



Nilachal Polytechnic

Bhubaneswar

Sem. : 4th

NOTE

Subject : Irrigation Engineering

Branch : Civil engineering

Name of the Faculty : M.Biswal

Sec : A

Sec: B

Text Book to be followed by Student / Faculty

Book-1 : N N BASAK (Ch - 1)

Ch. No. : 1

Name : Hydrology

1.Learning objective

- Students understand the essential components and function of the hydrologic cycle including precipitation, evaporation/evapotranspiration, overland flow and surface storage, groundwater flow and storage, and channel flow, storm water runoff and water quality.
- Students can develop unit hydrographs based on streamflow data, and conduct basic unit hydrograph analysis.

2.Essential Questions (Fundamental Question)

- What do you mean by hydrology?
- What do you mean by hyetograph?
- What do you mean by unit hydrograph?
- Describe hydrological cycle with neat sketch
- What are the various types of rain gauges?
- Write dicken's and ryve's formula for estimation of flood discharge?

3. Hours Required

Theory	3hr
Problems	Not required
Question & Answer Theory	1hr
Total	4hr

4. Question for Teaching / Assignment / Self Practice

	02 Marks	05 Marks	10Marks
Teaching	4 nos	2 nos	1 nos
Assignment	4 nos	3 nos	1 nos
Self Practice	5 nos	2 nos	2 nos
Total	13 nos	7 nos	4 nos

Lesson Description (Abstract of the Chapter) in the bullet form

The different forms of water available above the earth surface or below the earth surface is known as hydrology.

Catchment area or drainage basin is an area of land, where the surface water from rainfall, snowmelt, or ice flow into a lower elevation to form a single body of water, that may be a lake or a river.

Enclosed :

1. Course Material.
2. Question Set.

Faculty

HOD

Principal

Course Material

Chapter 1

HYDROLOGY

Hydrology:-

The different forms of water available above the earth surface or below the earth surface is known as hydrology.

Hyetograph:-

The graphical representation of rainfall and run-off is known as hyetograph.

Catchment Area:-

Catchment area or drainage basin is an area of land, where the surface water from rainfall, snowmelt, or ice flow into a lower elevation to form a single body of water, that may be a lake or a river

HYDROLOGICAL CYCLE With Neat Sketch

- ☐ The water of the universe always changes from one state to other under the effect of the sun. The water from the surface sources like lakes, rivers, oceans etc converts to vapour by evaporation due to solar heat.
- ☐ The vapour goes on accumulating continuously in the atmosphere.
- ☐ This vapour is again condensed due to sudden fall of temperature and pressure and thus clouds are formed. These clouds again cause the precipitation (i.e. rainfall)
- ☐ Some of the vapour is converted to ice at the peak of the mountains. The ice again melts in summer and flows as rivers to meet the sea or ocean.
- ☐ These processes of evaporation, precipitation and melting of ice go on continuously like an endless chain and thus balance is maintained in the atmosphere.
- ☐ This phenomenon is known as hydrological cycle.



Hydrograph

- ☐ The hydrograph is a graphical representation of the discharge of a river(in cumec) against the time(in hr or days).
- ☐ The discharge is plotted as ordinate (y- axis) and the time is plotted as abscissa (x-axis).
- ☐ During the dry season, there is only base flow(i.e ground water flow) but no surface run off.
- ☐ In rainy season, at the beginning of the rainfall there is only base flow.
- ☐ After some period, when the initial losses (like interception, evaporation, and infiltration) are fulfilled, the surface runoff starts and hence the discharge of the river goes on increasing. Hence the limb of the curve rises which is called the rising limb.
- ☐ This line reaches to the peak at the value 'C'. Again when the rain stops, the flow in the river decreases and the limb of the curve declines. This limb is known as recession limb.
- ☐ The discharge at the point C indicates the maximum discharge.
- ☐ The total area under the curve ABCDE indicates the total run off

Unit hydrograph

- ☐ A unit hydrograph may be defined as a hydrograph which is obtained from one cm of effective rainfall for unit duration.
- ☐ Here effective rainfall means the rainfall excess which flows directly to the river or stream.
- ☐ The unit duration is the period during which the effective rainfall is assumed to be uniformly distributed.
- ☐ The unit duration may be considered as 1hr, 2 hr, 3hr, 4hr.... etc.

- For example, if a hydrograph is prepared for an effective rainfall of one cm lasting for 2 hours, then it is known as 2 hr. unit hydrograph, for the duration of 3 hours it is known as 3 hr unit hydrograph

Factors Affecting Run-Off.

