

SUBJECT – IRRIGATION
ENGINEERING
BRANCH - CIVIL ENGG.
SEMESTER- 4th
UNIT-1 Introduction

LEARNING OBJECTIVES

- Explain concept of necessity of irrigation in India
- Recognise different crops and their water requirements
- Define rainfall and runoff
- Measure rainfall and read rain gauges and hydrographs
- Monitor construction and maintenance work of canal and canal linings
- Monitor installation of tubewells and water harvesting techniques
- Supervise maintenance and construction work of canal head works and cross regulators
- Supervise construction of various river training works
- Carry out desilting operation of canals

IRRIGATION:-

It is defined as the process of artificially supplying water to the soils for raising crops.

A crop requires a certain amount of water at some fixed interval throughout its period of growth.

If the water requirement of crop is met by natural rainfall during the growth period, there is no need of irrigation.

Advantages of Irrigation:-

1 Increase in food production

2 Optimum utilization of water for optimum benefits

General development of country

Elimination of mixed cropping

Generation of hydroelectric power

Domestic water supply Water for other purposes like swimming , washing ,bathing In land navigation

Facilities for transport

Major medium and minor irrigation projects

Major and Medium Irrigation Projects

2. Minor Irrigation Projects. Since 1951, major irrigation projects are those which cost about Rs.5 crores and more; medium projects between Rs.20 lakhs to Rs.5 crores, and minor irrigation projects costs Rs.20 lakhs or less. From 1978-79, Planning Commission has introduced a new classification for irrigation schemes, based on the area :

1. Major irrigation Projects are those with culturable command area (CCA) more than 10,000 hectares.
2. Medium irrigation Projects are those with CCA between 2,000 and 10,000 hectares,
3. Minor irrigation Projects are those with CCA upto 2,000 hectares.

Necessity of irrigation

- To make up for the soil moisture deficit.
- To ensure a proper sustained growth of crops.
- To make harvest safe.
- To colonize the cultivable wasteland for horizontal expansion of cultivation.
- To shift from seasonal cultivation.
- To promote more intensive cultivation by multiple cropping.
- To improve the level of agricultural productivity by acting as an agent for
- To adoption of modern technology.

Unit-2

RELATIONSHIP BETWEEN DUTY, DELTA AND BASE PERIOD :-

Let Δ be the depth of irrigation water required by a crop in cm

B be the base period in days d be the duty of water in ha/ cumec Then, The volume of water required per ha of cropped field = $\Delta \times 10000 = 100 \Delta \text{ m}^3$

The base period = B days = $B \times 24 \times 3600 = 86400 B$ seconds

The term duty explains that to irrigate d ha of land water is to be supplied at the rate of 1 cumec.

Therefore, To irrigate one ha the rate of flow required = $1/d$ cumec. The volume of water supplied @ $1/d$ cumec over B days = $86400 B/d \text{ m}^3$

Equating the volume required and supplied. we get, $100 \Delta = 86400 B/d$ i.e., $\Delta = 864 B/d$

Paleo: First watering of soil before crop is sown.

Kor:- watering: First watering which is given

WATER REQUIREMENTS FOR DIFFERENT CROPS:-

The term water requirements of a crop means the total quantity of all water and the way in which a crop requires water, from the time it is sown to the time it is harvested. The water requirement of a crop varies with the crop as well as with the place. The same crop may have different water requirements at different places of the same country; depending upon the climate, type of soil, method of cultivation and useful rainfall. For better understanding of crop water requirement, it is prudent to have knowledge of functions of irrigation water.

Factors affecting water requirement :

Type of soil

Temperature and wind

Rainfall and wind.

Type of Crop

Method of cultivation.

Water management to the crop

Crop Rotation:

Crop Rotation Growing different crops in rotation, one after the other, in the same field is called crop rotation. Same crop is grown again and again in the same field, the

fertility of land gets reduced as the soil becomes deficient in plant foods favorable to that particular crop. To enhance the fertility of land and to make the soil to regain its

original structure, it is necessary to give rest to the soil. Allow the land to lie fallow without any cultivation for some time or to grow crops which do not mainly require

these salts or foods which are mainly required by earlier grown crop. Wheat – Juar- Gram Rice – Gram Cotton – Wheat– Gram Cotton – Juar - Gram

