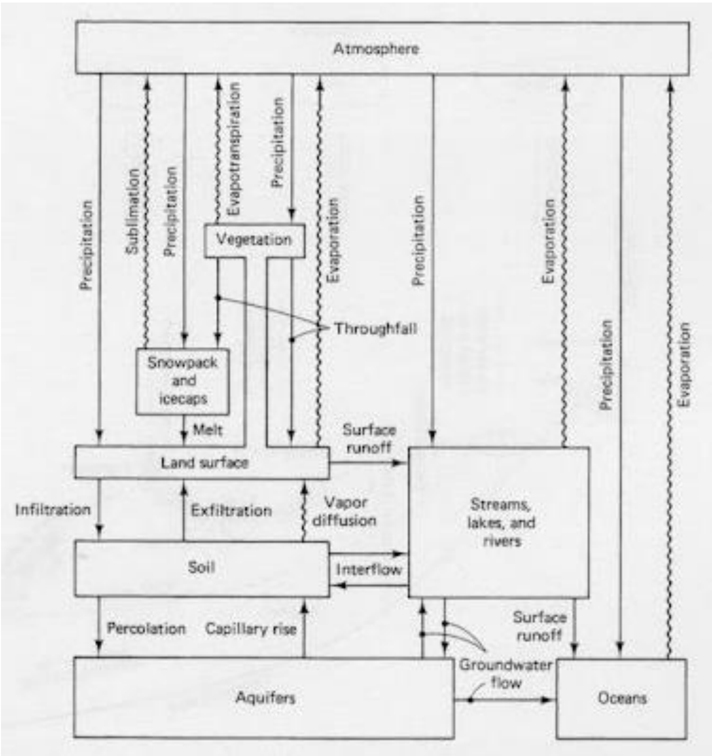
Internal Assessment Test 1
Scheme of Evaluation

Sub:	HYDROLOGY AND IRRIGATION ENGIEERING	Sub Code:	18CV63	Branch	CIVIL
					OBE
			Marks	CO	RBT
1	Explain Horton's Engineering representation of hydrological cycle, with neat sketch.		[10]	CO1	L2

