Solution

Hydrology & Irrigation Engineering (17CV73) Jan/Feb. 2021

Q1.a Importance of hydrology

* Design of hydraulic structures
* Municipal and Industrial water supply
* Irrigation
* Hydroelectric power generation
* Flood control in rivers
* Navigation
* Erosion & Sediment control
* Pollution control

* Design of hydraulic structures :- Structures such as bridges Causeways, dams, spillways etc are in contact with water Accurate hydrological predictions are necessary for their proper functioning. Due to a storm, the flow below a bridge has to be properly predicted.

* Municipal and Industrial water supply :-
Growth of towns and cities and also industries arou -nd them is often dependent on fresh water availability in the vicinity.

* Irrigation :-
Dams are constructed to store water for multiple uses for Estimating maximum storage capacity seepage, Evapora tion and other losses should be properly estimated. these can be done with proper understanding of hydrology of a given river basin and thus making the irrigation project a successful one.

* Hydroelectric Power Generation :-
A hydroelectric power plant need continuous water supply without much variations in the flow. Variations will affect the functioning of turbines. In the Electric plant.

* Flood Control on rivers :-

Controlling floods on a river is a complicated task. The flow occuring due to a storm can be predicted if the catchment characteristics are properly known.

1.b. Hydrological cycle :-

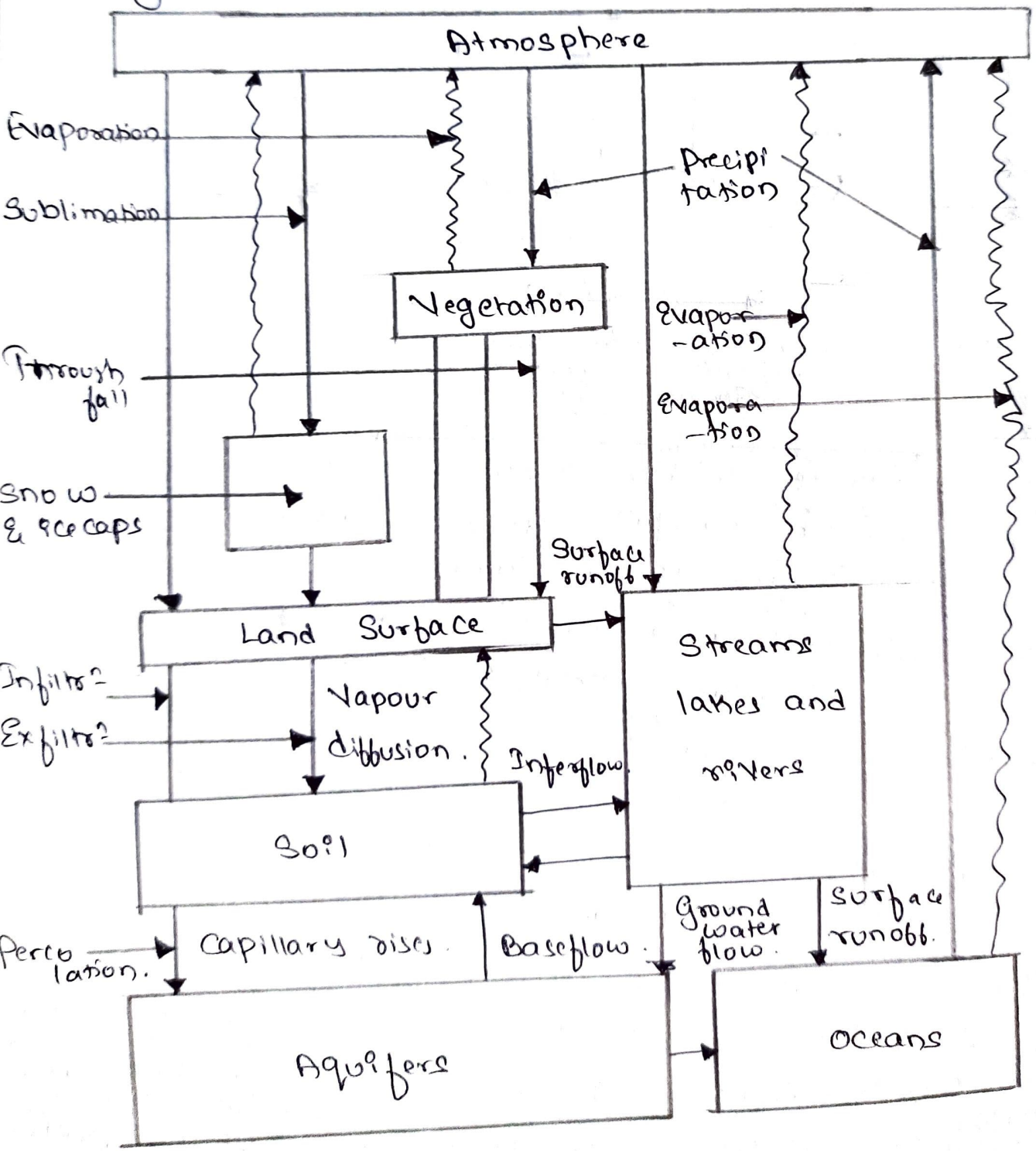
water exists on the earth in gaseous form (water vapour) liquid and solid (ice) forms and is circulated among the different components of the earth mainly by energy and planetary forces. Sunlight evaporates sea water and this evaporated form is kept in circulation by gravitational forces of earth and wind action. The different paths through which water in nature circulates and is transformed is called hydrological cycle.