Differences between Crop seasons – Kharif and Rabi

	Kharif	Rabi
Meaning	Kharif crops can be described as the crops which are sown with the beginning of the rainy season.	Rabi crops are the crops that are sown after the end of the monsoon, i.e. during the winter season.
Major Crops	Rice, maize, cotton, groundnut, jowar, bajra, etc.	Wheat, peas, gram, oilseeds, barley, etc.
Requirement	It requires huge amount of water and hot weather to grow.	It requires warm climate for seed germination and cold climate to grow
Flowering	Require shorter day length	Require longer day length
Sowing month	June - July	October - November
Harvesting month	September - October	March - April

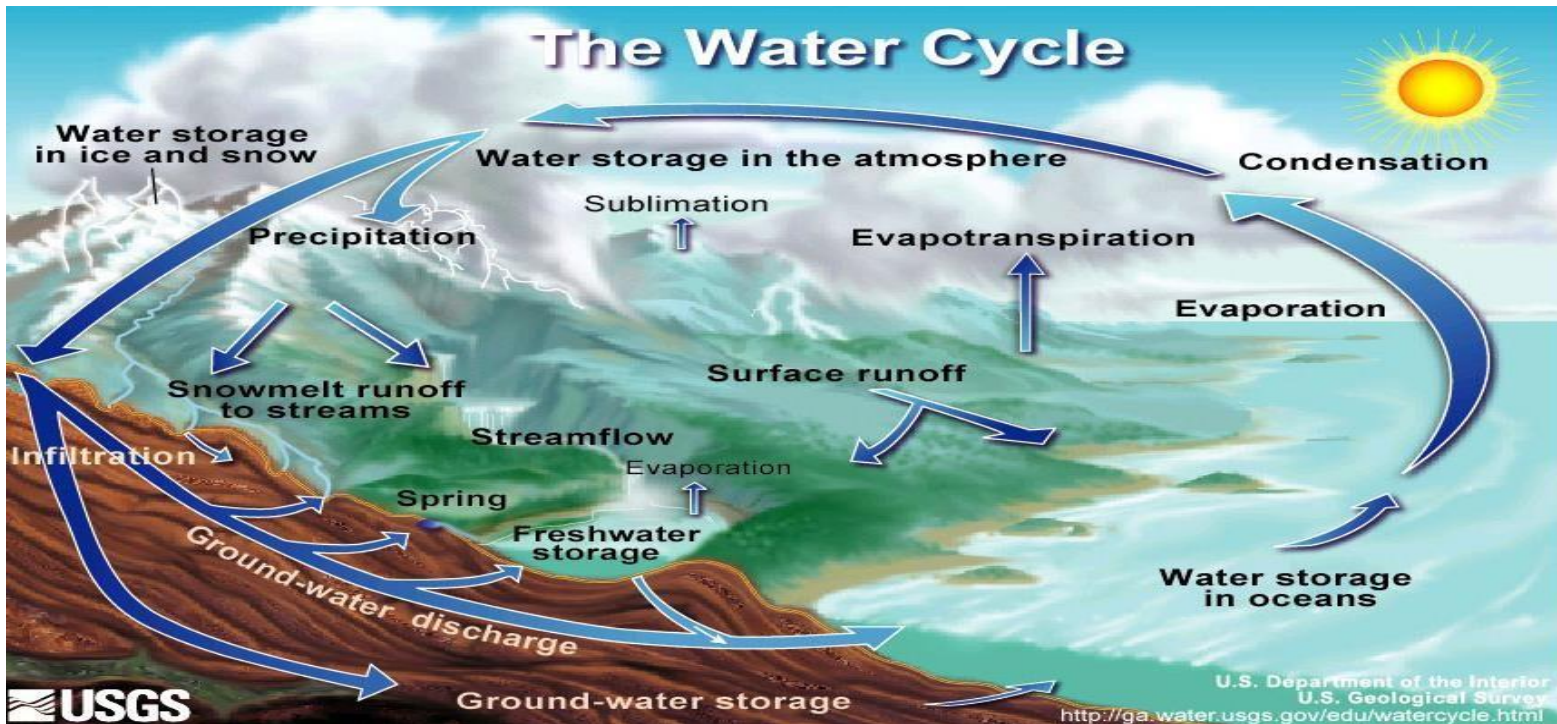
Unit - 3

Hydrological Cycle

The hydrologic cycle is composed of two phases, the first of which is the atmospheric phase, which describes water movement as gas (water vapor) and liquid/solid (rain and snow) in the atmosphere.

