IRRIGATION ENGINEERING

Theory
&
Objective

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CONTENTS

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PRACTICE SHEET

OBJECTIVE QUESTIONS

1. Delta (Δ) in cm, Duty (D) in hectare/cumec and Base period (B) in days are related as:

(a) $\Delta = 864$ B/D

(b) B = 864 D/Δ

(c) B = 864 Δ/D

(d) D = 8.64 B/Δ

2. If duty (D) is 1428 hectares/cumec and base period (B) is 120 days for an irrigated crop, then delta (Δ) in meters is given by

(a) 102.8 (b) 0.73

(c) 1.38 (d) 0.01

3. A tube well having a capacity of 4 m^3/hour operates for 20 hours each day during the irrigation season. How much area can be commanded if the irrigation interval is 20 days and depth of irrigation is 7 cm?

(a) 1.71×10^4 m^2

(b) 1.14×10^4 m^2

(c) 22.9×10^4 m^2

(d) 2.29×10^4 m^2

4. A field was supplied water from an irrigation tank at a rate of 120 lit/sec to irrigate an area of 2.5 hectares. The duration of irrigation is 8 hours. It was found that the actual delivery at the field, which is about 4 km from the tank, was 100 lit/sec. The runoff loss in the field was estimated as 800 m^3. The application efficiency in this situation is

(a) 62% (b) 72%

(c) 76% (d) 80%

5. A canal was designed to supply the irrrigation needs of 1200 hectares of land growing rice of 140 days base period having a Delta of 134 cms. If this canal water is used to irrigate wheat of base period 120 days having a delta of 52 cm, the area (in hectares) that can be irrigated is

(a) 2650 (b) 3608

(c) 543 (d) None of these

6. The total irrigation depth of water, required by a certain crop in its entire growing period (150 days), is 25.92 cm. The culturable command area for a distributary channel is 1000,000 hectares. The distributary channel shall be designed for a discharge

(a) less than 2 cumecs

(b) 2 cumecs

(c) 20 cumecs

(d) more than 20 cumecs

7. The moisture content of soil in the root zone of an agricultural crop at certain stage is found to be 0.05 The field capacity of the soil is 0.15. The root zone depth is 1.1 m. The consumptive use of crop at this stage is 2.5 mm/day and there is no precipitation during this period. Irrigation efficiency is 65%. It is intended to raise the moisture content to the field capacity in 8 days through irrigation. The necessary depth of irrigation is ($\gamma_d = 1.5$)

(a) 115 mm (b) 169 mm

(c) 200 mm (d) 285 mm

8. A sprinkler irrigation system is suitable when

(a) the land gradient is steep and the soil is easily erodible

(b) the soil is having low permeability

(c) the water table is low

(d) the crops to be grow have deep roots

9. A canal irrigates a portion of a culturable command area to grow sugarcane and wheat. The average discharges required to grow sugarcane and wheat are, respectively, 0.36 and 0.27 cumecs. The time factor is 0.9. The required design capacity of the canal is

(a) 0.36 cumecs (b) 0.40 cumecs

(c) 0.63 cumecs (d) 0.70 cumecs

10. The culturable commanded area for a distributary is 2×10^8 m^2. The intensity of irrigation for a crop is 40%. If kor water depth and kor period for the crop are 14 cm and 4 weeks, respectively, the peak demand discharge is

(a) 2.63 m^3/s (b) 4.63 m^3/s
(c) 8.58 m^3/s (d) 11.58 m^3/s

11. In a cultivated area, the soil has porosity of 45% and field capacity of 38%. For a particular crop, the root zone depth is 1.0 m, the permanent wilting point is 10% and the consumptive use is 15 mm/d. If the irrigation efficiency is 60%, what should be the frequency of irrigation such that the moisture content does not fall below 50% of the maximum available moisture?