The factors affecting run-off are:-

- a. **Intensity of rainfall:** - If the intensity of rainfall is more, the corresponding run-off will be more. Again the intensity of rainfall is low, the corresponding run-off will be low.
- b. **Soil characteristics of catchment:** - In the catchment area consisting of rocky or clayey soil, the run off will be more. Again if the soil characteristics of the catchment is sandy, the runoff will be low as the loss of infiltration is more.
- c. **Topography of the catchment:** - If the ground slope of the catchment is steep, the runoff will be more, If the ground slope is flat and consists of depressions, the runoff will be low.
- d. **Shape and size of catchment:** - If the catchment area is large and fan shaped, the runoff will be more. If the catchment area is small and fern shaped, the runoff will be low.
- e. **Geological condition:-** If the catchment area consists of fissures, cracks etc, the water losses will be more and the runoff will be low.
- f. **Weather condition:** - If the temperature in the catchment area is high, the evaporation loss will be more and hence run off will be less and vice versa.
- g. **Cultivation and vegetative cover in catchment area:-** If the catchment area consists of more cultivated area and forest areas, the run off will be low.

RAIN GAUGE

:-

The instrument which is used to measure the amount of rainfall is known as rain gauge.

Types Of Rain Gauges

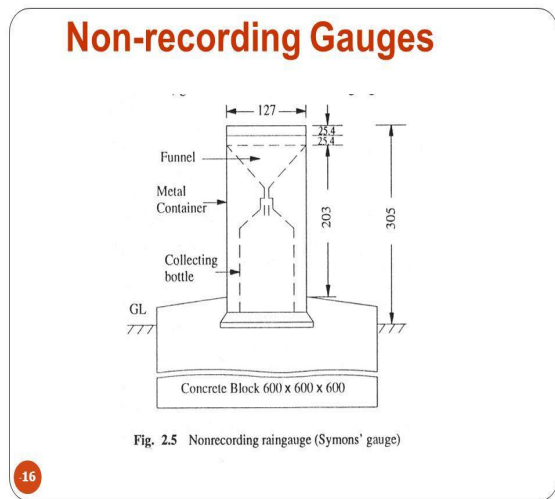
Types of rain gauges are-

A. Non- recording type rain gauge:-

- Simon's rain gauge is a non recording type of rain gauge which is most common used.
- It consists of metal casing of diameter 127 mm which is set on a concrete foundation.
- A glass bottle of capacity about 100 mm of rainfall is placed within the casing.
- A funnel with brass rim is placed on the top of the bottle.
- The arrangement is shown as below:-

The rain fall is recorded at every 24 hours, Generally, the measurement is taken at 8.30 a.m everyday. In case of heavy rainfall the measurement should be taken 2 or 3 times daily so that the bottle does not overflow. To measure the amount of rainfall the glass bottle is taken off and the collected water is measured in a measuring glass and

it is recorded. When the glass bottle is taken off it is immediately replaced with a new bottle of same capacity.



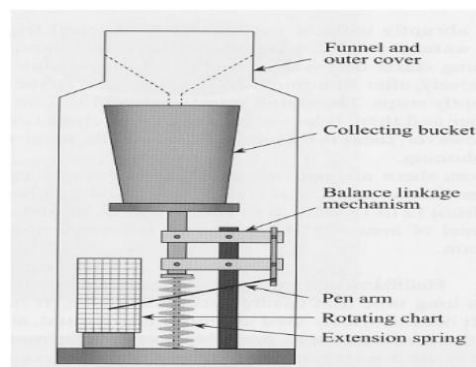
B. Recording type rain gauge:-

- In this type of rain gauge, the amount of rainfall is automatically recorded on a graph paper by some mechanical device.
- The Recording type rain gauge may be of 3 types:-

a) Weighing Bucket Rain gauge

This type of rain gauge consists of receiving bucket which is placed on pan. The pan is again filled with some weighing mechanism. A pencil arm is pivoted with the weighing mechanism in such a way that the movement of the bucket can be traced by a pencil on the moving recording drum. So when the water is collected in the bucket the increasing weight of water is transmitted through the pencil which traces a curve on the recording drum. The rain gauge produces a graph a cumulative rainfall versus time and hence it is sometimes called integrating rain gauge

WEIGHING BUCKET TYPE

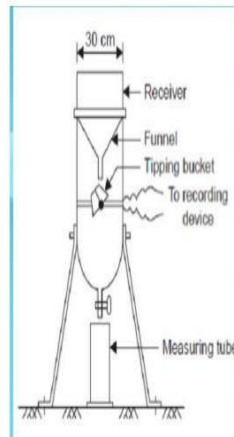


b) Tripping Bucket Rain gauge

It consists of a circular collector of diameter 30 cm in which the rain water is initially collected. The rain water then passes through a funnel fitted to the circular collector and gets collected in 2 compartments tipping buckets pivoted below the funnel.

