Irrigation Efficiency

1- For a particular soil, moisture at field capacity is 29% (w/w) and irrigation is to be applied at a moisture content of 19% (w/w). The apparent specific gravity is 1.30 and depth of the soil to be wetted is 1 m. Determine-

[IFS (Mains) AG 2019: 4×2=8 marks]

(i) Hectare-cm of water per hectare of land;

(ii)Time required irrigating 10 hectares of land with a 0.10 m^3/sec stream, if the efficiency of irrigation application is 75%.

2- Explain irrigation efficiency and also explain its different types along with formulas to compute them. [IFS (Mains) AG 2019: 10 marks]

3- The following data were obtained in determining the soil moisture content at successive depths in the root zone prior to applying irrigation water:

[IFS (Mains) AG 2019: 10 marks]

Depth of sampling (cm)	Wt. of moist soil sample	Oven dry wt. of soil sample (gm)
0-25	134.60	126.82
25-50	136.28	127.95
50-75	122.95	115.32
75-100	110.92	102.64

The bulk density of the soil in the root zone was 1.50 gm/cc. The available moisture- holding capacity of the soil was 17.8 cm/m depth. Determine-

(i) Moisture content at different depths in the root zone;

(ii) Moisture content in the root zone at the time of irrigation;

(iii) Net depth of water to be applied to bring the moisture content to field capacity;

(iv) Gross irrigation requirement at an estimated field irrigation efficiency of 70%.

4- The soil moisture at Field Capacity (FC) is 25% (W/W) and the moisture content at the time of irrigating is 15% (W/W). The apparent specific gravity is

1.52 and depth of soil to be wetted is 90 cm. How much water in ha-cm per hectare must be applied? [IFS (Mains) AG 2018: 8 marks]

5- Given: [IFS (Mains) AG 2017: 10 marks]

Climate	Hot humid
Soil	Fine sandy loam
Wind speed	7 km/h
Crop	Wheat
Effective root zone depth	1.5 m
Water available in top soil(1.0 m)	167 mm/m
Water available in top soil(0.5)m	183 mm/m
Irrigation application efficiency	80%
EC_w	2.0 dS/m
EC_e (for 10% yield reduction)	3.4 dS/m
Area	10 ha
Peak rate of water removal	6 mm/day
Management allowed deficit (MAD)	50%
Operating hours per day	12 hours

Find the Net and Gross depth of irrigation, Leaching requirement, Irrigation interval and Sprinkler system capacity.

6- Write short notes on the following irrigation efficiences:

[IFS (Mains) AG 2016: 10 marks]

(i) Water conveyance efficiency

(ii) Water application efficiency

(iii) Water storage efficiency

(iv) Water distribution efficiency

7- Tomato with 60 cm effective root zone depth is grown in a soil with field capacity and permanent wilting point of 22% and 8% respectively. Irrigation is applied after 40% depletion of the available moisture. Apparent specific gravity of soil = 1.6. Calculate the depth of irrigation required. If a pump delivers 10 1/s discharge, how much time will it take for the irrigation of 2 ha? Assume no loss of water. [IFS (Mains) AG 2016:20 marks]

8- A wheat crop is to be irrigated using the check basin method. The size of each basin is 10 m × 8 m. The size of the available irrigation stream is 18 litres per second. The water holding capacity of the root zone soil is 16%. The apparent specific gravity of the soil is 1.58. The soil moisture content before irrigation is 8.5%. Determine the irrigation duration, if the water application efficiency is 96%. The depth of root zone is 80 cm. [IFS (Mains) AG 2015: 8 marks]

9 - A stream of 150 litres/second was diverted from a canal and 6000 litres/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 litres/second for 3 hours. The depth of water penetration varies lineraly 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.

[IFS (Mains) AG 2015: 10 marks]

10- The following data were obtained in determining the soil moisture content at successive depth in the root zone prior to applying irrigation water:

[IFS (Mains) AG 2015: 10 marks]

Depth of sampling (in cm)	Weight of moist soil sample (in g)	Oven-dry weight of soil sample (in g)
0-25	135	127
25-50	137	128
50-75	123	115
75-100	111	102

The bulk density of the soil in the root zone was 1.5 g/cm^3. The available holding capacity of soil was 17.8 cm/m depth. Determine the-

(i) Moisture content at the different depths in the root zone:

(ii) Moisture content in the root zone at the time of irrigation:

(iii) Net depth of water to be applied to bring moisture content to field capacity;

(iv) Gross irrigation requirement at estimated field irrigation efficiency of 70%.