(a) 5d (b) 6d
(c) 9d (d) 15d

12. The consumptive use of water for a crop during a particular stage of growth is 2.0 mm/day. The maximum depth of available water in the root zone is 60 mm. Irrigation is required when the amount of available water is 50% of the maximum available water in the root zone. Frequency of irrigation should be

(a) 10 days (b) 15 days
(c) 20 days (d) 25 days

13. The culturable command area for a distributed channel is 20,000 hectares. Wheat is grown in the entire area dna the intensity of irrigation is 50%. The kor period for wheat is 30 days and the kor water depth is 120 mm. The outlet discharge for the distributary should be

(a) 2.85 m^3/s (b) 3.21 m^3/s
(c) 4.63 m^3/s (d) 5.23 m^3/s

14. An outlet irrigates an area of 20 ha. The discharge (L/s) required at this outlet to meet the evapotranspiration requirement of 20 mm occurring uniformly in 20 days neglecting other field losses is

(a) 2.52 (b) 2.31
(c) 2.01 (d) 1.52

15. An agricultural land of 437 ha is to be irrigated for a particular crop. The base period of the crop is 90 days and total depth of water required by the crop is 105 cm. If a rainfall of 15 cm occurs during the base period, the duty of irrigation water is

(a) 437 ha/cumec (b) 486 ha/cumec
(c) 741 ha/cumec (d) 864 ha/cumec

Common Data for Questions : (16 - 17)

The moisture holding capacity of the soil in a 200 hectare farm is 18 cm/m. The field is to be irrigated when 50 per cent of the available moisture in the root zone is depleted. The irrigation water is to be supplied by a pump working for 10 hours a day, and water application efficiency is 75 per cent. Details of crops planned for cultivation are as follows:

Crop	Root zone depth (m)	Peak rate of moisture use (mm/day)
X	1.0	5.0
Y	0.8	4.0

16. The capacity of irrigation system required to irrigate crop 'X' in 36 hectares is

(a) 83 litres/sec (b) 67 litres/sec
(c) 57 litres/sec (d) 53 litres/sec

17. The area of crop 'Y' that can be irrigated when the available capacity of irrigation system is 40 litres/sec is

(a) 40 hectares (b) 36 hectares
(c) 30 hectares (d) 27 hectares

18. Wheat crop requires 55 cm of water during 120 days of base period. The total rainfall during this period is 100 mm. Assume the irrigation effficiency to be 60%. The area (in ha) of the land which can be irrigated with a canal flow of 0.01 m^3/s is

(a) 13.82 (b) 18.85
(c) 23.04 (d) 230.40

19. The transplantation of rice required 10 days and total depth of water required during transplantation is 48 cm. During transplantation there is an effective rainfall (useful for irrigation) of 8 cm. The duty of irrigation water in hectare/cumecs is

(a) 612 (b) 216
(c) 300 (d) 108

ANSWER & EXPLANATIONS

1. Ans. (a)

Sol. $\therefore \quad \Delta = 8.64$ B/D

Here, Δ is in m B = base period in days, D = duty of crop in ha/cumec

$\Rightarrow \quad \Delta = 864\dfrac{B}{D}\text{cm}$

2. Ans. (b)

Sol. D = 1428 Ha/cum ; B = 120 days

$$\Delta = \frac{8.64B}{D} = \frac{8.64\times120}{1428}$$

= 0.726 m = 0.73 m

3. And. (d)

Sol. Q = 4 × 20 = 80 m^3/day or Q = 9.26 × 10^{-4} m^3/sec

Given B = 20 days, D = 7 cm = 0.07 m

$\therefore$ Duty at outlet $D = \dfrac{8.64B}{\Delta} = \dfrac{8.64\times20}{0.07}$

= 2468 Ha/cumec

Area A = D × Q ; = 2468 × 9.26 × 10^{-4}

= 2.29 Ha ; = 2.29 × 10^4 m^2

4. Ans. (b)

Sol. Water application efficiency

$$\eta_a = \frac{\text{Water stored in the roof zone during irrigation}}{\text{Water delivered to the field}}\times100$$

Water supplied to field during 8 hour @ 100 lit/s

= 100 × 8 × 60 × 60 = 2880 m^3

Runoff loss in the field = 800 m^3

Water stored in the root zone

= 2880 – 800 = 2080 m^3

$\therefore \quad \eta_a = \dfrac{2080}{2880}\times100 = 72.22\%$

5. Ans. (a)

6. Ans. (d)

Sol. Given Delta,

Δ = 25.92 cm = 0.2592 m

Base period,

B = 150 days

Then Duty, $D = \dfrac{8.64B}{\Delta} = \dfrac{8.64\times150}{0.2592}$

$\Rightarrow$ D = 5000 ha/cumec

$\therefore$ Minimum discharge = $\dfrac{100,000}{5000} = 20\,\text{cumecs}$

But the distributary channel should be designed for a discharge more than 20 cumecs.