Hydrological cycle is defined as the circulation of water from the sea to the land through the atmosphere back to the sea often with delays through process like precipitation, interception, run-off infiltration, percolation, ground-water storage, evaporation and transpiration also water that returns to the atmosphere without reaching the sea. The hydrological cycle has 3 important phases

1. Evaporation and Evapotranspiration
2. precipitation
3. Run-off

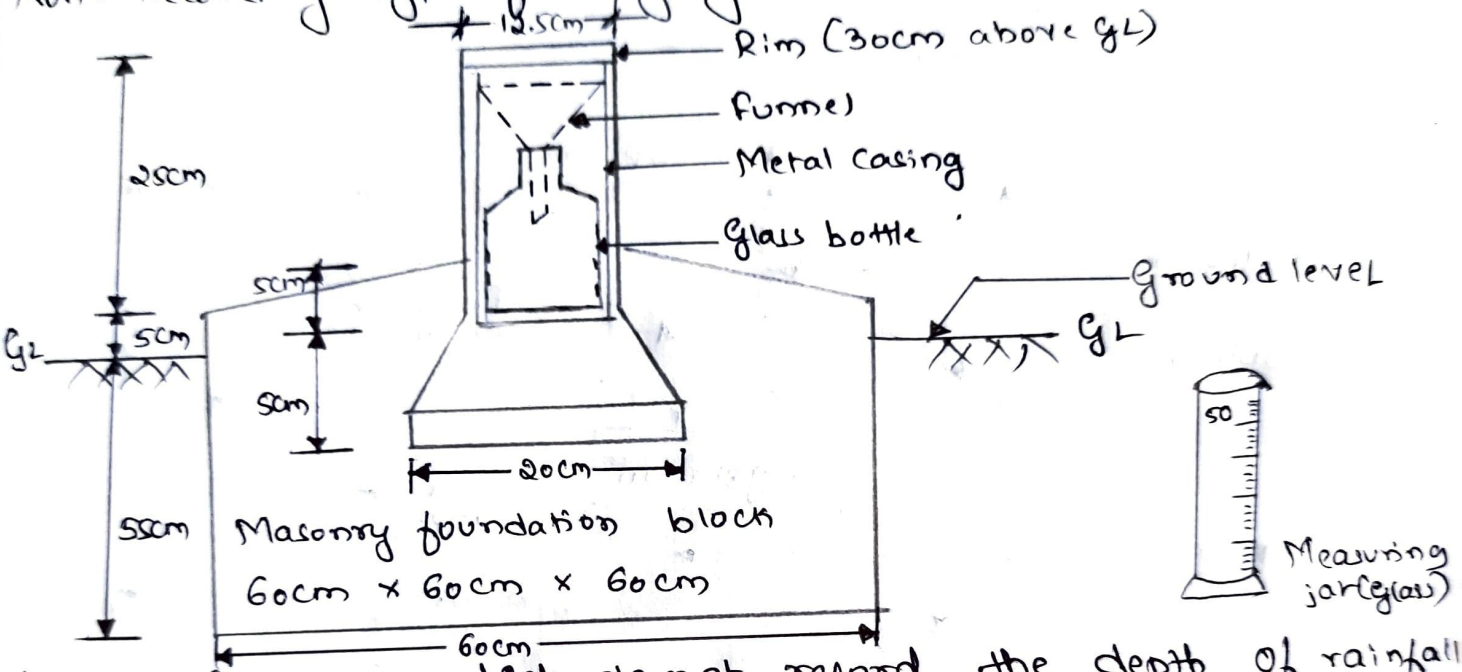
Evaporation takes place from the surface of ponds, lakes, reservoirs and ocean surfaces. Transpiration takes place from surface vegetation i.e from plant leaves of cropped land forest etc. these vapours rise to sky and are condensed at higher altitude and from the clouds. The clouds melts and sometimes burst resulting in precipitation of different form like rain, snow, hail,

mist and frosts. A part of this water precipitation flow over the land as run-off and a part infiltrate into the soil which build up ground water table. the surface run-off goins the stream and thus water stored in the reservoir. A portion of the surface run-off and ground water flows back to ocean. again evaporation starts from surfaces of lakes, reservoirs and ocean and thus the cycle repeats.



Q2.a. Rainfall is measured on the basis of the vertical depth of water accumulated on a level surface during an interval of time, if all the rainfall remained where it fell. It is measured in mm. The instrument used for measurement of rainfall is called "Rain gauge"

Non-Recording type of raingauge



these raingauges which do not record the depth of rainfall but only collect rainfall. Symons rain gauge is the used non recording type of rain gauge. It gives the total rainfall that has occured at a particular period. It essentially consists of a circular collecting area 127mm in diameter connected to a funnel. the funnel discharges the rainfall into a receiving vessel. The funnel and the receiving vessel are housed in a mettalic container. the compone-nts of this rain gauge are in the figure

the water collected in the receiving bottle is measured by a graduated measuring jar with an accuracy of 0.01 ml. The rainfall is measured every day at 8:30 am IST and hence this rain gauge gives only depth of rain-fall for previous 24 hours. During heavy rains, measure-ment is done 3 to 4 times a day.

thus Symons raingauge gives only the total depth of rain-fall for previous 24 hours and does not provide intensity and rainfall duration of the rainfall during different time interval of the day.