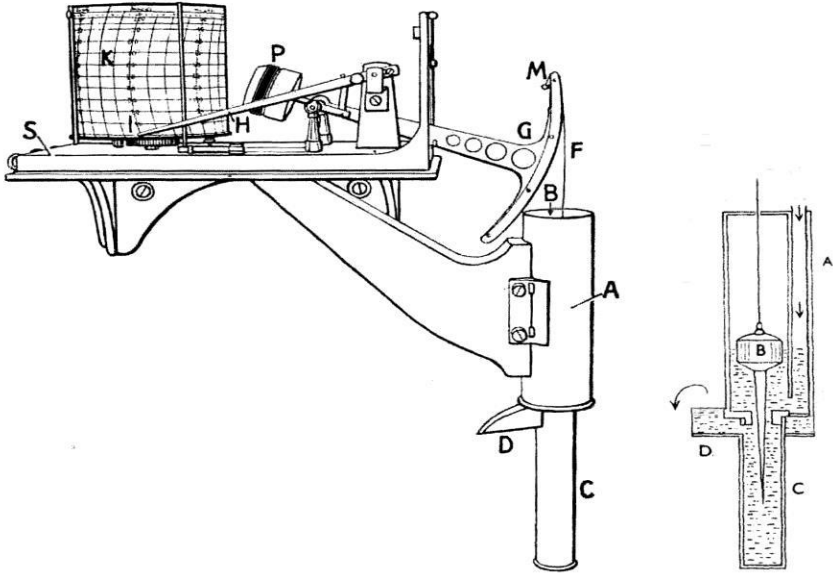
or

The water cycle describes the existence and movement of water on, in, and above the Earth. Earth's water is always in movement and is always changing states, from liquid to vapor to ice and back again. The water cycle has been working for billions of years and all life on Earth.



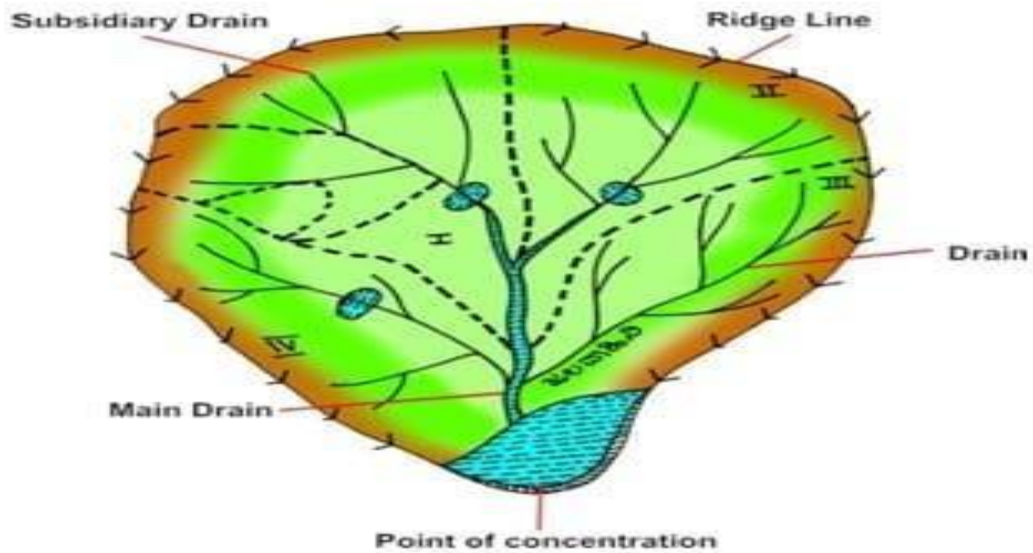
Rainfall water in the form of droplets that have condensed from atmospheric water vapor and then become heavy enough to fall under gravity. Rain is a major component of the water cycle

Rain-gauges:- is an instrument used to gather and measure the amount of liquid precipitation over a set period of time.



catchment are :- is an extent or an area of land where all surface water from rain, melting snow or ice converges to a single point at a lower elevation, usually the exit of the basin, where the waters join another body of water, such as a river, lake, reservoir, estuary, wetland, sea, or ocean.

WATERSHED



Runoff :-the quantity of water absorbed by the ground is called runoff.

