Practical Manual

on

Soil & Water Conservation Engineering

AAE 132–2 (1+1)

B.Sc. (Hons.) Agriculture, II Semester

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Syllabus AAE132 – 2 (1+1)

General status of soil conservation in India. Calculation of erosion index. Estimation of soil loss. Measurement of soil loss. Preparation of contour maps. Design of grassed water ways. Design of contour bunds. Design of graded bunds. Design of bench terracing system. Problem on wind erosion.

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Exercise No. 1

Objective: To study about general status of soil conservation in India.

Soil degradation:

Exercise No. 2

Objective: To study about various types of soil erosion.

Soil Erosion Principle:

Factors affecting soil erosion: ----------

Types of Erosion: ----------

Geologic erosion: ----------

Accelerated erosion: ----------

Water erosion: ----------

Mechanics of water erosion:----------

Raindrop or Splash erosion: ----------

Sheet erosion: ----------

Rill erosion: ----------

Gully erosion: ----------

Stream bank erosion: ----------

Glacial erosion: ----------

Snow erosion: ----------

Organic erosion: ----------

Anthropogenic erosion:----------

Exercise No. 3

Objective: To study about erosion control measures.

Gully control measures:

Principle: ----------

Control by vegetation: ----------

Control by structures: ----------

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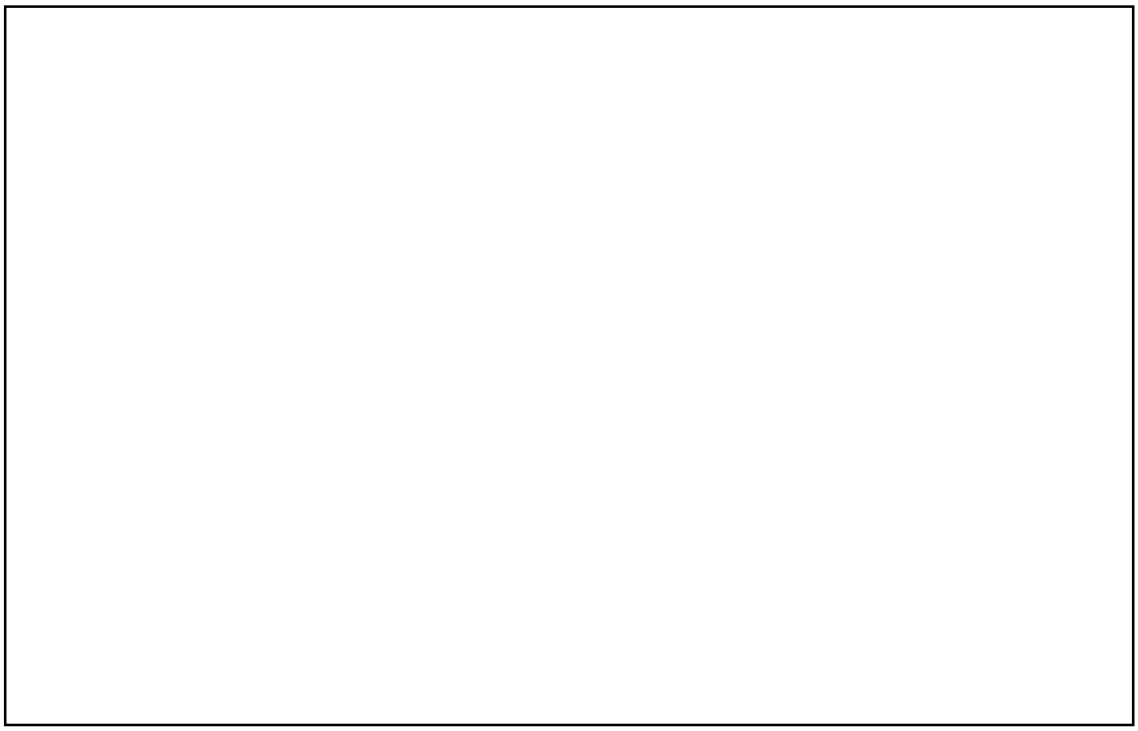
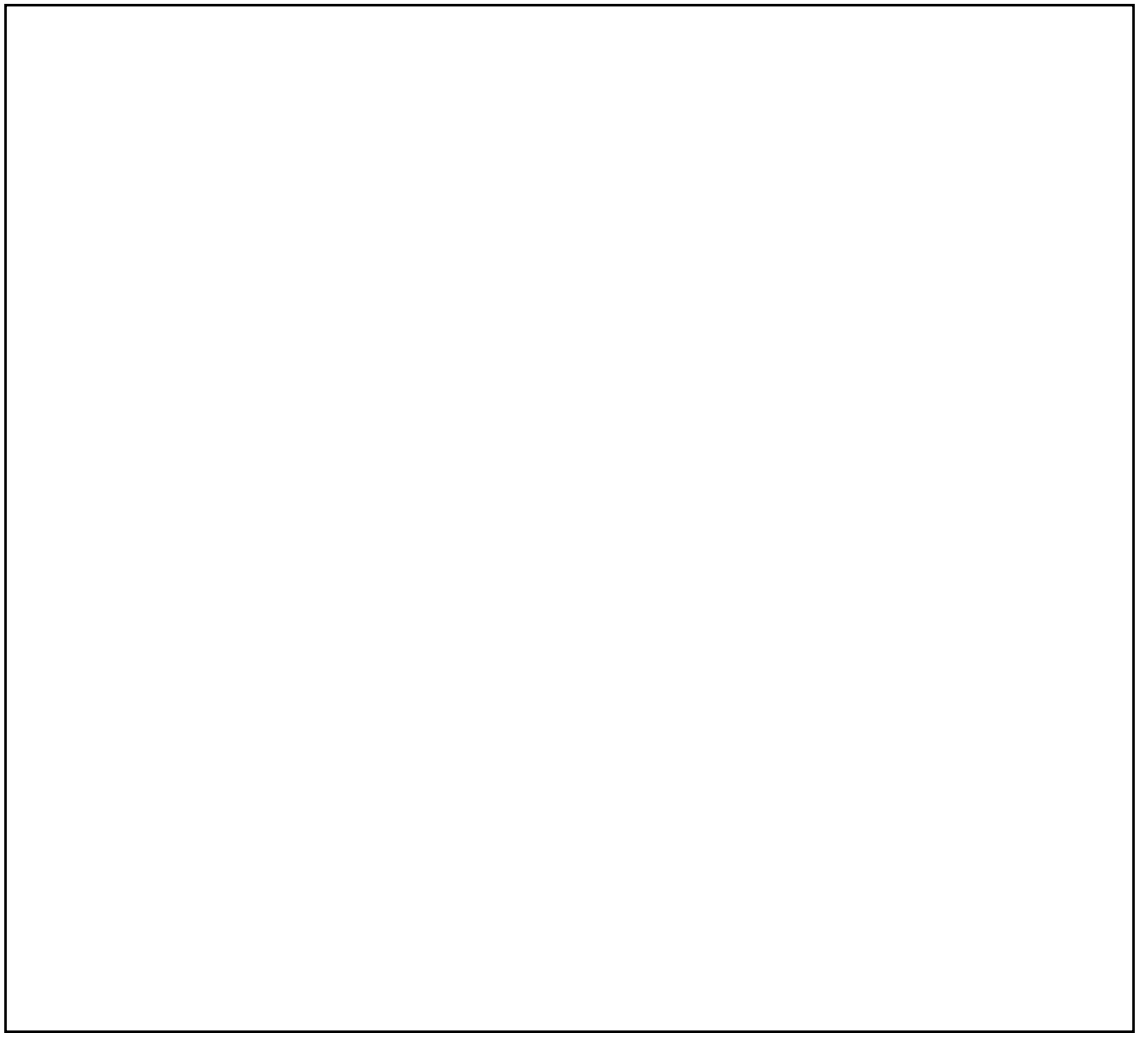
Permanent gully control structures: ----------