Q2.b. Mean of the rainfalls at the Existing gauges is given by.

$$\bar{X} = \frac{\Sigma X_i}{m} = \frac{89 + 68 + 54 + 45 + 41 + 55}{6}$$

$$\boxed{\bar{X} = 58.67}$$

Standard deviation of rainfall is given by

$$S_x^2 = \frac{\Sigma (X_i - \bar{X})^2}{(m-1)}$$

$$= \frac{(89-58.67)^2 + (68-58.67)^2 + (54-58.67)^2 + (45-58.67)^2 + (41-58.67)^2 + (55-58.67)^2}{(6-1)}$$

$$\therefore S_x^2 = 308.27$$

$$S_x = \sqrt{308.27} = 17.55$$

$$C_v = \left(\frac{S_x}{\bar{X}}\right) \times 100 = \left(\frac{17.55}{58.67}\right) \times 100 = 29.91 \text{ cm}$$

$$N = \left(\frac{C_v}{P}\right)^2 = 8.94 \qquad (\because P = 10\%)$$

$$\therefore N = 8.94 \approx 6$$

So number of additional gauges required are

$$= (N - m) = 8.94 - 6 = 2.94 \approx 3 \text{ Nos.}$$

Q3.a. Evaporation :-

It is the process by which a liquid changes to gaseous States at the free surface through transfer of heat energy

Factors affecting Evaporation

* Vapour pressure difference :- the number of molecules leaving or Entering a water body depends on the vapour pressure of water body at the surface and also the vapour pressure of air.

* Temperature of air and water :-

The rate of emission of molecules from a water body is a function of its temperature. At higher temperature molecules of water have greater energy to Escape.

* Wind Velocity :-

when wind velocity is more than saturated air is drifted away and dry air comes in contact with wate surface which is to absorb moisture.

* Quality of water :-

The rate of Evaporation of fresh water is greater than saline water. Specific gravity of saline water is greater than that of fresh water. It is established that saline water has lesser vapour pressure and it is observed that Evaporation from fresh water is 3 - 4 % more than sea water.

* Atmospheric pressure and altitude :-

Evaporation decrease with increase in atmospheric pressure as the rate diffusion from water body into the air is supressed. At the higher altitude the atmospheric

pressure is usually lesser and there by evaporation rate is higher.

6. Depth of water body :-

Evaporation shallow water bodies is greater when compared to deep water bodies as the water at lower levels in deep water bodies is not heated much and vapour pressure at lower levels is also reduced.

7. Humidity :-

If the humidity of the atmosphere is more than evaporation will be less because during the process of evaporation water vapour, moving from the point of higher moisture content to lower levels in deep water bodies is not heated much and vapour pressure at lower levels is also reduced.

8. Radiation :-

Since the evaporation requires continous supply of energy which is derived mainly from solar radiation. The radiation will be a factor of considerable importance Evaporation increase and the radiation increases & Vice -versa.

Q3.b. Water budget method.

By applying mass balance around water body and by writing water budget equation evaporation is estimated.

water budget equation around water body is

Σ inflow $-$ Σ outflow $= \pm \Delta s$

Σ Inflow includes rainfall and runoff

Σ outflow includes water used, Evaporation & Seepage.

ΔS = change in storage

ΔS is positive when water level rises

ΔS is negative when water level falls.

Calculate

Let 'x' cm Evaporation takes place in month of June

Total inflow in cm

$$= \frac{10 \times 30 \times 24 \times 60 \times 60}{20 \times 10^6} \times 100 + 10 = 139.6 \text{ cm}$$

Total outflow in cm

$$= \frac{15 \times 30 \times 24 \times 60 \times 60}{20 \times 10^6} \times 100 + 1.8 + x = (196.2 + x) \text{ cm}$$

As total outflow is more than total inflow, therefore depression in storage takes place.

Depression in Storage (ΔS)

$$\Delta S = \frac{-16 \times 10^6}{20 \times 10^6} \times 100 = -80 \text{ cm}$$

$$\Sigma \text{Inflow} - \Sigma \text{Outflow} = \pm \Delta S$$

$$139.6 - (196.2 + x) = -80$$

$$-x = -80 + 56.6$$

$\therefore$ Evaporation in month of June $= x = 23.4$ cm

Following are some reccommended measure to reduce Evaporation from water surfaces.

Storage reservoirs should have more depth and less surface area. The site for construction of a dam should be so chosen that a deep reservoir with minimum surface area exposed to atmosphere is formed

2. Tall trees on the wind ward side of the reservoir should be planted so that they act as wind breakers.

3. By Spraying a Chemical such as Acetyl Alcohol on water Surface. a film of 0.15 microns thickness is produced on the surface. this film allows precipitation in but does not allow Evaporation. this is suitable when wind velocities are less and for small and medium sized reservoirs.

4. In case of Ponds and lakes Entire water body can be Converted by thin polythene Sheets as mechanical covering

5. In reservoirs outlet arrangements should be so done to let out warmer water at top than cold water from bottom.

6. De-weeding the reservoirs Should be done Such that water consumed by weeds is reduced.

7. the Streams and channels to be straightened so that length and in turn Exposed area to atmosphere are reduced.

