# MEENAKSHI RAMASWAMY ENGINEERING COLLEGE

M.R. Kalvi Nagar, Thathanur, Ariyalur (Dt) – 621 804**.**

## DEPARTMENT OF AGRICULTURAL ENGINEERING

## LABORATORY RECORD BOOK

# B.Tech Practical Examination

Name :

Roll. No. :

Branch :

Semester/Year :

Subject code/Subject:

# MEENAKSHI RAMASWAMY ENGINEERING COLLEGE

M.R. Kalvi Nagar, Thathanur, Ariyalur (Dt) – 621 804.

## DEPARTMENT OF AGRICULTURAL ENGINEERING

## BONAFIDE CERTIFICATE

Certified that this is the Bonafide record of the Practical work done by Mr. /Ms. ………………………………. Register Number ………………………...…… Semester …………………… during the year ....................................................... In …………………………………………………………………….Laboratory.

**Signature of Staff In-Charge** **Signature of HOD**

**Submitted for the University Practical Examinations held in………………………….**

**INTERNAL EXAMINER** **EXTERNAL EXAMINER**

| | | |
|---|---|---|
| **Ex.No.** | **1** | **TO STUDY VARIOUS INSTRUMENTS IN THE METEOROLOGICAL LABORATORY** |
| **Date** | | |

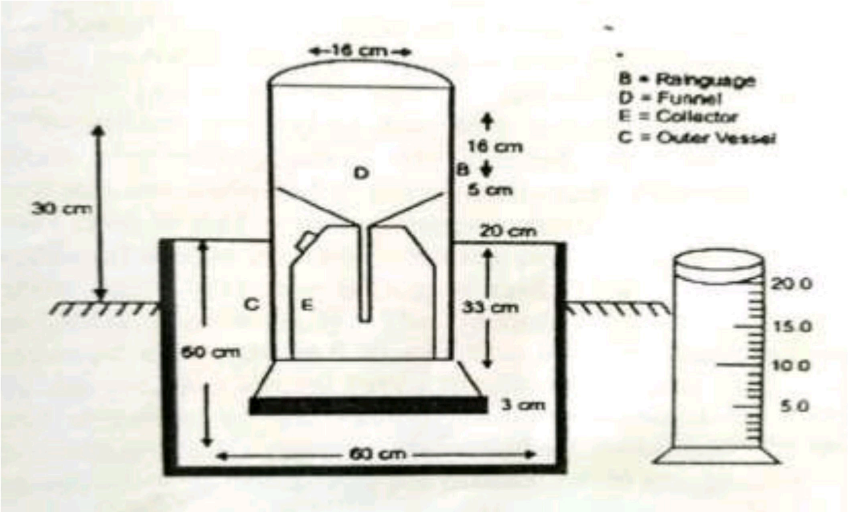
## AIM:

To study the following instruments in the meteorological laboratory

| S.No. | COMPONENT / EQUIPMENT |
|---|---|
| 1. | Raingauge |
| 2. | Cup count Anemometer |
| 3. | Wind Vane |
| 4. | Sunshine Recorder |
| 5. | Open Pan evaporation |
| 6. | Stevenson Screen |
| 7. | Dry bulb and Wet bulb thermometer |

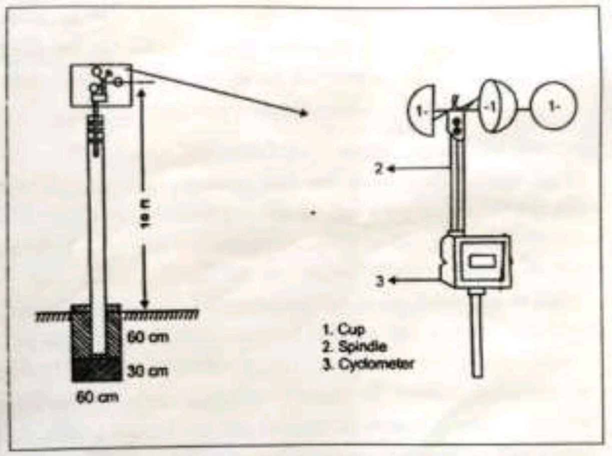
## RAINGUAGE

1. The bottom segment of this instrument is placed firmly into the ground.
2. Rainfall is collected in a bottle inside of the instrument.
3. The bucket ensures retention of rainfall for measurement as it facilitates for overflow of the bottle in heavy downpours.
4. This instrument should not be situated near tall buildings and trees since these obstruct the rain collection.
5. Put the jar out in the rain. Note: the rain gauge should not be put it near or under trees or too close to buildings which may block the rain.
6. Read the ruler to determine how much rain was collected.
7. Empty the jar after each use.



## CUP COUNTER ANEMOMETER

1. Wind pushes into the cups causing the instrument to spin. The amount of rotations is recorded by the counter on the device. This gives an idea of the wind speed.
2. Placement of this instrument is critical. It should not be close to buildings or tall obstructions.
3. Tall obstructions cause eddies, turning in the wind around obstacles.



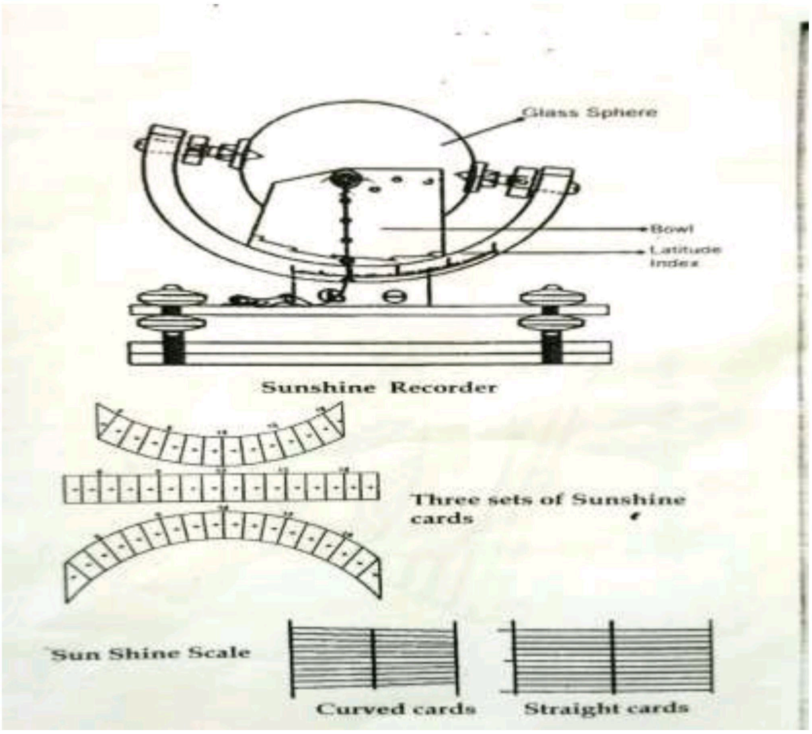
Robinson Cup Anemometer

## WIND VANE

1. Place the paper plate on a flat surface and put the wind vane on the plate.
2. Use the compass to show the students where north is so that they can set up their plates facing the right direction. If you have access to a blacktop area, mark the compass points in chalk to make it easier for the students to read the wind direction.
3. Students will observe the vane. If it is very breezy, one student should hold down the paper plate while another takes the direction reading. The arrow will point to the direction the wind is blowing from.
4. Check the direction on the paper plate.