7. Ans. (d)

8. Ans. (a)

Sol. The conditions favouring the use of spirnkler irrigation method are:

(i) When the land topography is irregular.

(ii) When the land gradient is steeper and soil is easily erobible.

(iii) When the land soil is excessively permeable.

(iv) When the water table is high.

(v) When the seasonal water requirement is low.

(vi) When the water availability is difficult and scarce.

9. Ans. (d)

Sol. Design discharge = $\dfrac{0.36+0.27}{0.9} = 0.70$

10. Ans. (b)

Sol. Area under crop = 2 × 10^8 × $\dfrac{40}{100} = 0.8\times10^8\ m^2$

Volume = Area × Δ

= 0.8 × 10^8 × 14 × 10^{-2} = 1.2 × 10^7 m^3

Discharge, $Q = \dfrac{1.12\times10^7}{4\times7\times24\times3600} = 4.63\ m^3/\text{sec}$

11. Ans. (b)

Sol. Depth of maximum available moisture,

$$d_w = \frac{\gamma_d}{\gamma_w}(F-\phi)$$

Field capacity

$$= \frac{\text{weight of water retained by soil}}{\text{weight of same area of soil}}$$

$$= \frac{\gamma_w\times V_v}{\gamma\times V}\ \text{But}\ \frac{V_v}{V} = n$$

$\therefore$ Field capacity = $\dfrac{\gamma_w}{\gamma}\times n$

$$\Rightarrow \frac{\gamma_w}{\gamma} = \frac{n}{\text{Field capacity}} \quad \Rightarrow \frac{\gamma_w}{\gamma} = \frac{0.45}{0.38}$$

$$\therefore \quad d_w = \frac{0.45}{0.38} \times 1 \times [0.38 - 0.1] = 0.331 \text{m}$$

But the moisture content should not fall below 50%.

$\therefore$ Depth of water required

$= 0.5 \times 0.331 = 0.165$ m

Actual depth stored

$$= \frac{0.165 \times 60}{100} = 0.099 \text{ m} = 99 \text{mm}$$

Frequency of irrigation

$$= \frac{\text{Actual depth stored}}{\text{Consumptive use}} = \frac{99}{15} = 6.63\text{d} \approx 6\text{d}$$

12. Ans. (b)

Sol. Consumptive use of water = 2.0 mm/day Maximum depth of available water = 60 mm If amount of available water is reduced by 50%, then irrigation is required for a depth

$$= \frac{50}{100} \times 60 = 30 \text{mm}$$

$$\therefore \quad \text{Frequency of irrigation} = \frac{30}{2} = 15 \text{ days}$$

13. Ans. (c)

Sol. Area to be irrigated = Culturable command area × Intensity of irrigation

$$= 20,000 \times \frac{50}{100} = 10,000 \text{ ha}$$

$$\text{Duty,} \quad D = \frac{8.64B}{\Delta} = \frac{8.64 \times 30}{120 \times 10^3}$$

= 2160 ha/cumec

$$\therefore \quad \text{Outlet discharge} = \frac{\text{Area to be irrigated}}{\text{Duty of crop}}$$

$$\frac{10,000}{2160} = 4.63 \text{ m}^3/\text{s}$$

14. Ans. (b)

Sol. Volume of water required for evapo-transpiration

$= 20 \times 10^4 \times 20 \times 10^{-3} \times 10^3$

$= 4 \times 10^6$ litres

$\therefore$ Discharge required at outlet

$$= \frac{4 \times 10^6}{20 \times 24 \times 60 \times 60} = 2.31 \text{ litres/sec}$$

15. Ans. (d)

Sol. Total depth of water required by the crop = 105 cm

Contribution of rainfall during the base period = 15 cm

$\therefore$ Delta, $\Delta = 105 - 15 = 90$ cm

$$\text{Duty of crop} = \frac{864 \text{ B}}{\Delta} = \frac{864 \times 90}{90}$$

= 864 ha/cumec

16. Ans. (b)

Sol. Moisture holding capacity of soil = 18 cm/m

Root zone depth of crop X = 1.0 m

Moisture holding capacity of soil fro crop

X = 18 × 1 = 18 cm

Allowable depletion of moisture

$$= \frac{50}{100} \times 18 = 9 \text{ cm}$$

Consumptive use of water for crop X = 0.5 cm/day

$$\therefore \quad \text{Frequency of irrigation } \frac{9}{0.5} = 18 \text{ days}$$

Thus 9 cm depth of water is to be applied to the crop X in the next 18 days.

