UNIT 1 - INTRODUCTION

PART - A (2 marks)

1. Define irrigation.
   Irrigation is defined as the science of artificial application of water to
   the land in accordance with the crop requirements.

2. What is the necessity of irrigation?
   1. Inadequate rainfall
   2. Increasing yield of crops
   3. Growing perennial crops
   4. Uneven distribution of rainfall.

3. What are the advantages of irrigation?
   1. Increase in food production
   2. Optimum benefits
   3. General prosperity
   4. Afforestation.

4. What are the disadvantages of irrigation?
   1. Over irrigation may lead to water logging
   2. It may reduce crop yield
   3. It is expensive and complex.

5. What are the types of irrigation?
   1. Surface irrigation
   2. Sub-surface irrigation.

6. What are the techniques of water distribution in the farms?
   1. Free flooding
   2. Border flooding
   3. Check flooding

7. What are the types of sprinkler system?
   1. Permanent system
   2. Semi-permanent system
   3. Portable system

8. What are the advantages of sprinkler irrigation?
   1. Land levelling is not required
   2. Fertilisers can be uniformly applied
   3. It is less labour oriented

9. What are the limitations of sprinkler irrigation?

(AUC Apr/May 2011)
(AUC Apr/May 2011)
(AUC Apr/May 2012)
(AUC Apr/May 2012)
(AUC Apr/May 2010)
(AUC Apr/May 2010)
(AUC Apr/May 2009)
(AUC Apr/May 2009)
(AUC Nov/Dec 2011)
1. Initial cost of the system is very high
2. It requires larger electrical power
3. High wind may distort sprinkler pattern

10. What is arid region? (AUC Nov/Dec 2011)

The area where irrigation is must for agriculture is called arid region

11. What is semi-arid region? (AUC Nov/Dec 2011)

The area in which inferior crops can be grown without irrigation

12. What is crop period? (AUC Nov/Dec 2013)

The time period that elapses from the instant of its sowing to the instant of its harvesting is called crop period.

13. What is base period?

The time between the first watering of a crop at the time of its sowing to its last watering before harvesting is called the base period.

14. What is rotation period?

The time interval between two such consecutive watering is called frequency irrigation.

15. Define duty of water?

It is the relationship between the volume of water and the area of crops it matures called duty of water.

16. Define delta of a crop?

Each crop requires a certain amount of water after a certain fixed interval of time, through its period of growth is called delta of a crop.

17. What are the factors on which duty depends?

1. Type of crop
2. Climate and seasons
3. Useful rainfall
4. Type of soil
5. Efficiency of cultivation method

18. What are kharif crops?

The kharif crops are rice, bajra, jawar, maize, cotton, tobacco, groundnut, etc.

19. What are rabbi crops?

Rabi crops are wheat, barley, gram, linseed, mustard, potatoes, etc.

20. Define irrigation efficiency?

It is the efficiency of water output to the water input, and is usually expressed as percentage.

21. What is called effective rainfall?

Precipitation falling during the growing period of a crop that is available to meet the evapo-transpiration needs of the crop, is called effective rainfall.

22. What is mode of irrigation?

1. The rainfall is insufficient for the maturity of crops
2. The rainfall is unevenly distributed over the base period
3. A controlled distribution system is required
4. It’s cools soil and the atmosphere
5. It’s dilute sautés in the soil
6. It reduces soil pipin
PART - B (16 marks)

