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CIVIL - ENGINEERING

UNACADEMY
Hydrology Engineering
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- Theory
- Explanation
- Derivation
- Example
- Shortcuts
- Previous Years Question With Solution

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HYDROLOGY It is the Science of water

- H deals with occurance, circulation and distribution of water of the Earth and atmosphere

Precipitation
{ Rain, Snow
  Hail EICI }

Evaporation

Runoff

It is further Classified into two

ⓐ Scientific Hydrology : It is the Study of water Concerned with Academic Aspects i.e Records of Past deta

ⓑ Engineering Hydrology OR APPlyied Hydrology :
Study of water Concerned with Engineering application of Sources of water, water Process i.e Precipitaliom, Evaporatim, transpiration, Infiltration etc.

- In order to understand occurance circulation and storaqe of water, Hydrological cycle or water cycle Can be analysed

- The Precipitation and Evaporation Comtineous forever, hence a balance is maimtained blw the two. which Com be understood from water cycle

→ Since it is the Comtineous Process it is no" starling Point, End Point or, Point at which it Paused
  — water in oceams vapourises upwards and forms clouds, which under condensation

and forms Precipitation that again falls over the ocean
Predominantly

Some Clouds moves over land due to wind and Precipitate
there

- Cont - This Precipitation further undergoes following
(i) Evaporation from Precipitation
(ii) intercepted by obstruction) which may be natural
(Plants or trees mountains) or artifical
(iii) Certain Portion of interception vapourises and Remaing
falls over the Surface
(iv) During Photosynthesis Plant utilises water from soil
and transpirs certain Portion into atmosphere
(v) Reaches the Surface which further undergoes
(a) Evaporation
(b) fills the depression over the ground (Depression storage)
(c) flows under gravity from Surface into the Soil through
Voids termed as infiltration

(d) flow over the Surface (Surface runoff) and meets the
Stream after which it is termed as stream runoff

Note Certain Portion of infiltration flows under head till Horizontally
and vertically [Prompt (fast) interflow] and meets the
Stream termed as seepage
▷ flow of water through voids of the Soil under gravity
from unsaturated to saturated soil mass is termed

As Percolation

— if this Percolation flows through voids cracks, fissures of impermeable starta it is termed as Deep Percolation

— Certain portion of the ground water also meets the stream over the period of time and is termed as Base flow or (Prolonged interflow

— There are Several Paths of water cycle Each of which has one or more following aspect.