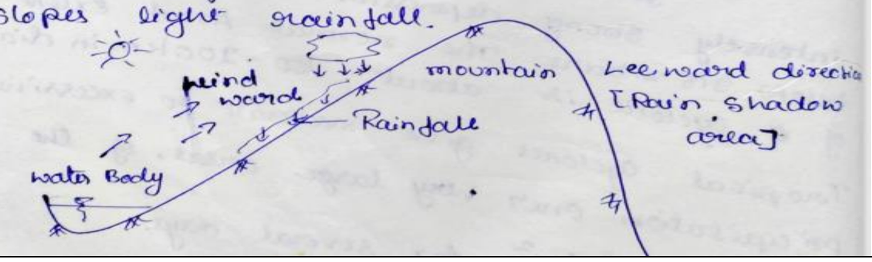


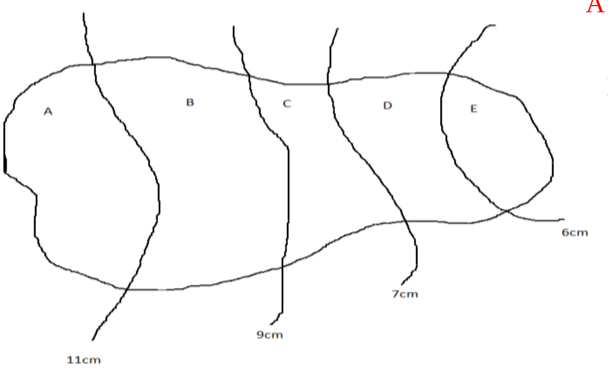
3M

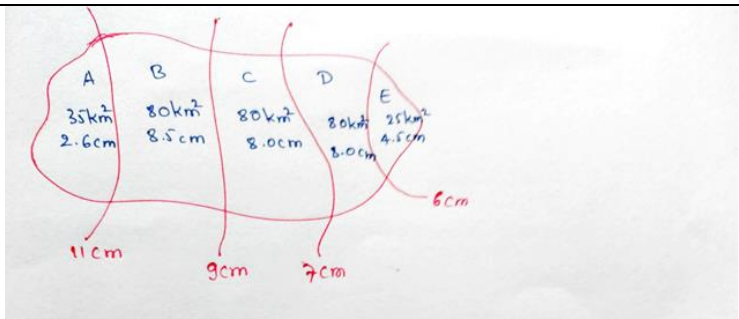
Figure 1.1 is a schematic representation of the hydrologic cycle. A convenient starting point to describe the cycle is in the oceans. Water in the oceans evaporate due to the heat energy provided by solar radiation. The water vapour moves upwards and forms clouds. While much of the clouds condense and fall back to the oceans as rain, a part of the clouds is driven to the land areas by winds. There they condense and *precipitate* onto the land mass as rain, snow, hail, sleet, etc. A part of the precipitation may *evaporate* back to the atmosphere even while falling. Another part may be *intercepted* by vegetation, structures and other such surface modifications from which it may be either evaporated back to atmosphere or move down to the ground surface.

A portion of the water that reaches the ground enters the earth's surface through *infiltration,* enhance the moisture content of the soil and reach the groundwater body. Vegetation sends a portion of the water from under the ground surface back to the atmosphere through the process of *transpiration.* The precipitation reaching the ground surface after meeting the needs of infiltration and evaporation moves down the natural slope over the surface and through a network of gullies, streams and rivers to reach the ocean. The groundwater may come to the surface through springs and other outlets after spending a considerably longer time than the surface flow. The portion of the precipitation which by a variety of paths above and below the surface of the earth reaches the stream channel is called *runoff.* Once it enters a stream channel, runoff becomes *stream flow.*

7M

2	Define Precipitation. With neat sketch, Explain different types precipitation	[10M]	CO2	L2
	The term *precipitation* denotes all forms of water that reach the earth from the atmosphere. The usual forms are rainfall, snowfall, hail, frost and dew. Of all these, only the first two contribute significant amounts of water. Rainfall being the predominant form	1M		
	Precipitation is classified according to the factors responsible for lifting and subsequent cooling. Types of precipitation are:			
	1) Cyclonic precipitation: A cyclone is a large low pressure region with circular wind motion. It is caused by the lifting of an air mass due to the pressure difference. If low pressure occurs in an area, air will flow horizontally from the surrounding area, causing the air in the low pressure area to lift. The precipitation that results, is called the non-frontal cyclonic precipitation. If one air mass lifts over another air mass, the precipitation is called the frontal cyclonic precipitation.	3M		
	2) Convective precipitation: In this type of precipitation the air which is warmer than the surrounding due to localised heating rises because lesser density. Air from cooler surroundi[ngs] to take up its place thus setting up a c[onvective] cell. The warm air continues to rise, under[goes] cooling & results in precipitation. Dependi[ng on] the moisture, thermal & other conditions l[ight] showers to thunderstorms can be excepted i[n convect]-ive precipitation.	3M		
	3) Orographic Precipitation Orographic precipitation is caused by air masses which strike some natural topographic barriers like mountains, and cannot move forward & hence, rise up. causing condensation & precipitation. Thus i[n] mountain ranges, the windward slopes have heavy precipitation and the leeward slopes light rainfall.  	3M		

3	The average annual rainfall of 8 rain gauge stations in a basin are 1000, 950, 900, 850, 800, 700, 600 and 400 mm. If the permissible error is 6%. Determine the optimum number of rain gauges required in the basin. ution:- $m = 8$ $\epsilon = 6\%$ $N = \left[\frac{C_v}{\epsilon}\right]^2$ $C_v = 100 \times \frac{\sigma_{m-1}}{\bar{P}}$ Avg. PcP → $\bar{P} = \frac{1000+950+900+850+800+700+600+400}{8}$ $\bar{P} = 775mm$ $\sigma_{m-1} = \sqrt{\frac{\sum(P_i-\bar{P})^2}{m-1}} = \sqrt{\frac{225^2+175^2+125^2+75^2+25^2+(-75)^2+(-175^2)+(-375)^2}{8-1}}$ $\sigma_{m-1} = 200$ $C_v = 100 \times \frac{200}{775} = 25.806\%$ $\therefore N = \left[\frac{25.806}{6}\right]^2 = 18.49 \simeq 19$ Rain gauges required. (Optimal No of RG) ∴ Additional 11 no of Raingauge stations are required.	[10] 1M 2M 2M 2M 3M	CO2	L3
4	Calculate the Mean areal rainfall using Isohyetal method using the necessary data.  A = $35km^2$ 2.6cm B = $80km^2$ 8.5cm C = $80km^2$ 8.0cm D = $80km^2$ 8.0cm E = $25km^2$ 4.5cm	[10M]	CO2	L3



