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Internal Assessment Test 1 – MAY 2021

Sub:	*Hydrology and Irrigation Engineering*					*Sub Code:*	*18CV63*	*Branch:*	*CIVIL*
Date:	20/05/2021	Duration:	90 min's	Max Marks:	50	Sem / Sec:	A&B		OBE

Answer any FIVE FULL Questions

		MARKS	CO	RBT
1 (a)	Define precipitation. Explain different forms of precipitation.	[05]	CO1	L2
(b)	Explain with neat sketch about the types of precipitation	[05]	CO1	L2
2	The details of Thiessen polygons surrounding each rain gauge and the recordings of the rain gauges in the month of August 2011 are given below.	[10]	CO1	L2

Stations	A	B	C	D	E	F
Rainfall (cm)	121	134	145	126	99.8	115
Thiessen polygon area (km2)	720	380	440	1040	800	220

Determine the average depth of rainfall on the basin in August 2011 by (i) Theisen polygon method and (ii) arithmetic mean method.

3	A catchment has six rain gauge stations. In a year, the annual rainfall recorded by the gauges are:	[10]	CO1	L2

Stations	A	B	C	D	E	F
Rainfall (cm)	92.8	112.6	190.8	110.3	99.8	146.7

	For a 10% error in the estimation of the mean rainfall, calculate the optimum number of stations in the catchment.		CO1	L2
4	Explain with neat sketch Horton's engineering representation of the hydrologic cycle.	[10]	CO1	L2
5	Explain with formulae to find the optimum number of rain gauge stations.	[10]	CO1	L2
6	Write brief notes the on importance of hydrology and its practical application.	[10]	CO1	L2
7	List out various types of measuring rain gauges. Explain with a neat sketch of Syphon's rain gauge.	[10]	CO1	L2

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Hydrology & Irrigation Enggineering

03 A catchment has Six rain gauge Stations. in a year the annual rainfall recorded by the gauges are

Stations	A	B	C	D	E	F
Rainfall (cm)	92.8	112.6	190.8	110.3	99.8	146.7

For a 10% Error in the Estimation of the mean rainfall in the Existing Set of raingauges optimum ~~num~~ number of Stations in the catchment

for Given data

Number of raingauges $m = 6$

Mean annual rainfall $\bar{P} = 125.5$

$$\bar{P} = \frac{1}{m}\left[\sum_{i=1}^{m} P_i\right)$$

$$= \frac{1}{6}\{92.8 + 112.6 + 190.8 + 110.3 + 99.8 + 146.7\}$$

$$\bar{P} = 125.5$$

Standard deviation σ_{m-1} =

9994.92 + 1109893

$$\sigma_{m-1} = \sqrt{\frac{\sum_{i=1}^{m}(P_i - \bar{P})^2}{m-1}}$$

$$= \sqrt{\frac{(92.8-125.5)^2+(112.6-125.5)^2+(190.8-125.5)^2+(110.3-125.5)^2+(99.8-125.5)^2}{6-1} + (146.7-125.5)^2}$$

$\sigma_{m-1} = 47.12$ Standard deviation

Co-efficient of Variation $C_v = \frac{100 \times \sigma_{m-1}}{\bar{P}} = \frac{100 \times 47.12}{125.5} = 37.54$

(a) Standard Error in the Estimation of the mean

$$= \varepsilon_{ex} = \frac{C_v}{\sqrt{m}} = \frac{37.54}{\sqrt{6}} = 15.32\%.$$

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When the Error is limited to 10%. $\varepsilon = 10$ and the optimum number of raingauges in the catchment is Given by $N = \left(\frac{Cv}{\varepsilon}\right)^2 = \left(\frac{37.54}{10}\right)^2 = 8.72$

Hence optimum number of raingauges is 9 raingauges

Thus the number of additional raingauges required = (9-6) = 3

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05) Explain with formulae to find the optimum no of raingauge Station.

If there are already some raingauge Stations in a catchment the optimal number of Stations that should Exist to have an assigned precentage of Error in the Estimation of mean rainfall is obtained by Statical mean rainfall is obtain by Stastical analysis as

$$N = \left(\frac{Cv}{\varepsilon}\right)^2$$

where N = optimal number of Stations

ε = allowable degree of Error in the Estimate of the mean rainfall & co-co-efficient of Variation of the rainfall and

Cv = co-efficient of varion of the rainfall values as m Station in the catment Each reording rainfall values = $P_1, P_2, P_i \ldots P_m$ in a know time the co-efficient of variation of Cr is calculation

$$C_r = \frac{100 \times \sigma_{m-1}}{\bar{P}}$$

Where $\sigma_{m-1} = \sqrt{\frac{\sum_{i=1}^{m} (P_i - \bar{P})^2}{m-1}}$ Standard deviation