Q4b. Factors affecting infiltration:-

*. Depth of Surface retention and thickness of Saturated layer of Soil.:-

Infiltration takes place due to combined influence of gravity and Capillary force. Due to this a layer of soil near the Surface becomes Saturated. If the thickness of Saturated soil at any given time & at any given Section is 'L' the water will flow through a series of tiny tubes of length 'L'. therefore infiltration

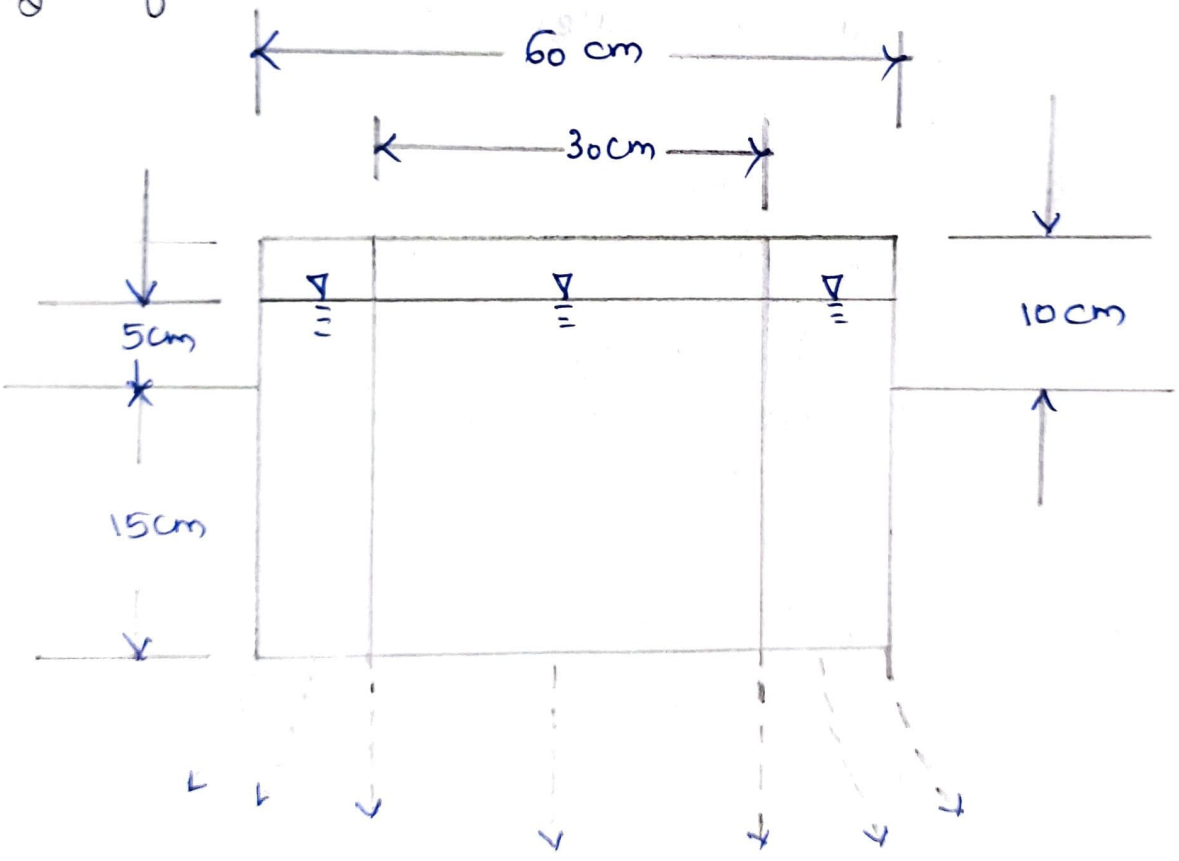
capacity should decrease with time in a continous rain becomes a constant ultimately.

b. Soil moisture :-

The soil moisture affect the infiltration capacity in 2 ways:-

(i) If the soil is quiet dry at the beginning of the rain, there is a stoong capillary attraction for moisture in subsurface layers that acts in the same direction as gravity and given high initial value of infiltration.

(ii) when the soil is subjected to wetting very fine soil particles colloids will swell slightly and reduce the size of the voids. this leads to reduce (f) with time



Double-ring infiltrometer

Double ring infiltrometer :-

A tube infiltrometer has a drawback that infiltration in it does not represent or simulate the actual field conditions because the water tends to disperse laterally after coming out at the bottom. To overcome this draw back a double ring infiltro-meter is widely used. It consists of two consecutive rings driven into the ground as shown in figure below. the inner ring has a diameter of 30cm and outer ring has a diameter of 60 cm. they are concentrically driven into the ground as shown in figure. A constant water depth of 5cm is maintained in both the rings. the outer ring provides a water jacket to the water infiltrating from the inner ring and thus simulates the natural conditions. the water depths in the both. the rings are maintained constant. During the observation period. the measurement of water volume added into the inner ring is only noted. the experiment is carried out till constant infiltration rate is obtained. To prevent any disturbance or accidental fall of foreign matter the top of the infiltrometer is covered with a perforated disc.

Qs.a. Runoff means the draining or flowing off of precipitation from a catchment area through a surface channel. It thus represents the output from the catchment in a given unit of time.