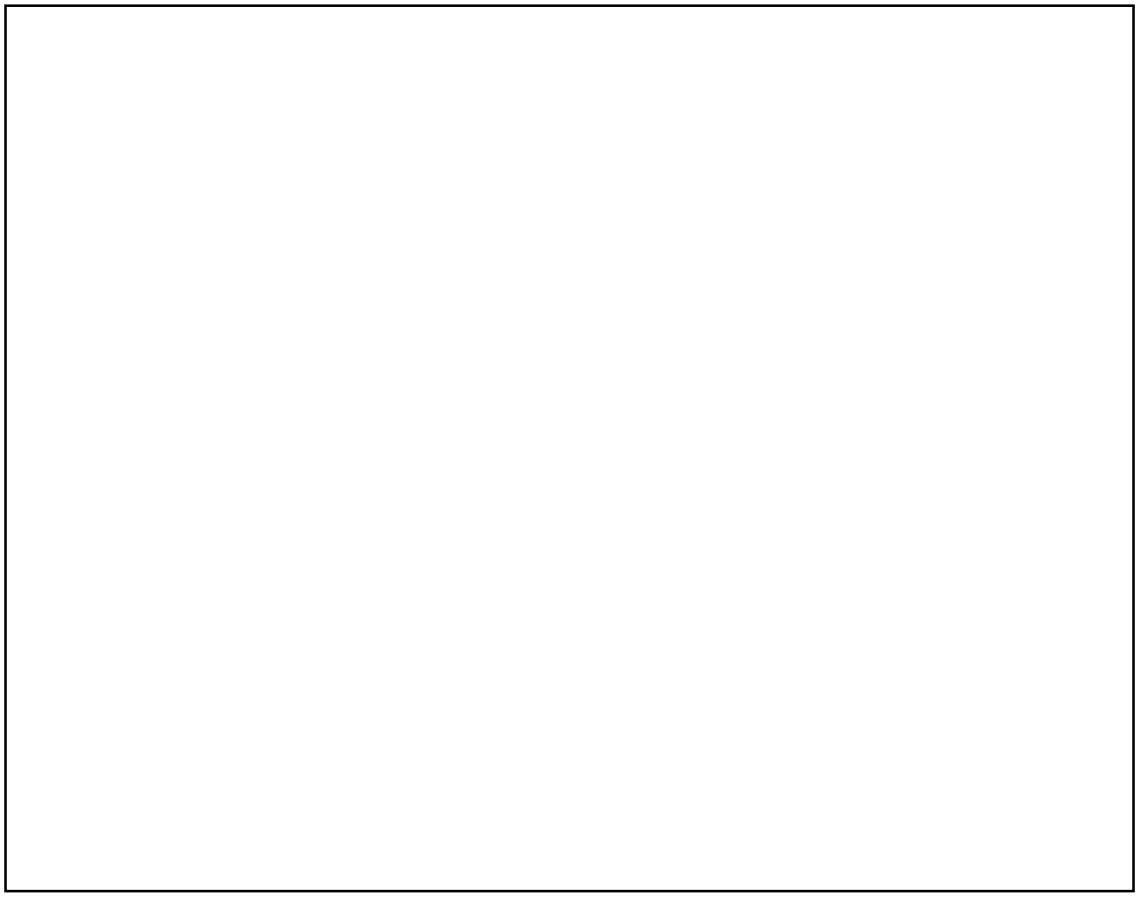
Drop-inlet spillway: ----------



Straight drop spillway: ----------



Chute spillway: ----------



Exercise No. 4

Objective: To study about erosivity and erodibility.

Erosivity: ----------

Erodibility: ----------

Estimation of erosivity from rainfall data:----------

EI_{30} index method: ----------

KE>25 index method:----------

Exercise No. 5

Objective: To calculate the erosion index.

Problem 1: Using the following rainfall data of a particular storm, determine 30, 60 and 120-minutes maximum rainfall depths and intensities and also compute rainfall erosivity index of the storm by EI_{30} and KE > 25 methods.