P_i - Precipitation magnitude in the ith Station

$\bar{P} = \frac{1}{m}\left[\sum_{i=1}^{m} (P_i)\right]$ mean precipitation

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Consider the existing m raingauges they have a mean rainfall of $\bar{P}$ and a co-efficient of variation of Cv

To know the precentage of Error (Ecr) of the Estimation of mean in the existing System of m raingauge Eq can be recoritume changing Nby (m) as

$$m = \left(\frac{Cv}{E_{ax}}\right)^2 = E_{cx} = \frac{Cv}{\sqrt{3}}$$

in the above Eqn the time E_{cx} represents the Expetied Error (in percentage) In the Estimation of a mean $\bar{P}$. it is a measure of the accuray Exitimation of mean precipitation in the existing System and is called Standard Error in the Extimation of the mean in calculating the number of raingauge N for a Given level of Error by using Eqn it is Usual to take E_{cx} as 10% it is Seen that if the Value of E_{cx} is Small No of raingauge required be more

02) The details of thiessen polygones Surrounding Each rain gauge and the recordings of the rain gauges in the month of August 2011 are given below

Stations	A	B	C	D	E	F
Rainfall	121	134	145	126	99.8	115
Thiessen polygon area (km^2)	720	380	440	1040	800	220

determine the average depth of rainfall on the basin in August 2011 by

i) Thiesen polygon method and ii) arithmetic mean method

Solution (ii) Arithmetic Mean: only raingauge Station. 1. 2 and 4 are within the basin

Hence the arithmetic mean is obtained by considering the readings of these station only

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$$\bar{P} = \frac{P_1 + P_2 + \ldots P_i + \ldots + P_n}{N} = \frac{1}{N} \sum_{i=1}^{n} P_i$$

$$= \frac{121 + 134 + 126}{3} = 127 \text{ mm}$$

(i) Thiessen Mean:- the calculation are performed in the tabular form

Totatal area of basin = Total of cl 2 = $3600 km^2$

Raingauge Station	Thiessen polygon area = (km^2)	Thiessen Wightage Factor (= Frition of total area (col 2/3600)	Station reading (= Monthy Rainfall in mm	Weighted Station rainfall (mm) = (col. 3 x col. 4)
1	720	0.200	121	24.2
2	380	0.106	134	14.1
3	440	0.122	145	17.7
4	1040	0.289	126	36.4
5	800	0.222	99.8	22.155
6	220	0.061	115	7.0
Total catiment area =	3600	1.000		121.655

Thiessen mean of the Station readings for the month of Aug. 2011 Total of col 5 = 121.655 mm

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07 List out Various types of measuring rain gauges. Explain with a Neat Sketch of Syphon's rain gauge

