v) \cos \theta$$
(5 marks)
- (d) Determine the spacing between windbreaks that are 15 m high if the 5-year return period wind velocity at 15 m height is 15.6 m/s and the wind direction deviates 10 degrees from the perpendicular to the field strip (Assume a smooth bare soil surface and a fully protected field). (4 marks)

QUESTION SIX

- (a) Define the following terms as used in the Universal soil loss Equation (USLE)
 - (i) Rainfall erosivity factor
 - (ii) Soil loss ratio (4 marks)
- (b) Explain how surface cover and management influence soil erosion (4 marks)
- (c) Two plots A and B with similar soils and topographic conditions were cultivated and planted with maize. In plot A, DAP fertilizer was applied during planting and a yield of 48 bags per hectare was realised. In plot B, no fertilizer was applied and a yield of 20 bags per hectare was

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realised. If the maize was grown for only one season, determine the crop management factor (C) of maize in the two plots and explain the variation in the C-factor in the two plots. (Use the information given in Tables 1 and 2 and Figure 1) (7 marks)

Table 1: Beginning and end of crop-growth stage periods

Crop-Stage Period	Dates
1) Seedbed	1st April - 30th April
2) Establishment	1st May - 30th June
3) Growing cover	1st July - 31st October
4) Stubble (from harvest to ploughing)	1st November - 31st January
5) Fallow (or preparation of seedbed)	1st February - 31st March

Table 2: Soil loss ratio from maize to corresponding loss from continuous fallow

Management	Yield	Crop-Stage period				
	Bag/ha	0	1	2	3	4
No treatment	20	85	92	80	50	85
No treatment	32	85	92	72	36	80
Fertilized, DAP	32	80	86	70	36	75
Fertilized, DAP	48	80	86	60	30	70

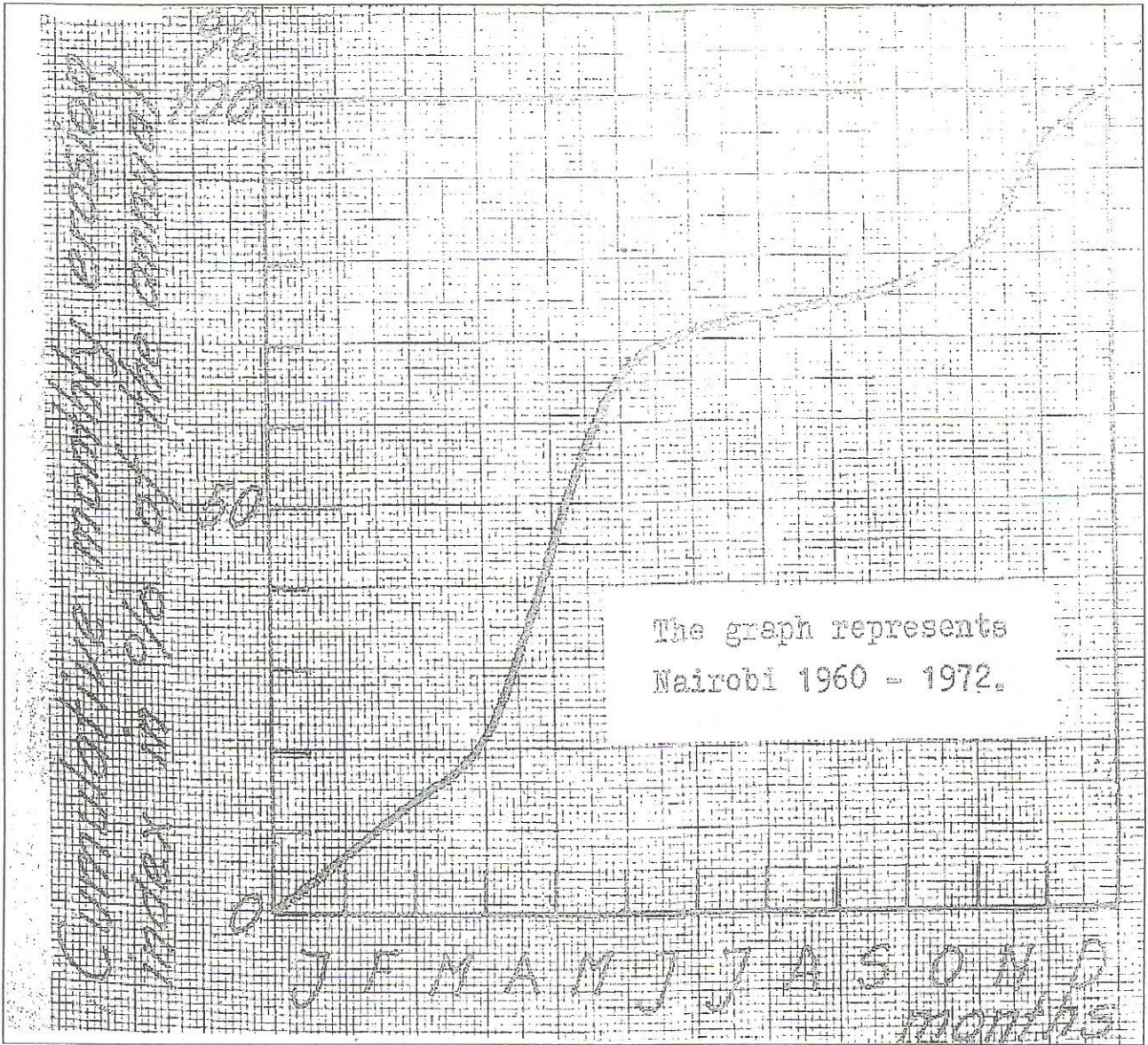


Figure 1: Monthly distribution of the annual rainfall erosion index in percent