Internal Assessment Test 3
Scheme of Evaluation

Sub:	HYDROLOGY AND IRRIGATION ENGIEERING	Sub Code:	17CV73	Branch	**CIVIL**
					OBE
			Marks	CO	RBT
1	Describe the methods of separating base flow from total runoff		[10]	CO3	L2

METHODS OF BASE-FLOW SEPARATION

METHOD I—STRAIGHT-LINE METHOD In this method the separation of the base flow is achieved by joining with a straight line the beginning of the surface runoff to a point on the recession limb representing the end of the direct runoff. In Fig. 6.5 point *A* represents the beginning of the direct runoff and it is usually easy to identify in view of the sharp change in the runoff rate at that point. [4M]

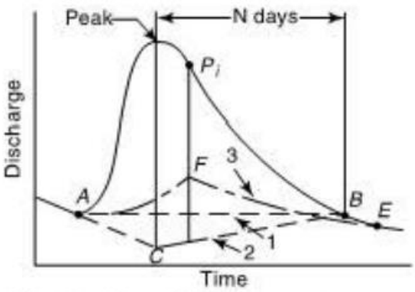


Fig. 6.5 Base Flow Seperation Methods

Point *B*, marking the end of the direct runoff is rather difficult to locate exactly. An empirical equation for the time interval *N* (days) from the peak to the point *B* is [2M]

$$N = 0.83A^{0.2} \quad (6.4)$$

where A = drainage area in km^2 and N is in days. Points *A* and *B* are joined by a straight line to demarcate to the base flow and surface runoff. It should be realised that the value of *N* obtained as above is only approximate and the position of *B* should be decided by considering a number of hydrographs for the catchment. This method of base-flow separation is the simplest of all the three methods.

METHOD 2 In this method the base flow curve existing prior to the commencement of the surface runoff is extended till it intersects the ordinate drawn at the peak (point *C* in Fig. 6.5). This point is joined to point *B* by a straight line. Segment *AC* and *CB* demarcate the base flow and surface runoff. This is probably the most widely used base-flow separation procedure. [2M]

METHOD 3 In this method the base flow recession curve after the depletion of the flood water is extended backwards till it intersects the ordinate at the point of inflection (line *EF* in Fig. 6.5). Points *A* and *F* are joined by an arbitrary smooth curve. This method of base-flow separation is realistic in situations where the groundwater contributions are significant and reach the stream quickly. [2M]

It is seen that all the three methods of base-flow separation are rather arbitrary. The selection of anyone of them depends upon the local practice and successful predictions achieved in the past. The surface runoff hydrograph obtained after the base-flow separation is also known as *direct runoff hydrograph* (DRH).

2	a. Explain with neat sketch the components of storm hydrograph	[5M]	CO3	L2

Consider a concentrated storm producing a fairly uniform rainfall of duration, D over a catchment. After the initial losses and infiltration losses are met, the rainfall excess reaches the stream through overland and channel flows. In the process of translation a certain amount of storage is built up in the overland and channel-flow phases. This storage gradually depletes after the cessation of the rainfall. Thus there is a time lag between the occurrence of rainfall in the basin and the time when that water passes the gauging station at the basin outlet. The runoff measured at the stream-gauging station will give a typical hydrograph as shown in Fig. 6.1. The duration of the rainfall is also marked in this figure to indicate the time lag in the rainfall and runoff. The hydrograph of this kind which results due to an isolated storm is typically single-peaked skew distribution of discharge and is known variously as *storm hydrograph*, *flood hydrograph* or simply *hydrograph*. It has three characteristic regions: (i) the rising limb AB, joining point A, the starting point of the rising curve and point B, the point of inflection, (ii) the crest segment BC between the two points of inflection with a peak P in between, (iii) the falling limb or *depletion curve* CD starting from the second point of inflection C. [3M]