Time (min)	0	5	10	15	20	25	30	35
Rainfall (cm)	**0**	**0.05**	**0.87**	**0.26**	**0.10**	**0.49**	**1.23**	**1.28**
Time (min)	40	45	50	55	60	65	70	75
Rainfall (cm)	**1.28**	**1.31**	**0.41**	**0.79**	**1.69**	**0.92**	**1.00**	**0.92**
Time (min)	80	85	90	95	100	105	110	115
Rainfall (cm)	**1.38**	**1.95**	**1.31**	**1.13**	**0.64**	**0.64**	**0.56**	**0.38**
Time (min)	120	125	130	135	140	145	150	
Rainfall (cm)	**0.23**	**0.23**	**0.31**	**0.08**	**0.03**	**0.05**	**0.03**	

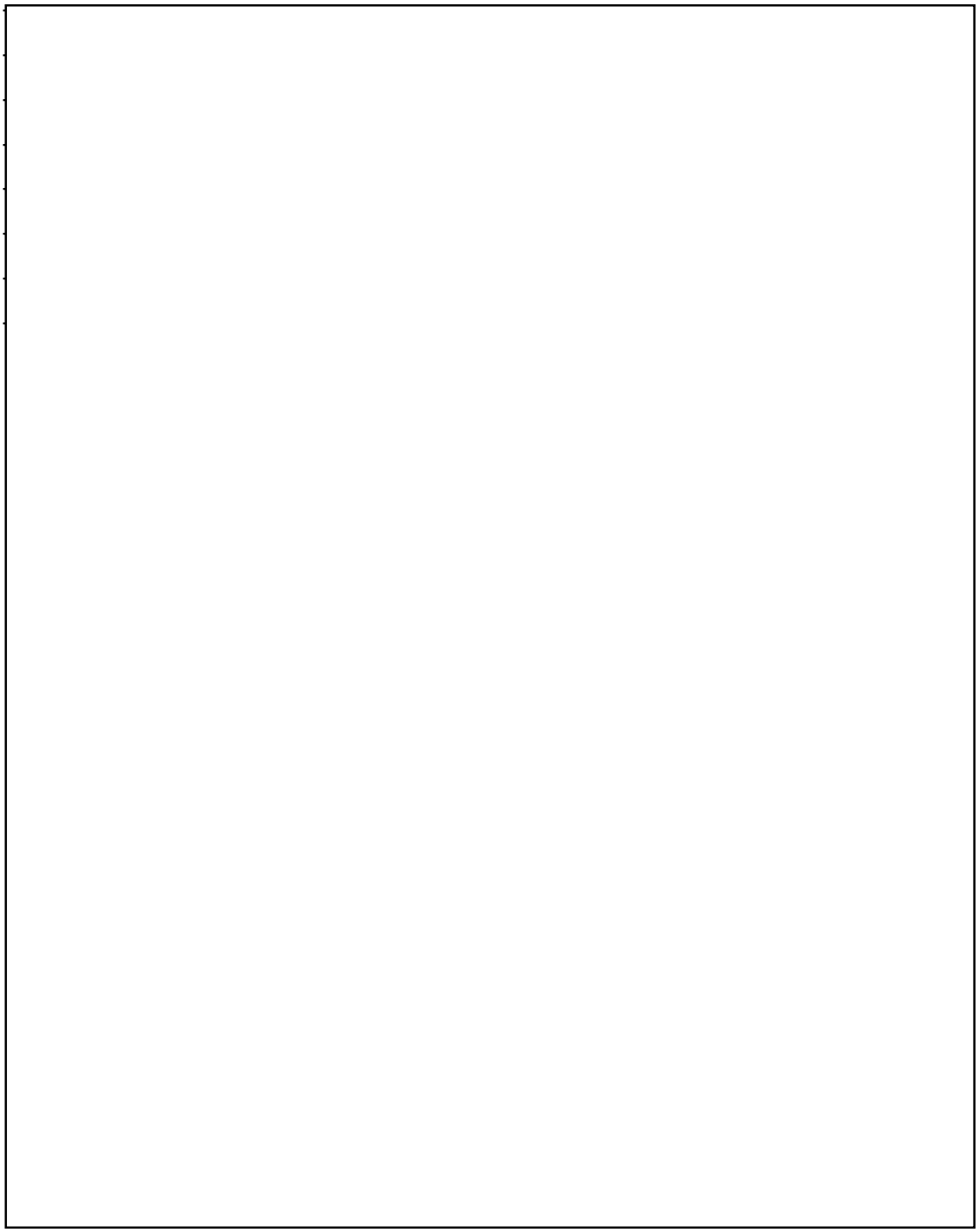
Solution: ----------

Exercise No. 6

Objective: To study about biological methods to control erosion.

Contour cultivation: ----------

Strip cropping: ----------



Cropping systems: ----------

Exercise No. 7

Objective: To study about engineering measures to conserve the water and erosion.

Bunding:

Types of bund: ----------

Contour bunding: ----------

Types of contour bunding: ----------

Graded bunding: ----------

Types of graded bunding: ----------

Contour trenching:

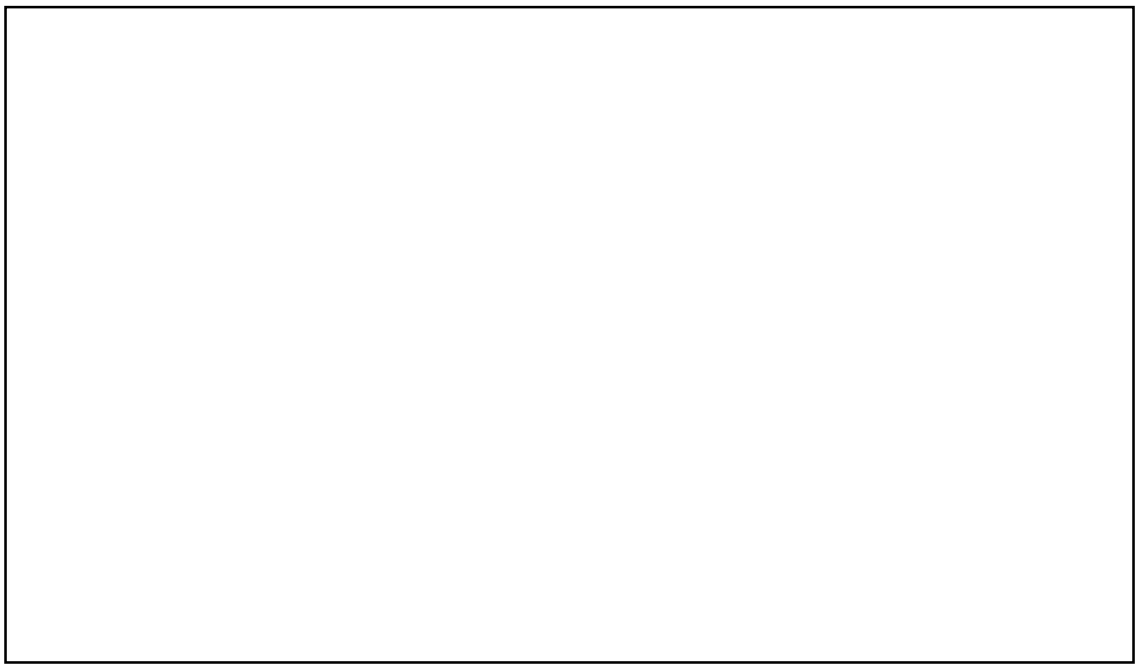
Graded trenches: ----------

Staggered trenches: ----------

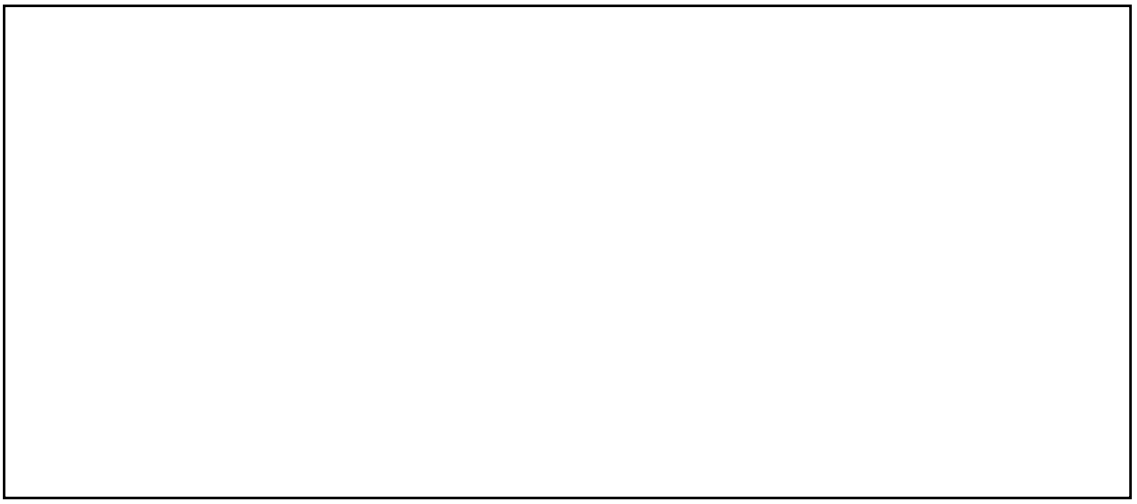
Terracing:----------

Bench terrace: ----------

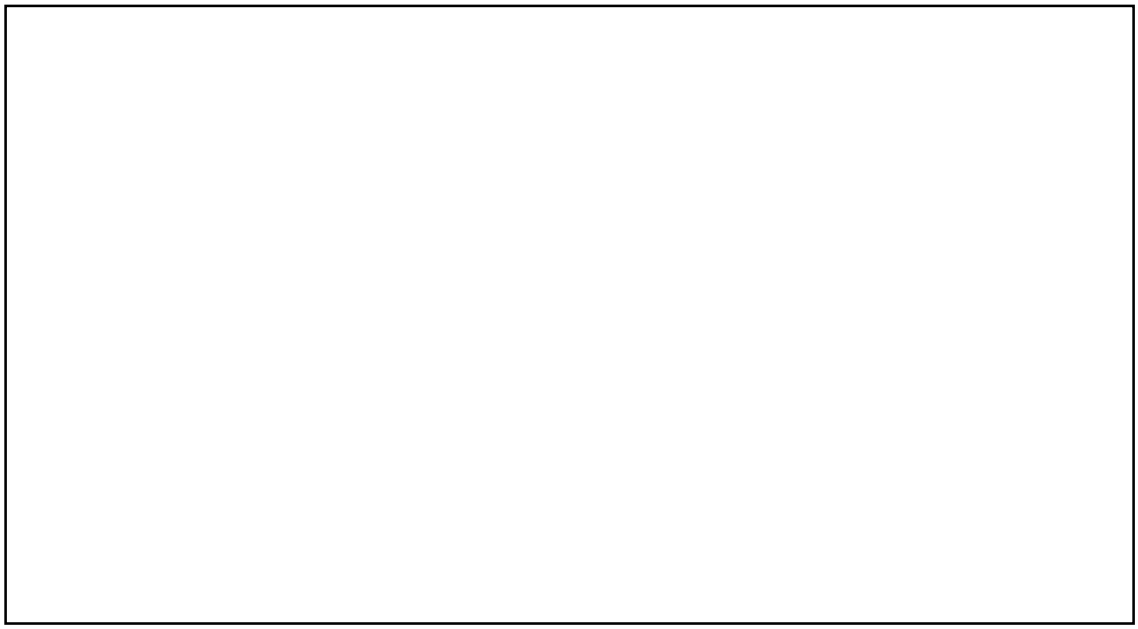
Hill type bench terraces: ----------



Irrigated type bench terraces:----------



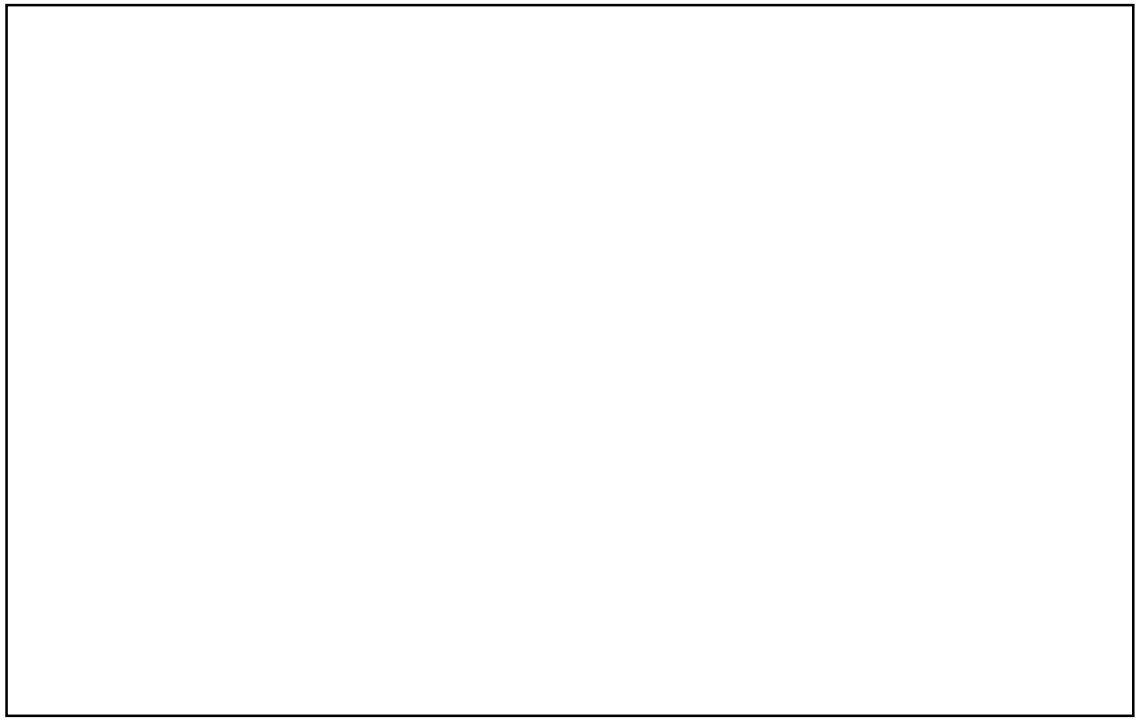
Orchard type bench terraces: ----------



Exercise No. 8

Objective: To study about various water harvesting techniques.

Water harvesting:----------

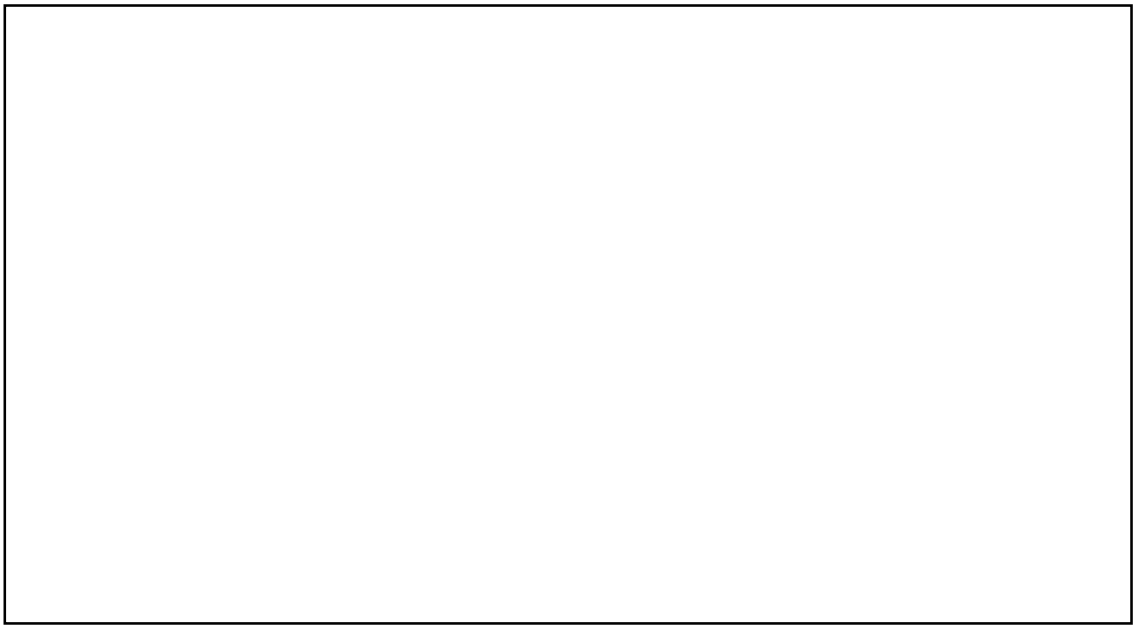


Catchment area treatments: ----------

Roof top water harvesting: ----------

Micro-catchment system: ----------

Negarim micro catchments (for trees):----------



Contour bunds (for trees):----------

Contour ridges (for crops):----------

Semi-circular bunds (for range and fodder): ----------

Macro catchment system of rainwater harvesting: ----------

Flood water harvesting: ----------

Water harvesting using storage structures: ----------

Water harvesting through spreading of water: ----------

Exercise No. 9

Objective: To study about soil loss estimation models.

Universal Soil Loss Equation (USLE):

Rainfall Factor : ---

Soil Erodibility Factor: ---

Length and Steepness of Slope Factor: ----------

Crop Management Factor: ----------

Conservation Practices Factor: ----------

Application of USLE: ----------

Limitations of USLE:----------

Problem 1: Calculate the annual soil loss from the field subjected to soil erosion problem, for the following informations:

Rainfall erosivity index = 1000 m tonnes/ha
Soil erodibility index = 0.20
Crop management factor = 0.50
Conservation practices factor = 1.0
Slope length factor = 0.10
Also explain, how the soil loss is affected by adopting soil conservation practices.

Formula used: ----------

Solution: ----------

Problem 2:Calculate the topographic factor for use in USLE for the land slope of 5% and slope length as 150 ft.