## SUNSHINE RECORDER

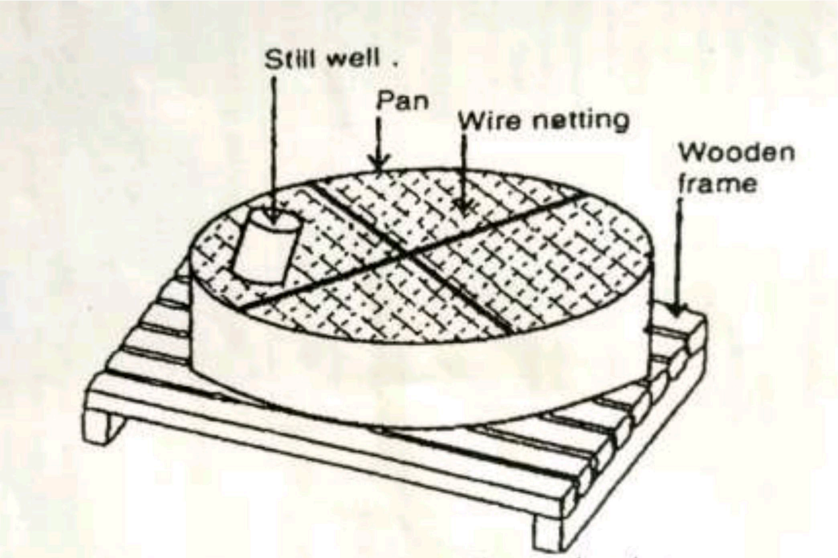
1. A solid glass sphere resting on an adjustable support.
2. The sun's rays are focused by the sphere, thus burning a mark onto a card held inside the bowl.
3. Three cards are used: summer card (long & curved), winter card (short & curved) and equinoctial card (a straight card). This is because of the apparent movement of the sun.



## OPEN PAN EVAPORATOR

1. Evaporation is the process by which water is converted from its liquid form to its vapour form and thus transferred from land and water masses to the atmosphere. It is an important process in the water cycle.
2. Evaporation from the oceans accounts for 80% of the water delivered as precipitation, with the balance occurring on land, inland waters and plant surfaces.
3. Three key parts to evaporation are heat, humidity, and air movement.
4. A pan filled with water to a known depth.
5. The stilling well is placed in the pan and supports the hook gauge, which is used to measure the height of the water in the pan.
6. Over a 24 hour period some water would be added by rainfall and removed by evaporation.
7. Rainfall is recorded and is thus known. Therefore the volume of water evaporated can be derived.

**DIAGRAM**



USWB Open Pan Evaporimeter

## STEVENSEN SCREEN

- To obtain measured parameter of weather at a particular place, instruments should be placed at that specific location. However, the instruments must be protected from the direct effects of the elements (sunshine, rainfall, wind) yet be able to be influenced by them as would occur in the real world.
- The Stevenson screen holds instruments that may include thermometers, a hygrograph and a

thermograph and thus, forms part of a standard weather station.

- A doubled-louvered wooden box that is used to house thermometers and other instruments from precipitation and radiation while also allowing free passage of air.
- The screen stands 1.25m above the ground covered with short grass – this ensures that the ground does not heat up quickly and the heat from the ground does not influence the temperatures of the thermometers housed in the screen.
- The screen faces north in the Northern Hemisphere and south in the Southern Hemisphere. This is so to ensure that the inside of the screen is never exposed to the sun.
- It is lowered so that air can pass through the screen – ventilation.

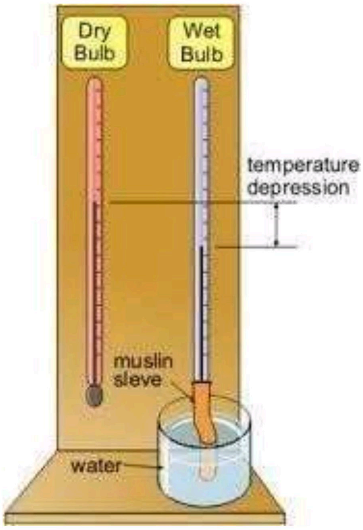
**DRY BULB WET BULB THERMOMETER**

1. Dry bulb and wet bulb thermometers are supported vertically. The wet bulb thermometer is has its bulb wrapped in a muslin and the wick in a reservoir of distilled water. Together, they measure the relative humidity.
2. The dry bulb thermometer measures the temperature of the atmosphere.
3. The wet bulb thermometer measures the temperature of the atmosphere if the atmosphere is 100% saturated.
4. Low humidity occurs when the difference between the dry bulb temperature and the wet bulb temperature are far apart.
5. High humidity occurs when the difference between the dry bulb temperature and the wet bulb

temperature are close together.

6. Maximum and minimum thermometers are supported horizontally and measures the maximum (daytime) temperature and minimum (night time) temperature respectively. They must be read at least twice a day. Usually it is done every main hour (8 a.m., 2 p.m., 8 p.m., 2 a.m.)
7. All are mercury-in-bulb thermometers except the minimum thermometer, which is an alcoholin- bulb thermometer.
8. Care must be taken when reading thermometers to avoid errors due to parallax.

**DIAGRAM**



**Result:**

Thus the various instruments in meterological laboratory was studied.

| Ex.No. | 2 | DETERMINATION OF INFILTRATION RATE USING DOUBLE RING AND DIGITAL INFILTROMETER |
|---|---|---|
| Date | | |

## AIM:

To determine the rate of infiltration using double ring and digital infiltrometer

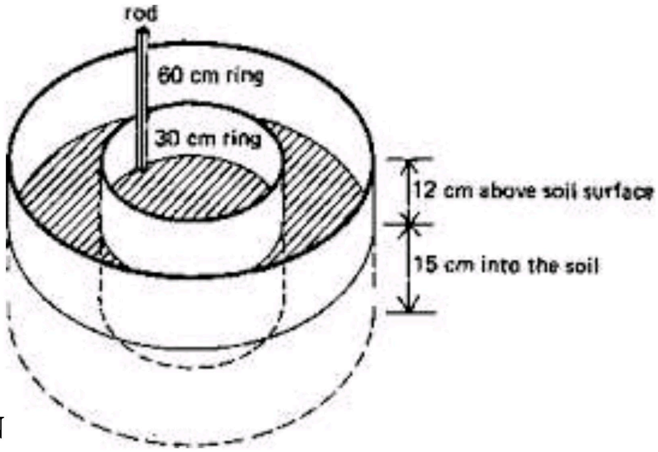
## APPARATUS REQUIRED:

| S.No. | COMPONENT / EQUIPMENT | QUANTITY |
|---|---|---|
| 1. | Galvanized iron cylinders 60 cm and 30 cm in diameter with circular caps | 1 |
| 2. | Hammer | 1 |
| 3. | Hook gauge | 1 |
| 4. | Spade | 1 |

## PROCEDURE:

1. Drive the cylinder vertically downwards into the soil to a depth of about 10-15 cm by hammering gently on the circular cap of the cylinder.
2. Remove the cap and tap the soil into the space between the soil column and the cylinder.
3. Then drive the higher outer ring to the same depth as inner cylinder. The region between inner ring and outer ring is known as buffer pond.
4. Place the hook gauge in the inner ring. The pour water first to the outer ring followed by inner cylinder to a height to 7-12 cm.
5. Record recession in water level against time at certain time intervals and plotthe curve.

