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Internal Assessment Test I – Sept 2016

Sub:	Hydrology and Irrigation Engineering					Code:	10CV55
Date:	07/09/16	Duration:	90 mins	Max Marks:	50	Sem: 5	Branch: CV

Note Answer all questions. Sketch figures wherever necessary.

1. Define precipitation. Explain different forms of precipitation. (8)
2. Explain the methods of finding the mean precipitation over an area. (7)
3. The average annual rainfall in cm at 4 existing rain gauge stations is 105, 79, 70 and 66 cm respectively. If the average depth of rainfall over the basin is to be estimated within 10% error, determine the additional number of rain gauges required. (7)

P.T.O

4. a) Define mass curve and hyetograph with the help of a sketch. (3)
   b) Discuss Blaney Criddle formula for evapo-transpiration. (3)
5. What is infiltration? What are the factors that affect infiltration? (7)
6. Define evaporation. With a neat sketch, explain the measurement of evaporation using class A pan. (7)
7. For a small catchment, the infiltration rate at the beginning of the storm was observed 90mm/hr and decreased exponentially to a constant rate of 8mm/hr after 2.5 hrs. The total infiltration during 2.5 hour was 60mm. Determine the infiltration rate at 90mins by developing the Horton's equation. (8)

Signature of CI

For Prof DPh

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1. Precipitation:- The process by which different forms of water reaches the earth from atmosphere it may be either rain, sleet, snow, hail etc, is called as precipitation.
It mainly depends upon temperature, humidity, wind, pressure etc.,

Different forms of precipitation are:-
1) Rain 2) Snow 3) Sleet 4) drizzle 5) hail

1) Rain
It is form of water drops that reaches the surface of earth due to precipitation. The size of rain drop must be greater than 0.5 mm and less than 6 mm. If greater raindrops are formed then they are broken into small raindrops and and their by reducing size. The rainfall may be classified as low, medium, heavy in terms of cm/hr or mm/hr.

2) Snow.
It is form of precipitation which resembles as ice crystals. The density of snow varies from $0.06 g/cm^3$ to $0.15 g/cm^3$ and the average density is $0.15 g/cm^3$.

3) Drizzle.
As spinkle fragments formed by water reaches the ground surface at 0°C. The intensity may 0.01cm/hr.

4) Sleet
These are particles when water enters the air at the subfreezing temperature in the precipitation. It is mixture of snow and rain.

5) ~~Ha~~

5) Hail.
It is a showery precipitation forms as lumps of ice with size greater than 8mm. It forms during high thunder storm.

$P_1 = 105cm$ $P_2 = 79cm$ $P_3 = 70cm$ $P_4 = 66cm$

$\varepsilon = 10\%$ $m = 4$

$$\bar{P} = \frac{105 + 79 + 70 + 66}{4} = 80cm$$

$$C_v = \frac{100\,\sigma_{(m-1)}}{\bar{P}}$$

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

$$\sigma_3 = \sqrt{\frac{(105-80)^2+(79-80)^2+(70-80)^2+(66-80)^2}{3}}$$

$$\sigma_3 = 17.53\ cm$$

$$C_v = \frac{100 \times 17.53}{80}$$

$$= 21.91$$

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

$$= \left(\frac{21.91}{10}\right)^2$$

$$= 4.8 \simeq 5$$

So, the additional no. of gauges required = 5-3=2 !

Infiltration:- The process of movement of water from surface to ground is called infiltration. It mainly influences or depends on runoff process. The infiltration process depends on timing, distribution, and magnitude of rainfall.

Usually the high intensity rainfall area will have high infiltration capacity compared to the low intensity rain area.