2. Tipping Bucket Rain-gauge

- Consists of 30 cm dia sharp edge receiver.
- At the end of receiver funnel is provided.
- Under the funnel a pair of buckets are pivoted (the central point which balances) in such away that when one bucket receives 0.25 mm (0.01") of rainfall it tips (to fall or turn over), discharging its contents into reservoir bringing other bucket under funnel.
- Tipping of bucket completes an electric circuit causing the movement of pen to mark on clock driven revolving drum which carries a record sheet



Types Of Precipitation

The different types of precipitation are:-

1. **Cyclonic Precipitation:-** This type of precipitation is caused by the difference of pressure with in the air mass on the surface of the earth. If low pressure is generated at some place the warm moist air from the surrounding area rushes to the one low pressure with violent force. The warm moist air rises up with whirling motion and gets condensed at higher altitude and ultimately heavy rain fall occurs. There are 2 types-

(a) Frontal Precipitation-

When the moving warm moist air mass is obstructed by the zone of cold air mass, the warm moist air rises up to higher altitude where its gets condensed and heavy rainfall occurs. This is known as frontal precipitation.

(b) Non Frontal Precipitation-

When the warm moist air mass rushes to the zone of low pressure from the surrounding area, a pocket is formed and the warm moist air rises up like a chimney towards higher altitude. At higher altitude this air mass gets condensed and heavy rainfall occurs. This is known as non frontal precipitation.

2. **Convective precipitation:** In tropical countries when on a particular hot day the ground surface gets heated unequally, the warm air is lifted to higher altitude and the cooler air takes its place with high velocity. Thus the warm moist air mass is condensed at the high altitude causing heavy rainfall. This is known as convective Precipitation.

Dicken's formula for estimation of flood discharge:-

$$Q = C \times A^{\frac{3}{4}} \times A^{\frac{3}{4}}$$

Q= Discharge in cumec;

A= Catchment area in sq.km;

C= A constant

Ryve's formula for estimation of flood discharge

$$Q = C \times A^{\frac{2}{3}} \times A^{\frac{2}{3}}$$

Q= Discharge in cumec;

A= Catchment area in sq.km;

C= A constant

Question Set Teaching

GROUP-A (Short questions) (2 marks)

1. What do you mean by 'hydrology'?
2. Define 'runoff'
3. What is a rain gauge?
4. Write down Dicken's formula for flood discharge and explain the terms used thereon.
[2015]

GROUP-B (5 marks)

1. Write short notes on Unit hydrograph and explain it. [2014, 2013, 2015(s),2017(s),2019 S]
2. Write short notes on Hydrograph? [2017]

GROUP-C (10 marks)

1. Describe briefly various types of rain gauges.

Assignment

GROUP-A (Short questions) (2 marks)

1. Define "Surface Runoff". [2013,2017]
2. What do you mean by "Catchment Area" ? [2013,2017, 2019S]
3. What do you mean by hydrology cycle ? [2015(s)]
4. Write dicken's and ryve's formula for estimation of flood discharge? [2018, 2019S]

GROUP-B (5 marks)

1. Describe any one of the rain gauges used to know the rainfall intensity.
2. What are the factors affecting run-off?
3. Describe hydrological cycle with neat sketch. [2018(s), 2019S]

GROUP-C(10 marks)

1. What are the various types of rain gauges available? Explain the working of any one with neat sketch. [2014, 2015(s),2018,2019 S]

Self Practice

GROUP-A (Short questions) (2 marks)

1. What do you mean by 'hyetograph'?
2. What do you mean by 'unit hydrograph'?
3. What do you mean by "Catchment Area" ? [2013,2017, 2019S]
4. What do you mean by hydrology cycle ? [2015(s)]
5. Write dicken's and ryve's formula for estimation of flood discharge? [2018, 2019S]

GROUP-B (5 marks)

1. Distinguish between hydrograph and hyetograph.
2. Write a short notes on rain gauge? [2019S]
3. What are the various types of rain gauges available? Explain the working of any one with neat sketch. [2014, 2015(s),2018,2019 S]

GROUP-C(10 marks)

1. What is meant by hydrologic cycle? Explain with a neat sketch.
2. . Describe the different types of precipitation?