Factors affecting runoff :-

1. Meteorological factors
2. Physical factors.

1. Meteorological factors.
   * Type of precipitation
   * Rainfall intensity
   * Rainfall amount
   * Rainfall duration
   * Distribution of rainfall over the watersheds
   * Direction of storm movement
   * Antecedent precipitation and resulting soil moisture

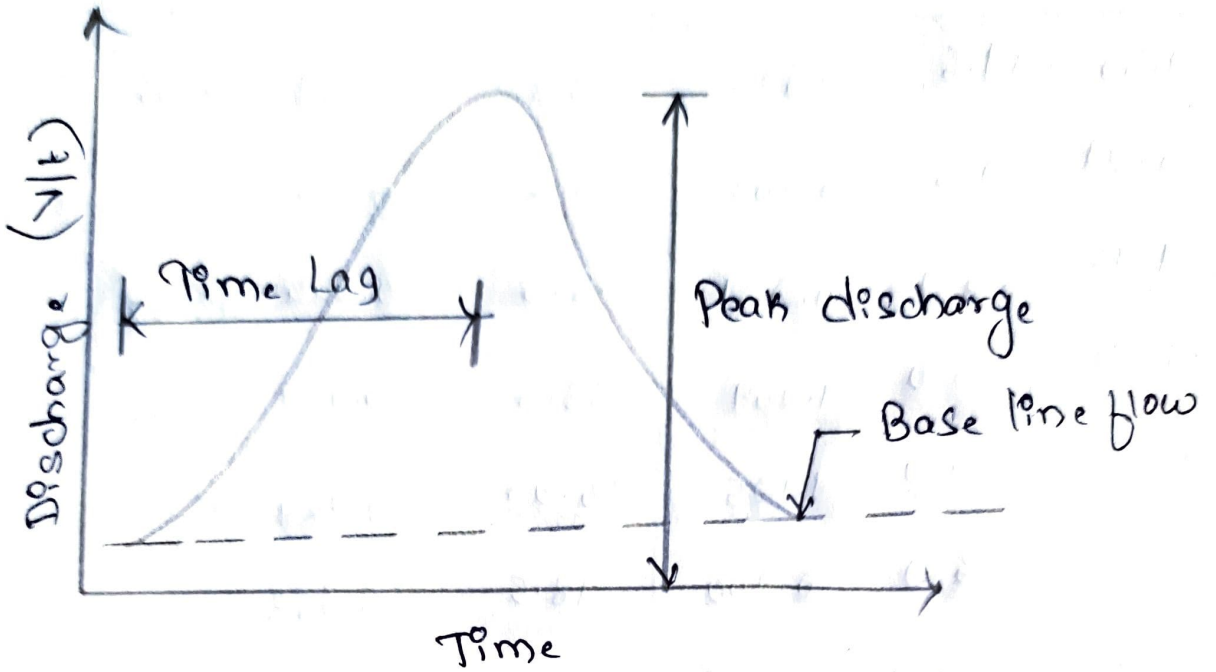
2. Physical factors
   * Land use
   * Vegetation
   * Drainage area
   * Soil type
   * Basin shape
   * Elevation
   * Slope
   * Topography
   * Direction of orientation
   * Drainage network patterns
   * Ponds, lakes, reservoirs, sinks etc.

Q5.b

Monthly flow V M m^3	Demand M m^3	Evapora-tion. M m^3	Riparian release M m^3	Rainfall M m^3	Net Demand D	(V-D)	Cumulative Surplus M m^3
50.35	19.6	0.675	18.5	0.089	36.86	+13.66	+13.664
36.29	21.5	0.703	18.5	0.107	40.59	-4.30	—
29.46	23.4	0.731	18.5	0.044	45.28	-15.82	—
19.44	27.0	1.069	18.5	0.054	46.51	-27.07	—
16.07	24.0	1.125	16.07	0.024	41.17	-25.1	—
49.25	26.0	0.900	18.5	0.658	44.34	+4.5	+4.508
200.88	20.0	0.675	18.5	1.097	38.07	+162.8	+167.31
217.49	20.0	0.619	18.5	0.902	38.27	+179.21	+346.52
155.52	18.5	0.563	18.5	0.999	36.62	+118.9	+465.42
80.35	18.5	0.563	18.5	0.049	37.51	+42.83	+508.26
68.43	16.0	0.506	18.5	0.219	34.78	+33.64	+541.90
58.93	19.0	0.619	18.5	0.446	37.97	+20.95	+562.85

$$V = \frac{Q \times N \times 24 \times 60 \times 60}{10^6} = 0.0864\, QN$$

Hydrograph :- A hydrograph is a graph showing Variation of discharge versus time.



At the beginning there is only base flow. (i,e. the gro water contribution to the stream) gradually deflectin in a conical form. After the storm commences, the initial losses like interception and infiltration are m & then the surface flow begins. the hydrograph grad rises and reaches its peak value after a time t p meas from the centroid of the inflection point i,e, there ar been inflow of the rain upto this point and after th there is gradual withdrawal of catchment storage. the after the GDT declines and the hydrograph again go on depleting in the exponential form called the ground water depletion curve or the recession curve.