Irrigation requirement

$$= \frac{\text{Net water depth}}{\text{Water application efficiency}} = \frac{9}{0.75} = 12 \text{ cm}$$

Quantity of water required

$$= \frac{12}{100} \times 36 \times 10^4 = 43200 \text{ m}^3$$

$\therefore$ Discharge through pump

$$= \frac{43200}{18 \times 10 \times 60 \times 60} \times 10^3 \text{ litres/sec}$$

= 66.67 litres/sec = 67 litres/sec

17. Ans. (d)

Sol. Moisture holding capacity of soil for crop

Y = 18 × 0.8 = 14.4 cm

Allowable depletion of moisture

$$= \frac{50}{100} \times 14.4 = 7.2 \text{cm}$$

Consumptive use of water for crop

Y = 0.4 cm/day

$$\therefore \quad \text{Frequency of irrigation} = \frac{7.2}{0.4} = 18 \text{ days}$$

Thus 7.2 cm depth of water is to be applied to the crop Y in the next 18 days.

Irrigation requirement = $\frac{7.2}{0.75} = 9.6$ cm

Quantity of water required = Discharge through pump

$\Rightarrow \frac{9.6}{100} \times A \times 10^4 = 40 \times 10^{-3} \times 18 \times 10 \times 60 \times 60$

$\Rightarrow$ A = 27 hectares

18. Ans. (a)

Sol. Given, Base period , B = 120 days

$\Delta = 55 - 10 = 45$ cm = 0.45 m

$\because \quad \Delta = 8.64\frac{B}{D}, \qquad \therefore \Delta = \frac{8.64 \times 120}{0.45} = 2304$

$\therefore$ Area, A = 2304 × 0.01 = 23.04 ha

As efficiency of Irrigation is 60% Then required area for wheat crop

$$= 23.04 \times \frac{60}{100} = 13.82 \text{ ha.}$$

19. Ans. (b)

Sol. D = 864 B/Δ hectares/cumecs

$$= \frac{864 \times 10}{(48-8) \times 10} = 216 \text{ hec./cumecs}$$

□□□

STUDENT'S SPACE

WATER REQUIREMENTS OF CROPS

THEORY

Irrigation

Three basic requirements of agricultural production are soil, seed, and water. In addition,fertilisers, insecticides, sunshine, suitable atmospheric temperature, and human labour are also needed. Of all these, water appears to be the most important requirement of agricultural production. The application of water to soil is essential for plant growth and it serves the following functions:

- o It supplies moisture to the soil essential for the germination of seeds, and chemical and bacterial processes during plant growth.
- o It cools the soil and the surroundings thus making the environment more favourable for plant growth.
- o It washes out or dilutes salts in the soil.
- o It softens clods and thus helps in tillage operations.
- o It enables application of fertilisers.
- o It reduces the adverse effects of frost on crops.
- o It ensures crop success against short-duration droughts

Water Requirements of a Crop

• The total quantity and the way in which a crop requires water, from the time it is sown to the time it is harvested

• It vary with the crop as well as with the place

• Depending on

o Climate

o Type of soil

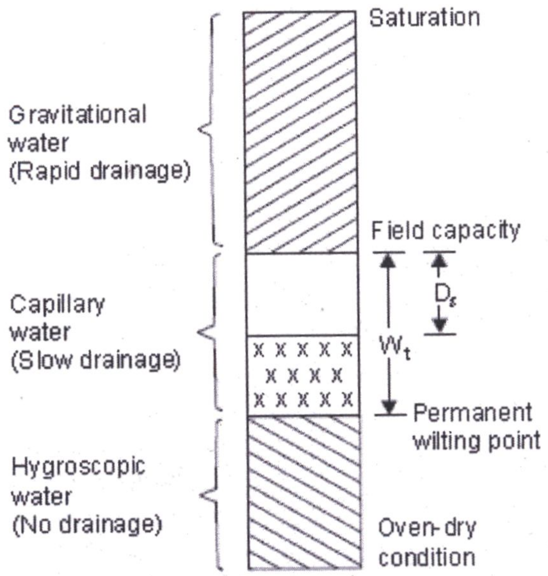
o Method of cultivation

o Useful rainfall

Classification of soil water

- **Gravitational water:** A soil sample saturated with water and left to drain the excess out by gravity holds on to a certain amount of water. The volume of water that could easily drain off is termed as the gravitational water. This water is not available for plants use as it drains off rapidly from the root zone.