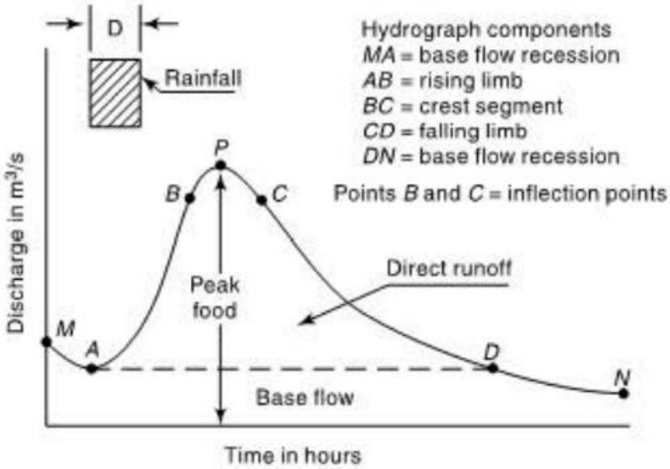


Fig. 6.1 Elements of a Flood Hydrograph

[2M]

	b. Define Irrigation. What is the necessity of Irrigation?	[5M]	CO4	L2

Irrigation is the process of artificially supplying water to soil for raising crops.

① ~~Less~~ Less Rainfall :->

When the total rainfall is less than required (needed) for the crop, artificial supply is necessary. In such a case, irrigation work may be constructed at a place where more water is available & then to convey the water to the area where there is deficiency or shortage of water.

Ex:-> Rajasthan canal is one such example. It conveys water to the arid zones of Rajasthan where the annual rainfall hardly

2) Non Uniform Rainfall :→

Rainfall in a particular area may not be uniform over the crop period. During the early periods of the crop rains may be there, but no water may be available at the end, with the result, either the yield may be less or the crop may die all together. By the collection of water during the excess rainfall period, water may be supplied to the crop during the period where there may be no rainfall.

Most of the irrigation projects in India are based on this principle. The rainfall during winter season is scanty & hence rabi crops need artificial supply of water through the irrigation works.

irrigation ... water

) commercial crops with additional water.

The rainfall in a particular area may be sufficient to raise the usual crops, but more water may be necessary for raising commercial & cash crops like sugarcane, Indigo, tobacco, cotton etc.

) controlled water supply :→

By the construction of proper

be increased because of controlled supply of water.

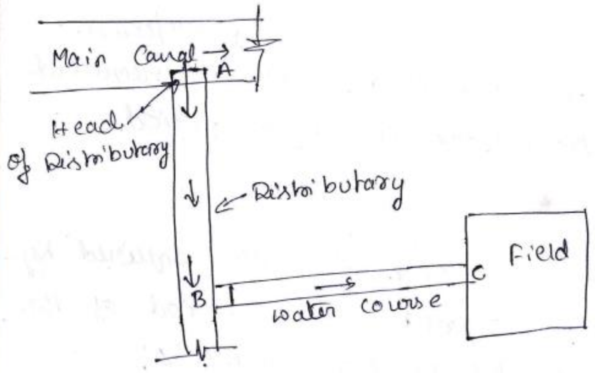
The importance of irrigation is well stated by Shri N.D. Gulati : "Irrigation in many countries is an old art - as old as civilisation - but for the whole world it is modern science - the science of survival."

3	Explain with neat sketch, the variation of duty with respect to place of measurement.	[10]	CO5	L2

* variation of Duty with the place of its Measurement

The Duty varies with place of its measurement because of continuous conveyance losses as the water flows.

The duty of water goes on increasing as the water flows.



at 1700ha. The

For ex:- let us consider an area of 1700ha. The discharge required at the field is 1 cumecs. Assume a conveyance loss of 0.1 cumec B/w B & C. Hence discharge required at B is 1.1cumec & duty of water is $\frac{1700}{1.1} = 1545.4$ ha/cumec.

Assume a conveyance loss of 0.2 cumecs B/w A & B. The head required at A is 1.3cum-ecs & duty of water is $\frac{1700}{1.3} = 1308$ ha/cumec.

duty of water increases as the water

The duty at the head of the water-course (A) is called the outlet duty. Thus measurements of duty are taken at four points noted below.