Time h	Total runoff m^3/s	Base flow	Direct runoff	Ordinates of unit hydrograph m^3/s	Time after start of direct runoff h.
6	14.2	14.2	0	0	0
8	158.5	14.7	143.8	12.52	2
10	260.0	15.2	244.8	21.32	4
12	286.0	15.7	270.3	23.54	6
14	221.0	16.2	204.8	17.84	8
16	186.5	16.7	169.8	14.79	10
18	157.0	17.2	139.8	12.18	12
20	133.0	17.7	115.3	10.04	14
22	113.0	18.2	94.8	8.26	16
24	93.4	18.7	74.7	6.51	18
2	76.4	19.2	57.2	4.98	20
4	65.0	19.7	45.3	3.95	22
6	55.2	20.2	35.0	3.05	24
8	46.7	20.7	26.0	2.26	26
10	39.6	21.2	18.4	1.60	28
12	34.0	21.7	12.3	1.07	30
14	22.7	22.7	0	0	34
16					

Q7.a. India is basically an agricultural country and its resources on depend on the agricultural output. prosperity of our country depends mainly upon proper development of agriculture. Even after 60 years of Independence, we have not Suceeded in Solving out food problems. The main reason for this miserable state of affair is that we still continue to remain at the mercy of rain & practice age old methods of cultivation. Therfore it is necessary to have a Systematic irrigation system for Supplying optimum quantity of water at correct timing.

* Benefits of irrigation

1. Increase in food production:- crops need optimum quantity of water at required intervals assured & timely Supply of water helps in achieving good yield & also Superior crops can be grown.

2. Protection from famine :- Irrigation works can be constructed during famine. This ~~com~~ helps in Employment generation and people also get protection from famine. After completion of such works, continuous water supply may be available for crops & people.

3. Cultivation of Cash crops :- with the availability of continuous water supply, cash crops such as sugarcane, indigo, tobacco, cotton etc can be grown

4. Generation of hydroElectric power :- Major river valley projects are designed to provide power generation facilities also apart from irrigation needs.

Ill effects of Irrigation

1. water logging :- Excess water applied to the fields allows water to percolate below and ground water table rise. The ground water table may rise saturating the root zone of the crop and cutting of air supply to the roots of the crops. Such a phenomenon is called water logging.

2. Breeding places for mosquitoes :- Excess application of water for irrigation leads to water logging and formation of stagnant water pools, which becomes breeding places for mosquitoes. thus helping spreeding of malaria

3. Unhealthy climate :- Due to intense irrigation the climate becomes damp during summer dee to humidity. the climate is sultry and in winter it becomes excessively cold. The resistance of the body to diseases is reduced. In addition to the above, careless use of water leads to wastage of useful irrigation water for which any governme will have incurred huge amounts.

Q7.b. System of irrigation

*. Lift irrigation :- It is that system of irrigation in which irrigation water is available at a level lower than that of the land to be irrigated and hence water is lifted by pumps or other mechanism & then conveyed to agricultor fields by gravity flow.

*. Inundation Irrigation :- It is that system of irrigation in which large quantity of water flowing in a river is allowed to flood or inundate the fields to be cultivated.

* Perennial Irrigation :- It is that System of irrigation in which irrigation water is supplied as per the crop requirements at regular intervals throughout the crop period.

*. Direct Irrigation :- It is a type of flow irrigation in which water from rivers and streams are conveyed directly to agricutural fields through a network of canals, without making any attempt to store water this is practised in areas where the rivers & streams are perennial.

* Storage irrigation :- Dams are constructed across rivers which are non-perennial. the discharge in such rivers may be very high during rainy season & may become less during dry stream.

Q8.a. Irrigation frequency :-

Irrigation frequency refers to the number of days between irrigation during periods without rainfall. It depends on consumption use of a crop and on the amount of available moisture in the crop root zone.

Factors affecting frequency of irrigation :-

*. Humidity :-

In the rainy season, the humidity is high and rains may be received just when the crop is in need of water In such case, some irrigation turns could be stopped. & frequency may be Extended to 20 days.

*. Stage of Growth of crops :-

During certain stages particularly at flowering & fruit formation stages of crop requires much large quantities of water than earlier stages.

* Type of crops :-
The frequency of irrigation will also depend upon the crop. A succulent leaf vegetable will require irrigation more often than cereal crop like jowar.

*. Soil type :-
Light soil requires more frequent irrigation than the loamy soils. Sandy loam soil need to be irrigated every fifth day while clay loam may be irrigated every ~~tenth~~ tenth day.

Q8.b Gross command area = 20000 hectares.
Cultorable command area = 0.75 × 20000 = 15000 hectares
Area under irrigation in Rabi season
at 40% intensity = 15000 × 0.4 = 6000 hectare
Area under irrigation in kharif season
at 10% intensity = 15000 × 0.1 = 1500 hecta
outlet discharge for Rabi = 6000/1800 = 3.33 Cumec
outlet discharge for kharif = 1500/775 = 1.94 Cumec.
From the equation.
Similary for rabi = $\Delta = 8.64B/D$
$\Delta = 8.64(47)/1800 = 134$
Similarly for rice $\Delta = 8.64B/D$
$\Delta = 8.64(2.57)/775 = 195$

Q9.a Difference between Lacey's theory & Kennedy's theory:-
1. The basic concept of silt transportation is the same in both the theories. Both the theories agree that the silt is carried by the vertical developed by the friction of the flowing water against surface of the channel.

2. According to Kennedy all those channels which neither Silt nor Scour are in regime condition. But Lacey's differential initial regime conditions & final regime cond?

