(To be filled by the Candidate)

Name of Examination: IFoS – Agricultural engineering Mock test 1

Medium of the Exam: English.

Agricultural Engineering (Mock Test I)

Paper I

Time allowed: Three Hours **Maximum Marks: 200**

General Instructions

This Question-Cum-Answer (QCA) Booklet contains 76+3 pages. Immediately on receipt of the Booklet, please check that this QCA Booklet does not have any misprint or torn or missing pages or items, etc. If so, get it replaced by a fresh QCA Booklet.

Candidates must read the instructions on this page and the following pages carefully before attempting the paper.

Candidates should attempts all questions strictly in accordance with the specified instructions and in the space prescribed under each question in the Booklet. Any answer written outside the space allotted may not be given credit.

Question Paper in detachable form is available at the end of the QCA Booklet and can be removed and taken by the candidates after conclusion of the exam.

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Roll No. .....

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Do's:

1. Read the instructions on the cover page and the specific instructions to this Question Paper mentioned on the next page of this Booklet carefully and strictly follow them.
2. Write your Roll number and other particulars, in the space provided on the cover page of the Question-Cum-Answer-Booklet.
3. Write legibly and neatly in ink. Pencil may be used for drawing diagrams, sketches, etc.
4. For rough work, blank pages provided at the end of this booklet should be used. The rough work should be crossed through afterwards.
5. If you wish to cancel any work, draw your pen through it or write "Cancelled" across it, otherwise it may be valued.
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(To be filled by Examiners only)

	Question No.	Starting Page No.	Marks	Section Total	Signature of Examiner
	1	5	18/40		
	2	15	19/40		
	3	23			Sagar
	4	31	21/40		
	5	39	18/40		
	6	49			
	7	57	22/40		Sagar
	8	65			
		Grand Total	98		

98/200

Write critical notes, within 150 words each, on the ... — 8

1(a) Explain the measures for controlling gully formation

Gully formation control measures

are easy and economical rather than

Gully structures. Gully control measures are used to decrease the erosion by safe disposal of water

(2)

Control measures

- temp
- Vegetative
  - 1) Sodding or thafing
  - 2) Shelter belts. (These are for wind erosion)
  - 3) Strip cropping
  - 4) Contour cropping
  - 5) Grassed waterway
- mechanical measures
  - 1) Zero tillage
  - 2) land levelling
  - 3) Creation of barriers
  - 4) mulching.
- parmonent
  - chute
  - Drop
  - Drop inlet

(Dams)

in Gulley, explain spillways

without spillway, you will not get marks

Gully Erosion can be controlled by stopping rain drop erosion and sheet and

u erosion.

Bringing watershed under canopy clps stop kinetic energy of rain drop.

Strip cropping, land leveling, land smoothening and land grading reduces sheet erosion.

Creating protective barriers, tilling and ploughing reduces rill erosion.

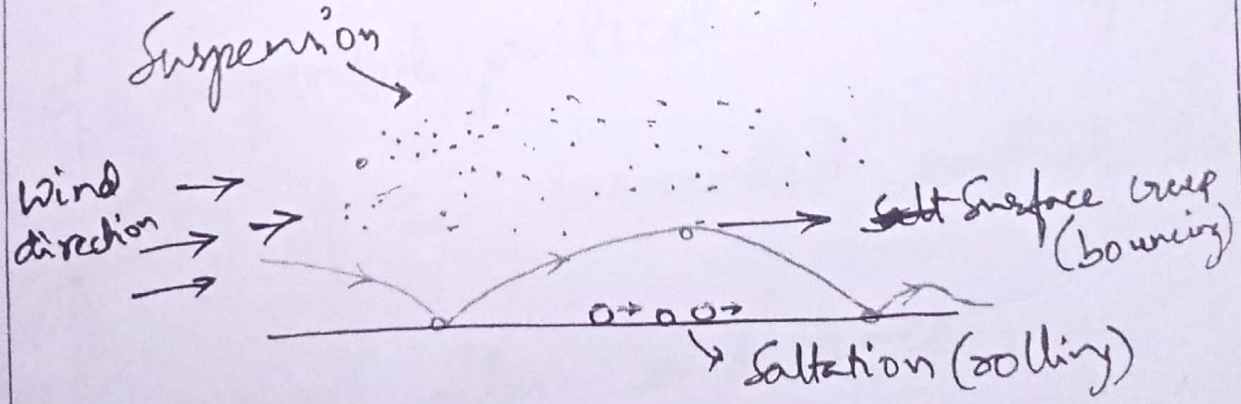
The control of speed of waterflow and the amount of soil erosion ie Erosivity and erodobility control helps control gully formation

(b) What are the different types of soil movement due to wind erosion? Describe how the movements of the particles of various sizes take place in different types of movement 8

Wind erosion is the detachment transportation and deposition of soil particle due to kinetic energy of wind.

(3)

Types of soil movement
- Suspension
- Surface creep
- Saltation



Suspension is transportation of fine clay or organic matter in air. These are of size less than 0.05mm

They travel over long distance with wind

Saltation → Rolling of soil partical due to attiration or abaration (0.05-0.5) or (0.1)-0.5) mm

These soil particals of ~~5mm~~ and more.