**DIAGRAM**



**TABULATION**

| S. No. | Elapsed time (min.) | Initial reading (cm) | Final reading (cm) | Depth (cm) | Av. Infiltration rate (cm / hr.) | Cumulative Infiltration (cm) |
|---|---|---|---|---|---|---|
| 1. | 5 | | | | | |
| 2. | 10 | | | | | |
| 3. | 15 | | | | | |
| 4. | 20 | | | | | |
| 5. | 25 | | | | | |

**Result:**

The average rate of infiltration =

| | | |
|---|---|---|
| **Ex.No.** | **3** | **DETERMINATION OF SOIL MOISTURE WETTING PATTERN FOR IRRIGATION SCHEDULING** |
| **Date** | | |

## AIM:

To determine the soil moisture wetting pattern for irrigation scheduling

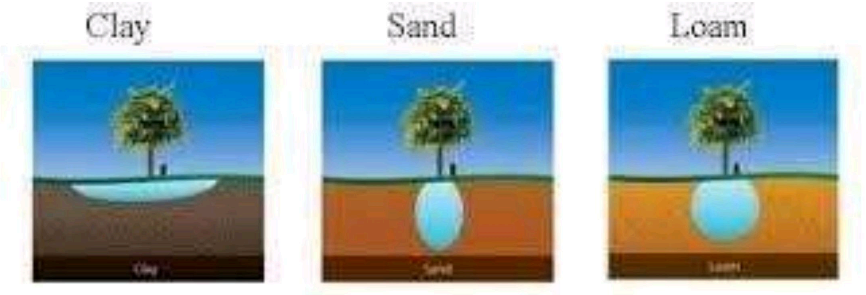
## APPARATUS REQUIRED:

| S.No. | COMPONENT / EQUIPMENT | QUANTITY |
|---|---|---|
| 1. | Main line | 1 |
| 2. | Submain | 1 |
| 3. | Lateral | 1 |
| 4. | Emitter | 1 |
| 5. | Spade | 1 |

## PROCEDURE

1. The field layout consists of a mainline connecting the source of water with the sub-main, both made of PVC pipes.
2. The sub-main was linked to two laterals. The emitters are fitted at 60 cm interval and each discharges at a fixed flow rate of 4 litres per hour. The irrigation system was set up on sandy loam.
3. This is to determine the configuration of their wetted radius on the surface, as well as at different depth of 0.0 cm, 5.0 cm, 10.0 cm, 15.0 cm, 20.0 cm, 25.0 cm, 30.0 cm and 35.0 cm intervals from the surface at the same discharge rate.
4. Water was discharged to the sub main from the source through the main line with a control valve; this was discharged at the different emitter location with a filament fitted at the drippers, which regulated the discharge to 4 litres per hour.
5. A coordinate system of the wetted soil was established on the profile between 30 min to 2 hour of irrigation, with the centre of the soil surface directly under the emitter.
6. At the end of every 30.0 min, three points of the lateral line around the emitter that were wetted were excavated to expose the vertical soil profile.
7. The distance of the wetted front was measured horizontally and vertically downwards at the above mentioned depths.

## DIAGRAM



**WETTING PATTERN FOR DIFFERENT SOIL CONDITION**

## CALCULATION

| S. No. | Time elapsed (min) | Wetting depth horizontal (cm) | Wetting depth vertical (cm) |
|---|---|---|---|
| 1. | | | |

**Result:**

Thus the soil moisture wetting Pattern was studied

| | | |
|---|---|---|
| **Ex.No.** | **4** | **DESIGN OF DRIP IRRIGATION SYSTEM** |
| **Date** | | |

**AIM:**

To design drip irrigation system for the given data.

Design a drip irrigation system for a groundnut field of 1 ha area with length and breadth of 100 m each. Groundnut has been planted at a spacing of 5 m ´ 5.5 m.

The maximum pan evaporation during summer is 8 mm/day.

The other relevant data are given below:

Land slope = 0.40 % upward slope from S – N direction,

Water source = A well located at the S–W corner of the field

Soil texture = Sandy loam, Clay content = 18.4 %, Silt = 22.6 %,Sand =59.0%,

Field capacity = 14.9 %, Wilting point = 8 %,Bulk density = 1.44 g/cc,

Effective root zone depth = 120 cm, Wetting Percentage = 40 %,

Pan coefficient = 0.7,Crop coefficient = 0.8

## DESIGN PROCEDURE:

### Step 1:

### Estimation of Water Requirement

Evapotranspiration of the crop = Open pan evaporation x Pan coefficient x Crop coefficient

$$= 8 \times 0.7 \times 0.8$$

$$= 4.48 \text{ mm/day}$$

Volume of water to be applied = Area covered by each plant x Wetting fraction x Evapotranspiration of the crop

$$= (5 \times 5.5) \times 0.40 \times 4.48$$

$$= 49.28 \text{ L day}^{-1} \text{ or } 50 \text{ L day}^{-1}$$

### Step 2:

### Emitter Selection and Irrigation Time

Emitters are selected based on the soil texture and crop root zone system. Assuming three emitters of 4 L h$^{-1}$, placed on each plant in a triangular pattern are sufficient so as to wet the effective root zone of the crop.

Total discharge delivered in one hour = 4 ´ 3 = 12 L h$^{-1}$

Irrigation time = 50 / 12 = 4 h 10 minutes

### Step 3:

### Discharge through Each Lateral

A water source is located at one corner of the field. Sub mains will be laid from the centre of field Therefore, the length of main, sub mains, and lateral will be 50 m, 97.25 m, 47.5 m each respectively. The laterals will extend on both sides of the sub mains. Each lateral will supply water to 10 plants.

Total number of laterals = (100/5.5) ´ 2 = 36.36 (Considering only 36)

Discharge carried by each lateral, $Q_{lateral}$ = 10 ´ 3 ´ 4 = 120 L h$^{-1}$

Total discharge carried by 36 laterals = 120 ´ 36 = 4320 L h$^{-1}$

Each plant is provided with three emitters, therefore total number of emitters will be 36 ´ 10 ´ 3 =1080

### Step 4:

### Determination of Number of Manifolds

Assuming the pump discharge = 2.5 L s$^{-1}$ = 9000 L h$^{-1}$

Number of laterals that can be operated by each manifold = 9000/120 = 75

So only one manifold or sub mains can supply water to all the laterals at a time.