(2M)

Isohyets	Avg value of P cm	Area km²	Ai/A	weighted P̄
A 11	11	35	0.116	1.276
B 11-9	10	80	0.266	2.660
C 9-7	8	80	0.266	2.128
D 7-6	6.5	80	0.266	1.729
E 6	6	25	0.083	0.498
		A = 300 km²		P̄ = 8.291 cm.

(4M)

$$\bar{P} = \frac{a_1\left(\frac{P_1+P_2}{2}\right) + a_2\left(\frac{P_2+P_3}{2}\right) \cdots\cdots + a_{n-1}\left(\frac{P_{n-1}+P_n}{2}\right)}{A}$$

$$\boxed{\bar{P} = 8.291\,cm}$$

(4M)

5 Explaine various method of obtaining mean preciptation with equatons (10M, CO2, L2)

Temporal Averaging - at a place is obtained by selecting a proper tie unit such as a day, week, month etc., and averaging the rainfall at that point over the given period of time.

$$\bar{P} = \sum_{i=1}^{n} \frac{P_i}{n}$$

- Where, P_1, P_2,……P_n are the rainfalls at the **same station** over a consecutive period of time and **n** is the number of rainfall data whose average is required.

Spatial Averaging – of rainfall over an area (converting point rainfall values at various stations into a average value over a catchment) can be obtained by the following three methods. (1M)

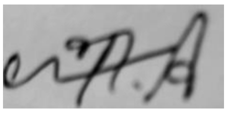
Arithmetic mean method

- The average depths of rainfall for the given catchment is calculated by finding arithmetic average of rain gauge readings in the given area.
- $\bar{P} = \frac{P_1+P_2+P_3 \ldots\ldots\ldots\ldots + P_n}{n} = \frac{1}{n}\sum_{i=1}^{n} P_i$
- Where, $\bar{P}$ is the average depth of rainfall and
- $P_1, P_2, P_3 \ldots\ldots\ldots\ldots, P_n$ are the rainfalls recorded at stations 1,2,3…..n
- n is the number of rain-gauge stations with in the area
- This method is called **'un-weighted mean method'**, as the same weightage is given to rainfall recorded at all the gauges irrespective of their location.

(3M)

	• **Thiessen Polygon method** • $\bar{P} = \frac{P_1A_1 + P_2A_2 + P_3A_3 + \dots P_NA_N}{A_1+A_2+A_3 \dots + A_N}$ • $\bar{P} = \sum_{i=1}^{N} \frac{P_iA_i}{A}$ Where $\frac{A_i}{A}$ is called weighted factor or theissen factor. $\bar{P}$ is the average depth of rainfall $A_1 + A_2 + A_3 \dots \dots \dots \dots + A_N$ Theissen areas	3M		
	• **Isohyetal method** **If P_1, P_2,…….P_n** are the values of Isohyets and **If a_1, a_2…………a_{n-1}** are the inter Isohyet areas respectively, then the mean precipitation over the catchment of area **A** is given by • $\bar{P} = \frac{a_1\left(\frac{P_1+P_2}{2}\right)+a_2\left(\frac{P_2+P_3}{2}\right) \dots + a_{n-1}\left(\frac{P_{n-1}+P_n}{2}\right)}{A}$ • The Isohyet method is superior to the other two methods especially when the stations are large in number.	3M		

P. T.O



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