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Internal Assessment Test 3 – Dec. 2020

Sub:	Hydrology and Irrigation Engineering					Sub Code:	17CV73/ 15CV73	Branch:	Civil
Date:	16/12/2020	Duration:	60 min	Max Marks:	50	Sem/Sec:	VII – A & B		OBE

Answer all questions

		MARKS	CO	RBT
1	List the limitations of unit hydrograph. Describe the methods of base flow separation along with diagram	[10]	CO2	L2
2	Write notes on canal classification.	[10]	CO5	L3
3	A channel section has to be designed for the following data: Discharge, Q = 30 cumecs, Silt factor, f = 1.00, Side slope = ½:1.Also, find the longitudinal slope.	[10]	CO2	L4
4	Find out the coordinates of a storm hydrograph resulting from a 3 hour storm with rainfall of 3, 4.5 and 1.5cm during subsequent 3 hour intervals. The ordinates of unit hydrograph are given in the table below.	[10]	CO2	L4

T(h)	0	3	6	9	12	15	18	21	24	27	30	33	36
3h - UH (m3 /s)	0	90	200	350	450	350	260	190	130	80	45	20	0

Assume an initial loss of 5 mm, infiltration index of 5mm/ h and base flow of 20 cumecs.

5	Convert the 4h unit hydrograph to 12h unit hydrograph using S curve method												[10] CO5 L4

T (h)	0	4	8	12	16	20	24	28	32	36	40	44
4h UH (m^3/ s)	0	20	80	130	150	130	80	52	27	15	5	0

All the Best

Sign of CI **Sign of CCI** **Sign of HOD**

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16/12/2020

1. => Limitations of Unit hydrograph

* It assumes uniform rainfall. Uniformity in rainfall rarely exist
* Min area 2km^2 – Max area 5000km^2.
* Precipitation - rainfall only.
* Catchment should not have large storage in the form of ponds, tanks & bank storages.
* In use of unit hydrographs, very accurate reproduction of results should not be expected. Variations in the hydrographs base of as much as ±20% & in the peak discharge by ±10% are normally considered applicable

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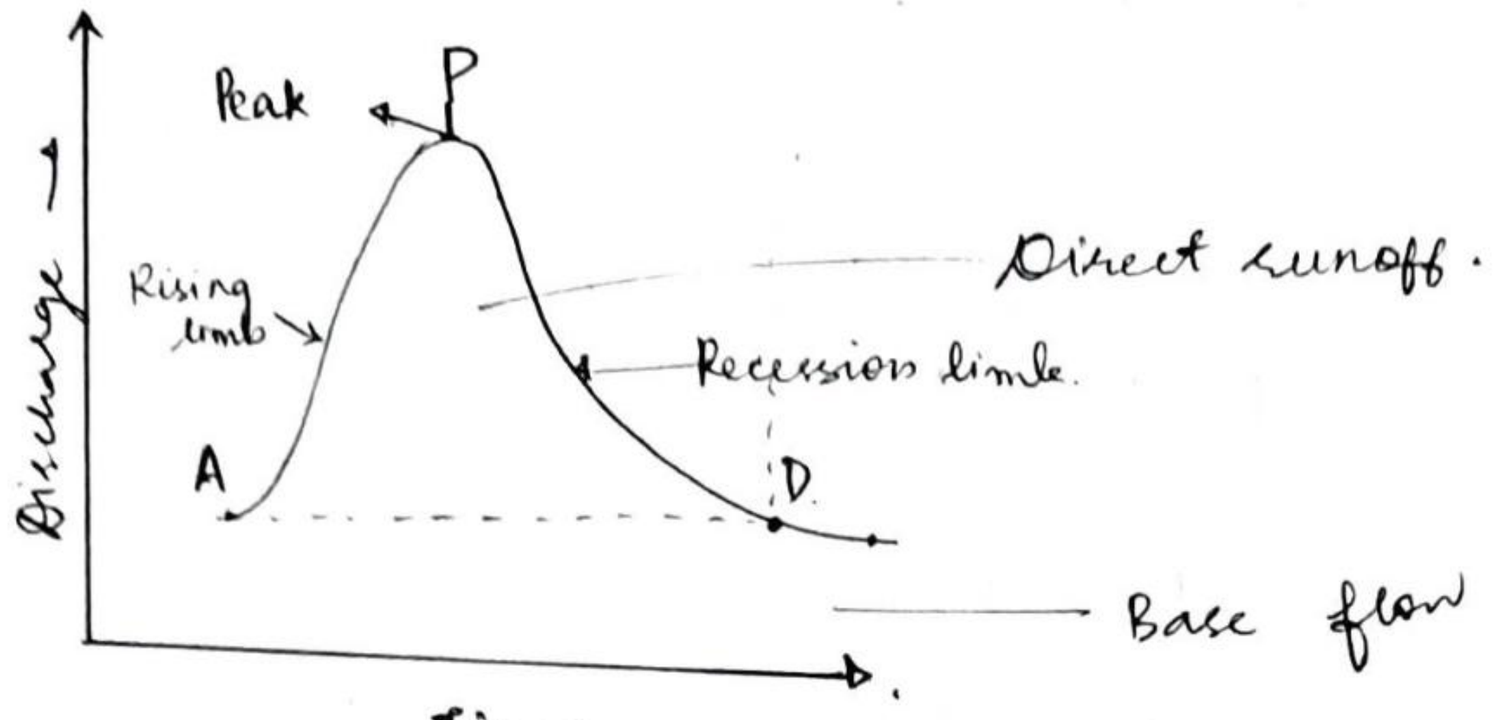
=> Methods of Base Flow Separation