Factors Affecting Infiltration Capacity

1) ~~S~~ Characteristics of soil →

→ sand, silt or clay, its texture, structure, permeability and underdrainage

→ loose ~~sand~~, permeable, sandy soil > ~~large~~ high infiltration capacity light clayey soil

→ A soil with good under-drainage (ie) facility to transmit the infiltered ~~do~~ water downward to GW storage - high infiltration

sedimentary rocks

→ soil in layers → transmission capacity of layer determine the overall infiltration rate

→ dry soil absorbs more water than ~~soil~~ whose pores are already full

→ Land use forest soil has ~~more~~ higher infil under identical con than urban area → compacted soi

2) Surface of Entry

At the soil surface, the impact of raindrops causes the fines in the soil to be displaced and these in turn can clog the pore spaces in the upper layers. This is an important factor affecting the infiltration capacity

Surface covered by grass and other vegetation → effect of fc

Fluid characteristics

Water infiltrating into the soil will have many impurities, both in solution & in suspension. Turbidity of the water, esp in clay and colloidal content is an important factor as such suspended particle block the fine pores in the soil and reduces its infiltration capacity.

temp of the water is a factor in a sense that it affects the viscosity of the water which in turn affects the infiltration rate.

contamination of the water by dissolved salts can affect the soil structure

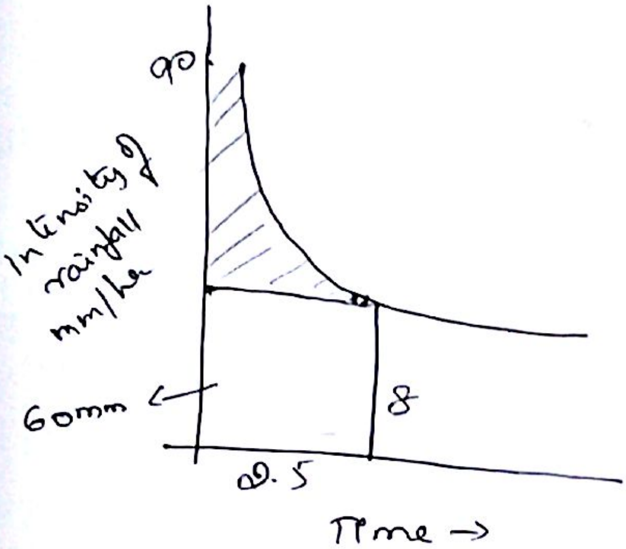
$f_{co} = 90 mm/hr$

$f_{cf} = 8 mm/hr$

$t_d = 2.5 hrs$

$I = 60 mm$ $t = 90 mins = 1.5$

$f_{ct} = ?$



$$f_{ct} = f_{cf} + (f_{co} - f_{cf})\, e^{-K_h t}$$

$$K_h = \frac{f_{co} - f_{cf}}{F_c}$$

F_c : field capacity

$= 60 - 2.5 \times 8$

$= 40 mm$

$$= \frac{90 - 8}{40}$$

$= 2.05$

$$f_{ct} = 8 + (90 - 8)\, e^{-2.05 \times 1.5}$$

$= 11.78 mm/hr$

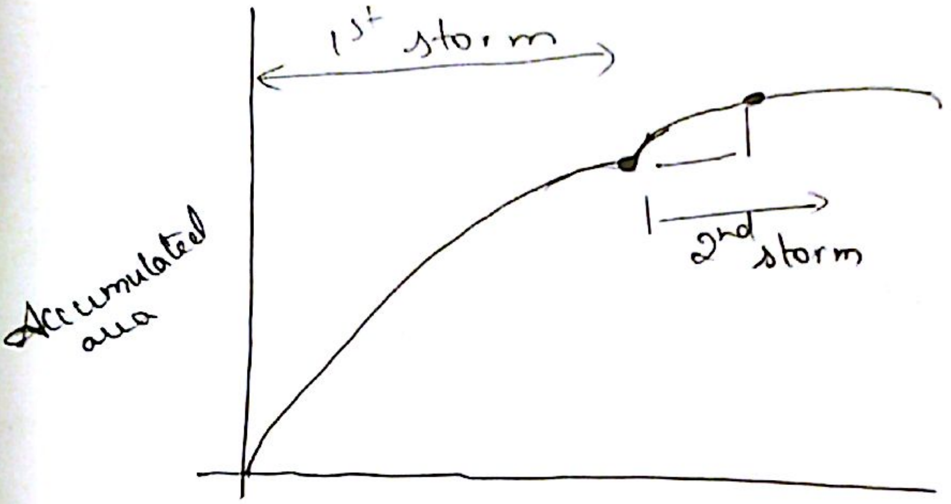
1hr:
30 = 0.5
90 = ?