	1) At the head of main canal ← known as Gross Quantity 2) At the head of Branch Canal ← lateral Quantity 3) At the outlet of a canal ← outlet Factor 4) At the head of land to be irrigated ← Net Quantity			
4	a. Define duty, delta and base period. Derive the relationship between them. Duty:→ (3) Duty represents the irrigating capacity of a unit of water. It is the relation b/w the area of crop irrigated & the quantity of water required during the entire base period of the crop. Delta:→[Δ] It is the total depth of water required by a crop during the entire base period of the crop & it is denoted by the symbol 'Δ'. Base Period:→ Base Period for a crop refers to the whole period of cultivation from the time when irrigation water is first issued for ... planting the crop	[5]	CO4	L3

Relationship B/w Duty & delta of Irrigation water

Let D = Duty in ha/cumec

Δ = total depth of water supplied (in m)

B = Base period in days

Consider a field of area 'D' hectares & the water supplied to the field corresponding to the water depth 'Δ' m will be

$= D \times \Delta$ ha-m

$= D \times \Delta \times 10^4 \ m^3 \rightarrow (1)$

Also for the same field of area 'D' ha one cumec of water is supplied during the entire Base period of 'B' days. Hence total quantity of water supplied to the field

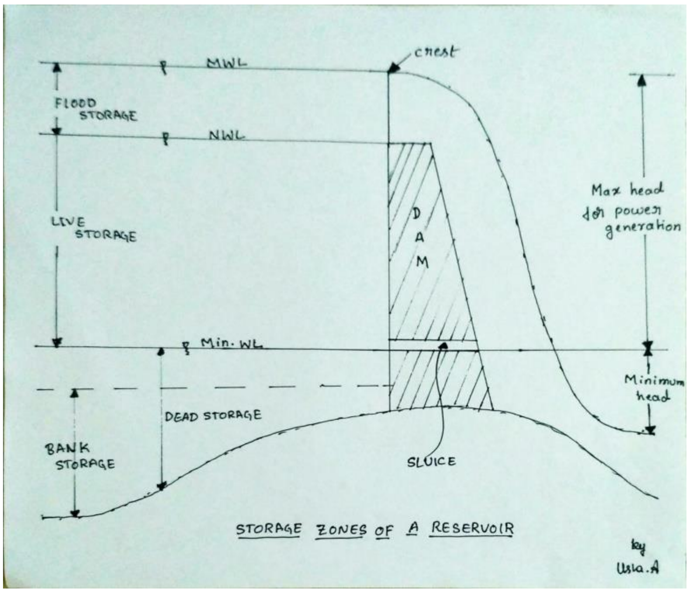
$= 1 \times B \times 24 \times 60 \times 60 \ m^3 \rightarrow (2)$

Equating (1) & (2)

$$D \times \Delta \times 10^4 = 1 \times B \times 24 \times 60 \times 60$$

$$\boxed{\Delta = 8.64 \ B/D \ m}$$

b. With neat sketch explain zones of storage in reservoir



Dead Storage: is the depth of reservoir storage created to cater for sediment deposition by the inflowing water. It is equivalent to the volume of sediment expected to be deposited during the life of reservoir.

Live Storage: is the usable portion of the total storage of reservoir. It is desirable to have additional live storage over and above the estimated one.

[5] CO6 L3

	Flood Storage: it is the water storage difference between normal water level and Maximum water level. **Bank Storage:** it is the storage developed in the voids of the soil cover in the reservoir. **Valley Storage:** it is the storage in the stream created after overflow of floods.			
5	A water course has cultivable commanded area of 2600 hectares, out of which the intensities of irrigation for perennial sugar- cane and rice crops are 20% and 40% respectively. The duty of these crops at the head of water course is 750 hectare/cumec and 1800 hectare/cumec respectively. Find the discharge required at the head of water course if the peak demand is 120% of the average requirement. Sol^n :- Area under sugar-cane $= 2600 \times 0.2$ $= 520$ ha Area under rice $= 2600 \times 0.4$ $= 1040$ ha water required for sugar-cane $= \frac{520}{750} = 0.694 \frac{m^3}{s}$ water required for rice $= \frac{1040}{1800} = 0.578$ cumec Since sugar-cane is perennial crop, it will require water through-out the year. Hence, the water course must carry a total discharge of $(0.694 + 0.578) = 1.272$ cumecs. The design discharge, to meet the peak demand, will be $1.272 \times 1.2 = 1.53$ cumecs.	[10]	CO6	L4

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