* There are 3 popular methods
* Point A can easily be identified - at the beginning of direct runoff.
* Point D - difficult to identify - at the end of direct runoff.

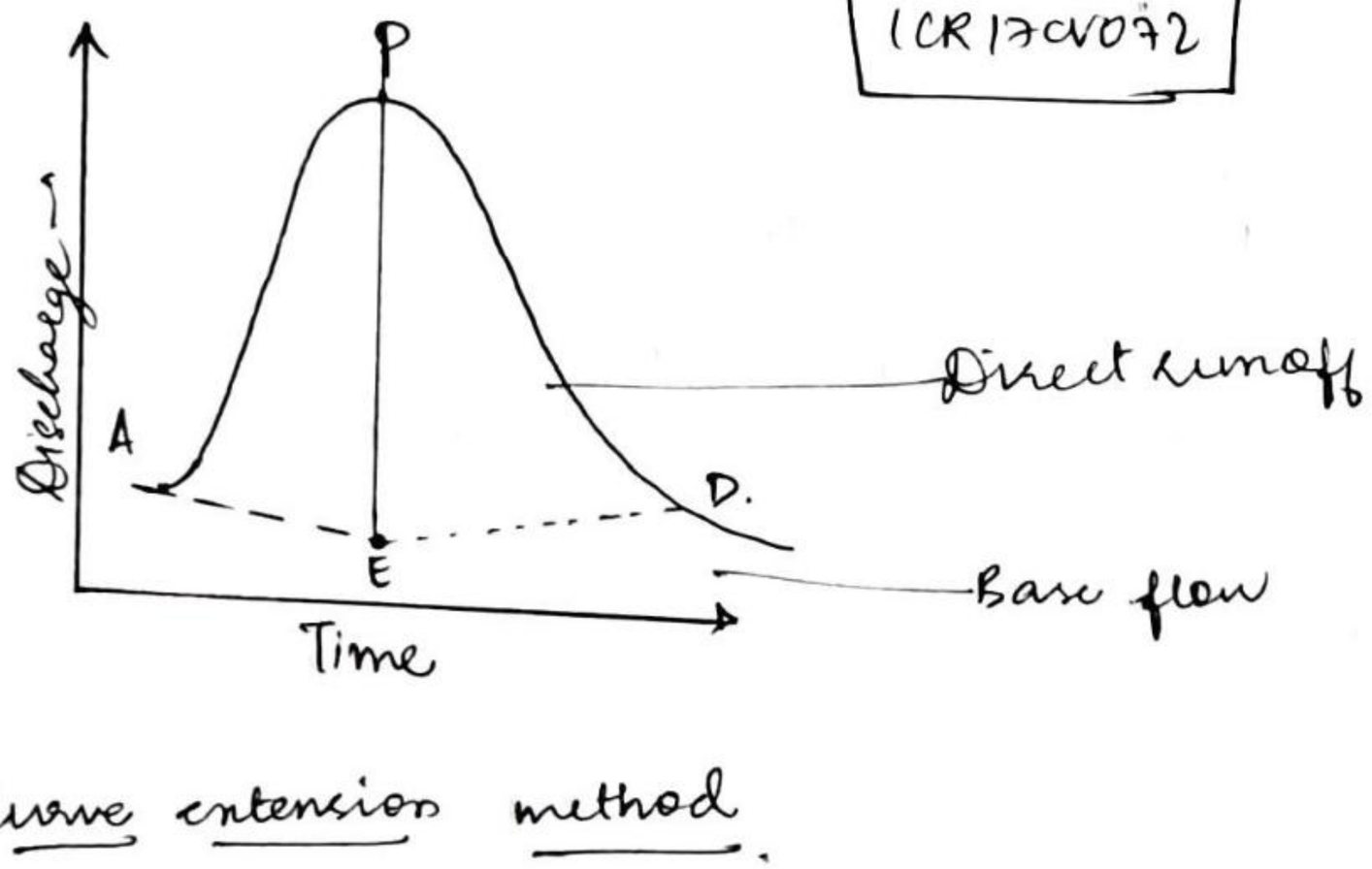
i) ~~Method of~~ Straight line method.