① Transportation of water

(II) Temporary Storage

(III) Change of Phase / stage

— Transportation Components of water cycle are

(I) Precipitation

(I) Evaporation

(II) Runoff

(iv) Transpiration

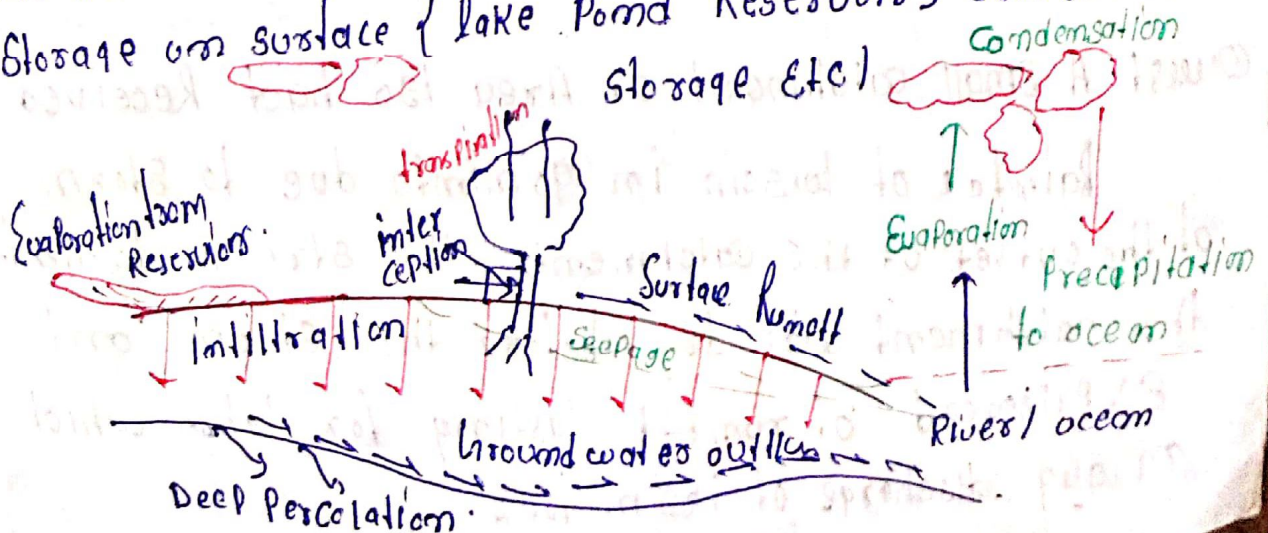(v) Infiltration / seepage /Percolation

— Storage Components of water cycle

① Ground water storage

(II) Soil moisture

(III) Storage on surface { lake Pond Reservoirs depression Storage Etc}

Condensation

Transpiration

Evaporation from Reservoirs

interception

Infiltration

Seepage

Surface Runoff

Ground water outflow

Deep Percolation

Evaporation

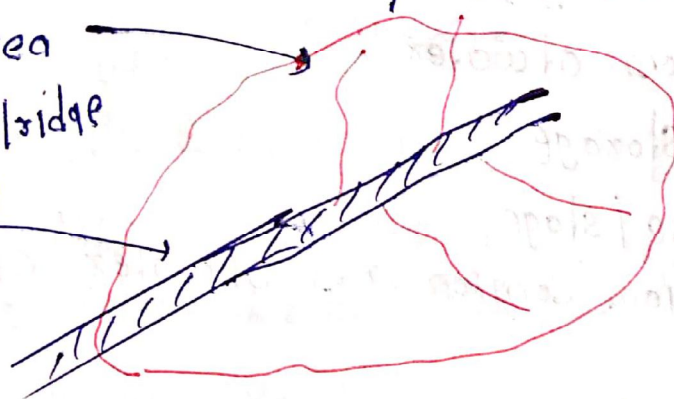Precipitation to ocean

River / ocean

WATER BUDGET EQUATION

for a Given Problem Area [catchment Area] in an interval
of time Δt, the continuity Equation for water i·e
Conservation of mass for water in its various phases is
Applicable

NotE → the area of land draining into the stream is termed
Catchment area

water shed/ridge
line

Mass inflow − mass outflow = Change in mass Storage

$$V_i - V_f = \Delta S$$

$$P - R - U - E - T = \Delta S$$

Here $\quad P - R = losses (L)$

Quest A small catchment of Area 150 had Received a
Rainfall of 10.5cm in 90 mints due to Storm
at the outlet of the catchment, the stream draining
the catchment was dry before the Storm and
EVPrienced of runoff lasting for 10hr which
an aug discharge of 1.5 m³/sec

The stream was again dry after the runoff Event

Compute ① what is the amount of water that is not available to form runoff

⑥ Coff. of Runoff

losses = P − R

$\Rightarrow 150 \times 10^4 \times 10.5 \times 10^{-2} - 1.5 \times 10 \times 60 \times 60$

$= 103500 \, m^3$

⑥ $K = \dfrac{R}{P} = \dfrac{1.5 \times 10 \times 60 \times 60}{150 \times 10^4 \times 10.5 \times 10^{-2}} = 0.34 \, \%$

Quest A lake had a water-surface Elevation of <u>105.2 m</u> above datum at the beginning of a certain month in that month the lake Recieved an average inflow of <u>6 m³/sec</u> from Surface Runoff Surfaces in the same Period outflow from the lake had a value of <u>6.5 m³/sec</u> further in that month the lake received Rainfall of 145 mm and Evaporation from the lake Surface was 6.10 cm