Formula used: ----------

Solution: ----------

Modified USLE: ----------

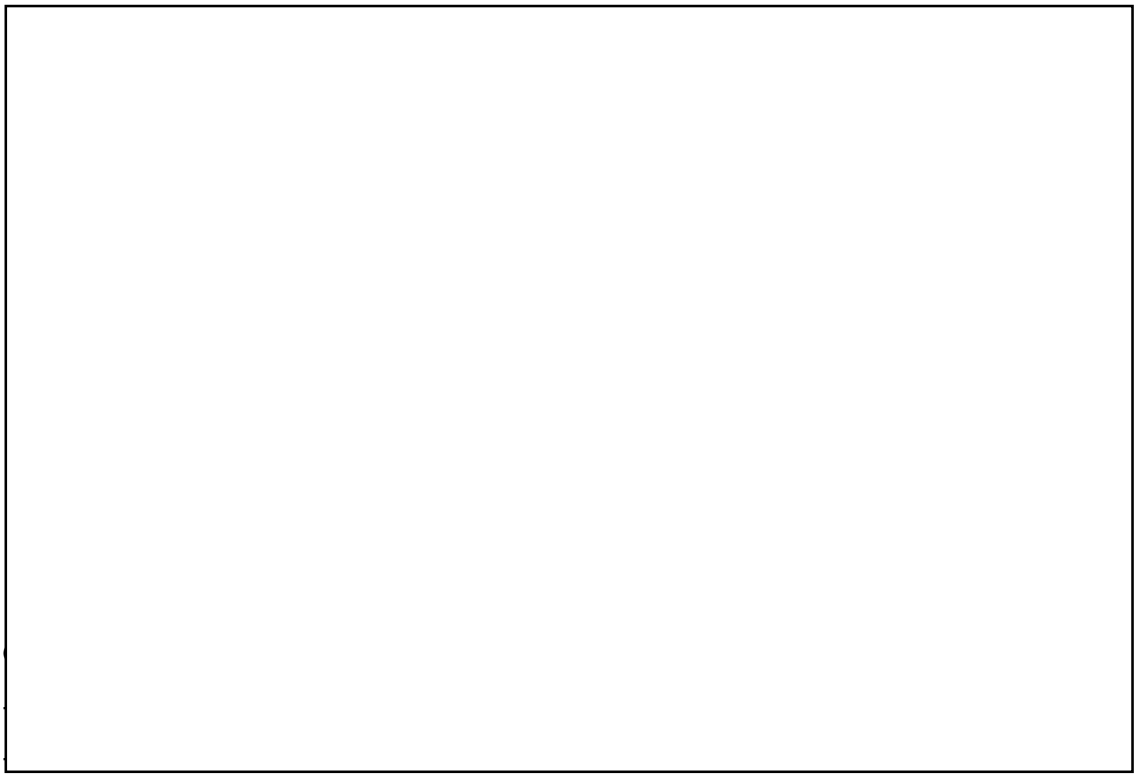
Revised USLE: ----------

Exercise No. 10

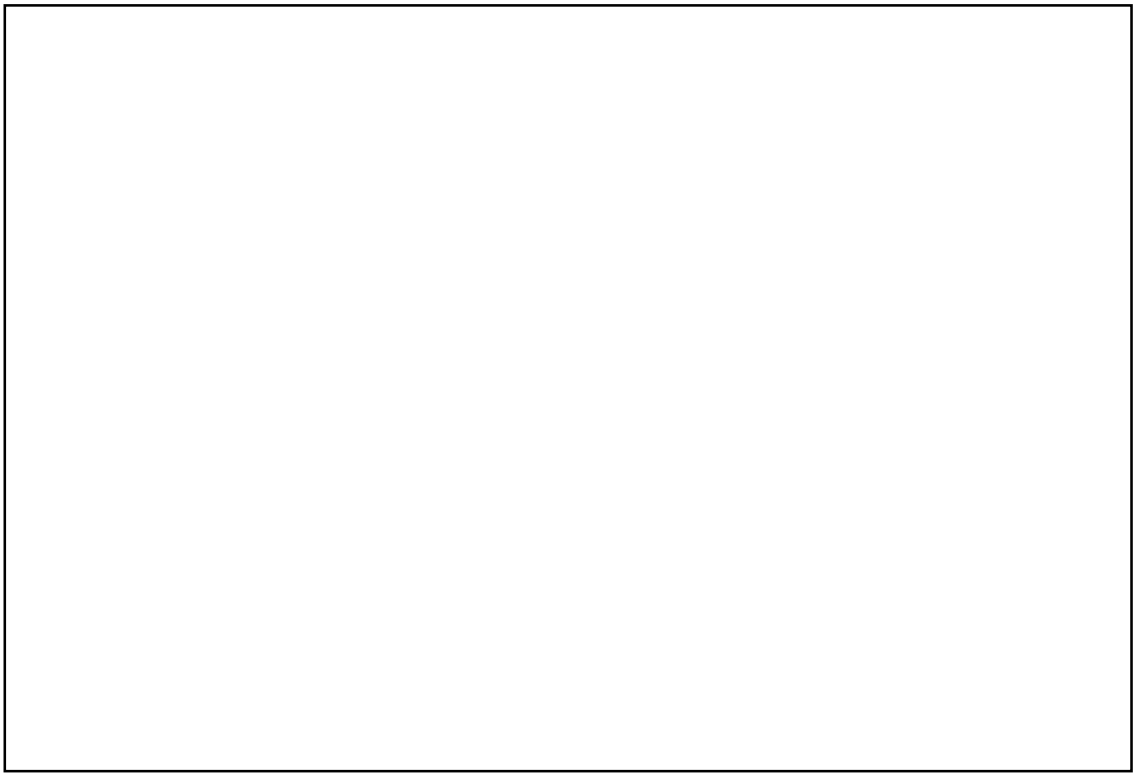
Objective: To study about measurement of soil loss.

Runoff plots: ----------

Multi-slot divisor: ----------



Coshocton wheel silt sampler: ----------



Exercise No. 11

Objective:To study the various steps involved in design of grassed waterways.

Grassed waterways: ----------

Steps involved in design of grassed waterways:----------

Exercise No. 12

Objective: To design a parabolic shape of grassed waterways

Problem 1. Design a parabolic shape diversion drain to divert the water of upper catchment area of 20 ha. The channel slope to be used is 8%. The other details are as follows:

1. **Diversion has good vegetation.**
2. **Runoff coefficient (C) =0.70**
3. **Rainfall intensity (I) = 20 mm/h**
4. **Manning's roughness coefficient (n) = 0.04**

Exercise No. 13

Objective:To study the various steps involved in design of bunds.

Design criteria for bund construction: ----------

Design specification of bunds: ----------

Exercise No. 14

Objective: To study design of bench terracing system.