### Step 5:

### Size of Lateral

Once the discharge carried by each lateral is known, then size of the lateral can be determined by using the Hazen- Williams equation .(Equation 44.4)

The reduction factor (F) can be estimated as

$$F = \frac{1}{1.852+1} + \frac{1}{2\times 30} + \frac{\sqrt{1.852-1}}{6(30)^2}$$

= 0.367

$$H_f(100) = 1.22 \times 10^{12} \frac{(0.033/130)^{1.852}}{(12)^{4.871}} \times 0.367 = 0.54\ \text{m}$$

$$H_f = 0.54 \times (47.5/100) = 0.26\ \text{m}$$

For D = 16 mm, = 0.063 m

The permissible head loss due to friction is 10% of head of 10 m (head required to operate 4 L $h^{-1}$ emitters) is 1 m, therefore 12 mm diameter lateral size is selected.

**Step 6:**

**Size of Sub Main**

Total discharge through the sub mains = $Q_{lateral}$ X Number of laterals

= 120 X 36

= 4320 L $h^{-1}$ = 1.2 L $s^{-1}$

Assuming the diameter of the sub mains as 50 mm, the values of parameter of the Hazen-Williams equation are

= 150

= 1.2 L $s^{-1}$

= 50 mm

= 1.22 X $10^{12}$

= 0.364

$$H_f\ (100) = 1.22 \times 10^{12} \times \frac{(1.2/150)^{1.852}}{50^{4.87}} \times 0.364$$

= 0.31 m

$H_f$ for 97.25 m of pipe length = 0.31 (97.25/100)

= 0.30 m

Therefore, frictional head loss in the sub mains = 0.30 m

Head at the inlet of the sub mains = $H_{emitter} + H_{f\,lateral} + H_{f\,sub\,main} + H_{slope}$

$$= 10 + 0.26 + 0.30 + 0.40$$

$$= 10.96 \text{ m}$$

Pressure head variation = $\frac{10.96 - 10.26}{10.96} \times 100$

$$= 6.38 \%$$

Estimated head loss due to friction in the sub main is much less than the recommended 20% variation, hence reducing the pipe size from 50 to 35 mm will probably be a good option.

$$H_f\ (100) = 1.22 \times 10^{12} \times \frac{(1.2/150)^{1.852}}{35^{4.87}} \times 0.364$$

$$= 1.75 \text{ m}$$

$H_f$ for 97.25 m pipe = 1.75 (97.25/100)

$$= 1.70 \text{ m}$$

Head at the inlet of the sub main = $H_{\text{emitter}} + H_{f\,\text{lateral}} + H_{f\,\text{sub main}} + H_{\text{slope}}$

$$= 10 + 0.26 + 1.70 + 0.40$$

$$= 12.36 \text{ m}$$

Pressure head variation = $\frac{12.36 - 10.26}{12.36} \times 100$

$$= 17\%$$

Pressure head variation lies within the acceptable limit, hence accepted.

**Step 7:**

**Size of the main line**

Assuming the diameter of main as 50 mm

Discharge of main, $Q_{\text{main}}$ = Discharge of sub main, $Q_{\text{sub main}}$

The values of parameter of the Hazen- Williams equation are

$C = 150$

$Q = 1.2 \text{ L s}^{-1}$

D = 50 mm

K = 1.22 X $10^{12}$

$$H_f(100) = 1.22 \times 10^{12} \frac{(1.2/150)^{1.852}}{(50)^{4.871}}$$

= 0.84 m

for 50 m main pipe = 0.84 ´ (50/100) = 0.42 m

**Step 8:**

**Determining the Horse Power of Pump**

Assume head variation due to uneven field variations and the losses due to pump fittings, etc. as 10 % of all other losses.

$H_{local}$ = 10 % of all other loss

Total dynamic head = ( $H_{emitter} + H_{f\,lateral} + H_{f\,sub\,main} + H_{f\,main} + H_{slope}$ )+$H_{static}$+$H_{local}$

= 12.36 + 0.42 +10 +1.28

= 29.06 m

Pump Horse power $$(hp) = \frac{H \times Q}{75 \times \eta_p}$$

where,

H = Total dynamic head, m

Q = Total discharge through main line, L $s^{-1}$

$\eta_p$= Efficiency of pump

$$hp = \frac{1.2 \times 24.06}{75 \times 0.60}$$

= 0.64 @ 1.0

Hence 1 hp pump or the pump giving 1.2L $s^{-1}$ discharge at head of 30.0 m is adequate for operating the drip irrigation system to irrigate for 1 ha area of citrus crop.

The design details of components micro irrigation system are estimated as

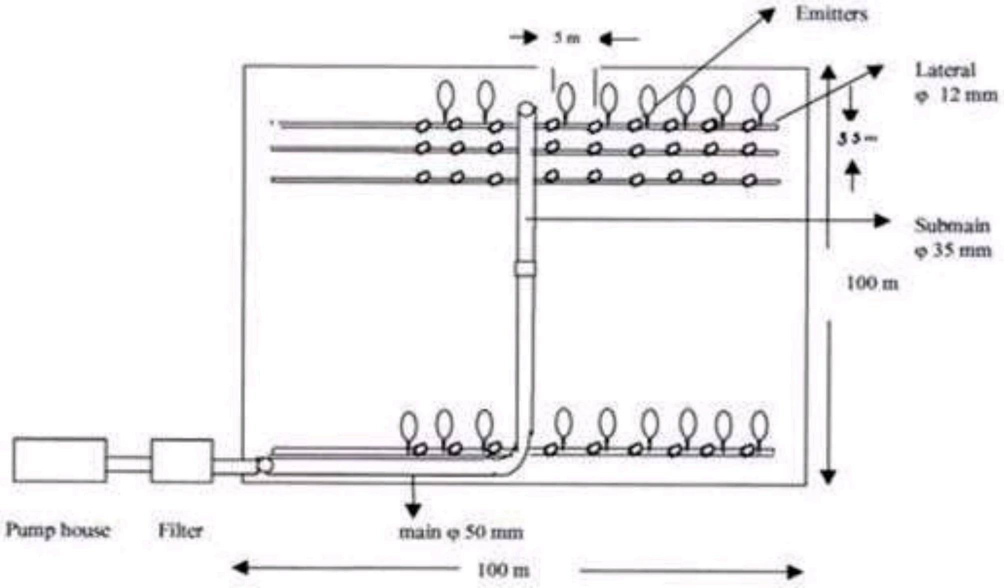
Length of laterals = 47.5 m, Number of laterals = 36,

Diameter of lateral = 12 mm, Length of sub main = 97.25 m,

Number of sub main = 1, Diameter of sub main = 35 mm,

Length of main = 50 m, Number of main = 1,

Diameter of main = 50 mm, Total power required = 1 hp,



**Layout of designed drip irrigation system.**

**Result:**

Thus the drip irrigation system was designed.

| | | |
|---|---|---|
| **Ex.No.** | **5** | **DESIGN OF SPRINKLER IRRIGATION SYSTEM** |
| **Date** | | |

**AIM**

To design a Sprinkler irrigation System

Design a Sprinkler Irrigation system for the following data:

Soil type = silt loam, Infiltration rate at field capacity = 1.25 cm h-1, Water holding capacity = 15 cm m-1, Root zone depth = 1.5 m, Daily consumptive use rate = 6 mm day-1, Sprinkler type = Rotating head.