Factors affecting runoff

Type of precipitation (rain, snow, etc.)

Rainfall intensity

Rainfall amount

Rainfall duration

Distribution of rainfall over the watersheds

Direction of storm movement

Antecedent precipitation and resulting soil moisture

Other meteorological and climatic conditions that affect evaporation, such as temperature, wind, relative humidity, and season.

Unit-4

Methods of Irrigation:- There are three principle

Methods of irrigation

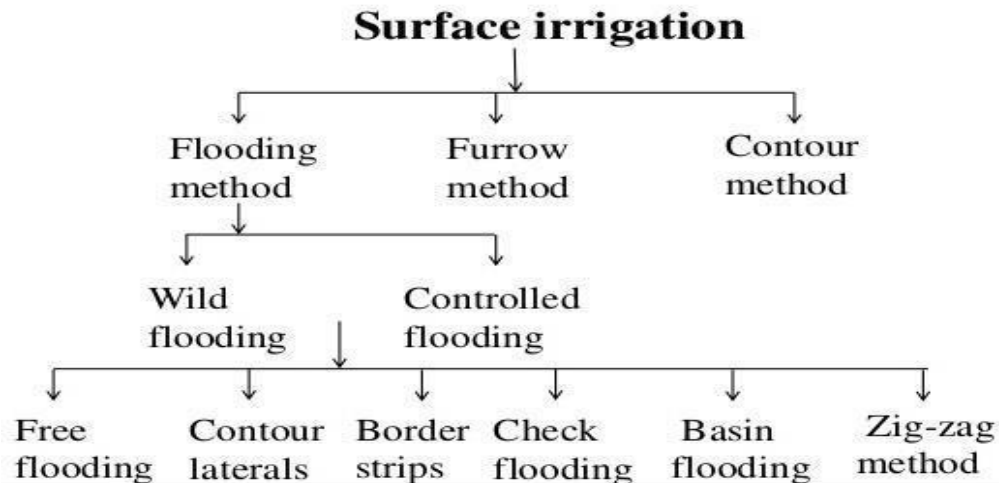
- Surface
- Sub surface
- sprinkler irrigation.

Surface irrigation:-There are 4 types under this method viz.

Wild flooding.

- Free Flooding
- Check Flooding
- Border Strip Method
- Basin method

➤ **Surface irrigation method.**



11. Wild Flood Irrigation Method:- This method is suitable where large quantity of water is available. Water is allowed to cover large areas during high floods so that area is completely saturated.

Free Flood Irrigation Method:-This method is quite popular in our country. The area to be irrigated is divided in to number of compartments. Water enters at the upper reach and flows towards the lower areas.



1 Check Flood Irrigation Method:-

This method of irrigation is popular in Punjab where it is known as Khal- Kiari system. Water from the source is fed in to a ditch from where it is fed in to a number of small compartments (kiari).

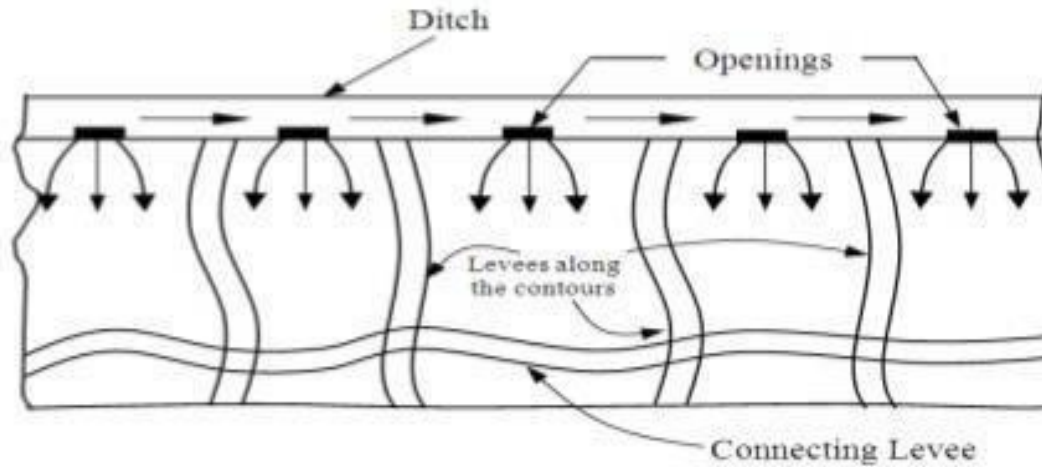


Fig: Check flooding (Plan view)