1. Explain the necessity of irrigation in India.  (AUC Apr/May 2011) (AUC Apr/May 2010)

1. India is a tropical country with a diversity of climate, topography and vegetation.
2. And then mainly rainfall in India, varies considerably in its place of occurrence as well as in its amount. Even at a particular place, the rainfall is highly erratic and irregular, as its occur only during a few particular months of the year.
3. Crops cannot, therefore be raised successfully, over the entire land without providing artificial irrigation of fields.
4. More than 70% to 80% directly depends on agriculture and remaining indirectly on agriculture.
5. Out of a total geographical area of about 328 million hectares, about 184 million hectares is the cultivable area.
6. To ensure the full growth of crops, it is necessary to provide adequate artificial irrigation facilities.
7. In Indian government is trying hard and spending enormously to provide irrigation facilities for the entire cultivable land.
8. The average annual rainfall for India has been estimated at 1,143mm varies from 11,489mm around in Assam (the maximum one-day rainfall equal to 1040mm).
9. 75% and 90% of the annual rain fall occurs during 25 to 60 rainy days of the months from June to September.
10. Increasing the utilisable component of the country water resources.
11. Solving the problems of shortages and excesses of water in some parts of the country.
12. The export of agricultural products earns a major part of foreign exchange. Our country exports basmati, rice, cotton, fruits, mango, apple, grapes, banana, etc. vegetables (potato, tomato ,etc) flowers (rose etc)
13. Increasing our country export and then developing the country (traffic).

<table>
<thead>
<tr>
<th>Region</th>
<th>Recurrence of the period of deficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assam</td>
<td>Very rare, once in 15 years</td>
</tr>
<tr>
<td>West Bengal, Madhya, Pradesh, konkan</td>
<td>Once in 5 years</td>
</tr>
<tr>
<td>Karnataka, Eastern Uttar Pradesh</td>
<td>Once in 4 years</td>
</tr>
<tr>
<td>Tamil Nadu, Kashmir, Telengana, Western Rajasthan</td>
<td>Once in 2 1/2 years</td>
</tr>
</tbody>
</table>

2. Explain the advantages and disadvantages of irrigation. (AUC Apr/May 2010)

Merits of irrigation:
1. Increase in food production
2. Optimum benefits
3. Elimination of mixed cropping
4. General prosperity
5. Generation of hydro-electric power
6. Domestic water supply
7. Facilities of communication
8. Inland navigation
9. A forestation

Demerits of irrigation
1. Given rise to disease Lila malaria
2. Excessive seepage causes water-logging
3. The climate becomes cooler and makes the locality damping resulting ill-health in the public.

4.  
1) Increase in food production:  
   Irrigation helps in increasing crop yields and hence, to attain self-sufficiency in food.
2) Optimum benefits:  
   i. Optimum utilization of water is made possible by irrigation
   ii. Its obtaining maximum crop yield with required amount of water
   iii. The yield will be smaller for any quantity lesser than or in excess of this optimum quantity.
3) Elimination of mixed cropping:  
   By mixed cropping, its mean souring together of two (or) more crops in the same field. Mixed-cropping is thus found necessary and also economical when irrigation facilities are locking and especially during periods of crash programmers in under-developed countries. During the time of harvesting, the crops get intermixed with each other, reducing the purity of each other.
4) General prosperity:  
   Revenue returns with well developed irrigation, are sometimes quite, high, and helps all around development of the country. And prosperity of the entire nation and community.
5) Genet ration of hydro-electric power:  
   Cheaper power generation can be obtained from water development the projects, designed for irrigation alone canal outlets from dam and canal falls on irrigation canals can be used power genet ration. (EX) ganges - sarda canvas, constructed for irrigation, are generating hydro-electric powder as a side product, up to about 80,000 kw.
6) Domestic water supply:  
   Development of irrigation facilities in an area helps is the water supply in near by villages and towns, when sources of water available. Its also helps in providing drinking water for animals, and water for swimming, bathing etc.
7) Facilities of communications:  
   i) irrigation channels are generally provided with embankments and inspection roads.
   ii) The inspection paths provide good road ways to the villagers for walking cycling (or) sometimes even for motoring.
8) Inland navigation:  
   Sometimes, larger irrigation canals can be used and developed for navigation purposes
9) Aorestation:

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Trees are generally grown along the banks of the channels which increase the timber wealth of the country and also help in reducing and erosion and air pollution.