11- What do you mean by irrigation efficiency? Determine the water use efficiency from the following data: [IFS (Mains) AG 2014: 8 marks]

No. of treatment	Depth of water applied, cm	Effective rainfall, cm	Soil water used, cm	Seed yield, kg/ha
1	4	3.5	2.5	1225
2	6	3.5	2.3	1320
3	8	3.5	2.1	1440
4	10	3.5	1.9	1450

12- What do you mean by irrigation efficiency? What is the importance of it? A stream of 150 l/s was diverted from a canal and 120 l/s was delivered to a wheat field of 1.75 ha. The irrigation continued for 7.5 hours. The effective root zone depth was 1.8 m. The runoff loss in the field was 450 m^3. The depth of water penetrated linearly from 1.8 m at the head end to 1.2 m at the tail end. The moisture holding capacity of the soil is 25 cm/depth of soil. Irrigation was given at 50% depletion of available soil moisture. Determine the water conveyance efficiency and application efficiency.

[IFS (Mains) AG 2014: 10 marks]

13- A pre-fabricated concrete channel section used for lining irrigation channel has the following specifications: [IFS (Mains) AG 2013:10 marks]

Bottom width = 17.5

Top width = 20 cm

Height = 17.5 cm

Calculate the carrying capacity of the section when the channel slope is 0.25%. Take Manning's n = 0.06

14- Explain Franci's formula and compute the discharge of rectangular weirs 45 cm long with a head of 12 cm, under following conditions:

[IFS (Mains) AG 2013:5 marks]

(i) With no end-contractions

(ii) With two end-contractions.

15- Discharge of a tube well is 40 lit/sec. It irrigates 1.2 ha area in 16 hrs. Water is available at the plot at the rate of 35 lit/sec. The depth of root zone of crop is 1.2 m and loss of water in the plot is 150 m^3. Water holding capacity of the soil is 20 cm/m. 50% of available moisture was available in the plot before irrigation. Calculate water conveyance, water application and water storage efficiency. [IFS (Mains) AG 2012:10 marks]

16- An earthen channel is laid on a grade of 0.15% with bottom width of 60 cm and side slope 1:1. The depth of flow of water is 1.2 m. Calculate the velocity of flow and carrying capacity of channel assuming Manning's roughness coefficient as 0.04. [IFS (Mains) AG 2012:10 marks]

17- Water from a tube well is flowing over a rectangular weir. The width of crest of the weir is 120 cm and depth of water flowing over the crest is 36 cm. The stream of water is diverted into a field of 1 ha. The depth of irrigation is 7.5 cm. Calculate the time required to irrigate the field.

[IFS (Mains) AG 2012:10 marks]

18- Discuss briefly about water conveyance, water application, water storage, water distribution and water use efficiency. [IFS (Mains) AG 2011:10 marks]

19-An undisturbed soil sample was taken with core sampler from a field 36 hrs after irrigation when the moisture was at field capacity. The core sampler was

7.5 cm in diameter and 15 cm deep. The weight of the sampler with moist soil was 2.52 kg and weight of oven dry soil was 2.34 kg. The weight of core sampler was 1.34 kg. What is the available moisture holding capacity?

[IFS (Mains) AG 2011:10 marks]

20- The following data were obtained in determining the soil moisture content at successive depths in the root zone prior to applying irrigation water:

[IFS (Mains) AG 2011:10 marks]

Depth of sampling, cm	Wt. of moist soil sample, gm	Oven dry weight of soil sample, gm
0-25	135	127
25-50	137	128
50-75	123	115
75-100	111	102

The bulk density of the soil in the root zone was 1.50 gm/cm^3. The available moisture holding capacity of soil was 17.8 cm/m depth. Determine

(i) The moisture content at the different depths in the root zone

(ii) Moisture content in the root zone at the time of irrigation

(iii) Net depth of water to be applied to bring moisture content to field capacity.

(iv) Gross irrigation requirement at estimated field irrigation efficiency of 70 percent.