2.Border Strip method :- The area to be irrigated is

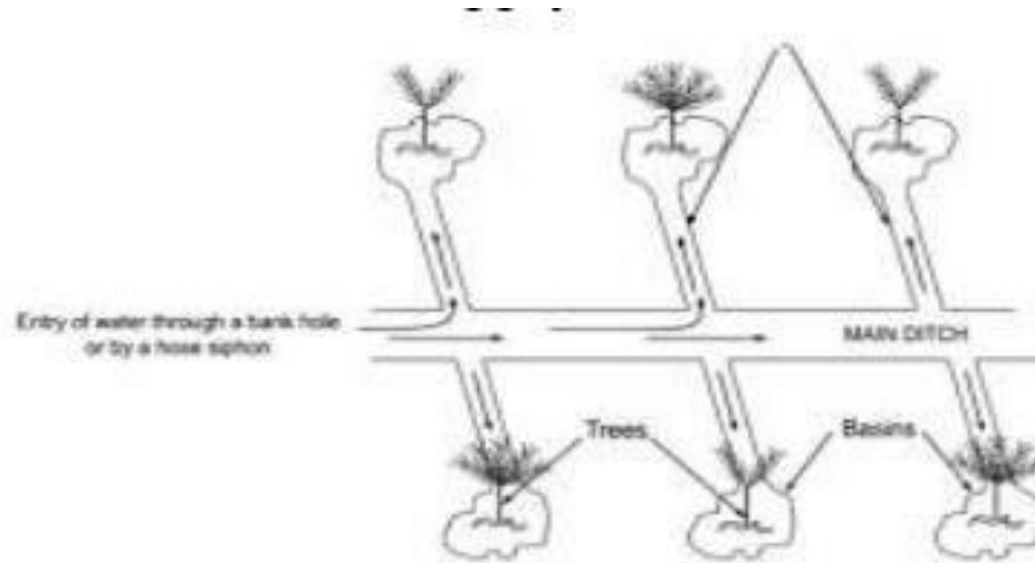
converted in to a number of smaller plots or strips which may be of 10*100m to 20*300m. Water is fed in to each strip in turn.



3. BASIN IRRIGATION:

This method is suitable for Orchids Or Fruit crop and other high value crops where the size of the plot to be irrigated is very small. One basin is constructed around each plant. Water is fed in to these basins from the field ditch referred to under check flooding method.

The basin may be square, rectangular or circular shape.



Furrow method (Ridges and Furrow, Broad ridges, Counter furrow):-

Row crops such as potatoes, cotton, sugarcane, vegetable etc. can be irrigated by furrow method.

Water is allowed to flow in furrow opened in crop rows. It is suitable for sloppy lands where the furrows are made along contours.

The length of furrow is determined mostly by soil permeability. It varies from 3 to 6 meters. In sandy and clay loams, the length is shorter than in clay and clay loams.



B. SUBSURFACE IRRIGATION :-

Subsurface irrigation or sub-irrigation may be natural or artificial. Natural sub surface irrigation is possible where an impervious layer or loose surface exists below the root. In artificial sub surface irrigation, perforated or porous pipes are laid out underground below the root zone and water is led into the pipes by suitable means. The method involves initial high cost, but maintenance is very cheap. It is very efficient in the use of water as evaporation is cut off almost completely. This method is adopted in the Israel country.

Sprinkler irrigation:- Sprinkler irrigation is a method of applying irrigation water which is similar to natural rainfall. Water is distributed through a system of pipes usually by pumping. It is then sprayed into the air through sprinklers so that it breaks up into small water drops which fall to the ground. The pump supply system, sprinklers and operating conditions must be designed to enable a uniform application of water. Components of sprinkler System Pressure generating unit (Pumps and booster pumps) Water carrier unit (Main and lateral pipe lines) Water delivery unit



Advantages of sprinkler irrigation:-

System losses (runoff, seepage) substantially reduced

Over irrigation is completely eliminated and uniformity of application is high.

Irrigation water requirement reduced as compared to other methods.

No land leveling required in the field and land use for productive purposes can be maximized. Fertilizer can be injected in the irrigation water to reach the root zone directly

The system allows better weed control

Limitations of sprinkler irrigation:-

Poor uniformity and application efficiency in high wind regimes and / or dry and hot conditions.