- **Capillary water:** The water content retained in the soil after the gravitational water has drained off from the soil is known as the capillary water. This water is held in the soil by surface tension. Plant roots gradually absorb the capillary water and thus constitute the principle source of water for plant growth.
- **Hygroscopic water:** The water that an oven dry sample of soil absorbs when exposed to moist air is termed as hygroscopic water. It is held as a very thin film over the surface of the soil particles and is under tremendous negative (gauge) pressure. This water is not available to plants.



Soil water constants :

For a particular soil, certain soil water proportions are defined which dictate whether the water is available or not for plant growth. These are called the soil water constants, which are described below.

- **Saturation Capacity:** This is the total water content of the soil when all the pores of the soil are filled with water. It is also termed as the maximum water holding capacity of the soil. At saturation capacity, the ***soil moisture tension*** is almost equal to zero.
- **Field Capacity:** This is the water retained by an initially saturated soil against the force of gravity. Hence, as the gravitational water gets drained off from the soil, it is said to reach the field capacity. At field capacity, the macro-pores of the soil are drained off, but water is retained in the micropores. Though the soil moisture tension at field capacity varies from soil to soil, it is normally between 1/10 (for clayey soils) to 1/3 (for sandy soils) atmospheres.
- **Permanent Wilting Point:** Plant roots are able to extract water from a soil matrix, which is saturated up to field capacity. However, as the water extraction proceeds, the moisture content diminishes and the negative (gauge) pressure increases. At one point, the plant cannot extract any further water and thus ***wilts.***

Two stages of wilting points are recognized and they are:

- Temporary wilting point: this denotes the soil water content at which the plant wilts at day time, but recovers during right or when water is added to the soil.

- Ultimate wilting point: at such a soil water content, the plant wilts and fails to regain life even after addition of water to soil.

Crop Period or Base Period: The time period that elapses from the instant of its sowing to the instant of its harvesting

Base Period: The time between the first watering of a crop at the time of its sowing to its last watering before harvesting. It is represented by B (in days)

• Crop period is slightly more than the base period

• But for all practical purposes, they are taken as one and the same thing

Delta (Δ)

- Depth to which water would stand on the irrigated area if the total quantity supplied were to stand above the surface without percolation or evaporation
- This total depth of water (in cm) required by a crop to come to maturity.

Duty of Water

- It is the relationship between the volume of water and the area of the crop it matures
- A unit discharge flowing for a time equal to the base period of the crop., called Base of the duty
- If water flowing at a rate of one m^3/s, runs continuously for B days, and matures 200 hectares, then the duty of water for that particular crop will be defined as 200 hectares/cumec to the base of B days
- Duty is defined as the area irrigated per cumec of discharge running for base period B
- The duty is generally represented by D

Relationship Between Duty and Delta

– Let there be a crop of base period B days

– Let 1 cumec of water be applied to this crop on the field for B days

– Now, the vol. of water applied to this crop during B days

$= V = (1 \times 60 \times 60 \times 24 \times B)\ m^3$

$= 86400\ B\ (m^3)$

– By definition of duty (D), 1 m^3 supplied for B days matures D hectares of land

– Therefore this quantity of water (V) matures D hectares of land or 10^4 D sq. m of area

– Total depth of water applied on this land

$$\frac{\text{Volume}}{\text{Area}} = \frac{86400B}{10^4 D}$$

$$= \frac{8.64B}{D}\ \text{meters} = \frac{864B}{D}\ \text{cm}$$

– By definition, this total depth of water is called delta (Δ)

– Therefore, $\Delta = \frac{8.64B}{D}$ metres

or

$$\Delta = \frac{864B}{D}\text{cm}$$

- Duty of water for a crop, is number of hectares of land which the water can irrigate
- Therefore, if the water requirement of the crop is more, less number of hectares of land it will irrigate
- If water consumed is more, duty will be less
- The duty of water at the head of the water course will be less than the duty of water 'on the field'; because when water flows from the head of the water course and reaches the field, some water is lost as transit losses (evaporation, percolation)

Commanded area (CA): This is defined as the area that can be irrigated by a canal system. CA may further be classified as under:

Gross command area (GCA): This is defined as total area that can be irrigated by a canal system on the perception that unlimited quantity of water is available. It is the total area that may theoretically be served by the irrigation system. But this may include inhibited areas, roads, ponds, uncultivable areas etc which would not be irrigated.

