Notes by-

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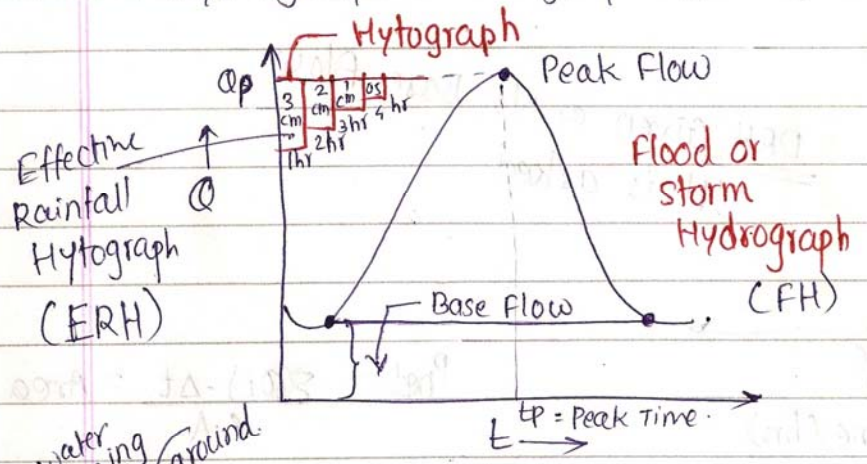
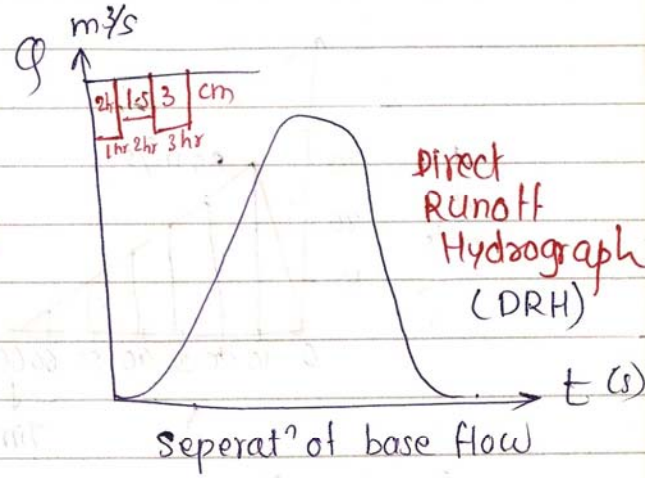
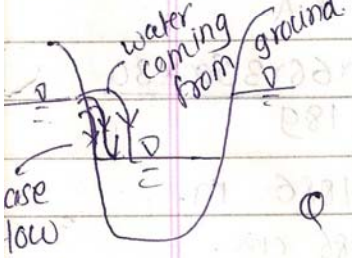
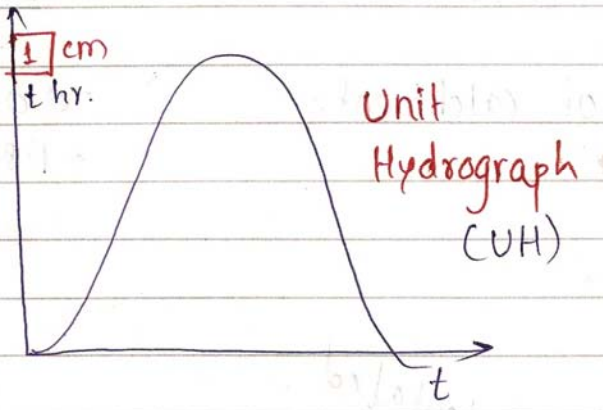
Hydrograph

Hydrograph is a graph of Q Vs t









Area of Hydrograph
= Q × t (m³) Vol
= Runoff vol.
= Eff Rainfall Q = P.I. (m³/s)

Ruoff vol = Eff. rainfall depth × ~~catment~~ catchment area
(Rainfall excess)

FH − Baseflow = DRH

DRH + Baseflow = ~~FH~~ FH

Area of Hydrograph = Pnet (eff. rainfall) × CA (catchment area).

$$\therefore P_{net} = \frac{\text{Area of Hydrograph}}{C.A.}$$

$$\boxed{P_{net} = \frac{\Sigma(Q_i \cdot \Delta t)}{C.A.}}$$

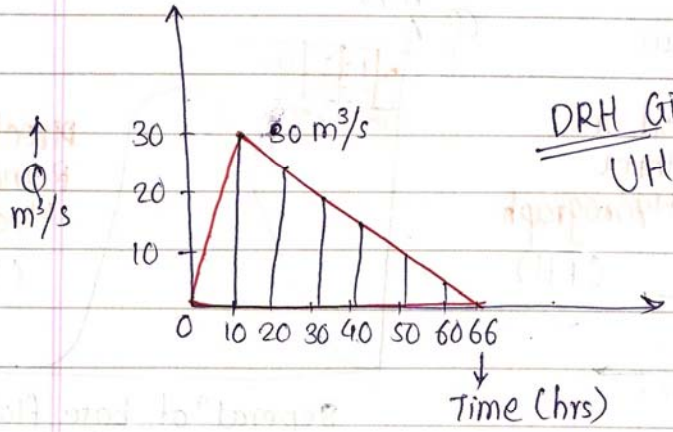
$$UH = \frac{FH}{P_{net}} = \frac{DRH}{P_{net}}$$

