

UNIT-I (Introduction)Hydrology :-

The word hydrology is derived from the Greek word hydro which means water and logos which means the science.

Thus

hydrology means the science of water.

It is the science which deals with the occurrence, circulation and distribution of water of earth's surface and earth's atmosphere.

Scientific hydrology — the study which is concerned with chiefly the scientific aspects.

Engg. or applied hydrology — with engg. applications.

Scope and Applications of hydrology to engineering problems.

Scope :-

- 1) Water is one of the most valuable resources essential for human and animal life, industries and agriculture.
- 2) It is also used for various purposes in power generation, navigation and fisheries.
- 3) The main importance given to the hydrology all over the world is to be used in the development and management of water resources for irrigation, water supply, flood control, hydro-power and navigation.

cloud formation.

Q. 3. What are the practical applications of hydrology ?

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Ans. Some of the practical applications of hydrology are briefly discussed below :

Design of hydraulic structures : The design of any structure related to water such as spillway, dam, culvert, highway bridge, rail bridge etc., may be considered to consist of three parts, hydrologic design, hydraulic design and structural design. Hydrologic design deals with the estimation of the quantities of water to be handled at the site of the structure, their time distribution, time of occurrence and frequency of occurrence hydraulic design provides the best suitable shape and section of the structure to cope with the waters estimated and the structural design ensures the stability and safety of the chosen section against the water pressure and other pressure. So hydrology plays an important role in the design of any structure.

Municipal and industrial water supply : The availability of water is often the most important factor in locating the major industries and it has considerable effect on the growth of municipalities. Hydrologists would answer such questions as whether the flow in the nearby stream is sufficient to meet the needs of the municipal city.

Irrigation : Provision of adequate storage facilities at the irrigation and other multipurpose projects either to irrigate the ayacut under the project or to meet the demands of other purposes is the essential part of the design. In arriving at the storage capacity of the reservoir the evaporation, seepage and other losses must be properly accounted for. This requires the information on the hydrological variables such as runoff, infiltration and evaporation. A large river basin is taken as a system and all the projects in the system are together optionally designed and operated to achieve the stipulated objectives.

Hydropower : Hydrologic studies are essential for the planning of any water power development. To determine the feasibility of the run-of-river plant operating with pondage, a reliable prediction is needed of the absolute minimum daily flow that may be expected in the stream and of the percentages of time that various other flows may be expected to exist. For storage plants, however, low seasonal flows rather than low daily flows are important. After commissioning, the storage plant is continuously faced with problems in the economics of operation. Whether the reservoir can be emptied boldly permitting the shut down of the other thermal plants in the grid resulting in fuel saving.

Flood control : Reservoirs, levees, channel improvements and channel diversions or a combination of them are the most commonly used flood control structures. Flood control problems are complicated because any type of flood control project modifies the natural regime of the stream and thus in the process of protecting one area it may increase the flood damage in another. Hence the technique of flood routing is essential to the intelligent and economic planning of flood control projects. Flood control measures will really become very effective where they are associated with

flood forecasts. The forecasts which are the joint work of the hydrologists and the meteorologists could be profitably utilised in planning the advanced evacuation of the threatened areas, in organising the stand-by crews for the emergency works on rail roads.

Navigation : Hydrologic problems in navigation projects require answers to such questions as how much water will be required for lock gates and to maintain minimum draft, where from this water can be obtained.

Erosion and sediment control : Excessive erosion in the catchment feeds sediment into the runoff. This leads to many undesirable effects. The reservoirs may lose their capacity at a faster rate reducing their economic life span drastically. Tons and tons of fertile top soil will be lost every year resulting in reduced crop yields. The problem of erosion control is mainly linked with the phenomena of overland flow and infiltration. Hydrology of the catchment alongwith the knowledge of the existing watershed management practices will help in finding out the effective erosion control measures suitable for the given soil conditions.