Disadvantages:

i) Irrigation may result in colder and damper climate, resulting is land and breeding of mosquitoes, causing outbreak of diseases like malaria (or) denga.

ii) Over-irrigation may lead to water logging and reduces crop yields.

iii) Supplying irrigation water is complex and expensive in itself. Cheaper water has to be provided at the cost of the government which reduces revenue returns.

3. What is meant by irrigation efficiency? List various efficiencies under which irrigation performance is evaluated. Discuss about each one and mention how it could be improved.

(AUC April/May 2011) (AUC Nov/Dec 2009)

Irrigation efficiency:

i) Efficiency is the ratio of the water output to the water input. Efficiency = water output / water input %
   It's expressed as percentage.

ii) Input-output=losses

iii) Losses are more, output is less and the efficiency is lays.

iv) Efficiency is inversely proportional to the losses.
   Water is cost in irrigation during various process and various kind of irrigation efficiency.

1: Efficiency of water conveyance: (ηv)

i) Its ratio of the water delivered in to fields from the outlet of the channel, to the water entering into the starting point channel.

ii) It may be represented by (nc) it takes the conveyance (or) transmit losses into considered

\[ \eta_v = \frac{W_c}{W_f} \times 100 \]

\( W_f \) = water conveyance efficiency

\( W_c \) = water delivered to the farm or irrigation plot

\( W_s \) = water supplied or delivered from the river or reservoir

2: Efficiency & water – application: (ηa)

It's the ratio of the quantity & water stored into the root zone of the crops to the quantity of water actually delivered into the field. Its represented by ηa. Its also farm efficiency etc. Its considered the water lost in the form
ηa=the quantity of water stored into root the crop/the quantity of water delivered into the fields.

3. Efficiency of water-storage: (ηs)
   It is the ratio of the water stored in the root zone during irrigation to the water needed in the root zone prior to irrigation. Its may be represented by (ηs)
   ηs=water stored is the root zone during irrigation/ water needed in the root zone.

4) Efficiency of water use:
   It is ratio of the water beneficially used, including leaching water, to the quantity of water required. Its may be represented (ηu)
   ηu=water beneficially used in the field crop / the quality to water delivered

4. Explain the Duty of water and Relation between duty and delta. (AUC Nov/Dec 2009)

Duty:
"The duty" water is the relationship between the volume of water and the area of the crop it matures. It's defined as a number of heat over of land irrigated for full growth of a given crop by supply of 1m³/sec of water continuously during the entire base period (B) of the crop.

• The duty of water is the relationship between the volume of water and the area of the crop it matures.
  1. Its defined as the number of hectares of land irrigated for full growth of a given crop by supply 1 m³/sec of water continuously during the entire base period (B) the crop
  2. Its water flowing at rate of one cubic metre (m³) per second, runs for 3 days its generally represented by (D).

Relation between duty and delta:
Let there be a crop of base period 3 days. Let one cumes of water be applied to this crop on the field for 3 days

\[ v = (1 \times 60 \times 60 \times 24 \times B) \text{ m}^3 \]
\[ = 84000 B \text{ m}^3 \]

By definition of duty (D), one meter applied for B days matures D haitares & land.
The quantity of water (V) matures D haitares of land \((10^4 \text{ D sqm of area})\)
Total depth of water applied on this land,
\[ \alpha = \text{volume/area} \]
\[ = 84,000B/10^4 \text{ D}=8.64B/D \text{ m} \]
Total depth of water is called delta (Δ)
\[ \Delta = 8.64B/D \text{ m} \]
\[ \Delta = 864B/D \text{ cm} \]
5. Explain the factors affecting on the duty in detail. (AUC Apr/May 2010)

Factor affecting duty:
1. Type of crop
2. Climate and season
3. Useful rainfall
4. Type of soil
5. Efficiency of cultivation method

Type of crop:
   i. The different crops require different amount of crops, and hence duties for them are different
   ii. A crop requiring more water will have less flourishing average for the same supply of water as compared to that requiring less water.
   iii. The duty will be less for a crop requiring more water and vice versa.