① Mention the water budged Eq for this lake

② Calculate the water surface of lake at the end of the month

The avg Surface area of lacke 5000 ha

Ans   mass inflow − mass out flow = Change in storage

$(I \Delta t + P.A) - (0 \cdot \Delta t + EA) = \Delta S$

$(I - 0)\Delta t + A(P - E) = \Delta S$

$(6 - 6.5) \, 30 \times 24 \times 60 \times 60 + 5000 \times 10^4 \cdot (140 \times 10^{-3} - 6.10 \times 10^{-2})$
$= \Delta S$

$\Delta S = 2904000 \ m^3$ or $\dfrac{2904000}{5000 \times 104} = 0.058 m$

Water Surface Elevation $= 105.2 + 0.058 = 105.258 m$

＃ PRECIPITION ＃

⇒ It Represents all forms of water that Reaches the Earth Surface from the Atmosphere.

⇒ for Precipitation to form conditions Required are

Ⓐ Presence of moisture in the atm.

Ⓑ Presence of Sufficient nuclei (medium) Particles to help Condensation. $\emptyset < 0.1 mm$

Ⓒ Weather Condition must be optimum for Condensation to takes Place

Ⓓ The Products of Condensation must reach the earth Surface.

— Precipitation occurs in following forms.

① Rain : This term is used generally when water droplets are of size $0.5 - 6mm$

— The Rain Can be classified on the basis of its intensity As follows

INTENSITY (mm/hr)	Type of Rain
< 2.5	light
$2.5 - 7.5$	moderate
> 7.5	Heavy

1) In India avg Precipitation is about 120 cm per year which is grater than World avg of of 100 cm/year

2) In order to find this Annual average Rainfall of a place a minimum of 30 years data is Required.

3) If total Rain in a day is more than 2.5mm , than that day is called "Rainy DAY".

② SNOW :— It Consist of Ice crystals which Combine to form ice flakes . Size < 1mm.
initially these flakes have density in the range of 0.06-0.19 gm/cm³
(Having average value of 0.1 gm/cm3)

— It is Also one othe the major form of Precipitation in india that takes Place in Himalyan Region

③ DRIZZLE When water droplets are of size less than 0.5 mm , then it is termed as Drizzle

—its intensity be less than 1mm/hr

→ Here Particle size are of such Range , that they can be seen floating into the air

④ GLAZE When Rain or drizzle Comes in contact with Cold ground at around 0°c , the water is converted into ice Coating termed as glaze / freezing Rain

(Rain + drizzle)

⑤ SLEET It is frozen Rain drop which is formed When Rainfalls through air at some freezing , °c temp.

⑥ HAIL : snow — It irregular ice Particles combines with each-other to form a lump of size greater than 8mm , it is termed as Hail

It occures in violent thunder storms in which vertical Currents are very strong

Note: Air ——→ Wind   ↑ Current
                              Air
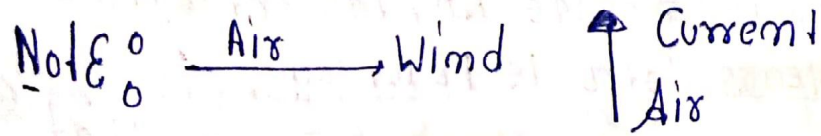
Note INDEX OF WETNESS (ICE)

Iow: It signifies the Amount of Rainfall occuring in an area in Comparision to average rainfall of that area

$$Iow : \frac{Rainfall\ in\ given\ year}{Avg\ Rainfall\ of\ all\ the\ year} \times 100$$
$$(at\ lest\ 30\ year)$$

$$EY\ Iow_{2020} = \frac{P_{2020}}{\frac{P_{1940}----P_{2020}}{30}} \times 100$$

Ex 2 Iow = 40%, it signifies rain deficiency of 60%.

— if Iow > 100% ⇒ flood.
      Iow < 100% ⇒ Deffeciency of Rain

— If Rain defficiency	Classification
30 – 45	large defficiency
45 – 60	Severe
> 60	( ) Distastrous Defficiency

9/Jan/2 DROUGHT:

It is a climatic anomaly which is characterized by insufficient supply of moisture over long period of time

— like flood, drought is hydrological Extreme