$\frac{90 \times 0.5}{30}$

a) Mass curve method :-

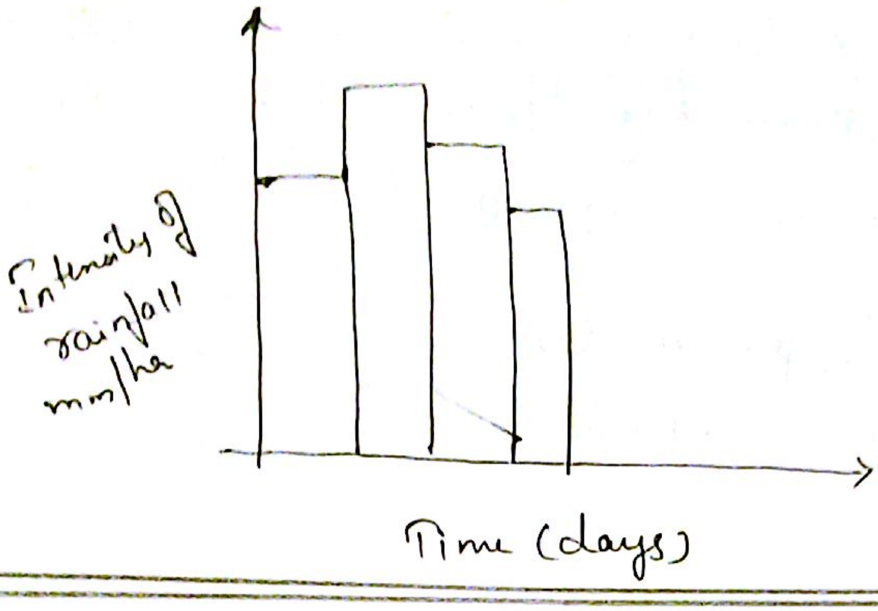
Mass curve:

This method is used to know the nature of storm or rainfall occuring @ that particular area. It is plotted between accumulated area & against the time.



Hyetograph:-

It is a bar graph, which derived from the the mass curve and it plotted by intensity of rainfall aganist time. It shows the magnitude and duration of rainfall of that particular area.



Blaney criddle formula for evapo-transpiration.
This formula is used @ the arid region.

$E_T = 0.54 K F$

E_T :- Evapo-transpiration of that particular area.

K = crop factor

$F = \frac{\Sigma P \bar{T_f}}{100}$

where F :- field capacity at that particular month.

P :- sum of rainfall data

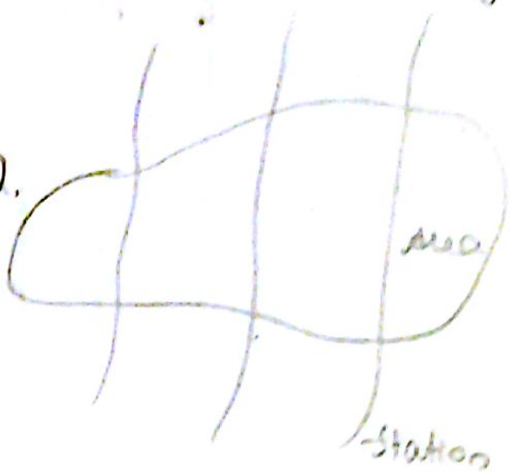
$\bar{T_f}$:- Temperature @ which the rainfall occurs in fahrenheit.

The methods of finding the mean precipitation over an area is given by three methods namely.

1) Arithmetic mean method.

2) Theissen polygon method.

3) Isohyetal method.



1) Arithmetic mean method

$$\text{Mean precipitation over an area} = \frac{\text{Sum of annual rainfall (cm)}}{\text{Total of rain gauge stations}}$$

$$= \frac{(P_1 + P_2 \; \ldots \; + P_m)}{m}$$

P_1, P_2 :- annual rainfall in mm

2) Theissen polygon method.