Two types of Rain gauge

01 Non Recording rain gauge

(a) Symon's rain gauge

(b) IMD rain gauge

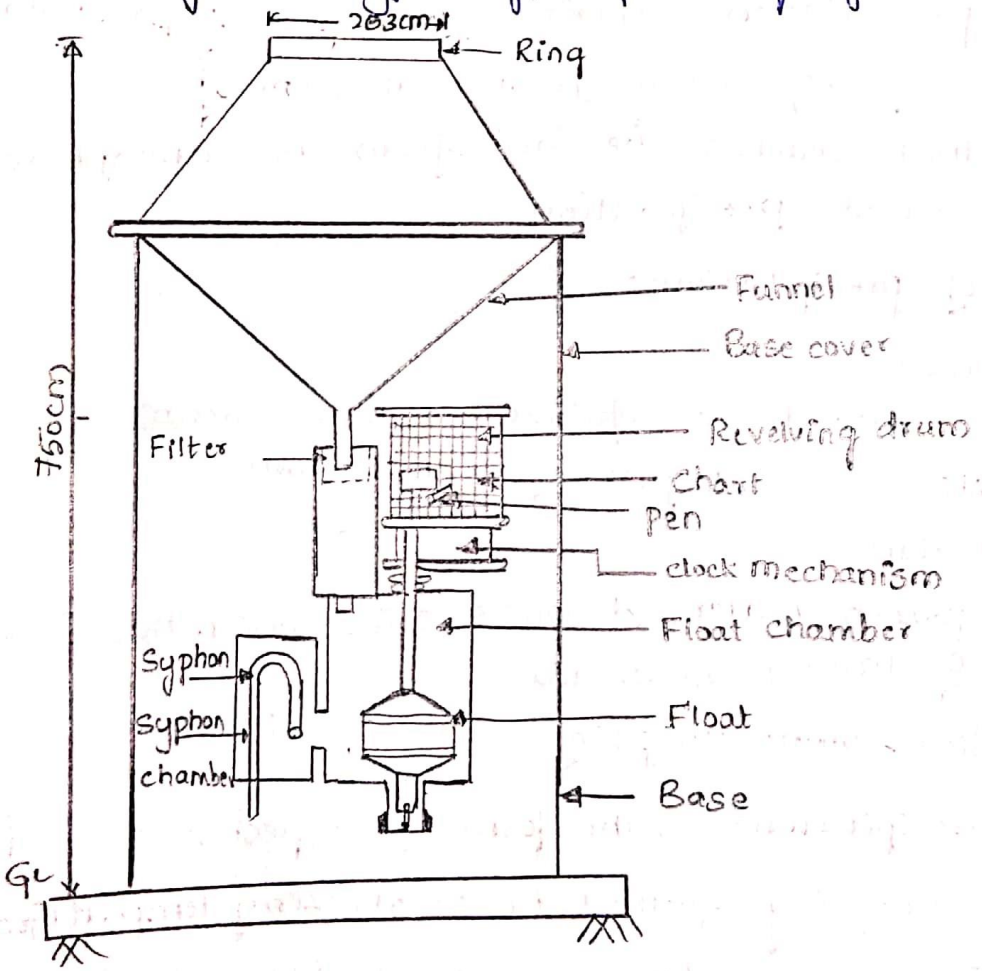
02 Recording Rain gauge

01) Tipping bucket type rain gauge

02) Weighing bucket type rain gauge

03) Flat type rain gauge / Natural Syphon type rain gauge

01 ~~Symon's~~ Syphon type of Rain gauge



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- This is also called integrating rain gauge as it depicts an integrated graph of rain fall with respect to time
- A recievrs and funnel arrangement drain the rainfall into a container in which a float mechanisum at the bottom is provided
- As Water accumulates the float rises A pen arm attached to the float mechin. continuously records the rainfall on a clock driven chart and also Produces a mass curves of rain fall
- When the water level rises above the crest of the Siphon the accumulated water in the continer will be drained off the Syphonic action the rain gauge is ready to receive the New rainfall

01) (a) Define precipitation, Explain different forms of precipitation

The term precipitation denotes all form of water that reaches the Earth from the atmosphere is called precipitation

formation of precipitation:-

-) Rain & Drizzle:
  Rain - wates droplets of Size = 0.5mm to 6mm
  Drizzle - water droplets of Size < 0.5mm

02) Sleet and Hail

Slut: frozen water droplets orice which has Size of 1mm to 4mm dia

Hail : Size > 5mm lumps of ice

03 Snow: Precipitaions in the form of ice flecks

04 Glaze : ice coating formed due to freezing temp at Ground

05 Dew: They wates droplets formed due to condensation of Atmospheric moisture during Night

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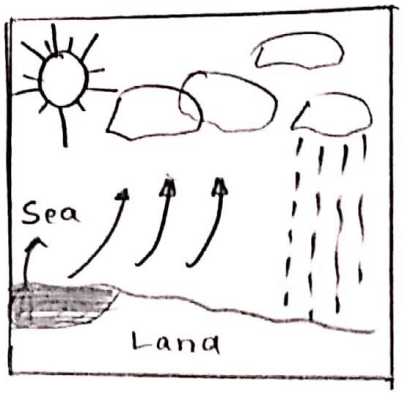
1)(b)

Types of precipitation:-

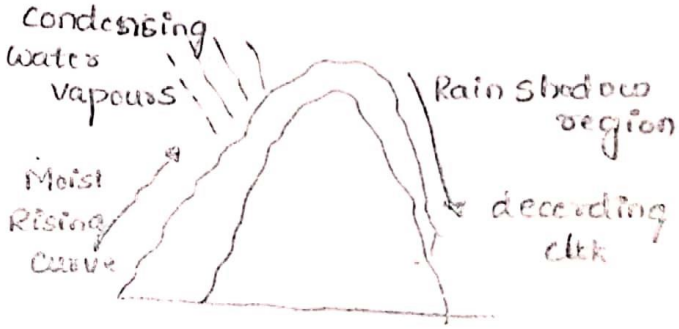
01 Convective precipitation

- This types of precipitation occurs due to Even heating of air masses
- The air mass close to the Earth Surface gets heated and its density decreases
- Consequently the air mass raises upword in the atmosphere and it gets cooled adiabatically to form colud precipition coused by such coluds is called convective preciptiation
- it covers a small area (less then 50 km²)
- The rain fall intensity may be very high sometimes it may even reach 10cm/hr



02 Orographic precipitation

- The precipitation caused by lifting of air over a mountain barrior is called orographic precipitation



- Due to lifting air masses gets cooled and condensation process takes place
- Heavy precipitation occurs on the wind word side of the mountain where as an the leawood direction

03 Cyclonic / Fontal precipitation

- Air tends to move into the low pressure zone form soursending Airs

04 Turbulent prepcipitation:

→ This type of prepictation occure when an air mass is forced to rise op due to fricition of the Earth Surface

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