Surface creep → Bouncing movement of soil partical due to bombardment of suspended partical or the specific gravity of the suspended partical losses its energy after a distance. (0.5-2) mm

	size	%
suspen	<0.05	3-3%
soltation	0.05-0.5	56-72
surface creep	0.5-2	7-25 %

(c) Write short notes on the following: 8

(i) Universal Soil Loss Equation

(ii) Agronomic Erosion Control Measures

i) Universal soil loss equation is a scientific rational and empherical formula to determine the amount of soil loss (Averge) in tonnes per hectare due to erodibility of agent, erosivity of soil, topography, Crop management and conservation practices. (4)

U = USLE = RKLSCP = write down formula of R and LS

R = erodibility (erosivity) of rainfall

K ⇒ Soil erosivity (erodibility) depends on soil structure partical, soil surface, wetness etc.

L → length factor watershed in meters.

S → slope factor of watershed LS = topography factor

C → Crop grown.

P → Conservation practices like terrace, bunds shelter beds

gronomic erosion control measures.

ixed cropping

ulching

trip cropping

allow for season.

Mulching
Agroforestry
crop Rotation

rowing soil erosion control plants.

Sodding or turfing.

Providing shelter belts.

Increasing the canopy of the watershed.

Buffer cropping

Increasing organic matter of soil.

Increasing moisture of soil through irrigation.

Agroforestry.

(d) What is water harvesting? Discuss the common techniques adopted for water harvesting. Write the limitations of water harvesting systems 8

Water harvesting is a method of judicious usage of rainwater through storage, proper usage and conjunctive usage of all forms of water.

Main Techquine Roof-toop water harvesting

(4)

Common techniques

Bunding → storage of water using bunds

terracing → Increase of infiltration of water using terraces.

Percolation ponds and dams.

Reduction of Kinetic energy of flow of runoff.

Agronomic practices → mulching, shelter belts agroforestry.

Limitations of water harvesting

1) Stored water used for growing cash crops such as sugarcane, rice in areas which are not suitable for water intense ~~water~~ crops.

2) Loss of land due to construction and storage of water.

3) Reduction of flow in rivers.

4) Expensive and require high skill level of people.

5) Maintenance and upkeep is expensive.

Uncertainty in Rainfall

High M

e) Discuss the mechanics and symptoms of water erosion.

8-

Water erosion mechanics.

Initiation → Detachment of soil particle due to rain drops. (5)

Abrasion → soil mixed with water causes sloughing of soil.

Also draw Diagram

Attrition → Soil mixed with water causes bombardment of soil particals.

Hydraulic action → air present in the voids causes pressure and detachment of soil.

Transportation → Suspension → clay, organic matter

Saltation → bouncing of soil

Surface creep → rolling of soil

Deposition → Due to obstruction or reduction of flow velocity or saturation the soil is deposited.

Detatz $\propto V^2$

Tran $\propto V^5$

Symptoms of water erosion

1) Siltation of reservoirs and dams.
2) Removal of fertile soil and organic matter
3) Reduction in crop yield & productivity.
4) patchy, increase of depression.
5) formation of gully, rills. which reduces the land availble to production.
6) Removal of top layer and expose of parent rock.
7) Sandy, stoney appearence of field.
8) Increase in flooding in downstream.

Q.2 **Answer the following questions in about 250 words each:**

Q2(a) Discuss gulley erosion, its formation and different stages of its formation 15

8

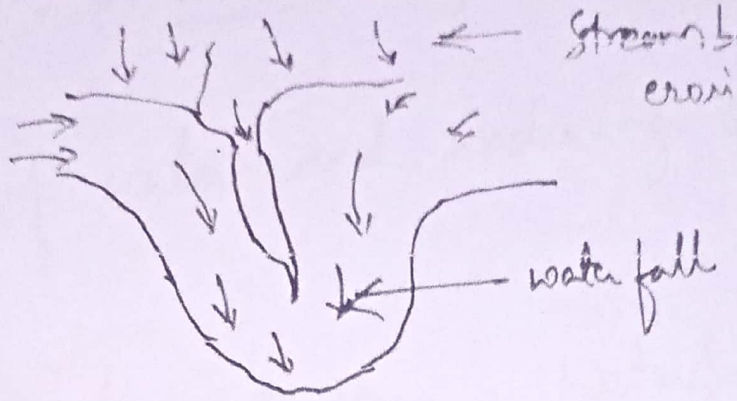
Gulley erosion is a form of erosion in which the depth and height of the gulley is more than a meter. This hinders the movement of machines and causes loss of arable land.

Formation

Gulley are formed due to excessive flow of runoff.

The velocity of runoff is very high

causing stream bank erosion and water fall erosion.



Stream bank erosion → The water flows over the banks of the field due to difference in pressure from the sides causing slumping and collapse of stream bank.

Waterfall erosion → The increase in height of the gully increases the kinetic energy and potential energy. The hydraulic jump increases erosion of gully.