Culturable command area (CCA): This is the actually irrigated area within the GCA. However, the entire CCA is never put under cultivation during any crop season due to the following reasons:

- The required quantity of water, fertilizer, etc. may not be available to cultivate the entire CCA at a particular point of time. Thus, this is a physical constraint.
- The land may be kept fallow that is without cultivation for one or more crop seasons to increase the fertility of the soil. This is a cultural decision.
- Due to high water table in some areas of the CCA, irrigated water may not be applied as the crops get enough water from the saturation provide to the surface water table.

During any crop season, only a part of the CCA is put under cultivation and this area is termed as ***culturable cultivated area***. The remaining area which is not cultivated during a crop season is conversely termed as ***culturable uncultivated area***.

Intensity of irrigation

Intensity of irrigation is defined as the percentage of the irrigation proposed to be irrigated annually. Usually the areas irrigated during each crop season (Rabi, Kharif, etc) is expressed as a percentage of the CCA which represents the intensity of irrigation for the crop season. By adding the intensities of irrigation for all crop seasons the yearly intensity of irrigation to be obtained.

Factors on which duty depends

- **Type of crop :**
  - Duty will be less for a crop requiring more water and vice versa

- **Climate and season**
  - – Duty includes the water lost in evaporation and percolation which vary with time, season and climate
- **Useful rainfall**
  - – If some of the rain, falling directly over the irrigated land, is useful for the growth of the crop, then so less irrigation water will be required to mature the crop
- **Type of soil**
  - – If the permeability of the soil under the irrigated crop is high, the water loss due to percolation will be more and hence, the duty will be less
  - – Therefor sandy soils, the duty of water is less
- **Efficiency for cultivation method**
  - – If the cultivation method (including tillage and irrigation) is faulty and less efficient, resulting in the wastage of water, the duty of water will naturally be less
  - – If the irrigation water is used economically, then the duty of water will improve, as the same quantity of water would be able to irrigate more area

Measures for Improving Duty of water

- **Precautions in field preparation and sowing**
  - – Land to be used for cultivation should, as far as possible, be levelled
  - – The fields should be properly ploughed to the required depth
  - – Improved modern cultivation methods may preferably be adopted
  - – Porous soils should be treated before sowing crops to reduce seepage of water
  - – Alkaline soils should be properly leached before sowing
  - – Manure fertilisers should be added to increase water holding capacity of the soil
  - – Rotation of crops should be preferred, as this will ensure increased crop yields with minimum use of water
- **Precautions in handling irrigation supplies**
  - – The source of irrigation water should be situated within the prescribed limits, and be capable of good quality of water
  - – Canals carrying irrigation supplies should be lined to reduce seepage and evaporation
  - – Water courses may preferably be lined or RCC pipes may be used for the same
  - – Free flooding of fields should be avoided and furrow irrigation method may preferably be adopted, if surface irrigation is restored.
  - – Subsurface irrigation and drip irrigation may be preferred to ordinary surface irrigation
  - – If canals are not lined, then two canals running side by side may be preferred to a single canal, as this will reduce the FSL, thereby reducing percolation losses.
  - – Irrigation supplies should be economically used by proper control.

Type of Soils	Favourablve for raising crops	Water requirement
Heavy retentive soil (40% clay)	Sugarcane, rice, etc.	Require more water
Light sandy soil (2-8% clay)	Gram, fodder, etc.	Require less water
Medium or normal soil (having about 10-20% of clay)	Wheat, cotton. Maize, vegetables, oil seeds, etc.	Require normal amount of water

Types of irrigation methods

- Surface irrigation method
- Subsurface irrigation method
- Sprinkler irrigation system
- Drip irrigation system

SURFACE IRRIGATION METHOD

In this system of field water application the water is applied directly to the soil from a channel located at the upper reach of the field. It is essential in these methods to construct designed water distribution systems to provide adequate control of water to the fields and proper land preparation to permit uniform distribution of water over the field.