Pollution abatement : Indiscriminate disposal of sewage from cities and industries into the nearby streams, which has been general tendency, results in health hazards to the public and the destruction of the fish and other wild life. Complete prevention of river pollution is not economically feasible. As the stream is a natural water purification system, it is generally considered permissible to allow disposal of certain amount of sewage into streams. The purification in the stream is a result of bacterial action and aeration.

Drainage Basin And its characteristics :-

All rivers or streams receive a water supply and the area of the land this comes from is known as drainage basin or catchment area.

The boundaries of the basin are known as the watershed and will usually be marked by areas of higher land.

Drainage basin can be measured by dividing total length of all streams in a basin (L) by its area (A).

As the higher the den drainage density, the more quickly the water drains to a river.

A catchment area is separated from its neighbouring areas by a ridge called divide.

Drainage basins are an open system with inputs and outputs of water.

Component of drainage basins —

Various components are —
watershed —

watershed is the area of high land forming the edge of a river basin.

Source — source is that where a river begins.

Mouth — where river meets the sea.

Confluence — the point at which the two rivers meet.

Tributary — A small river or stream that joins a larger river.

channel — this is where the river flows.

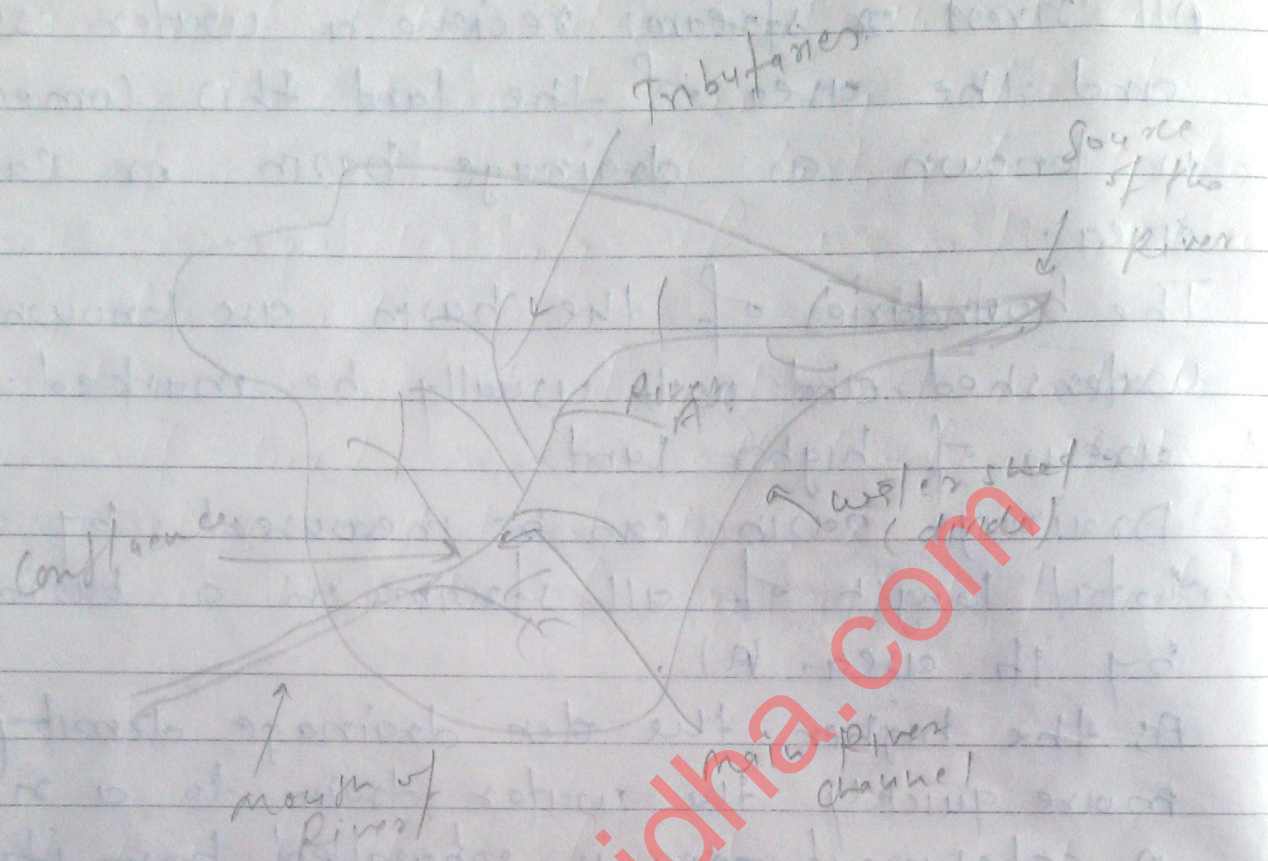


fig — Drainage basin

Characteristics:

Drainage basin has many different characteristics that influence how quickly or slowly and easily a main river drains with in respond to a period of intense rainfall, these are —

- * Inputs — in the form of precipitation.
- * Outputs —
 - water is lost through evapo-transpiration.
- * Within the system, some of the water —
 - a) is stored in water storage such as lakes or soil.
 - b) passes through a series of transfer or flow e.g. infiltration and through flow.

Input - Precipitation (rains, snow or hail etc)

Type of T/P are - snow, rains, or hail etc

PAGE NO:

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Factor affecting the amount of water in the system -

- * The intensity
- * the duration