* A straight line is drawn between point A and point D. to demarcate to the base flow and surface runoff.
* This method is the simplest of all three methods



ii). Two - lines method

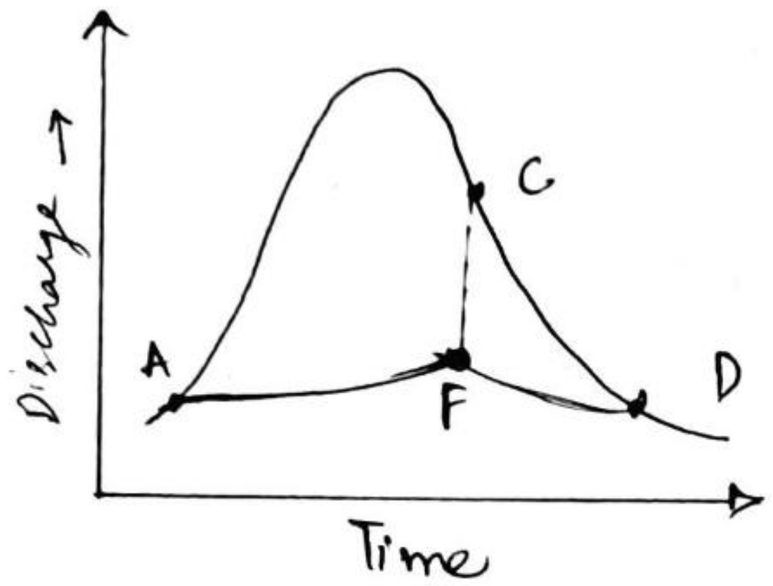
* The base flow curve existing prior to the commencement of surface runoff is extended till it interseets the ordinate drawn at the peak 'P' (point E].
* This point is joined to point 'D' by a straight line.
* Segment AE & ED demarcate the base flow & surface runoff.
* This is widely used.



iii) Curve extension method.

* After depletion of the flood water, ~~is extended backwards~~. the base flow recession curve is extended backwards till it intersects the ordinate at the point of inflection.
* Points A & F are joined by a smooth curve.

* This is practical when groundwater contributions are significant & reach the stream quickly.



2) Canal classification

i) Based on Source of supply

a) Permanent canal - * there is a continuous source of water supply.
* Also called perennial canals

b) Inundation Canal - * Draws it's supplies from a river only during the high stages of the river

ii) Based on Financial Output

a) Productive Canal - net revenue to the nation after full development of irrigation of the area

b) Protective canal - It is a relief work constructed with the idea of protecting a particular area from famine.

c) Based on Function

i) Irrigation Canal - Carries water from its source to agricultural fields

ii) Navigation canals. Used to transport goods

iii) Power Canal - to carry water for generation of hydroelectricity

iv) Feeder canal - + feeds two / more canals.

d) Based on boundary surface of canal.

i) Alluvial canal - excavated in alluvial soils such as silt.

ii) Non-alluvial canals - in non alluvial soils eg clay, hard soil, rock etc

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iii) Rigid Boundary canal - rigid sides & base - lined canals.

e) Based on lining provided

i) Unlined canal → * bed & banks made of natural soil.
* water velocities higher than 0.7m/s are not tolerable
* high seepage & conveyance water losses
* profuse growth of aquatic weeds retards the flow.

ii) Lined canal → * lining of impervious material on its bed & banks to prevent seepage.
* Diff types of lining are used eg - concrete, brick / burnt clay.

6) Based on Discharge

i) Main Canal — takes off directly from upstream side of weir head works or dam
* no direct cultivation is proposed,

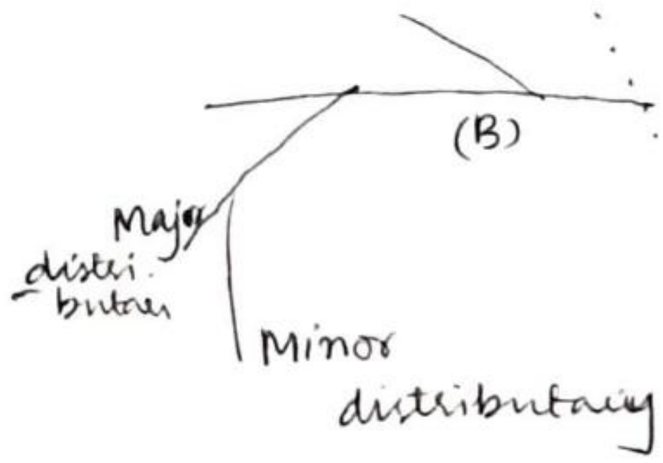
ii) Branch canal — branches off from either side of main canal.
* All offtakes from main canal with head discharge of $5\ m^3/s$ & above are termed as branch canals.
* acts as feeder channel for major distributaries.

iii). Major Distributary.
* All offtakes from main canal / branch canal with head discharge from 0.25 to $5\ m^3/s$ are termed as major distributaries.

iv) Minor Distributary
* all offtakes from a major distributary carrying discharge less than 0.25 cumecs are termed as minor distributary.

v) Water course.
Small channels which carry water from the outlets of a major / minor distributary or a branch canal to the fields to be irrigated.