Δt = Time interval

Q_i = Ordinate of DRH or ~~UH~~ UH

Prob:-1] CA = 189 km^2

Duration of storm = 6 hrs.



DRH Given as No Base flow.
UH is asked.

Base Flow = 0

Peak ordinate = 30

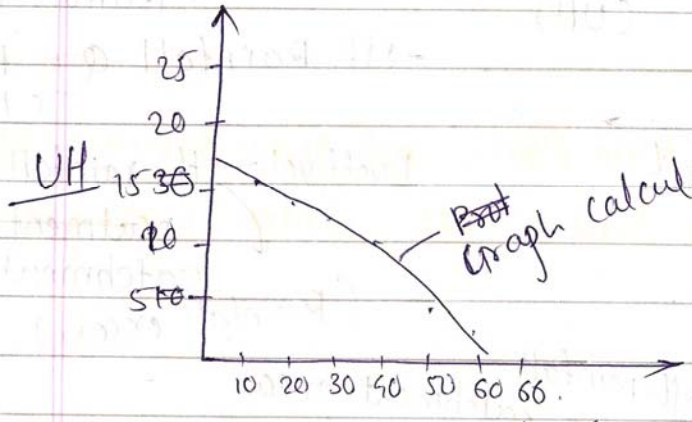
Develop 6 hr. UH of catchment.

$$P_{net} = \frac{\Sigma(Q_i)\cdot\Delta t}{C\cdot A} = \text{Area}.$$

$$= \frac{\frac{1}{2}\times 66\times 3600\times 30}{189}$$

$$= 0.01886.\ m.$$

$$= 1.886\ cm.$$



Graph calculated.

Net accurate

Time	DRO	UHO = DRO/Pnet
0	0	
10	30	30/1.886 = 15.91
20	25	13.26
30	19	10.07
40	13.5	~~4.50~~ 7.158
50	8.5	4.50
60	3.0	1.59
66	0	0

FHO of 6 hr. Durat^n given

~~40~~ 42 assumed

Pro: 2]

Time (hr)	FHO Q (m³/s)	DRH = FHO − Base Flow	UH = DRH / Pnet
0	40	0	0
6	65	23	4.637
12	215	173	34.88
18	360	318	64.113
24	400	358	68.145
30	350	308	62.096
36	220	228	45.97
42	205	163	32.86
48	145	~~105~~ 103	20.77
54	100	~~6~~ 58	11.69
60	70	28	5.65
66	50	8	1.61
72	42	0	0
		ΣQ = 1768	

$$P_{net} = \frac{\Sigma Q \cdot \Delta t}{L.A.} \quad (\Delta t \text{ in sec})$$

$$= \frac{1768 \times 6 \times 3600}{770 \times 10^6} \quad (\text{L.A. in } km^2)$$

$$= 0.04959$$

$$= 4.96 \text{ cm}$$

Plot Graph

as ~~DRH is~~ Base flow is not given assume as 42 or 40 ~~to~~ first & last which is greater

Pro 3]

Note

6H FH	6H DRH	6H UH	4H UH = $\frac{4}{6}$ × UH of 6

Pro: 3] Duration = 6 Hr

FH Q_p = 470 m³/s

Pmean = 8 cm

Iloss = 0.25 cm/hr.

Base flow = 15~~8~~ m³/s

Estimate the peak discharge of UH = ?

Sol^:- $(Q_p)_{DRH} = (Q_p)_{FH} - \text{Base Flow}$

$= 470 - 15 = 455 \ m^3/s$

$(Q_p)_{UH} = \frac{(Q_p)_{DRH}}{P_{net}}$

$\therefore P_{net} = P_{mean} - \text{Infiltrat}^n$

$= 8 \text{ cm} - 0.25 \times 6^{hr}$ (cm/hr)

$= 6.5 \text{ cm}$

$\therefore (Q_p)_{UH} = \frac{455}{6.5} = 70 \ m^3/s$

Pro:4] S-curve Hydrograph :-

Time (hr)	Q (m^3/s) ← UH ⇒ Rainfall excess for 1 UH = Pnet = 1 cm
UH → 0	0
1	5
2	8
3	5
4	3
5	1
6	0
	$\Sigma Q_i = 22$

shows UH

$P_{net} = \frac{(\Sigma Q_i) \cdot \Delta t}{C.A}$

$\therefore CA = \frac{(\Sigma Q_i)\Delta t}{P_{net}} = \frac{22 \times 1 \times 3600}{(1/100)} = 7.92 \times 10^6 \ m^2$ (1/100 in cm)