Climate and season:
   i. Duty includes the water lost in evaporation and percolation.
   ii. These loss vary will vary with the reason.
   iii. Duty varies from season to season, and also from time to time is the same season the average values considered over the entire crop period.

Use rainfall:
   1. if some of the rain, falling directly over the irrigated land, is useful for the growth of the crop, then so much less irrigation waters will be required to nourish the crop.

Types of soil:
   2. if the permeability of soil under the irrigated crop is high the water lost due to percolation will be more and hence, the duty will be less. For sandy soils, the permeability will be more the duty of water is less.

Efficiency of cultivation method:
   3. The cultivation method is faulty and less efficient, resulting in the wastage of water; the duty of will less.

6. Explain the Importance of duty and the methods of improving duty of water: (AUC Nov/Dec 2011)

Importance of duty:
4. Its helps use in designing efficient control system.
5. Knocking the total available water at the head of a main control, and then overall duty for the crops required to irrigated in different season for the year, the area which can be irrigated can be worked out.
6. The average value of duties for certain important minds crops are tabulated.

Measures for improving duty of water:
1. The duty of control water can certainly to improve by efficiently economy in the use of water by restoring to the following precautions and particules.

Precautions in field preparation and sowing:
   i) the land to be used for cultivation method should as far as possible be leveled.
   ii) The field should be properly ploughed to required depth.
ii) Improved modern cultivation methods may preferably be adopted.
iv) Process soil should be treated before sowing crops to reduce seepage of water.
v) Alkaline soil should be properly reached before sowing.
vii) Manure fertilizers should be added to increase water holding capacity of the soil.
vi) Rotations of crops should be preferred, as this will ensure increased crop yields with minimum use of water.

Precautions in handling irrigation supplies:

i) The sources of irrigation water should be situated within the prescribed limits and should be capable of delivering sufficient the quantity of irrigation water.
ii) Canals carrying irrigation supplies should be lined to reduce seepage and evaporation and reducing on field requirement of water and consequently improving the duty of water.
iii) R.c.c pipes be used for the same to reduce on field requirement of water and improving duty.
iv) Sub-surface irrigation and drip irrigation may be preferred to ordinary surface irrigation.
v) The two canals running side by side may be preferred to a single canal, it will reducing percolation losses.
vi) Irrigation supplies should be economically used by proper control on its disturbing and then volumetric assessment.

<table>
<thead>
<tr>
<th>Crop</th>
<th>Duty in hectares/coma</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Sugar cane</td>
<td>730</td>
</tr>
<tr>
<td>ii) Rice</td>
<td>775</td>
</tr>
<tr>
<td>iii) Other kharif</td>
<td>1500</td>
</tr>
<tr>
<td>iv) Perennials</td>
<td>1100</td>
</tr>
<tr>
<td>v) Rabi</td>
<td>1600</td>
</tr>
<tr>
<td>vi) Hot fodder</td>
<td>2000</td>
</tr>
</tbody>
</table>

7. Explain the various of the Crop seasons and Indian Agriculture. (AUC Nov/Dec 2008)

Crop and crop reasons:
Crop period is the time, in days that a crop takes from the instant of its sowing to that of its harvesting. Crop seasons are,
1. Kharif crops season, (summer crops)
2. Rabi crops season (winter crops)
3. Monsoon season.
4. Cut winter season
5. Spring season