21- Irrigation was given to bring the soil in field capacity. Determine the field capacity of the soil from the following data: [IFS (Mains) AG 2010:10 marks]

Root zone depth = 1.5 m

Moisture content in the soil = 7.5%

Dry density of the soil = 7.5%

Water applied to soil = 50 m^3

Water lost due to evaporation, etc = 15%

Area of plot = 100 m^2

22- A stream of 150 lit/sec was diverted from a canal and 120 lit/sec was delivered to a wheat field of 1.75 ha. The irrigation continued for 7.5 hours. The effective root zone depth was 1.8 m. The run-off loss in the field was 450 m^3. The depth of water penetrated linearly from 1.8 m at the head end to 1.2 m at the tail end. The moisture holding capacity of the soil is 25 cm/m depth of soil. Irrigation was given at 50% depletion of available soil moisture. Determine the (i) water conveyance efficiency, (ii) water application efficiency, (iii) water storage efficiency, and (iv) water distribution.

[IFS (Mains) AG 2010:20 marks]

23- An irrigation stream of 24 litres per second is diverted to a check basin of size 10 m × 8 m. The water holding capacity of the soil is 13%. The average soil moisture content in the crop root zone prior to applying water is 6%. How long should the irrigation stream be applied to the basin to replenish the root zone moisture to its field capacity, assuming no loss due to percolation? The average depth of crop root zone is 1.2 m. The apparent specific gravity of the root zone soil may be assumed to be an appropriate value.

[IFS (Mains) AG 2009:10 marks]

24- Differentiate the following: [IFS (Mains) AG 2009:4 marks]

(i) Unsteady flow and Steady flow

(ii) Uniform flow and Non-uniform flow

25- Mention four types of irrigation efficiency with expressions to calculate each.

[IFS (Mains) AG 2007: 10 marks]

26- An irrigation stream of 30 litres per second is diverted to a check basin of size 12 m × 10 m. The water holding capacity of the soil is 15%. The average soil moisture content in the root zone prior to applying water is 7%. How long should the irrigation stream be applied in the basin to replenish root zone moisture to its field capacity, assuming no loss, due to deep percolation? The

depth of root zone may be assumed 1.0 m. The apparent specific gravity of the soil is 1.5. [IFS (Mains) AG 2007: 10 marks]

27- Potato with 60 cm effective root zone depth is grown in a soil with field capacity and permanent wilting point of 22 and 8% respectively. Irrigation is applied after 40% depletion of the available moisture. Apparent sp.Gr.Of soil 1.60. Calculate the depth of irrigation required if a pump delivers 10 lit/s discharge, how much time it will take for the irrigation of 1.0 ha assuming no loss of water? [IFS (Mains) AG 2006: 10 marks]

28- Explain different types of irrigation efficiencies used to evaluate irrigation water management practices. [IFS (Mains) AG 2005: 10 marks]

29- Determine the depth of irrigation water which would change 50 cm depth of loam soil into saline condition, if EC of irrigation water is 1 millimhos/cm. The bulk density of soil is 1.3 gm/cm^3, the density of water is 1 cm/cm^3 and saturation percentage of soil is 40. [IFS (Mains) AG 2002: 05 marks]

30- A sprinkler irrigation system is to be designed to irrigate to 10 hectares of vegetable crops in deep silt loam soil in moderate dry climate. The field is flat. Determine the limiting rate of application, the irrigation period, the net depth of water per application, the depth of water pumped for application and the required system capacity in hectare centimeters per day. Assume system operation 14 hours each day and determine pump capacity, limiting application rate is 1.3 cm/hr, moisture holding capacity of soil may be taken as 9.5 cm/m depth. The root zone depth is 60 cm, peak rate of moisture used by crop is 5 mm/day and water application efficiency is 75%.

[IFS (Mains) AG 2002: 15 marks]

31- Maize is growth in a soil having field capacity of 25% and apparent specific gravity of 1.60. Before irrigation, 4 moisture samples were collected upto the root zone depth of 1.20m at equal interval and the following data were

obtained. Determine the depth of irrigation required. Soil Depth, cm 0 – 30, 30 – 60, 60 – 90 , 90 – 120 Wet weight, gm 98.0, 110.0, 116.0, 118.0 Dry weight, gm 84.0, 93.4, 96.6, 99.8 [IFS (Mains) AG 2001: 10 marks]