3. Kennedy did not given any importance of B/D ratio. But Lacey's connected wetted perimeter (P) and area of cross-section (A). Thus in case of Lacey's theory there is a definite relationship between Bed width & depth of the channel.

4. Kennedy did not give any Slope formula. Lacy gave a definite Slope formula in terms of discharge & Silt factor

5. Kennedy used Kutter's formula for determining the actual velocity of flow where in value of N is again a guess work. Lacey on the other hand gave a general regime Equation stating $V = 10.8 R^{2/3} . S^{1/3}$.

6. Kennedy's theory involves trial procedure for the design of canals. Lacey's theory does not involve any trial & error procedure.

Q9.b Given

$FSD = 14 \ m^3/s$

$f = 1$

Side slope = 1/2 : 1 (H:V)

Co-Efficient of rugosity, $N = 0.0225$

Q) Mean Velocity $V = 0.438\,2\,(14 \times 1^2)^{1/6} = 0.68$ m/s

Hydraulic mean radius

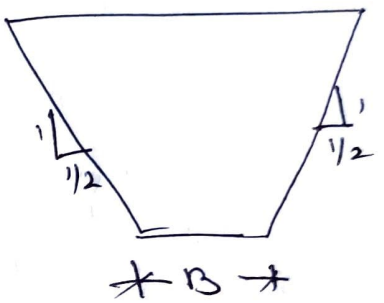
$$R = 2.46\,\frac{(0.68)^2}{1} = 1.14 \text{ m}$$

Wetted perimeter $P = 4.825 \times (14)^{1/2} = 18.06$ m

C/S area $A = R \times P = 1.14 \times 18.06 = 20.55 \text{ m}^2$

$$A = BD + \frac{D^2}{2} \quad \text{---(i)}$$

$$P = B + \sqrt{5}\,D \quad \text{---(ii)}$$



$$20.55 = BD + D^{3/2}$$

$$18.06 = B + \sqrt{5}D$$

Putting value of B in Eq² (i).

$$20.55 = (18.06 - \sqrt{5}\,D)\,D + D^{3/2}$$

or $20.55 = 18.06 - 1.73\,D^2$

or $1.73\,D^2 - 18.06\,D + 20.55 = 0.$

from Quadratic Eq². on D.

$$D = \frac{18.06 \pm \sqrt{(18.06)^2 - 4 \times 1.73 \times 20.55}}{2 \times 1.73}$$

$\therefore$ $D = 9.13$ & 1.3 m

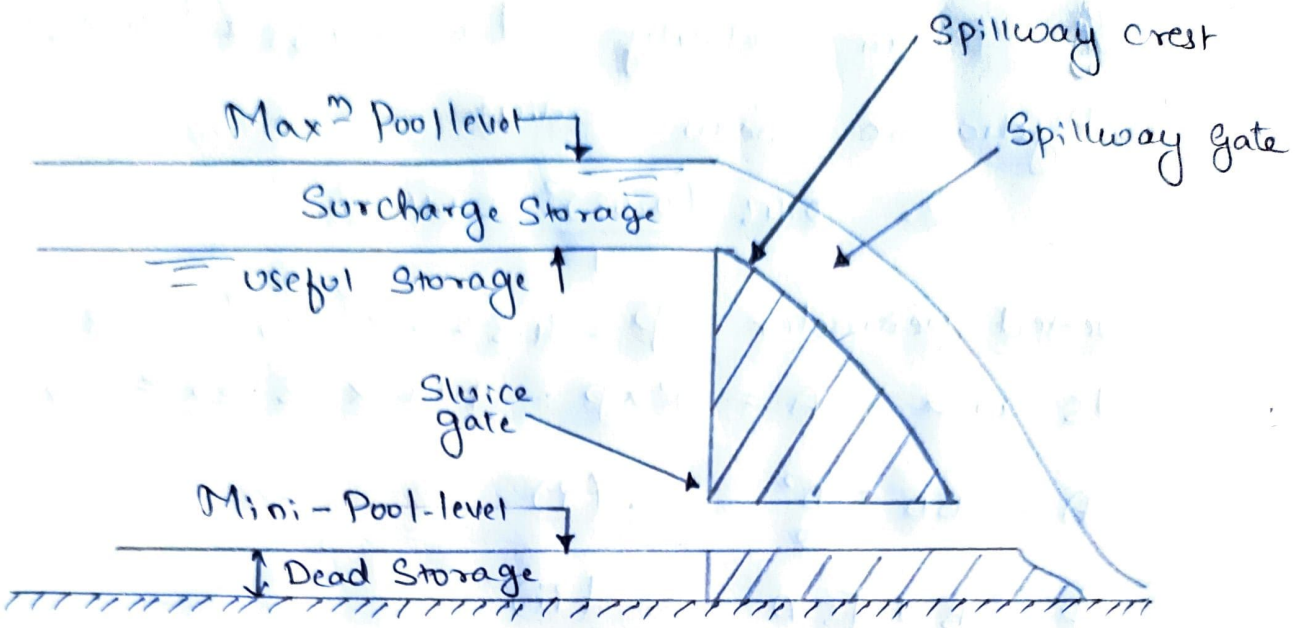
Taking $D = 9.13$.

$$B = 18.06 - 2.23 \times 9.13 = -2.14$$

Taking $D = 1.3$ m

$B = 15.15$ m. , $R = 1.14$m , $S = 1/5160$.