## DESIGN PROCEDURE

### Step I

Given infiltration capacity =1.25 cm h-1

Hence maximum water application rate = 1.25 cm/h

### Step II

Total water holding capacity of the soil root zone = 15 x 1.5 = 22.5 cm

Let the water be applied at 50% depletion, hence the depth of water to be applied = 0.50 x 22.5 = 11.25 cm

Let the water application efficiency be 90 per cent

Depth of water to be supplied = 11.25 / 0.9 = 12.5 cm

### Step III

For daily consumptive use rate of 0.60 cm

Irrigation interval = 11.25 / 0.6 = 19 days

In period of 19 days, 12.5 cm of water is to be applied on an area of 5 ha. Hence assuming 10 hrs. of pumping per day, the sprinkler system capacity would be

$$= \frac{5\times10^{4}\times12.5\times10^{-2}}{19\times10\times3600} = 0.009\ m^{3}s^{-1}$$

### Step IV

Let the spacing of lateral (Sm) = 18 m,

Spacing of Sprinklers in lateral (Sl) = 12 m

This selection is based on using following consideration:

Operating pressure of nozzle = 2.5 kg cm-2

Maximum application rate = 1.25 cm h-1

Referring sprinkler manufacturer’s M/S NOCIL, Akola catalogue (Table 38.4), the nozzle specifications with this operating pressure and application rate is:

Nozzle size : 5.5563 x 3.175 mm

Operating pressure : 2.47 kg/cm2 and

Application rate : 1.10 cm hr-1 (which is less than the maximum allowable application rate of 1.25 cm h-1)

Diameter of coverage: 29.99 ≈ 30.0 m

Discharge of the nozzle: 0.637 L s-1 = 0.637 x 10-3 m3s-1

**Step V**

Total no. of sprinkler required = $\frac{0.009}{0.637\times 10^{-3}}$ $= 14.12 \approx 14$ sprinklers

Considering two sprinkler laterals, therefore 7 sprinklers on each lateral.

**Step VI**

Assume the sprinklers spaced at 12 m intervals on each lateral. The lateral lines will be at 18 m spacing.

**Step VII**

Total length of each lateral = 12 x 7 = 84

Operating pressure = 2.47 kg cm-2

Total allowable pressure variation in the pressure head is 20%, hence maximum allowable pressure variation in pressure = 0.2 x 2.47 = 0.494 kg/cm2 = 4.94 m

Assume pressure variation due to elevation = 2 m

Permissible head loss due to friction = 4.94 – 2 = 2.94 m

Total flow through the lateral = 7 x 0.637 x 10-3 = 4.459 x 10-3 m3s-1

Reduction factor (F) = $\frac{1}{3}+\frac{1}{2\times 7}+\frac{1}{6\times 7^2}$ $= 0.333 + 0.071 + 0.0034 = 0.407$

Head loss due to friction = using Darcy’s weisbach equation and reduction factor.

Hf = $$\frac{0.811\times 0.04\times 277778\times 84\times (4.459\times 60)^2}{9.81\times D^5}\times 0.407$$

or 2.94 =
$$\frac{0.811\times 0.04\times 277778\times 84\times (4.459\times 60)^2}{9.81\times D^5}\times 0.407$$

$$\Rightarrow D^5 = \frac{0.811 \times 0.04 \times 277778 \times 84 \times (4.459 \times 60)^2}{9.81 \times 2.94} \times 0.407$$

$$\Rightarrow D = 59.79 \approx 63 \text{ mm}$$

Hence diameter of lateral = 63 mm

Assume height of riser pipe =1 m

The head required to operate the lateral lines (Hm) = 24.7 + 2.94 + 2 + 1 = 30.6 m

Frictional head loss in main pipe line (Hf) = 30.6  0.2 = 6.12 m

Calculating in the same way as done in case of lateral

$$6.12 = \frac{0.811 \times 0.04 \times 277778 \times 36 \times (0.009 \times 1000 \times 60)^2}{9.81 \times D^5}$$

$$D^5 = \frac{0.811 \times 0.04 \times 277778 \times 36 \times (0.009 \times 1000 \times 60)^2}{9.81 \times 6.12}$$

Or D = 69.10 ≈ 75 mm

Total design head (H) = Hm+ Hf +Hj +Hs

Where,

Hj = Difference in highest junction point of the lateral and main from pump level = 0.5 m (assume)

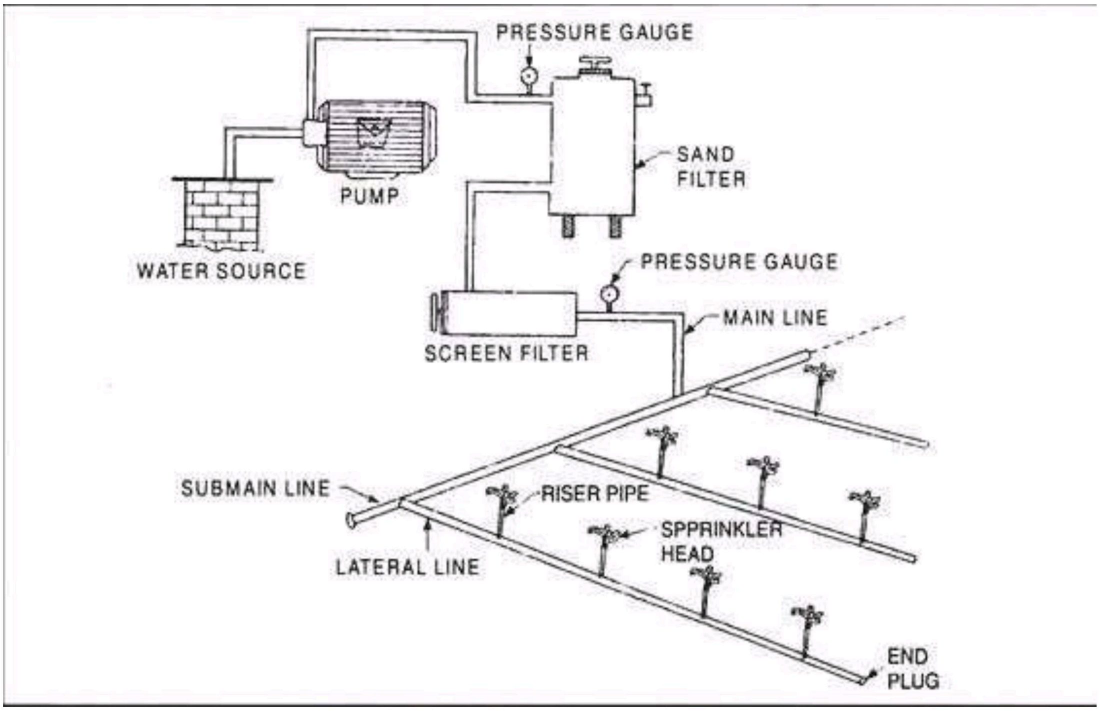
Hs = Suction lift (20 m, assume)