:- water shed.



9) Based on Canal Alignment

i) Water shed canal / Ridge Canal.

* It is the dividing ridge line b/w the catchment areas of 2 streams
* b/w 2 major streams, there is a ridge line that divides the drainage area of the 2 stream
* aligned along any natural water shed.
* saves the cost of construction of cross-drainage works

ii) Countor Canal

* also water shed canal is not found economical in hilly areas.
* This canal irrigates only oneside because the area on the other side is higher.

iii) Side slope canal

* that is aligned at right angles to the contours
* runs parallel to natural drainage flow.

3) Given $Q_s = 30\ m^3/s$

$f = 1$

side slope : 0.5 : 1

i) $V_{mean} = \left(\frac{Qf^2}{140}\right)^{1/6} = \left(\frac{30*1^2}{140}\right)^{1/6} = 0.773\ m/s.$

ii) $A = Q/V = \frac{30}{0.773} = 38.80\ m^2.$

iii $A = BD + 0.5D^2$ [side slope = 0.5:1]

$38.8 = BD + 0.5D^2 \longrightarrow (1)$

iv) $P = 4.75\sqrt{B}$

$= 26\,cm$ //

v) $P = B + D\sqrt{5}$

$26 = B + D\sqrt{5} \longrightarrow (2)$

from (1) & (2)

$B = 26 - D\sqrt{5}$. substituting in (1).

$38.8 = (26 - D\sqrt{5})D + 0.5D^2$

$38.8 = 26D - D^2\sqrt{5} + 0.5D^2$

$38.8 = 26D - 1.736D^2$

$D = 1.68\,m$ //

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$P = B + D\sqrt{5} = B + 1.68\sqrt{5} = 26$

$B = 26 - 1.68\sqrt{5}$

$B = 22.24\,m$ //

$R = \frac{5}{2} * \frac{r^2}{f} = \frac{5}{2} * \frac{0.773^2}{1} = 1.49m$

$R = \frac{BD + 0.5D^2}{B + D\sqrt{5}} = \frac{22.24 * 1.68 + 0.5(1.68)^2}{22.24 + 1.68(\sqrt{5})}$

$R = 1.49m$

So the design is OK //.

Bed slope $S = \frac{f^{5/3}}{3340Q^{1/6}} = \frac{1^{5/3}}{3340 * (30)^{1/6}} = \frac{1}{5887.53}$ //

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4)

Time (h)	Rainfall (cm)	ϕ index. cm/hr.	If	Rainfall excess.
0	0	[illegible]	[illegible]	—
3	3	0.5	1.5	1.5
6	4.5	0.5	1.5	3
9	1.5	0.5	1.5	0.

T(h).	3h-UH	(X) 3H*1.5 DRH 1.5cm	3H*3cm DRH 3cm.	(Y) DRH3cm lag by 3h.	(Z) Base flow.	Storm hydrograph (X+Y+Z)
0	0	0	0		20	20
3	90	135	270	0	20	155
6	200	300	600	270	20	590
9	350	525	1050	600	20	1145
12	450	675	1350	1050	20	1745
15	350	525	1050	1350	20	1895
18	260	390	585	1050	20	1460
21	190	285	570	585	20	890
24	130	195	390	570	20	785
27	80	120	240	390	20	530
30	45	67.5	135	240	20	327.5
33	20	30	60	135	20	185
36	0	0	0	60	20	80.
				0	—	

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5)

T(h)	4h (UH) (m^3/s)	Scurve additon	Scurve (X)	Scurve lag by 12hr. (Y)	Diff (D) (X-Y)	12h UH D/12 * 4.
0	0		0		0	0
4	20	0	20		20	6.667
8	80	20	100		100	33.33
12	130	100	230	0	230	76.66
16	150	230	380	20	360	120
20	130	380	510	100	410	136.66
24	80	510	590	230	360	120
28	52	590	642.	380	262	87.33
32	27	642	669	510	159	53
36	15	669	684	590	94.	31.33
40	5	684	689	642	47	15.66.
44	0	689	689	669	20	6.667
				684		
				689		
				689.		

Varsha's ICR17CN0072