Stages of gully formation

Stage 1 → Initiation stage → Increase in flow of water and widening of gully.

Stage 2 → Development stage → Waterfall erosion and stream bank erosion.

Stage 3 → Healing stage → The gradient of streams smoothens and deposition of silt from other areas

Stage 4 → Stabilization stage → The growth of vegetation and grasses. → Reduction of flow speed and deposition of silt.

Vegetation starts to grow

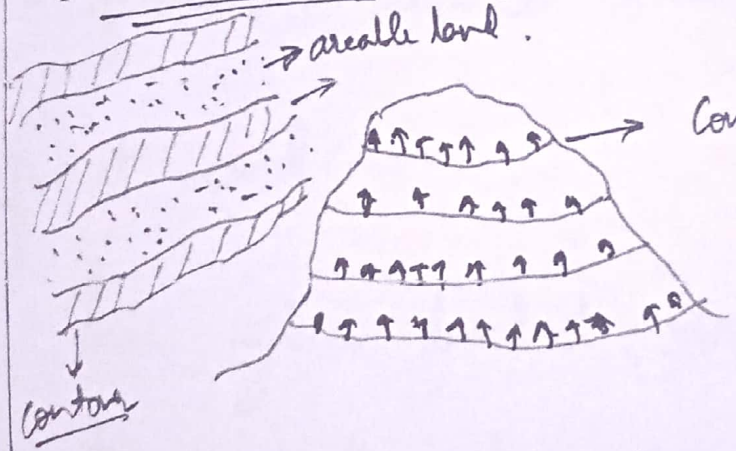
(In this stabilization takes place)

2(b) Differentiate between contour strip cropping, field strip cropping and buffet-strip cropping for assisting soil and water in a cultivated field - 15

Strip cropping is a agronomical method of soil and water conservation method. This improves the productivity and increases the yield of the land.

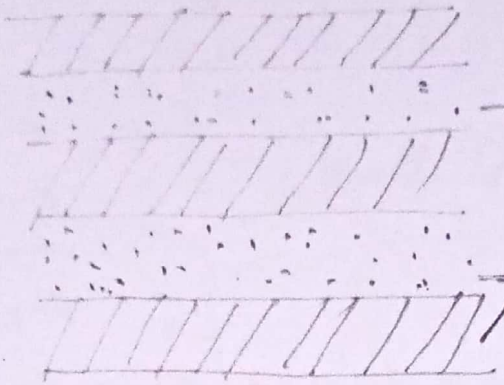
8

Contour strip cropping.



Contour strip cropping are growing of shelter trees along the contour. This provides protection from wind and water erosion. Also increases productivity by conserving water.

Field strip cropping

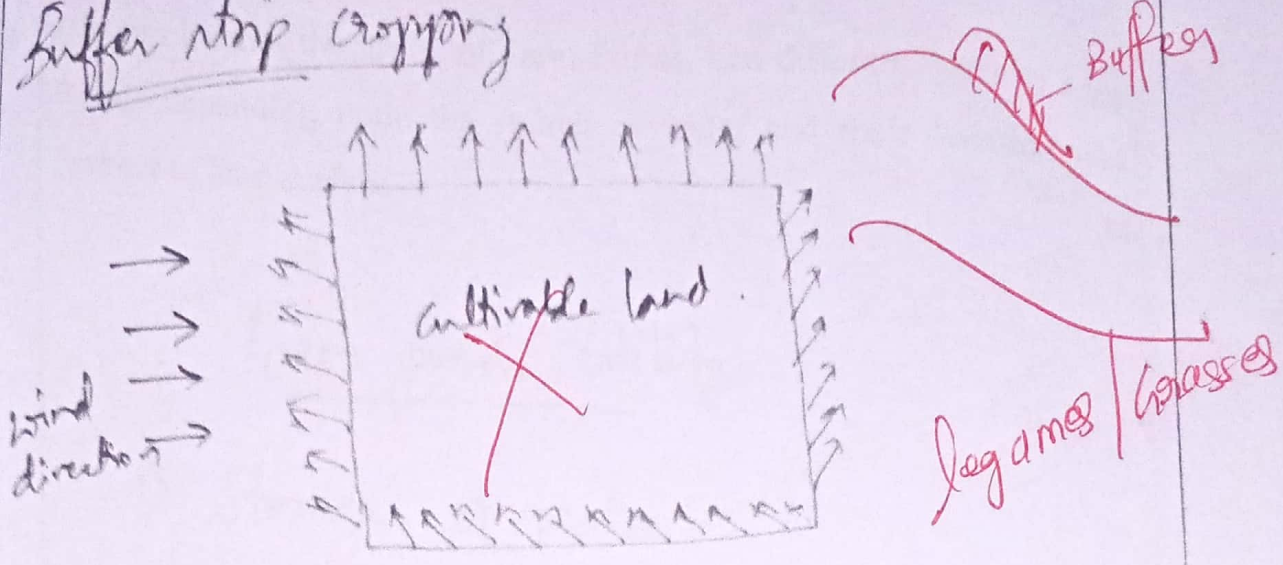


growing crops in a strip form in the field to reduce the effects of frost and wind.