Capital cost is high with greater operational costs due to higher energy requirements.

Not suitable for paddy crops prone to diseases due to moist environment. Water with impurities and sediments may damage the system

Drip irrigation system :- Drip irrigation , also known as trickle irrigation or micro irrigation , is an irrigation method which saves water and fertilizer by allowing water to drip slowly to the roots of plants, either onto the soil surface or directly onto the root zone, through a network of valves, pipes, tubing, and emitters.



Advantages of drip irrigation:-

Minimized fertilizer/nutrient loss due to localized application and reduced leaching.

High water application efficiency.

Leveling of the field not necessary. Ability to irrigate irregular shaped fields.

Allows safe use of recycled water.

Moisture within the root zone can be maintained at field capacity.

Highly uniform distribution of water i.e., controlled by output of each nozzle.

Lower labour cost.

Variation in supply can be regulated by regulating the valves and drippers.

Foliage remains dry thus reducing the risk of disease.

Usually operated at lower pressure than other types of pressurized irrigation, reducing energy costs.

Limitations of drip irrigation:-

Expense. Initial cost can be more than overhead systems. Waste.

The sun can affect the tubes used for drip irrigation, shortening their usable life. Longevity is variable.

Clogging. If the water is not properly filtered and the equipment not properly maintained, it can result in clogging.

Drip irrigation might be unsatisfactory if herbicides or top dressed fertilizers need sprinkler irrigation for activation.

Drip tape causes extra cleanup costs after harvest. You'll need to plan for drip tape winding, disposal, recycling or reuse.

Waste of water, time & harvest, if not installed properly.

These systems require careful study of all the relevant factors like land topography, soil, water, crop and agro-climatic conditions, and suitability of drip irrigation system and its components.

Salinity. Most drip systems are designed for high efficiency, meaning little or no leaching fraction. Without sufficient leaching, salts applied with the irrigation water may build up in the root zone, usually at the edge of the wetting pattern.

On the other hand, drip irrigation avoids the high capillary potential of traditional surface-applied irrigation, which can draw salt deposits up from deposits below

Important Questions

SECTION -A

Important Questions in 1or 2 marks.

- A. TYPES OF IRRIGATION
- B. CASH CROPS
- C. DELTA
- D. CROP RATIO
- E. GROSS COMMAND
- F. TRANSPIRATION
- G. HYDROLOGICAL CYCLE
- H. UNIT HYDROGRAPH
- I. LIFT IRRIGATION
- J. FREE FLOODING
- K. CANAL LINING
- L. FREE BOARD
- M. AQUIFER
- N. YIELD OF WELL

SECTION -B

Important Questions in 4or 5 marks.

- Q.1- WHAT IS WATER LOGGING? WHAT ARE ITS CAUSES?
- Q.2- WHAT ARE RETIRING EMBANKMENT? WHAT ARE THEIR ADVANTAGES?
- Q.3- WHAT IS ESCAPE? WHAT ARE ITS FUCTIONS?
- Q.4- DEFINES LEVEL CROSSING WITH NEAT SKETCH.
- Q.5- WHAT POINT SHOULD BE KEPT IN MIND WHILE SELECTING THE SITE FOR CANAL HEAD WORKS?
- Q.6- WHAT ARE THE COMPONENTS OF REGULARTORY WORKS?
- Q.7- DIFFERENTIATES A WEIR AND BARRAGE?
- Q.8- WHAT ARE THE DESIGN PRINCIPLES OF EARTHEN DAM ?
- Q.9- SHORT NOTE- (A) WATER HARVESTING
(B) HYDRAULIC JUMP
- Q.10- DEFFRENCE BETWEEN CONFINED AND UNCONFINED AQUIFER?

SECTION - C

Important Questions in 8or 10marks.

- Q.1- DESCRIBES THE METHODS TO IMPROVE THE DUTY OF WATER?

Q.2- EXPLAINS VARIOUS TYPES OF CANALLININGS?

Q.3- DESCRIBES THE COMPONENT OF EARTHEN DAM WITH NEAT SKETCH?

Q.4- EXPLAINS THE LAUOUT AND FUNCTIONS OF DEFFERENT PART OF HEAD WORKS?

Q.5- WHAT IS AQUEDUCT? DISCUSS ITS VARIOUS TYPES IN BRIEF.