Design of bench terrace: ----------

Type of bench terrace: ----------

Terrace spacing: ----------

Width of bench terrace: ----------

Terrace cross-section: ----------

Area lost in bench terracing:--

Exercise No. 15

Objective:To study about features of graded bunds

Graded bunding----------

Main functions----------

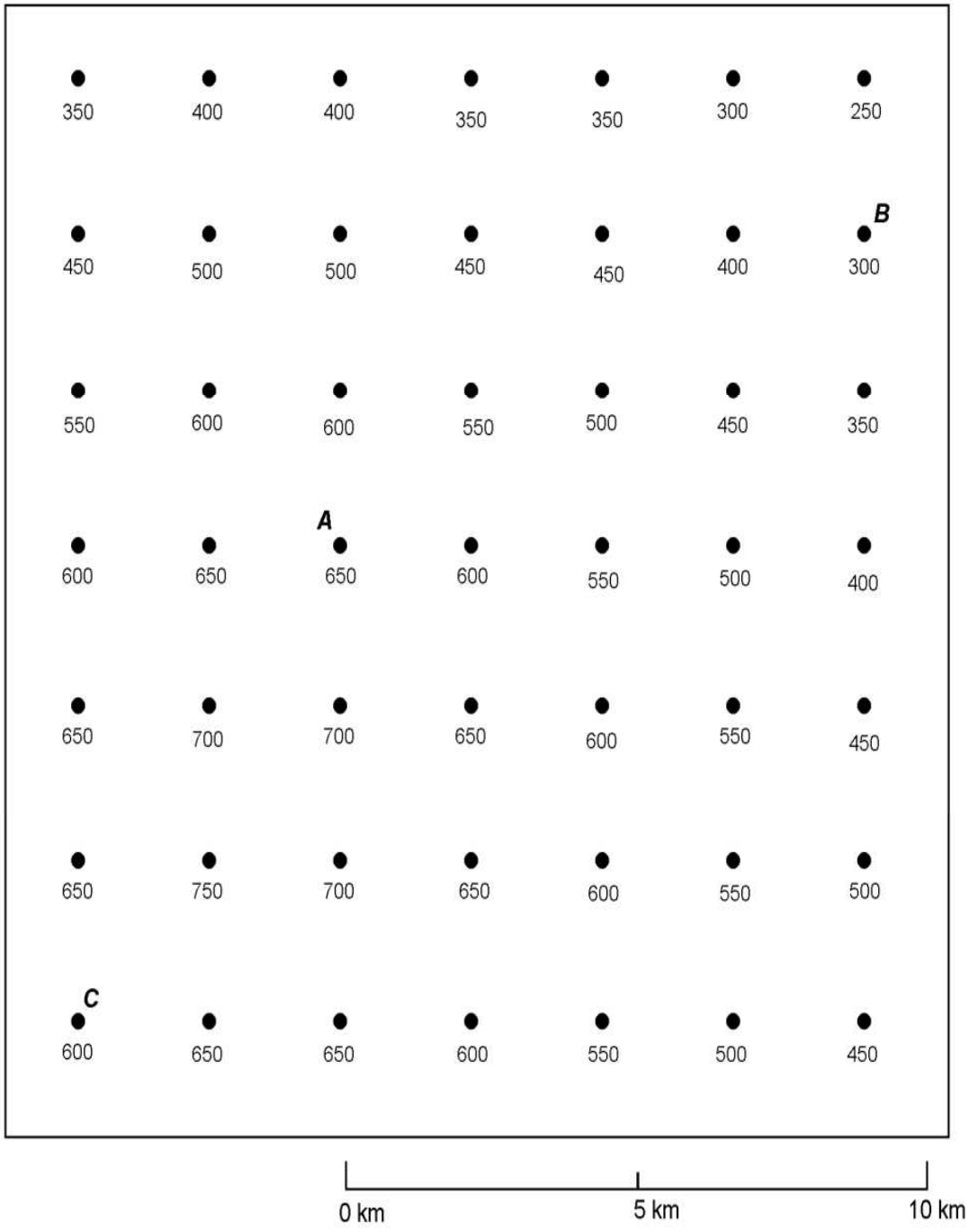
Limitations----------

Exercise No. 16

Objective: To prepare the contour maps.

Problem 1: Draw the contour lines at the following elevations (all numbers are given in meters above sea level):

250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750



(a) Calculate the gradient from point A to point B

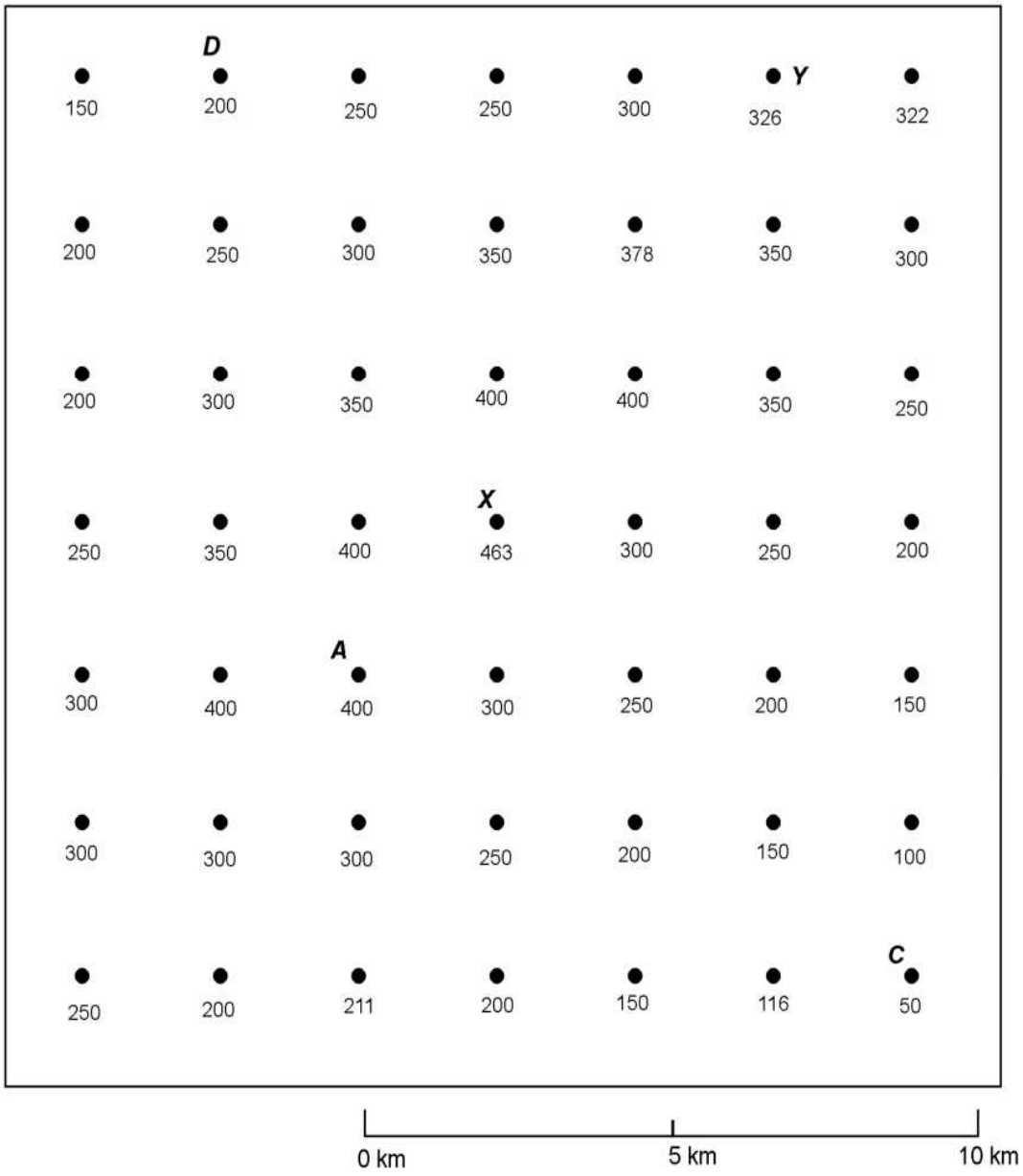
(b) Calculate the gradient from point A to point C