- * the frequency.

Output -

- * final release of the water in a drainage basin
- * Flow into the sea will be the main out of a drainage basin.
- * Some water will be lost via -
Evaporation/Transpiration.

- a) Evaporation from water bodies and soils
- b) Transpiration from plants.

Hydrological Cycle or Water Cycle.

Water exists on the earth in all its three states viz- liquid, solid and gaseous and in various degrees of motion.

The hydrologic cycle also known as water cycle describes the continuous movement of water on above and below the surface of earth.

The hydrologic cycle has no beginning and end as the water in nature continuously kept in cyclic motion.

Thus,

The water moves from river to ocean, or from ocean to the atmosphere by the process of evaporation, condensation, precipitation, infiltration, runoff and sub surface flow is known as hydrologic cycle.

The hydrologic cycle or water cycle consists of.

- 1) Evaporation / Transpiration
- 2) Condensation
- 3) Precipitation
- 4) Run-off.

Numerical :-

A small Catchment area 150 hectares received a 10.5 cm rainfall in 90 minutes due to a storm. At the outlet of the Catchment, the stream draining the Catchment was dry before storm and experienced a run-off lasting for 10 hours with average discharge of $1.5 \text{ m}^3/\text{s}$. It went dry afterwards.

- What is the amount of water not available to run-off due to combined effect of infiltration, evaporation and transpiration?
- What is the ratio of run-off to precipitation?

Solⁿ :-

Let L is the loss of water i.e. water not available to run-off due to infiltration, evaporation and precipitation.

The water budget eqⁿ for the Catchment area in a time t is

$$R = P - L$$

We know that the rainfall occurred in the first 90 minutes and the rest 8.5 hours the precipitation was zero.

$$\begin{aligned} a) \quad P &= I/P \text{ due to precipitation for in 10 hours} \\ &= 150 \times 100 \times 100 \times (10.5/100) = 157,500 \text{ m}^3 \\ R &= \text{Run-off volume} = \text{outflow volume at the} \\ &\quad \text{Catchment outlet in 10 hours} \\ &= 1.5 \times 10 \times 60 \times 60 = 54,000 \text{ m}^3 \end{aligned}$$

$$\text{Hence losses } (L) = P - R = 157,500 - 54,000$$

$$b) \quad \text{Run-off / Precipitation} = \frac{54,000}{157,500} = \frac{103,500 \text{ m}^3}{157,500 \text{ m}^3}$$

$$= 0.34$$