H = 30.6 + 6.12 + 0.5 + 20 = 57.22 m

The pump has to deliver 0.009 m3s-1 of water against a required head of 57.22 m

Hence, the horse power of a pump at 60% efficiency

$$= \frac{0.009 \times 57.22 \times 10^3}{0.6 \times 75} = 11.44 \text{ hp}$$



**Sprinkler Irrigation system Layout**

**Result:**

Thus the sprinkler irrigation system was designed

| Ex. No. | 6 | MEASUREMENT OF FLOW PROPERTIES IN OPEN IRRIGATED CHANNELS (FLUMES, NOTCHES) |
|---|---|---|
| Date | | |

**AIM:**

To study and measure the flow properties in open irrigated channel

**APPARATUS REQUIRED:**

| S. No. | COMPONENT / EQUIPMENT | QUANTITY |
|---|---|---|
| 1. | Triangular weir | 1 |
| 2. | Rectangular weir | 1 |
| 3. | Trapezoidal weir | 1 |
| 4. | Parshall flume | 1 |
| 5. | Scale | 1 |

**PROCEDURE**

**Direct discharge methods**

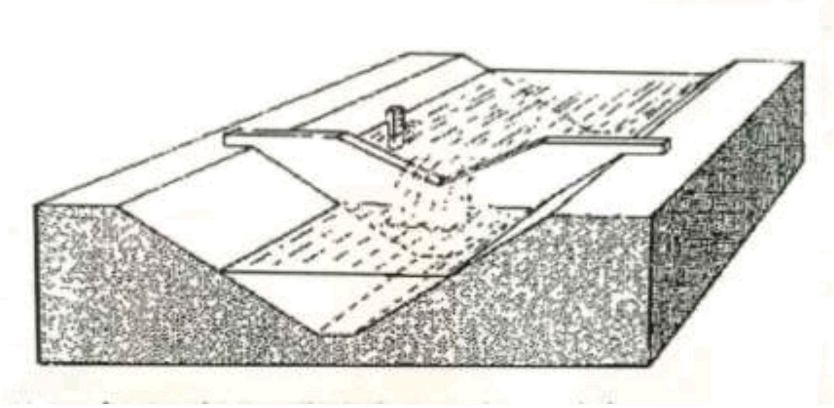
In this method, the volume of flow of water is determined directly by installing certain devices of known dimensions at a desired point across the channel.

**Devices for measuring the irrigation water:**

1. Weirs 2. Flumes

**1. Weirs:**

**a) Triangular weir (90ov notch)**



It is commonly used to measure small and medium size streams accurately.

i) The discharge through 90°V notch weir may be computed either by using the following formula$Q = 0.0138 (H)^{5/2}$

where,

Q = Discharge (lit/sec) H = Height of water flow (cm)

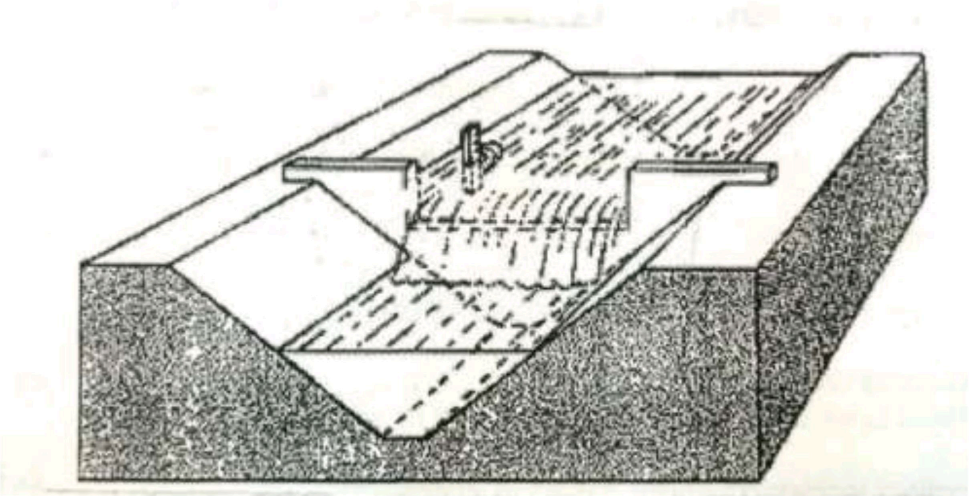
Height of water flow in the weir is-------- cm

**Cal:**

$Q = 0.0138 \times (\ )^{5/2}$

Q =------- lit/sec.

### b) Rectangular weir



i) It is used to measure comparatively larger discharges.

ii) It has a horizontal crest and vertical sides.

iii) They may be either contracted rectangular weirs or suppressed rectangular weirs.

iv) The discharge through rectangular weirs may be computed by the Francis formula stated below.

$Q = 0.0184 (LH)^{3/2}$

where,

Q = Discharge (lps)
L = length of water flow (cm)
H = height of water flow (cm)

**Calculation**

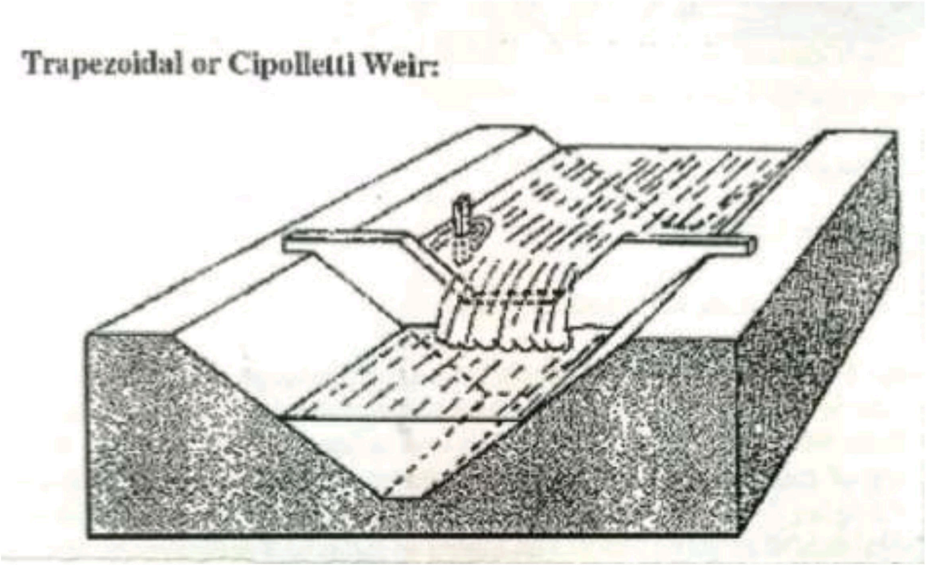
Length of water flow in the weir =

Height of water flow in the weir =

$Q = 0.0184 \times (h)^{3/2}$

=---------- lit/sec

## C) Trapezoidal weir (Cipoletti weir)



i) This is invented by an Italian Engineer by name Cipoletti therefore it iscalled as Cipoletti weir.

ii) Each side of the weir has a slope of 1 horizontal to 4 vertical. It is used to measure medium discharges.

iii) The discharge through Cipoletti weir is computed by the following formula.

