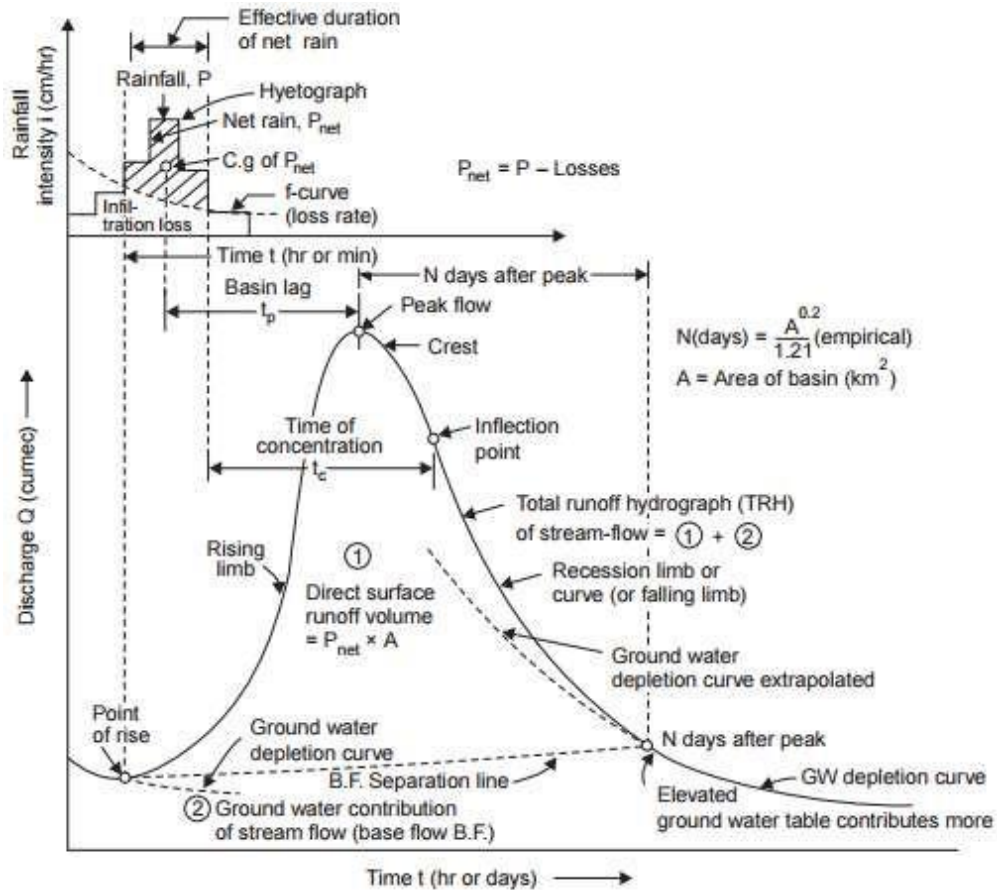
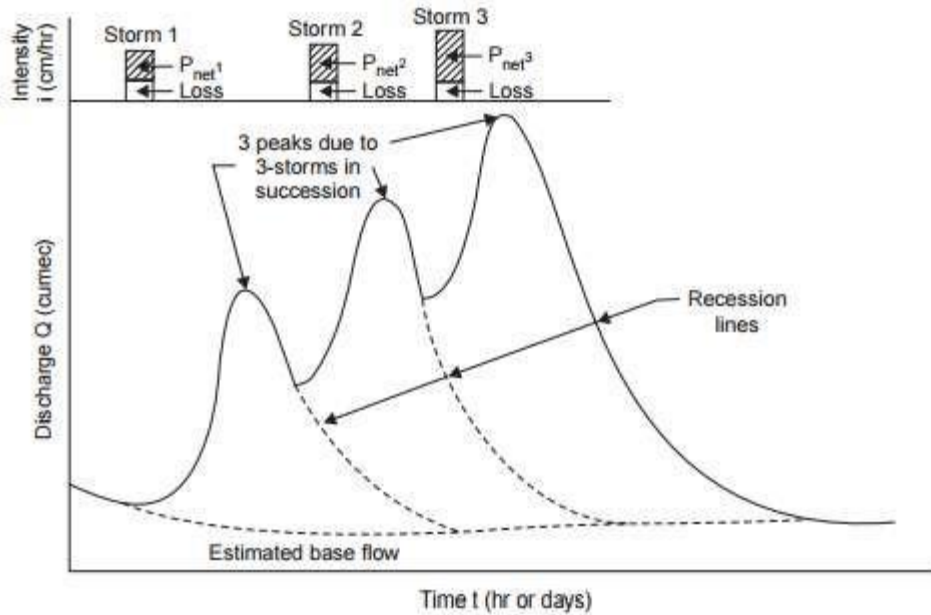


**HYDROGRAPH:** A hydrograph is a graph showing discharge (i.e., stream flow at the concentration point) versus time. The various components of a natural hydrograph are shown in Fig.3. At the beginning, there is only base flow (i.e., the ground water contribution to the stream) gradually depleting in an exponential form. After the storm commences, the initial losses like interception and infiltration are met and then the surface flow begins.



**Figure 3: Components of stream flow hydrograph**

The hydrograph gradually rises and reaches its peak value after a time  $t_p$  (called lag time or basin lag) measured from the centroid of the hyetograph of net rain. Thereafter it declines and there is a change of slope at the inflection point, i.e., there has been, inflow of the rain up to this point and after this there is gradual withdrawal of catchment storage. By this time the ground water table has been built up by the infiltrating and percolating water, and now the ground water contributes more into the stream flow than at the beginning of storm, but thereafter the GWT declines and the hydrograph again goes on depleting in the exponential form called the ground water depletion curve or the recession curve. If a second storm occurs now, again the hydrograph starts rising till it reaches the new peak and then falls and the ground water recession begins, Fig. 4.



**Figure 4: Hydrograph with Multiple Peaks**

Thus, in actual streams gauged, the hydrograph may have a single peak or multiple peaks according to the complexity of storms. For flood analysis and derivation of unit hydrograph, a single peaked hydrograph is preferred. A complex hydrograph, however, can be resolved into simple hydrographs by drawing hypothetical recession lines as shown in Fig. 4.

### **HYDROGRAPH SEPARATION**

For the derivation of unit hydrograph, the base flow has to be separated from the total runoff hydrograph (i.e., from the hydrograph of the gauged stream flow). Some of the well-known base flow separation procedures are given below, Fig. 5.

(i) Simply by drawing a line AC tangential to both the limbs at their lower portion. This method is very simple but is approximate and can be used only for preliminary estimates.

(ii) Extending the recession curve existing prior to the occurrence of the storm up to the point D directly under the peak of the hydrograph and then drawing a straight line DE, where E is a point on the hydrograph N days after the peak, and N (in days) is given by  $N=0.83A^{0.2}$

(iii) Simply by drawing a straight line AE, from the point of rise to the point E, on the hydrograph, N days after the peak. (iv) Construct a line AFG by projecting backwards the ground water recession curve after the storm, to a point F directly under the inflection point of the falling limb and sketch an arbitrary rising line from the point of rise of the hydrograph to connect with the projected base flow recession. This type of separation is preferred where the ground water storage is relatively large and reaches the stream fairly rapidly, as in lime-stone terrains.