In this method, particular catchment area pertaining to that station is divided into small areas and the avg ~~precip~~ precipitation is calculated by annual rainfall of that area.

It is given by.

$$= P_1\left(\frac{a_1}{A_1}\right) + P_2\left(\frac{a_2}{A_2}\right) + P_3\left(\frac{a_3}{A_3}\right)$$

where $\frac{a_1}{A}$ is the weightage factor of area.

3) Isohyetal method.

This method is more precison compared to other two method and it is determined by knowing average precepitation of the area with fraction of area pertaining to that particular catchment area.

It is given by.

$$= \frac{\left(\frac{P_1 + P_2}{2}\right) a_1 + \left(\frac{P_2 + P_3}{2}\right) a_2 + \cdots \left(\frac{P_{m-1} + P_m}{2}\right) a_m}{A}$$

$P_1, P_2 \ldots P_m$:- annual rainfall in mm

$\frac{a_1}{A_1}$:- fraction area factor or weightage area factor.

6. Evaporation:-

It process converting water from liquid state to gaseous state under the influence of heat energy. Evaporation may depends on temperature, wind, vapour pressure, soluble salts, Atmospheric pressure. It type of loss.

Factors which affects evaporation are:-

1) Temperature:- As the temperature increases the evaporation rate goes on increasing

2) Wind:- The wind will also influence the water to evaporate from evaporation zone. As the wind increases, the evaporation goes on increasing and at critical point further increase in wind will not affect evaporation.

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3) Soluble salts:-
When salts are added to water the vapour pressure goes on decreasing due to this the evaporation decreases.

4) Vapour pressure:- As the vapour pressure increases the evaporation goes on increasing. And it depends on relative humidity.

Measurement of evaporation using class A pan.

This type of apparatus which is used to measure the rate of evaporation. It is a container of diameter 1210mm and ~~depth~~ height about 550 mm. And it covered by galvanised iron sheet. If it causes the corrosion then monal steel is used. The depth 18mm to 25mm is maintained for water. It is placed on the wooden horizontal surface of 1215mm dia. Now a days it is covered by wire mesh which prevents the attack of birds and wind. The pointing gauge is attached to it to measure the rate of evaporation. It is not placed on ground surface, minimum 10-15mm is left space for air penetration purpose.

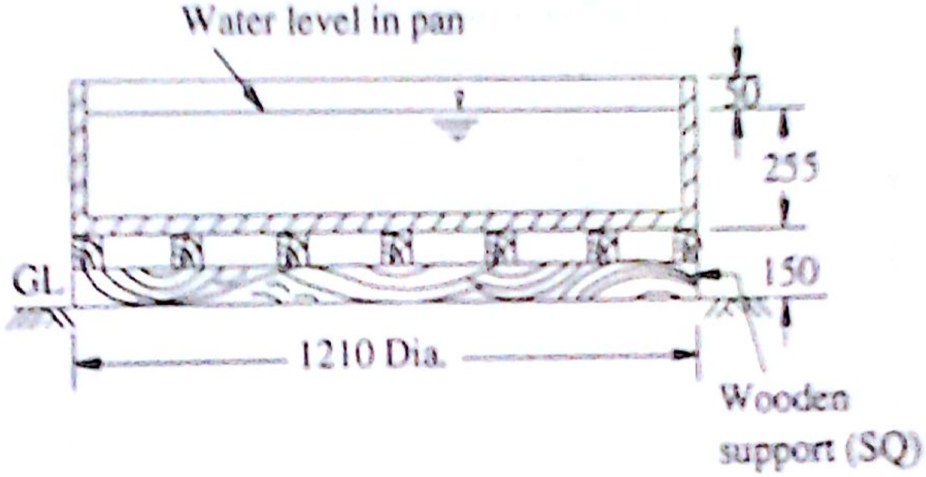

Fig. 3.1 U.S. Class A evaporation pan