This gives land to recycle the nutrients as alternate strips are cultivated and the non cultivated zone as either trees or grasses.

This reduces erosion and provide protection to plants.

Buffer strip cropping



Buffer strip cropping is used to reduce the speed of the wind or protect from cold frost winds.

The trees which are frost resistent are grown on the sides to protect the main crop.

Agronomic control of erosion is necessary to protect field crops.

Discuss in brief the utility of Farm Ponds. List different types of Farm Ponds depending upon the source of water and their location with respect to land surface 10

Farm ponds utility

3

1) Storage of water.
2) Percolation of water
3) ground water recharge.
4) Manage micro climate
Recreational Activities
livestock purpose

Different types of farm ponds.

1) ground water source.
2) Diversion ponds.
3) Dam / ponds.

embankment
Dugout
spring / feed
surface
stream

4) Domestic and village ponds.

5) Wild life ponds.

6) livestock ponds.

location of farm pond

close to usage of water

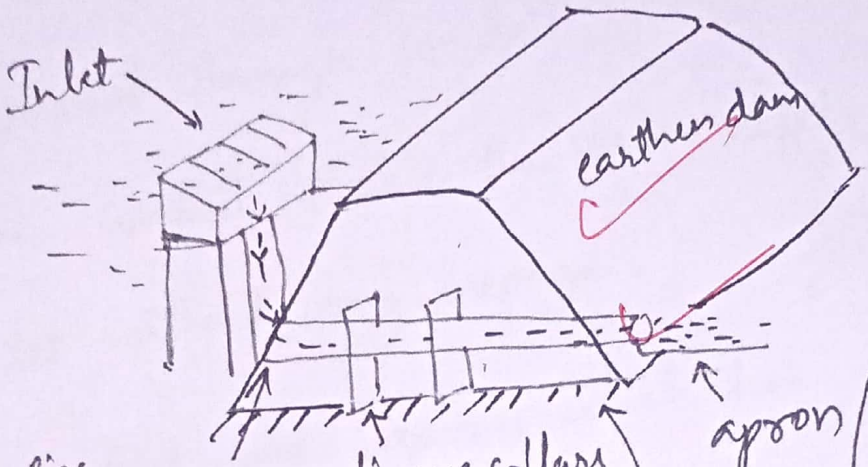
close to source of water.

easily accessible to water.

Q.4- **Answer the following questions in about 250 words each:**

Q4(a) With a neat sketch, explain the working of drop inlet spillway. Under what situation is it preferred? 15.

10



Working principle

good

Drop inlet spillway are having three major components.

1) Inlet → Box inlet, Circular inlet

2) Conduit → pipe conduit.

3) outlet → Apron or Saintantony Still way.

water is stored behind the earthen dam.

which has a strong foundation.

⇒ The water when it reaches the height of the inlet enters the inlet chamber and passed through conduit.

drop > 3 m

low to medium flow

- The conduit carries the water safely to outlet without any seepage.
- The outlet are apron which has the capacity to control the kinetic energy and hydraulic Jump and conduct the water without any erosion to downstream.

Preference to Inlet spillway

1) When water storage area is available.
2) When we need to peredate the water. and increase infiltration to recharge ground water.
3) The gully control structure is needed.

4) The height of the Drop inlet spillway is more than 1 meter.

5) when piping and slanging is high in soil.