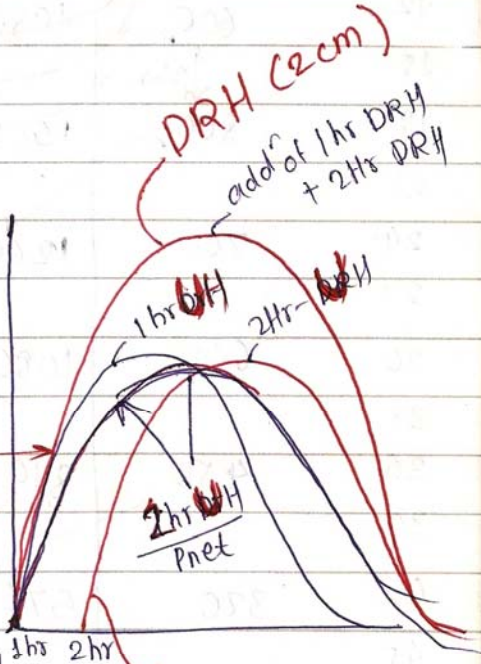
S curve is nothing but Summat^ Curve

Time (hr)	Q m³/s	S_A	S_B (starts after T hrs. ↳ To be calculate 2H UH)	$(S_A - S_B)\cdot\frac{D}{T}$ (Given D hr UH → Reqd. T hr UH to be find out)
0	0	0	—	$0 \times \frac{1}{2} = 0$
1	5	5	—	$5 \times 0.5 = 2.5$
2	8	13	0	6.5
3	5	18	5	6.5
4	3	21	13	4
5	1	22	18	2
6	0	22	21	0.5
	$\Sigma = 22$	22	22	0

Both same stop

2Hr UH ordinates

1hr DRH



Mtd IInd :- Mtd. of Super position :-

Time (hr)	Q (m³/s)	DRH 1 hr UH	UH 2 hr UH	DRH 2cm, 2hr	UH 2hr = DRH 2h / Pnet
0	0	0	0	0	0
1	5	5	0	5	2.5
2	8	8	5	13	6.5
3	5	5	8	13	6.5
4	3	3	5	8	4
5	1	1	3	4	2
6	0	0	1	1	0.5
			0	0	

Pro: 6]

Time (h)	6hr UH m³/s	1.8 DRH	3.8 DRH	2.8 DRH (start about 12hr. : upto 12hr zero)	DRH (1.8+3.8+2.8 starts at 6Hr.	FH = DRH + Base Flow
0	0	0×1.8 = 0	0 (start at 6hr see Fig)		0	30
3	150	150×1.8 = 270	0		270	300
6	250	250×1.8 = 450	0		450	480
9	450	810 →	150×3.8 = 570		1380	1410
12	600	1080 →	250×3.8 = 950	—	2030	2060
15	↕3hr		450×3.8 = 1710	150×2.8 = 420 →	No need	
18	800	1440 →	2280	700	4420	~~445~~ 4450
21			↕	1260		
24	700	1260 →	3040	1680	5980	6010
27				} 6hr		
30	600	1080	2660	2240	5980	6010
33						
36	450	810	2280	1960	5050	5080
39						
42	320	576 →	1710	1680	3966	3996
45						
48	200	360	1216	1260	2836	2866
51						
54	100	180	760	896	1836	1866
57						
60	50	90	380	560	1030	1060
63						
66	0	0	190	280	470	500
69						
72			0	140	140	170
75						
78				0	0	30
80						6Hr.

$Q = AV$

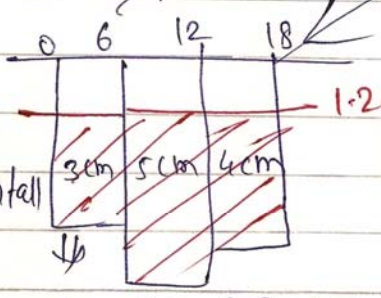
$m^3/s = m^2 \times m/s$

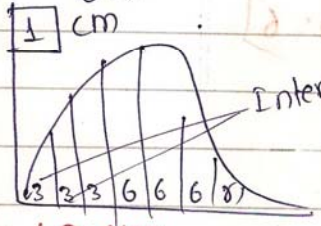
$m^3/s = m^2 \times m/s$

cm^3/s

$C = \frac{1}{n}$

Next DRH start at the end of 6 Hr.





$\phi = 0.2$ cm/h.

ϕ index for 6hr = $0.2 \times 6 = 1.2$ cm.

1.8 3.8 2.8 ~ after deducting ϕ index = Eff. rainfall = ERH