Mid-Sem Exam- 2018
Engineering Hydrology [Solution]
Code: 011X12

Qu1 Define following:-

a) Rainfall distribution:- Rainfall distribution is the variability of the intensity throughout a storm. although the overall depth for a storm will be the same for a given duration no matter which distribution is chosen.

b) Infiltration Capacity:- The maximum rate at which rain can be absorbed by a soil in a given condition.

c) ϕ index:- ϕ index is the average rainfall above which the rainfall volume is equal to the runoff volume. It is the average filtration rate during the priod of rainfall excess.

d) Confined aquifer:- A confined aquifer is an aquifer below the land surface that is saturated with water. Layers of impermeable material are both above and below the aquifer, causing it to be under pressure so that when the aquifer is penetrated by a well, the water will rise above the top of the aquifer.

e) Flow duration curve:- A flow-duration curve of a stream is a plot of discharge against the percent of time the flow was equalled or exceeded. This curve is also known as discharge-frequency curve.

Qu2

Ans Area = 500 ha = $500 \times 10^4 m^2$

discharge = $0.34 \times 10^6 m^3$

Runoff = $\frac{\text{discharge}}{\text{Area}} = \frac{0.34 \times 10^6}{500 \times 10^4} = 0.068 m = 6.8 cm$

Time start (hr)	2	4	6	8	10	12	14	16	18
Cummulative rainfall (cm)	0.8	2.6	2.8	4.1	7.3	10.8	11.8	12.4	12.6
Incremental rain (cm)	0.8	1.8	0.2	1.3	3.2	3.5	1	0.6	0.2
Intensity of rain (cm/hr)	0.4	0.9	0.1	0.65	1.6	1.75	0.5	0.3	0.1

given duration = 18 hrs.

N = 9

Trail : 1

Assum $m = 9$

$$R_d = \sum_{1}^{9} (I_i - \phi)\Delta t$$

$$= \sum_{1}^{9} (I_i \Delta t - \phi \Delta t)$$

$$= (0.4 \times 2) + (0.9 \times 2) + (0.1 \times 2) + (0.65 \times 2) + (1.6 \times 2) + (1.75 \times 2) + (0.5 \times 2) + (0.3 \times 2) + (0.1 \times 2) - 18\phi$$

$$6.8 = 12.6 - 18\phi$$

$$\phi_1 = \frac{5.8}{18} = 0.32$$

$m_c = 6 \neq m$

try a value of less than 9

$m = 8$

$$\phi_2 = \frac{(12.6 - 6.8) - 0.2}{16}$$

$$= 0.35$$

$m_c \neq 6 \neq m$

$m = 7$

$$\phi_3 = \frac{5.8 - 0.2 - 0.6}{14} = 0.36$$

$m = 6$

$$\phi_4 = \frac{5.8 - 0.2 - 0.6 - 0.2}{12}$$

$$= 0.4$$

hence $m_c = m$

$$\phi_{index} = 0.40 \text{ cm/h}.$$

Qu 3

(a) The relationship between rainfall in a period and the corresponding runoff is quite complex and is influenced by a host of factors relating to the catchment and climate. Further, there is the problem of paucity of data which forces one to adopt simple correlation for adequate estimation of runoff.

The eqn of the straight line regression between runoff R & rainfall P is

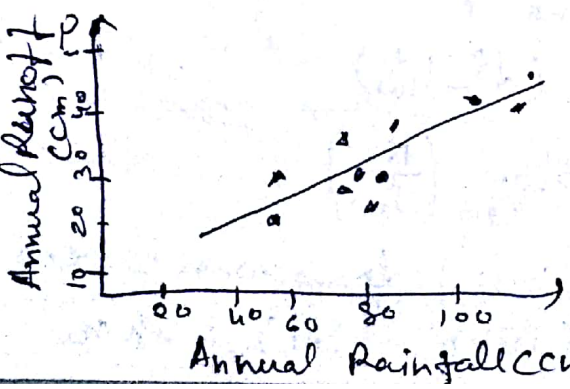
$$R = aP + b$$

a & b given by

$$a = \frac{N(\Sigma PR) - (\Sigma P)(\Sigma R)}{N(\Sigma P^2) - (\Sigma P)^2}$$

$$b = \frac{\Sigma R - a(\Sigma P)}{N}$$

N = no. of observation sets R and P. The coefficient of correlation r can be calculated ---