Disadvantages

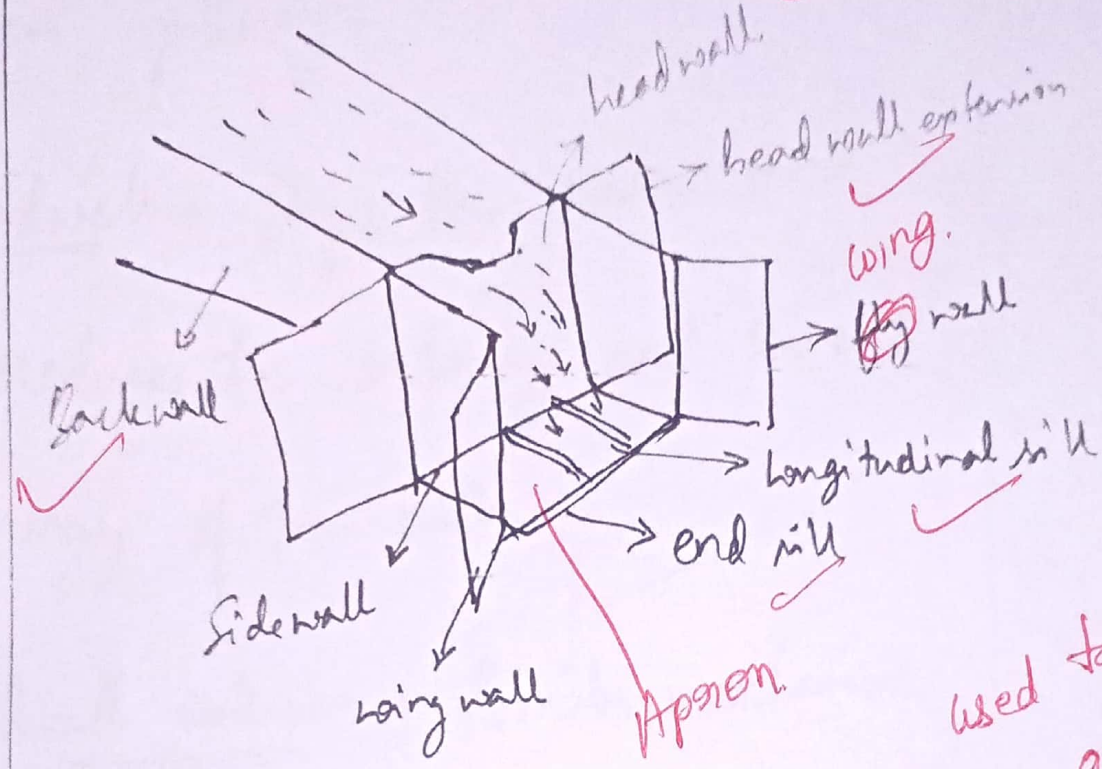
1) Expensive to construct

2) Need skilled workforce.

3) Problems of rodents and burrowing animals.

Q4(b) With the help of neat sketch, describe purposes of various structural components of a drop spillway. 15-

9



Drop spillway is a structure which is used to control reduce the speed of the flow and store water and discharge it at a constant speed.

Components

Back wall → controls the flow of the water towards the spillway.

It stops the sloughing of stream. and diversion & piping of stream away from spillway.

Headwall → Stops the water and reduces the velocity and kinetic energy of the water.

Headwall extension → Provides mechanical & structural support to the headwall and avoids overturning.

Sidewall → Reduces the sloughing of side banks from waterfall created

Apron → Apron reduces the kinetic and potential energy. It provides a

safe hydraulic jump less than critical value

Longitudinal sill → Provides support and uniformity to the apron.

End sill → Provide non erosive conduit to the water. It reduces the kinetic energy before going into downstream.

Fly wall/wingwall → Provide mechanical support.

Limitations

- Need skilled worker for masonary work
- Can't be used for gully more than 3 meter.

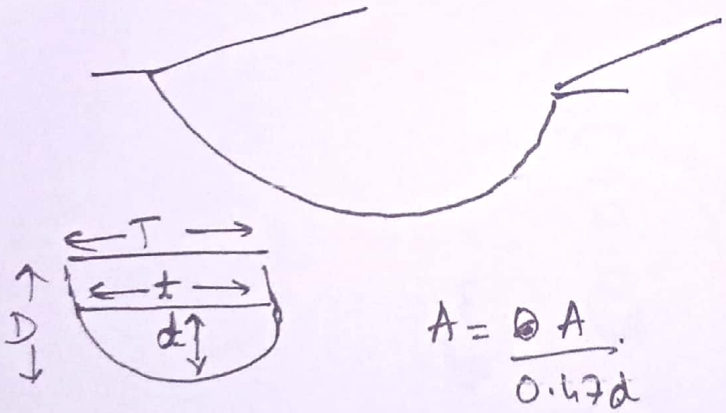
(c) Design a parabolic shaped waterway to carry a flow of 3 m^3/sec down a slope of 4 percent. An excellent of dub grass is to be maintained in the waterway. Assume the necessary data required for calculation and draw a parabolic cross-section. The maximum flow velocity allowed is 2.5 m/sec 10-

$Q = 3 m^3/sec$ ✓

$S = 4\% = 0.04$ ✓ (2)

dub grass $= \eta = 0.04$ ✓

$V = 2.5 m/sec.$



$A = \frac{A}{0.47d}$

$Q = AV.$

$d = 1.5t.$

$V = \frac{1}{\eta} R^{2/3} S^{1/2}$

$R = \frac{A}{P}$ area / wetted perimeter

$R = \left[\frac{\eta V}{S^{1/2}}\right]^{3/2}$

~~Q = A~~ $\frac{1}{n}$

Assume t = 1 metre

d = 1.5(1) = 1.5 m.