Crop seasons and Indian Agriculture:

i) More than 70% of the Indian population is directly (or) indirectly connected with agriculture.
ii) The chief crop of India are rice, wheat, sugarcane, tea, cotton, ground nut, jute, coffee, rubber, garden crops.
iii) Heavy retentive soil (40% clay) is favourable for raising crops like sugarcane, rice, requirement more water.
iv) Light sandy soil (2 to 8%) is suitable for crops like gram, folder. It’s requiring less water.
v) Medium (or) normal soil (10 to 20%) is suitable for crops like wheat, cotton, maize, vegetables, oil seeds, requiring normal of water.
vi) The agricultural point of view, they your can be divide in two principal cropping seasons,
vii) Rabi-1st October and 31st March
viii) Kharif-1st April and 30th Sept
ix) Kharif crops-rice, bajra, jowar, maize, cotton, tobacco, groundnut (summer crops)

Rabi crops as “winter crops” kharif crops require about two to three the quantity of water required by rabi crops.
In north India it's to be classified in to extra cut winter, spring, summer and autumn seasons. Mainly other country to be classified
1) Hot weather (or) kharif season
2) Monsoon season
3) Winter (or) rabi season

<table>
<thead>
<tr>
<th>No</th>
<th>Crops</th>
<th>Period of growth</th>
<th>Average &amp; water depth required(cm)</th>
<th>Average quantity of seed required in (kg/h)</th>
<th>Average quantity of yield obtained in</th>
<th>Kg/hectare</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Wheat</td>
<td>Out to march-april</td>
<td>37.5</td>
<td>80-100</td>
<td>1500</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>High yielding wheat</td>
<td>Out to march-april</td>
<td>45</td>
<td>100-125</td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Gram</td>
<td>Sep-out to march</td>
<td>30</td>
<td>12.5</td>
<td>3500</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Barley</td>
<td>Out to mar-april</td>
<td>30</td>
<td>120</td>
<td>1300</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Potatoes</td>
<td>Sept-out to feb</td>
<td>60-90</td>
<td>15000</td>
<td>35000</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Tobacco</td>
<td>Out – feb to feb-may</td>
<td>60</td>
<td>-</td>
<td>4500</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Mustard</td>
<td>Outto feb-march</td>
<td>45</td>
<td>33</td>
<td>1000 to 1600</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Over-lapping crop but it's classified rabi</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>
2. Bajra or (peral millets high yielding) July to nov 30 3.75 to 6 2000

3. Ground-nut May to nov-dec 45 100 -120 1600


5. Transplanted rice (paddy) July - nov 125–120 30 – 35 4500

6. Til July – Aug to Oct- Nov 1.25-3 350

8. Explain the Estimation or empirical of consumptive use:

**Consumptive use (or) Evapotranspiration:**

It's may be defined as the total amount of water used by the plants in transpiration and evaporation from adjacent soils, in any specified time. The value of consumptive use (Cu) may be different for different crops and may be different for the same crop at different times and places.

**Estimation of consumptive use:**

i) **Blaney – criddle equations:**
   - it’s states that the monthly consumptive use is given by,
   - \( Cu = k \times \frac{p}{40} \times (1.8t + 32) \)
   - \( K = \) crop factor; \( p = \) crop period
   - \( Cu = \) monthly in consumptive use (Cm)
   - \( Cu = k \times \sum f \times \frac{K_t}{2} \)
   - \( Cu = \) seasonal consumptive use

ii) **Hargreaves class A pan evaporation method:**
   - \( K = \) evapotranspiration(Et or Cu) / pan evaporation (Ep)
   - \( Et \) or \( Cu = k \times Ep \)
   - \( K = \) consumptive use efficiency(\( k \))

iii) **Penman’s equation:**
   - \( Et = A. H_n + B. \gamma \times \sqrt{A + \gamma} \)

iv) **Effective rainfall (Re) :**
   - Precipitation falling during the growing period of a crop that’s is available to meet the evapo-transpiration needs the crop is called effective rainfall

v) **Consumptive irrigation requirement (CIR)**

vi) **CIR = Cu-Re**

vii) **Net irrigation requirement (NIR)**
   - a. \( NIR = Cu-Re + \) water lost as percolation in satisfying other needs such as leaching.
   - b. **Transpiration ratio:**
     - i. \( T.R = \) Total mass of the water transpired by
9. Explain the Planning and Development of irrigation projects. (AUC Apr/May 2011)