- One of the surface irrigation method is ***flooding method*** where the water is allowed to cover the surface of land in a continuous sheet of water with the depth of applied water just sufficient to allow the field to absorb the right amount of water needed to raise the soil moisture up to field capacity.
- The flooding method applied in a controlled way is used in two types of irrigation methods as under:
  - o ***Border irrigation method***
  - o ***Basin irrigation method***

Border irrigation method

- Borders are usually long uniformly graded strips of land separated by earth bunds (low ridges).
- The essential feature of the border irrigation is to provide an even surface over which the water can flow down the slope with a nearly uniform depth.
- Each strip is irrigated independently by turning in a stream of water at the upper end.

Basin irrigation method

- Basins are flat areas of land surrounded by low bunds.
- The bunds prevent the water from flowing to the adjacent fields.
- The basins are filled to desired depth and the water is retained until it infiltrates into the soil. Water may be maintained for considerable periods of time.

- Basin irrigation is suitable for many field crops. Paddy rice grows best when its roots are submerged in water and so basin irrigation is the best method for use with this crop

Furrow Irrigation

- Furrows are small channels, which carry water down the land slope between the crop rows.
- Water infiltrates into the soil as it moves along the slope.
- The crop is usually grown on ridges between the furrows.
- This method is suitable for all row crops and for crops that cannot stand water for long periods, like 12 to 24 hours, as is generally encountered in the border or basin methods of irrigation
- Furrow irrigation is suitable to most soils except sandy soils that have very high infiltration water and provide poor lateral distribution water between furrows.

As compared to the other methods of surface irrigation, the furrow method is advantageous as:

- Water in the furrows contacts only one half to one-fifth of the land surface, thus reducing puddling and clustering of soils and excessive evaporation of water.
- Earlier cultivation is possible

Subsurface irrigation methods

The application of water to fields in this type of irrigation system is below the ground surface so that it is supplied directly to the root zone of the plants.

- The main advantages of these types of irrigation is reduction of evaporation losses and less hindrance to cultivation works which takes place on the surface.
- There may be two ways by which irrigation water may be applied below ground and these are termed as:
    - Natural sub-surface irrigation method
    - Artificial sub-surface irrigation method

Sprinkler Irrigation System

- Sprinkler irrigation is a method of applying water which is similar to natural rainfall but spread uniformly over the land surface just when needed and at a rate less than the infiltration rate of the soil so as to avoid surface runoff from irrigation.
- This is achieved by distributing water through a system of pipes usually by pumping which is then sprayed into the air through sprinklers so that it breaks up into small water drops which fall to the ground.
- The system of irrigation is suitable for undulating lands, with poor water availability, sandy or shallow soils, or where uniform application of water is desired.
- No land leveling is required as with the surface irrigation methods.
- Sprinklers are, however, not suitable for soils which easily form a crust. The water that is pumped through the pump pipe sprinkler system must be free of suspended sediments.

Drip Irrigation System

- Drip Irrigation system is sometimes called trickle irrigation and involves dripping water onto the soil at very low rates (2-20 litres per hour) from a system of small diameter plastic pipes filled with outlets called emitters or drippers.
- Water is applied close to the plants so that only part of the soil in which the roots grow is wetted, unlike surface and sprinkler irrigation, which involves wetting the whole soil profile.
- With drip irrigation water, applications are more frequent than other methods and this provides a very favourable high moisture level in the soil in which plants can flourish.

Some Important Definitions

Kharif-Rabi ratio or Crop Ratio

- The area to be irrigated for Rabi crop is generally more than that for the Kharif crop.
- This ratio of proposed areas, to be irrigated in Kharif season to that in the Rabi season
- This ration is generally 1:2, i.e. Kharif area is one-half of the Rabi area

Paleo Irrigation

- Sometimes, in the initial stages before the crop is sown, the land is very dry.
- This particularly happens at the time of sowing of Rabi crops because of hot September.
- In such a case, the soil is moistened with water

Kor-watering

- The first watering which is given to a crop, when crop is few centimeters high
- It is usually the maximum single watering followed by other watering at usual intervals, as required by drying of leaves
- The optimum depth of kor-watering for different crops are different
- For example For wheat (in U.P.) is about 13.5 cm For sugarcane is 16.5 cm
- The kor-watering must be applied within a fixed limited period, called kor-period

Puddling -watering

- Preparation of land for transplantation
- Requires lump sum of water
- 200 mm at field level for rice crop

Cash Crop

- A crop which has to be encashed in the market for processing, etc. as it cannot be consumed directly by the cultivators
- All non-food crops, are thus, included in cash crop
- Examples, jute, tea, cotton, tobacco, sugarcane, etc.