$2.5 = \frac{1}{0.04} (R^{2/3}) (0.04)^{1/2}$

$R^{2/3} = 0.5$

$\boxed{R = 0.35}$

$d = 1.5 \times R$

$= 1.5 \times 0.353 = 0.5295$

$Q = A \times V$

$A = 3/2.5 = 1.2$

D =

$A = \frac{2}{3} Dd$

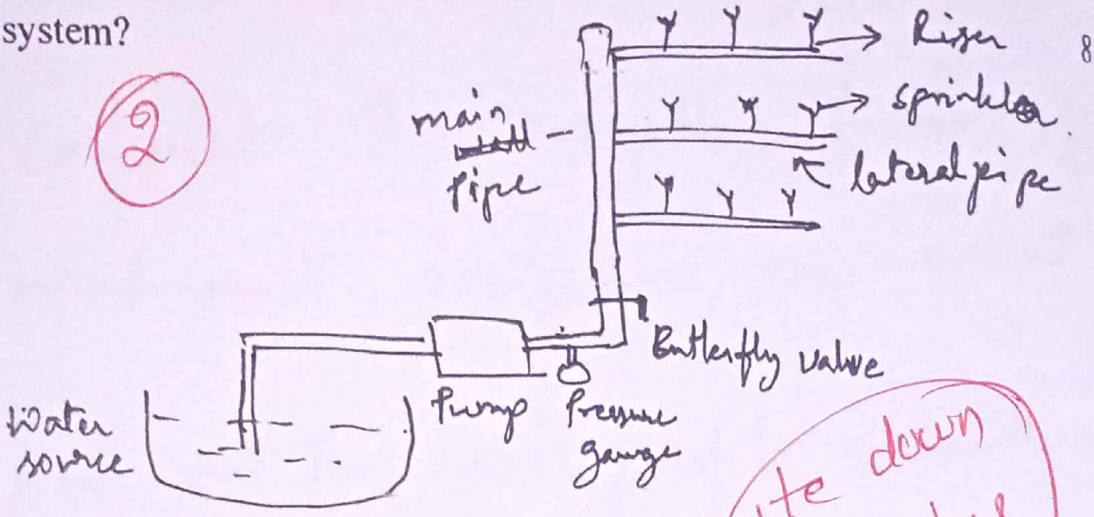
$d = 3.394$

SECTION B

Q5. **Write critical notes, within 150 words each, on the following:** 8×5=40

Q5(a) What are the steps involved in the design of sprinkler irrigation system? 8

(2)



write down formulas

Design of Sprinkler irrigation

1) Calculate the area which needs irrigation

2) Calculate the water availability, source consistency and quality.

3) Calculate the quantity of water required

$$Q = \frac{S_l \times S_m \times I}{360} \times 2n$$

S_l = lateral

S_m = main

I = Intensity

$$q = \frac{1}{m+1} + \frac{1}{2N} + \frac{\pm\sqrt{m+1}}{6N^2}$$

$$H_n = H_a + H_o + \frac{3}{4} H_f + \frac{3}{4} H_e$$

$$H_a = H_o + \frac{H_f}{4}$$

4) divide the area into number of mains and lateral needed.

5) Calculate the irrigation frequency, wind speed, irrigation requirement of crop.

6) find out the soil profile & texture and the ability of water retention and infiltration.

7) The sprinkler irrigation need clean water which is free from debris and salts.

8) Calculate the spacing of riser and the sprinkler nozzle capacity and determine the readings of sprinkler irrigation.

Q5(b) What are the different sources of irrigation in India? List different factors influencing planning and development of minor irrigation projects. What are the positive and negative impacts of irrigation on the ecosystem and environment? 8.

Types and Sources of irrigation In India

River lifts

surface

Groundw

3

1) flood irrigation → furrow irrigation, canal irrigation, siphon irrigation.

Conve

2) ground water irrigation → Drawing water from aquifers to irrigate the land.

3) Micro irrigation → Drip or sprinkler irrigation

Major sources are Cannal

Groundwater

lift irrigation

Pond irrigation

tank irrigation.

Factors influencing planning and development.

1) Water shed size, slope.

2) Soil characteristics → Erodibility of soil, Soil infiltration, texture of soil

3) Rainfall intensity and frequency

4) flooding and erosion concerns.

5) Socio-economic and environment concerns.

6) Crop grown in the area.

Positive & negative impact-

explain more water logging salinization

- Increase in irrigated land, water harvesting Conservation, increase in per capita income Welfare and rise in social life are positive
- land submergence, displacement of people change in river system are negatives of irrigation.

5(c) Discuss various factors influencing irrigation water requirement. How can you estimate total irrigation water requirement incorporating different components for a given field and crop? 8.

(2) Factors influencing irrigation water requirement

1) wind velocity,
2) temperature of the field
3) Relative humidity
4) Soil infiltration and soil temperature,
5) Crop requirement for evapotranspiration
6) Frequency and time period for irrigation
7) Rainfall and soil moisture.

CWR = ET + WL + WSP
IR = CWR - ER - WS
formulae of NIR / GWR

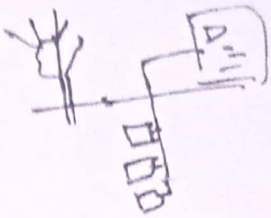
Total irrigation water requirement.

Water present ie antecedent water in soil layer water irrigation, minus runoff, evaporation, evapotranspiration and water used by plant to build tissue. It also includes

deep percolation and sub surface runoff.

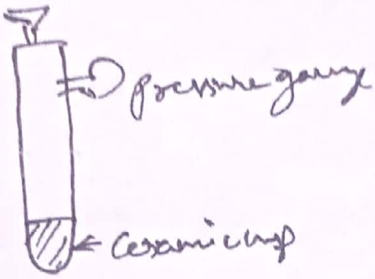
Experiment used to determine water requirement are

1) Lysitometer

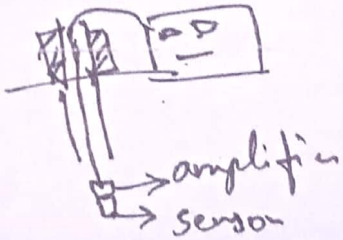


2) Hydro electron resistence.
resistance calculator

3) tensio meter.