$Q = 0.0186\ (LH)^{3/2}$

where

L = length of water flow (cm)
H = height of water flow (cm)

**Calculation**

Length of water flow in the weir -------- cm

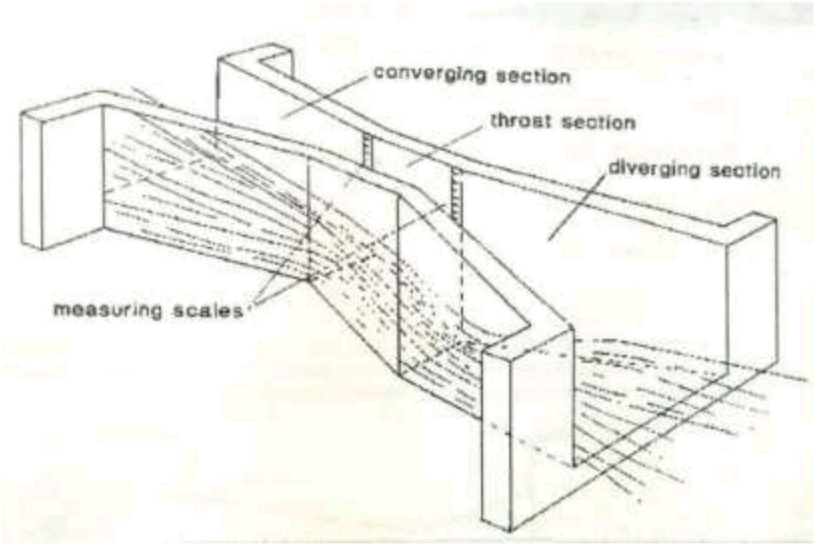
Height of water flow in the weir-------- cm

$Q = 0.0186 \times (h)^{3/2}$

= 0.0186 x

= --------lit/sec.

## 2. Parshall flume (Venturi flume)



i) This has been designed by Parshall in the year 1950 and hence named after him.

ii) Parshall flume is an open channel type measuring device that operates witha small drop in head.

iii) It is a self cleaning device.

iv) Sand or silt in the flowing water does not affect its operation or accuracy.

v) It gives reasonably accurate measurement even when partially submerged.

Q = 0.992Ha^1.547

Q = Flow rate in cubic feet per second$H_a$ =

Height in feet

Height -

Q = 0.992 x 1^1.547Q

=0.992 x

Q = 1 cubic feet per seconds.

**Result:**

Thus the flow properties was measured and studied

| | | |
|---|---|---|
| **Ex. No.** | 7 | **EVALUATION OF SURFACE IRRIGATION** |
| **Date** | | |

**AIM:**

To evaluate the various efficiencies of surface irrigation for the given data

A stream of 135 litres/sec. was diverted from a canal and 100 litres /sec. were delivered to the field. An area of 1.6 ha was irrigated in 8 hours. The effective depth of root zone was 1.8 m. The run off loss in the field was 432 $m^3$. The depth of water penetration varied linearly from 1.8 m at the head end of the field to 1.2 m at the tail end. Available moisture holding capacity of the soil is 20 cm/m depth of soil. Calculate water conveyance efficiency, water application efficiency, water storage efficiency and water distribution efficiency, irrigation was started at a moisture depletion level of 50per cent of the available moisture.

**Theory:**

Irrigation efficiency indicates how efficiently the available water supply is being used, based on different methods of evaluation. The objective of efficiency concept is to show where improvements can be made, which will result in more efficient irrigation. Various efficiency terms are :

***1. Waterconveyance efficiency***

This term is used to measure the efficiency of water conveyance systems associated with the canal network, water courses and field channels. It is also applicable where the water is conveyed in channels from the well to the individual fields. It is expressed as follows :

$$Ec = \frac{Wd}{Wf} \, 100$$

Where,

Ec = Water conveyance efficiency, per cent

Wd = Water delivered to the irrigated plot (at the field supply channel)

Wf = Water diverted from the source

***2. Water application efficiency***

After the water reaches the field supply channel, it is important to apply the water as efficiently as possible. A measure of how efficiently this is done is the water application efficiency, expressed as follows :

$$Ea = \frac{Ws}{Wd} 100$$

Where,

Ea = Water application efficiency, per cent

Ws = Water stored in the root zone of the crop

Wd = Water diverted to the field (at the supply channel)

### *3. Waterstorage efficiency*

The water storage efficiency refers how completely the water needed prior toirrigation has been expressed as:

$$Es = \frac{Ws}{Wn} 100$$

Where,

Es = Water storage efficiency, per cent

Ws = Water stored in root zone during irrigation

Wn = Water needed in root zone prior to irrigation

### *4. Water distribution efficiency*

Water distribution efficiency indicates the extent to which water is uniformly distributed along the run. It is expressed as :

$$Ed = 1 \frac{y}{d} 100$$

Where,

Ed = Water distribution efficiency, per cent

$\overline{d}$ = Average depth of water stored along the run during the irrigation

y = Average numerical deviation from d

### *5. Water use efficiency*

The water utilization by the crop is generally described in terms of water use efficiency (kg/ha- mm or q/ha- cm). It can be defined in following ways:

**(i) Crop water use efficiency**: It is the ratio of crop yield (y) to the amount of water depleted by the crop in the process of evapotranspiration (ET).

$$\text{Crop water use efficiency} = \frac{Y}{ET}$$

**(ii) Field water use efficiency**: It is the ratio of crop yield (y) to the total amount of water used in the field (WR)

$$\text{Field water use efficiency} = \frac{Y}{WR}$$

### *6. Project efficiency*

Project efficiency indicates the effective use of the irrigation water source in crop production. It is the percentage of irrigation water that is stored in the soil and is available for consumptive use by crops. When the delivered water is measured at the farm head gate or well, it is called farm irrigation efficiency, when measured in the field, it is designated as field irrigation efficiency, and when measured at the point of diversion from the canal or the main source of supply it may be called project efficiency.