Q10.a



1. Dead Storage :-
The volume of water stored below the minimum pool level of the reservoir is known as dead storage.

2. Useful Storage :-
The volume of water stored in a reservoir between minimum pool level is known as useful storage.

3. Surcharge Storage :-
The volume of water stored between normal pool level and the maximum pool level is known as surcharge storage

4. Bank Storage :-
When reservoir is full of water some amount of water seeps in the permeable banks of the reservoir. This seeped water comes out as soon the reservoir level gets deplete. This amount of seeped water which becomes available after the reservoir is deplet is known as Bank Storage.

5. Valley Storage :-
Some amount of water is stored by the stream channel even before a dam is constructed. this storage is known as Valley Storage.

Q10.b Hydrologic Investigation :-
It is very important aspect of reservoir planning. capacity of reservoir, its potential for irrigation, power generation etc all deepend upon the availability of water from the reservoir. capacity of spillway, storage capacity, height of dam etc.

Points to be Consider for Selection of site for a reservoir :-

1. Catchment area should have such geological conditions that Percolation and absorption losses are minimum.
2. Available runoff should be maximum
3. The site should be free from fissured rocks
4. The reservoir site must be adequate capacity.
5. Site should be such that deep reservoir is formed
6. Reservoir site should be well connected by rail & road.
7. The soil formation at reservoir site should be free from harmful salts
8. Reservoir should not submerge habited area or areas of fertile lands or gardens
9. River bank should be hard, strong and high so that cost on river training works is minimum.
10. Materials for the construction of dam should be available near by.

CBCS SCHEME

17CV73

USN

Seventh Semester B.E. Degree Examination, Jan./Feb.2021
Hydrology and Irrigation Engineering

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. List and explain the importance of hydrology. **(10 Marks)**

b. What is hydrological cycle? Explain with neat sketch, Horton's engineering representation of hydrological cycle. **(10 Marks)**

OR

2 a. What is Rain gauge? Explain with neat sketch non recording types of raingauge. **(10 Marks)**

b. The average annual rainfall of 6 rain gauge stations in a basin are 89, 68, 54, 45, 41 and 55 cm. If the error in the estimation of basin rainfall should not exceed 10%. How many additional rain gauges should be installed in the basin? **(10 Marks)**

Module-2

3 a. What is evaporation? Explain the factors affecting evaporation. **(10 Marks)**

b. A reservoir had a average surface area of 20 km^2 during June. In that month the mean rate of inflow = 10 m^3/sec. Mean outflow = 15 m^3/sec, monthly rainfall = 10 cm and change in storage = 16 million m^3. Assuming the seepage losses to be 1.8 cm. Estimate the evaporation in that month. **(10 Marks)**

OR

4 a. Explain the process of methods to control evaporation from lakes. **(10 Marks)**

b. What are the factors affecting the infiltration? Explain with neat sketch double ring infiltrometer. **(10 Marks)**

Module-3

5 a. What is runoff? List and explain the factors affecting on it. **(10 Marks)**

b. The following ordinates are of 3 hr unit hydrograph. Find out the volume of surface runoff from 1.5 cm effective rainfall of 3 hr duration.

Time in (Hr)	0	6	12	18	24	30	36	42	48	54	60
Unit Hydrograph ordinates	0	5.1	21.6	27	23.5	17	10.7	6.2	3.2	1	0

(10 Marks)

OR

6 a. Define Hydrograph. With neat sketch explain component parts of hydrograph. **(10 Marks)**

b. Find out the ordinates of a storm hydrograph resulting from a 3 hr storm with rain fall of 3, 4.5 and 1.5 cm during subsequent 3 hr intervals. The ordinates of unit hydrograph are given in the table.

Hr	0	03	06	09	12	15	18	21	24	03	06	09	12
OVH (cumecs)	0	90	200	350	450	350	260	190	130	80	45	20	0

Assume an initial loss of 5 mm infiltration index of 5 mm/hr and base flow of 20 cumecs. **(10 Marks)**

Module-4

7 a. What is the necessity of irrigation in India and write benefits and ill effects of irrigation? **(10 Marks)**

b. Explain in detail system of irrigation. **(10 Marks)**

OR

8 a. What is irrigation frequency? Explain the factors affecting on frequency of irrigation. **(10 Marks)**

b. The gross commanded area for a distributor is 20000 hectares. 75% of which can be irrigated. The intensity of irrigation for Rabi season is 40% that for Kharif season 10%. If Kov period is 4 weeks for Rabi and 2.5 weeks for Kharif. Determine the out let discharge. Outlet factors for Rabhi and Kharif may be assumed as 1800 hectares/cumecs and 775 hectares/cumec. Also calculate delta for each crop. **(10 Marks)**

Module-5

9 a. Write the difference between Lacey's theory and Kennedy's theory. **(10 Marks)**

b. The slope of a channel in alluvial soil is $s = \frac{1}{5000}$. Lacey's silt factor $f = 0.9$. Channel side slope are $\frac{1}{2}H:1V$. Find the channel section and maximum discharge which can be allowed to flow in it. **(10 Marks)**

OR

10 a. With a neat sketch, explain zones of storage in a reservoir. **(10 Marks)**

b. Explain Hydrologic investigation of reservoir planning? List the points to be consider for selection of site for a reservoir. **(10 Marks)**

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