(c) Draw profile from C to B

(d) What are the areas susceptible for erosion

Problem 2: Draw in contour lines at the following elevations (all numbers are given in meters above sea level):

450, 400, 350, 300, 250, 200, 150, 100, 50



(a) Calculate the gradient from point X to point Y

(b) Calculate the gradient from point X to point C

(c) Draw profile from C to D

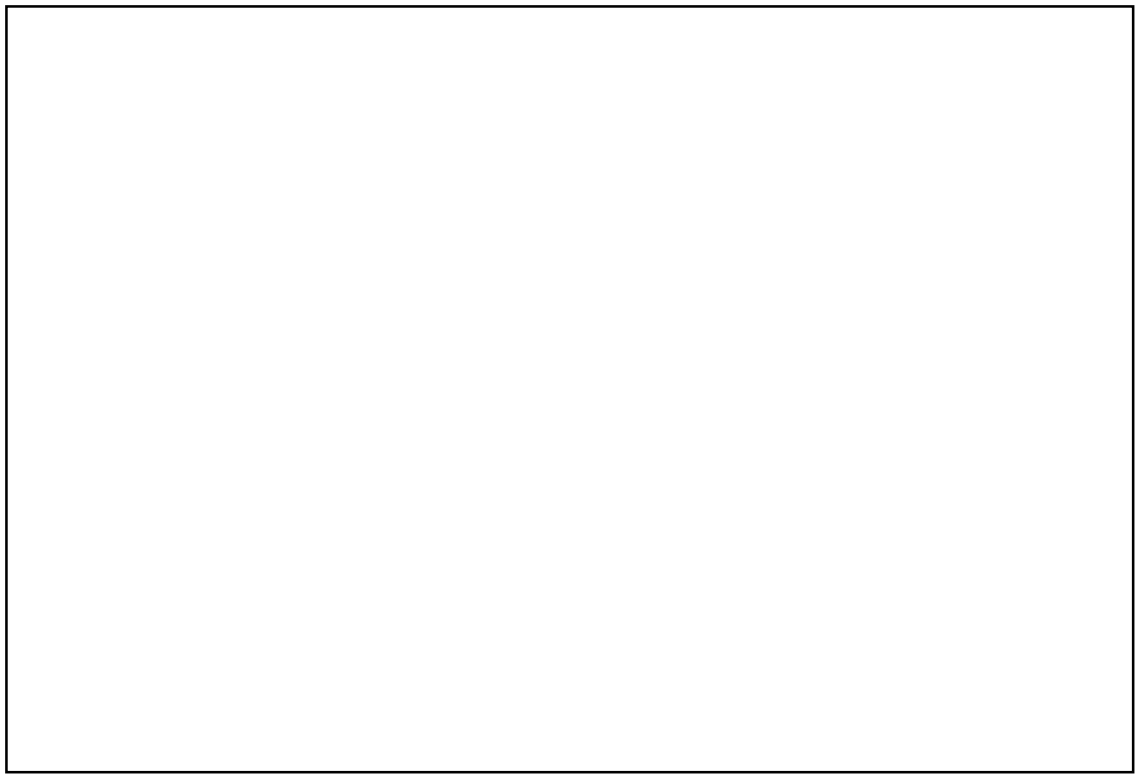
(d) What are the areas susceptible for erosion

Exercise No. 17

Objective:To study about mechanics of wind erosion.

Mechanics of wind erosion

Differentiate between wind break and shelterbelt



Principles of wind erosion control and its control measures:

Exercise No. 18

Objective: To solve the problems on wind erosion.

Problem 1: Find out the distance of protection from a wind break of 18 m height. The angle of deviation of the prevailing wind perpendicular to the wind break is 22°. The actual wind velocity at 15 m height is 14 kmph and the minimum wind velocity at 15 m height, capable of moving the soil fraction is 18 kmph.

Given data: ----------

Formula used: ----------

Solution: ----------

Result: ----------

Problem 2: Calculate the area of protection from a wind break of 250 m in length and 15 m height. The angle of deviation of the prevailing wind perpendicular to the barrier is 25°. The actual wind velocity is 13.5 kmph at 15 m height and minimum wind velocity that is capable of moving the soil fraction is 15 kmph at 15 m height.

Given data: ----------

Formula used: ----------

Solution: ----------

Result: ---

Rational formula

$$Q_P = 0.28 \times C \times I \times A$$

Where,
Q_p = Peak runoff rate (m^3/sec)
C = Runoff coefficient (dimensionless)
I = Rainfall intensity (mm/hr)
A = Drainage area (km^2)

Methods of rainfall erosivity

1. EI_{30} Index method
2. KE > 25 Index method

$$KE = 916 + 331\log_{10} I$$

Rainfall erosivity is given by:

$$EI_{30} = KE \times I_{30}$$

Relationship between kinetic energy and rainfall intensity

$$E_k = 210.3 + 89\log_{10} I$$

In which, E_k is the kinetic energy (metric-tonnes per hectare per cm of rain) and I is the rainfall intensity (cm/h).

Wind erosion

$$d = 17h\frac{V_m}{V}Cos\theta$$

D = distance of area protection
h = barrier height its unit is same as d
V_m = minimum (threshold) wind velocity at the height of 15 m required to move the most erodible soil particles.
V = actual wind velocity at the height of 15m
Ɵ = angle of deviation of prevailing wind from perpendicular to the wind break.

Universal soil loss equation

$$A = R\ K\ LS\ C\ P$$

Where,A = computed soil loss, expressed in t/ha/year for a given storm.
R = Rainfall erosivity factor, which is the measurement of the kinetic energy of a specific rain event or an average year's rainfall.
K = soil erodibility factor.
L = slope length factor
S = slope gradient factor
C = cover or crop rotation factor.
P = erosion control practices or soil conservation practices factor.