- Planning of irrigation projects:
  1. Agricultural establishment capable & applying controlled amount of water to
     lands to produce crops are termed irrigation projects.
  2. These projects mainly consist of engineering structures which collect, convey,
     deliver, water to areas on which crops are grown.
  3. A small irrigation project may consist of a Low diversion weir or inexpensive
     pumping along with small ditches and some controlled structures.
  4. A large irrigation project includes a large storage reservoir, a huge dam,
     hundreds of kilometers of canals, braches, and distributaries, control
     structures and others works.

- The process of planning an irrigation project can be divided into the stages:
  i) Preliminary planning
  ii) Detailed planning
  iii) The decision of irrigation structures and canals.
  a. Preliminary planning- it's based on available information, are approximate, it's
     reference only.
  b. Detailed planning-based on preliminary planning, the detailed measurement are
     taken and the detailed plans are prepared detailed plans more accurate.
  c. The following are the main factors which must be determined accurately during
     the planning stage of an irrigation project:
       i. Type of project and general plan of irrigation works.
       ii. Location, extent and type of irrigable lands,
       iii. Irrigation requirement for crop production
       iv. Available water supplies for the project
       v. Irrigable areas which can be economically supplied with water
       vi. types and locations & necessary engineering works
       vii. needs for immediate and future drainage
       viii. feasibility of hydroelectric power development
       ix. cost of storage, irrigation, power and drainage
       x. evaluation of probable power, income
       xi. method of financing the project construction
       xii. desirable type of construction and development
       xiii. probable annual cost of water to the farmers
       xiv. Cost of land preparations and fram distribution system
xv. Cost of crop production and probable crop returns

- Development of irrigation project:
  a. A small irrigation project can be development in a short time farmers having land suitable for agriculture and water supply can plan own irrigation system, necessary finance from banks or other agencies and get irrigation works constructed without any delay.
  b. The development of a large irrigation project more complicated and time-consuming the time required for completion of a large project increase with size of the project.
  c. The principal stages of a large irrigation project
     i. Promotional stage
     ii. The planning stage
     iii. The construction stage
     iv. The settlement stage
  d. The planning stage itself consists of the three sub-stages:
     i. Preliminary planning
     ii. Detailed planning of water and land use.
     iii. The design of irrigation structures and canals.
  e. Engineering activities are needed during all stages (including operation maintenance) of the development of an irrigation project.
  f. A large irrigation project may take 10-30 years for completion depending upon the size of the project.

10. What do you understand the Crop rotation?

Crop rotation:
   i. This method of growing different crops in rotation, one after another in the same field is called ‘rotation of crops’. Crop rotation will that help in increasing the fertility of soil and reducing the diseases and wastaged due to in seeds and then increasing the overall crop yield
   ii. Wheat-juar-gram
   iii. Ripe-gram
   iv. Cotton-wheat-gram-fallow
   v. Cotton-juar-gram
   vi. Sugarcane (18 months)-wheat (or) gram-fallow (up to jely)

1. Cash crops:
   A crop crop defined as a which has to be ensheathed in the market for processing, its cannot be consumed directly by the cultivators. crops like tea, cotton, tobacco, sugarcane etc.

2. Crop ratio:
   The ratio of the area irrigated in rabi season to the area irrigated in kharif season
3. **Overlap allowance:**
   when a crop requires water for its crop season and also for some time
   in the beginning of the next crop season, allowance has to made for
   this overlap its overlap allowance.

4. **Factors affecting consumptive use of water:**
   a. Evaporation
   b. Transpiration
   c. Temperature
   d. Sunlight
   e. Humidity
   f. Wind movement.