### *7. Operational efficiency*

Operational efficiency is the ratio of actual project efficiency compared to the operational efficiency of an ideally designed and managed system using the same irrigation method and facilities. Low operational efficiency indicates management or system design problems, or both.

### *8. Economic (irrigation) efficiency*

Economic efficiency is the ratio of the total production (net or gross profit) attained with the operating irrigation system, compared to the total production expected under ideal conditions. This parameter is a measure of the overall efficiency, because it relates the final output to input.

**Result:**

Thus, the various irrigation efficiency have been studied.

|  |  |  |
|---|---|---|
| **Ex. No.** | **8** | **DETERMINATION OF UNIFORMITY COEFFICIENT FOR DRIP IRRIGATION SYSTEM** |
| **Date** |  |  |

## AIM:

To determine the uniformity coefficient for drip irrigation system

### APPARATUS REQUIRED:

| S.No. | COMPONENT / EQUIPMENT | QUANTITY |
|---|---|---|
| 1. | Pump | 1 |
| 2. | Header Assembly | 1 |
| 3. | Filters – Hydro cyclone, Sand, Screen Filter | 1 |
| 4. | Fertigation Equipment - Ventury Injector, Fertilizer Tank, Injector Pump | 1 |
| 5. | Main Line | 1 |
| 6. | Submain Line | 1 |
| 7. | Pressure gauge | 1 |
| 8. | Air release valve | 1 |
| 9. | Catch cans | 18 |

## PROCEDURE

1. Select a container for determining flow rate determination (approx. 50 ml)
2. Choose 18 emitters at random in the sub main unit and measurethe time taken to fill the container
3. Write the times (t) in descending order
4. Find out the sum of first three values ($t_{us}$)
5. Find out the sum of last three values ($t_{ls}$)
6. Use the following formula to find out the value of Variation of Discharge ($V_q$). Variation below 10 % is good and variation between 10 % to 20 % is acceptable. Variation between 20% to 30% is not very bad. Variation above 30 % is unacceptable.

$$V_q = 0.667 \frac{tus-tls}{tus+tls} \times 100$$

## Calculation:

Uniformity coefficient for drip irrigation

Container capacity -20 ml

| SL.NO | TIME TAKEN TO FILL IN SEC | DESCENDING ORDER (SEC) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

$$V_q = 0.667 * [(t_{us} - t_{ls})/(t_{us} + t_{ls})]*100$$

## Result:

The uniformity coefficient of drip irrigation system=

| | | |
|---|---|---|
| **Ex. No.** | **9** | **DETERMINATION OF UNIFORMITY COEFFICIENT FOR SPRINKLER IRRIGATION SYSTEM (CATCH CANS)** |
| **Date** | | |

**AIM:**

To determine the uniformity coefficient for sprinkler irrigation system

**APPARATUS REQUIRED:**

| S.No. | COMPONENT / EQUIPMENT | QUANTITY |
|---|---|---|
| 1. | Pump | 1 |
| 2. | Header Assembly | 1 |
| 3. | Main Line | 1 |
| 4. | Submain Line | 1 |
| 5. | Pressure gauge | 1 |
| 6. | Air release valve | 1 |
| 7. | Sprinkler head | 1 |
| 8. | Catch cans | 18 |

**PROCEDURE:**

1. Approximately 50 ml catch cans are kept in the field on 2 m x 2m grid
2. Operate all the sprinklers for specified amount of time
3. Find out the volume of water collected in each can
4. Find out the opening of the can
5. Divide the volume of water collected by the area of opening of can to get the depth of water applied at each can
6. Then the formula can be used for finding the uniformity of sprinkling

$$\mathrm{CU} = 100 \text{ X } \left[1 - \frac{\sqrt{\frac{\sum_i^n (z-m)^2}{n}}}{m}\right]$$

If the uniformity values obtained from this formula is above 80 % then the design and installation is said to be satisfactory.

## Calculation:

**Uniformity Coefficient For Sprinkler Irrigation Time - 20 seconds**

| CONTAINER | VOLUME (Z) | DESCENDING ORDER(ml) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

$$\mathrm{CU} = 100 \text{ X } [1 - \frac{\sqrt{\frac{\Sigma_i^n (z-m)^2}{n}}}{m}]$$

## Result:

Uniform Co efficient of Sprinkler Irrigation System =

| | | |
|---|---|---|
| **Ex. No.** | **10** | **TO CONDUCT EXPERIMENT ON DISC FILTER FOR MICRO IRRIGATION SYSTEMS** |
| **Date** | | |

**AIM:**

To study the concept on disc filter for micro irrigation system.

**APPARATUS REQUIRED:**

| **S. No.** | **COMPONENT / EQUIPMENT** | **QUANTITY** |
|---|---|---|
| 1. | Disc Filter | 1 |

## PROCEDURE

1. Disc filters are used to filter small size particles that cannot be separated by sand filter
2. They contain discs with diagonal grooves
3. When the disc are placed one over the other, openings occurs
4. The cross section of opening changes as one moves diagonally
5. The filter needs to be cleaned periodically
6. If arrangements are made to reverse the direction of flow, the accumulated impurities can be removed easily.
7. This filter may cause a pressure head loss of 2m to 3m.

## Result:

We have studied cleaning process of disc filter.

| | | |
|---|---|---|
| **Ex. No.** | **11** | **STUDY OF GREENHOUSE IRRIGATION SYSTEM DESIGN.** |
| **Date** | | |

A greenhouse irrigation system plays a critical role in maintaining optimal growing conditions for plants by supplying water in a controlled and efficient manner. The design of such systems depends on factors such as the type of crops being grown, climate conditions, available water resources, and energy costs. A well-designed irrigation system helps reduce water waste, ensure uniform moisture distribution, and promote healthy plant growth.

Here's an overview of the key factors and types of irrigation systems commonly used in greenhouses:

**Key Factors to Consider in Greenhouse Irrigation Design**

- **Water Requirements of Plants:** Different plants have different water needs depending on their growth stage. The irrigation system must be adaptable to meet these varying requirements.
- **Climate and Temperature Control:** Greenhouses are often used in controlled environments where temperature, humidity, and light are carefully regulated. The irrigation system should complement the climate control systems to prevent over-watering or under-watering, which could impact plant health.
- **Water Quality:** The water used in a greenhouse should be clean, with minimal impurities like salts, heavy metals, or pathogens. High salinity or poor-quality water can harm plants and affect crop yield.
- **Water Availability:** Depending on the water source (groundwater, rainwater, recycled water, etc.), the system needs to be designed for efficiency to minimize water usage while meeting the demands of the crops.
- **Energy Efficiency:** The irrigation system should also consider energy costs, especially if pumps or other machinery are used to distribute water. Low-energy solutions such as gravity-fed systems or solar-powered pumps can be considered for sustainability.
- **Automation and Monitoring:** Incorporating sensors and automation in irrigation systems can optimize water usage by adjusting the water flow based on real-time data such as soil moisture levels, humidity, and plant water needs.