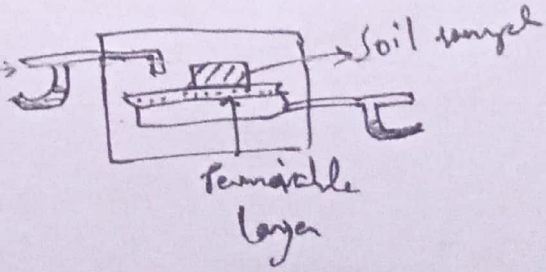


4) neutron meter
detects the neutron from Hydrogen atom



5) Direct method → gravimetric method using soil weight with moisture & soil weight after 105°c for 24 in oven.

6) Pressure method
Permeable layer to transmit water



d) Differentiate between the following:

(i) Water requirement and Irrigation requirement

(ii) Crop water use efficiency and Field water use efficiency

(iii) Evaporation and Consumptive use

6

i)

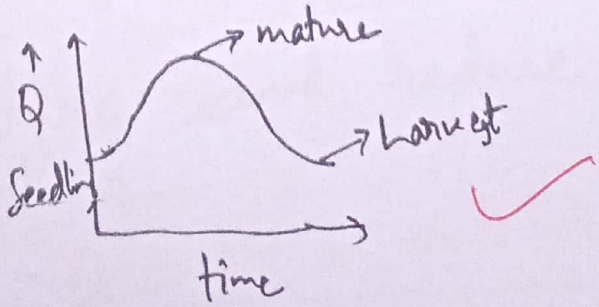
•) Water requirement is the amount of water need by crop for its evapotranspiration and time building and to maintain its temp.

IR < WR

•) Irrigation requirement is the amount of water needed to the field this includes evaporation, run off, ground penetration.

Y/BT

ii) Crop water use efficiency → The water used by crop from the start (seedling) to harvest.



It is the capillary water requirement of crop.

→ Y/WR

field water use efficiency is the water given to the field which included good run off water and capillary water.

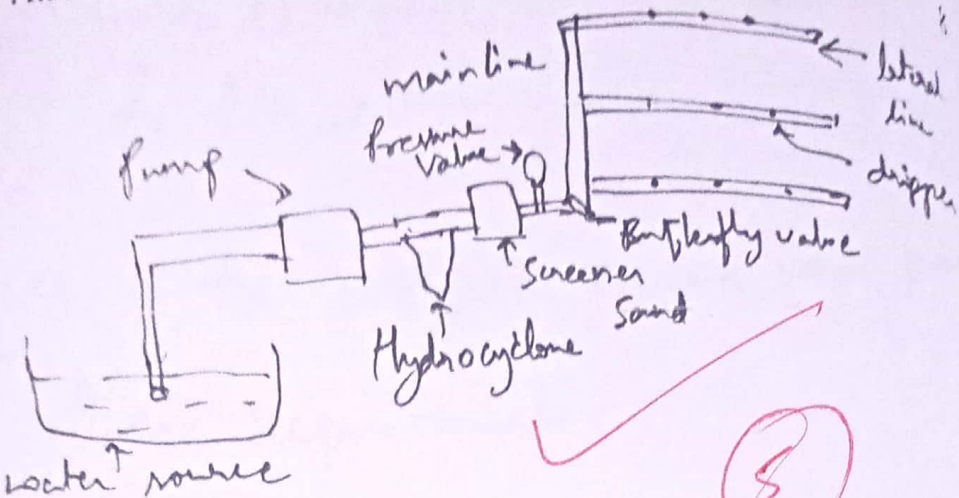
iii) Evaporation → The rate at which water is transfered into atmosphere from land.

Consumptive use → water used by field to grow crops, remove salts, maintain soil moisture and reduce soil erosion.

Cu = ET + metabolic Activity

~~Q~~ = ET + $\frac{1}{100}$ X ET

Draw a neat sketch showing the basic components of a drip irrigation system. Also describe the functions of each of them in brief



8

Components

filtration system

Sand filter → Removes sand & dirt from water

Screenerfilter → Screens organic matter and other particles

Pump → to transmit water to the main line & lateral.

Hydrocyclone → used to increase the speed of the water and create a potential head.

main line → Transmit water to the field.

lateral line → transmit water from main line to lateral

Risers → to irrigate crops as per their requirements

Pressure gauge → to determine the pressure of water from pump.

Butterfly valve → to start or stop the flow.

Air vent valve → To remove the air in the pipe.

end valve → to remove the dirt & silt from main & lateral line

fertigation tank → to mix fertilizer

Venturi system → To mix fertilizer.

Answer the following questions in about 250 words each.