Qu 3

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

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

$C_v = \frac{1006}{\bar{P}}$

$\sigma = \sqrt{\frac{\sum_1^n (P_i - \bar{P})^2}{n-1}}$

$= \sqrt{\frac{(105-80)^2+(79-80)^2+(70-80)^2+(66-80)^2}{4-1}}$

$= 17.53$

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

$C_v = \frac{100 \times 17.53}{80} = 21.914$

$N = \left(\frac{21.914}{10}\right)^2 = 4.80 \cong 5$

Additional raingauge req^d = 5 − 4 = 1 Ans

Qu 4

Ans $d = 100\ m$

$S_1 = 12\ m$ $\quad S_2 = 18\ m$

$Q_1 = 250\ l/minute$ $\quad Q_2 = ?$

using Dupuit's formula for unconfined aquifers

i.e. eqn we have

$$Q = \frac{\pi K (d^2 - h_w^2)}{2.3 \log_{10}\left(\frac{R}{r_w}\right)}$$

In the first case; drawdown = 12m

$h_w = (100m - 12m) = 88\ m$

$$<50\,l/\text{minutes} = \frac{\pi K[(100)^2-(88)^2]}{2.3\log_{10}\left(\frac{R}{r_w}\right)}$$

(here R & r_w are the same for both the cases)

$$\frac{\pi K}{2.3\log_{10}\left(\frac{R}{r_w}\right)} = \frac{250}{(100)^2-(88)^2} = \frac{250}{188\times 12} \quad ----(A)$$

In the 2nd case: Drawdown = 18 m

$h_w = 100 - 18 = 82$ m

$$Q_2 = \left[\frac{\pi K\times(100)^2-(82)^2}{2.3\log_{10}\left(\frac{R}{r_w}\right)}\right]$$

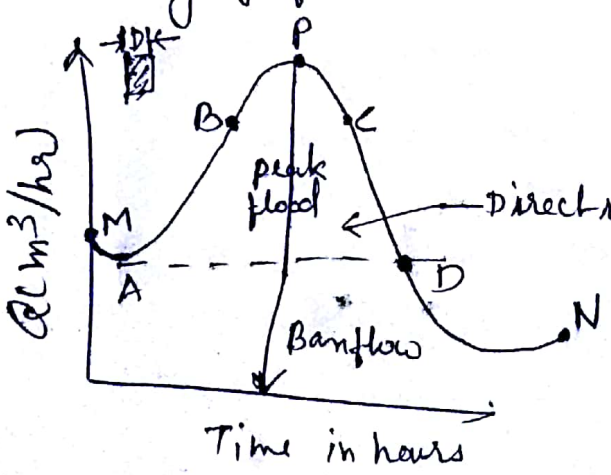
putting the value from (A), we get

$$Q_2 = \left[\frac{250}{188\times 12}\right][(100)^2-(82)^2]$$

$$= \frac{250\times 182\times 18}{188\times 12} = 363 \text{ litres/minute}$$ Ans

Qu 5 Ans

a) Hydrograph is a graph showing the rate of flow versus time passing a specific point in a river channel carrying flow.



Hydrograph components

MA = base flow recession
AB = rising limb
BC = crest segment
CD = falling limb
DN = base flow recession
points B and C = Inflection points

Elements of a flood hydrograph

Qu5 Ans

(b)

Time (1)	1 hr UH (2)	1 hr. U.H lagged by 1 hr (3)	2+3 (4)	Ordinate of 2 hr (4/2)
0	0	—	0	0
1	5	0	5	2.5
2	8	5	13	6.5
3	5	8	13	6.5
4	3	5	8	4
5	1	3	4	2
		1	1	0.5

Qu6 Methods of recording of rainfall:-

→1) Non-Recording gauge

→2) Recording gauge

a) Tipping Bucket type

b) Weighing bucket type

c) Natural Syphon type.

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