7(a) A stream of 150 liters/second was diverted from a canal and 6000 liters/minute was delivered to the field. An area of 2 ha was irrigated in 8 hours. The root zone depth of crop was 1.8 m. The loss of water from the field was 40 liters/second for 3 hours. The depth of water penetration varies linearly from 1.7 m at the head end of the field to 1.3 m at the tail end of the field. Determine the water conveyance, water application and water distribution efficiency 15

$Q = 150 l/s$

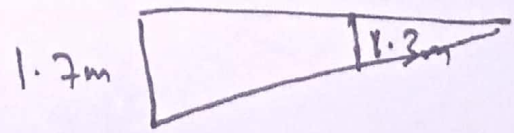
$Q = 100 l/s = \frac{6000}{60 sec}$

$A = 2 ha$

$t = 6 hours.$

$d = 1.8 m$

loss = 40 litre/sec for 3 hours.



Water conveyance = $\frac{\text{water diverted to field}}{\text{water from source}} \times 100$

$= \frac{100}{150} \times 100.$

$= 66.66\ \%.$

Water application efficiency =

Water used = Area × time × depth of root

$= \frac{ws}{wf}$

$= 2 \times 100 \times 100 \times \frac{8 \times 1.8}{3600} = \frac{288000}{3600} = 80\ l/s$

2880 m^3

$wf = 2880$

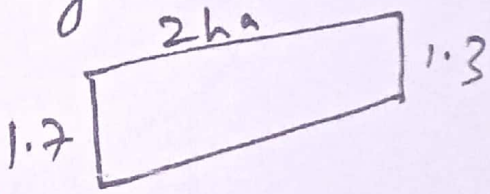
Water used / Water diverted $= \frac{80}{100} = 80\%$

Runoff $= 40 \times 10 \times 8 \times 3600^{-3} = 432$

$wf = 2880 - 432 = 2448$

$Ea = \frac{2448}{2880} = 0.85$

loss water distribution efficiency.



$2 \times 100 \times 100 \left(\frac{1.7 + 1.3}{2}\right)$

20000×1.5

$= 30,000\ m^3$

$\bar{d} = \frac{1.7 + 1.3}{2} = 1.5$

$y_1 = 0.2$ $\quad \bar{y} = 0.2$

$y_2 = 0.2$

$Ed = \left(1 - \frac{\bar{y}}{\bar{d}}\right) \times 100$

$= 86\%$

$= 1 - \frac{0.2}{0.5} \times 100$

Define drip irrigation. Give some other names of drip irrigation. What are the advantages and disadvantages of drip irrigation 15

Drip irrigation is a micro irrigation technique to provide water to the root of the plant through dripper. (10)

Drip irrigation is also called micro irrigation, root irrigation / trickle irrigation

Advantage

Most effacey

1) Reduce erosion of ~~water~~ soil due to excessive water.

2) water harvesting and judicious use of water.

3) low evaporation losses.

4) grow more crops as drip irrigation increases the yield by 20% to 25%.

5) fertilizer can be mixed & used which reduces the wastage & eutrophication of water resources.

6) reduce leaching of the field fertilizer.

7) less spread of diseases due to over irrigation and ~~reduce~~ soil aeration is increased.

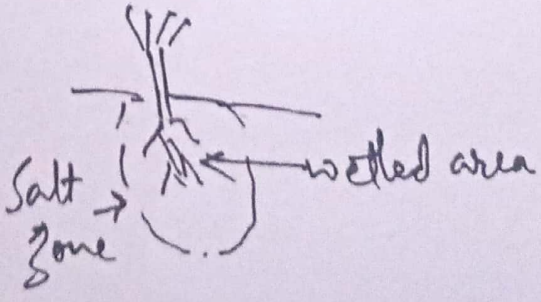
Disadvantage

1) High initial cost.

2) Need clean water without salts & debris. (clogging)

3) Need electricity to use the system.

4) Increase salt accumulation at the root zone.



5) Root donot grow longer due to availability of water at root zone.

6) Rodents bite the dripper and damage them

7) Interference with mechanical ploughing and tilling operations.

8) Drippers are blocked due to salt accumulation.

Q7(c) What are main types of canal linings? List advantages of having lining of irrigation canals 10

Canal lining is a method of covering by impervious material of canals to avoid or reduce the seepage of water and sloughing by water (6)

lined

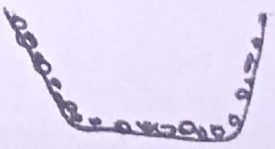
Types

unlined (earthen)

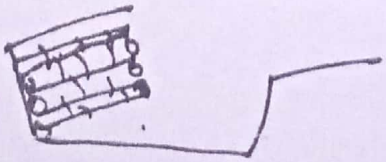
Plastic lining → using plastic sheets to line the canal.

Cement → Concrete mix to line the canal

Stone lining → using stones



wood lining →



Rip rap →

Advantage

1) Reduction in slaughing and erosion
2) Reduction in piping of canal.
3) Reduction in leaching of ~~can~~ water into field
4) Reduction in losses due to leaching
5) Reduction in canal colapsing

Disadvantage

1) Expensive
2) Require maintinence.