The process where by the form of sinusoidal and also non sinusoidal signal is altered when passing through a non linear network is known as non linear wave shaping.

NONLINEAR NETWORK: the network which consists of atleast one nonlinear element is known as a nonlinear network.

Diodes , transistors are non linear elements.
The most widely used nonlinear wave shaping circuits are
1.clipping circuits(clippers)
2.clamping circuits(clampers)

1.clipping circuits(clippers): clipping circuits are used to select for transmission that part of an arbitrary waveform which lies above or below some particular reference level.

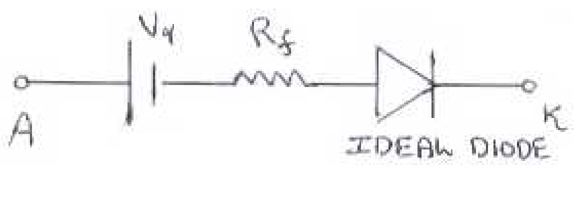
Clipping circuits are also known as limiting circuits, voltage limiters ,amplitude selectors, Slicers.
Clipping circuits are classified into
- (i) Diode clippers
- (ii) Transistor clippers
- (iii) Emitter-coupled clippers

Diode clippers: these are of two types
1.shunt clippers(diode is in shunt with the output)
2.series clippers(diode is in series with the input)

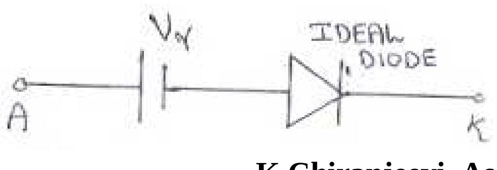
SHUNT CLIPPERS: these are of two types
1.positive peak or negative base clippers
2.negative peak of positive base clippers

To understand the operation of diode clippers there is a need of diode equivalent circuits
Diode equivalent circuits:
A circuit which best represent the actual terminal characteristics of a given device is known as equivalent circuit.
Anyway diode equivalent circuits are of three types

1.piece wise linear equivalent circuit($R_f \neq 0$, $R_r \neq \infty$, $V_\gamma \neq 0$)



2.simplified equivalent circuit($R_f = 0$, $R_r = \infty$, $V_\gamma \neq 0$)

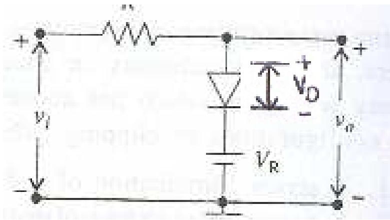


3. idle equivalent circuit($R_f = 0$, $R_r = \infty$, $V_\gamma = 0$)

For an idle diode $R_f = 0$, $R_r = \infty$, $V_\gamma = 0$

Positive peak or negative base clipper:

NOTE: to understand the operation of clipping circuits there is a need to know for what value of input voltage diode is in on state and for what value of input voltage diode is in off state.
Circuit diagram of positive peak clipper is shown in figure.



Case (i) : consider for a diode $R_f = 0$, $R_r = \infty$, $V_\gamma = 0$ (diode is an idle one)

Now for the given circuit, $V_D = V_i - V_R$
If $V_i > V_R$, V_D =positive value so diode is in ON state(replaced with short circuit)

Then $V_O = V_R$

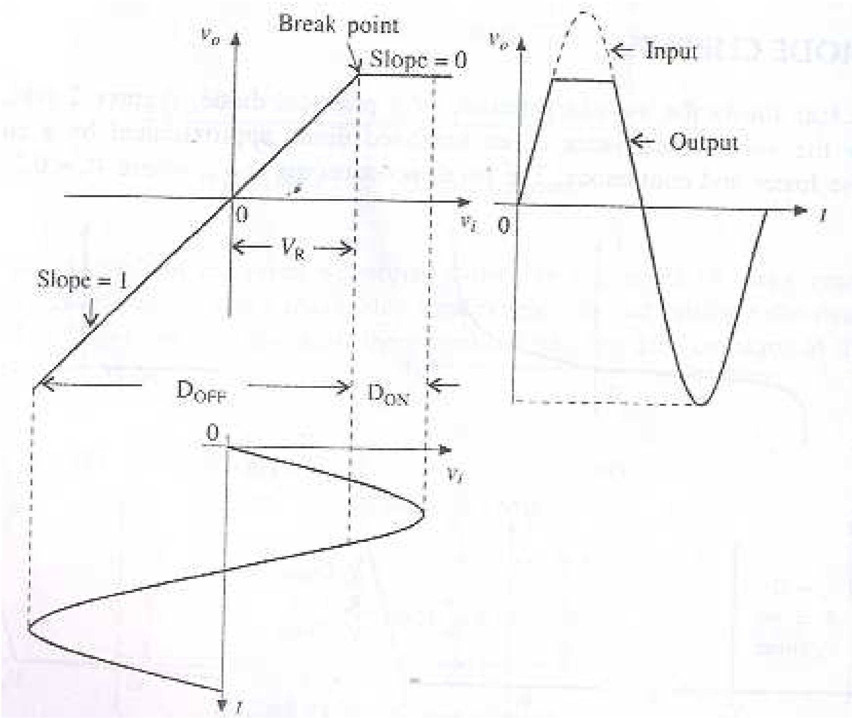
If $V_i < V_R$, V_D =negative value so diode is in OFF state(replaced with open circuit)
Then $V_O = V_i$
Here the input waveform above the reference level (V_R) has been clipped means positive peak(negative base)of the input signal is clipped.

Transfer characteristics:

It is a plot of output voltage as a function of input voltage.

If $V_i > V_R$, Then $V_O = V_R$ so slope of transfer characteristics curve is zero(since output is independent of input).

If $V_i < V_R$, Then $V_O = V_i$ so slope of transfer characteristics curve is one.



Case (ii) : consider for a diode $R_f = 0$, $R_r = \infty$, $V_\gamma \neq 0$ (by replacing diode with simplified equivalent circuit)

Now for the given circuit, $V_D = V_i - (V_R + V_\gamma)$

If $V_i > (V_R + V_\gamma)$, V_D = positive value so diode is in ON state(replaced with short circuit)

Then $V_O = (V_R + V_\gamma)$

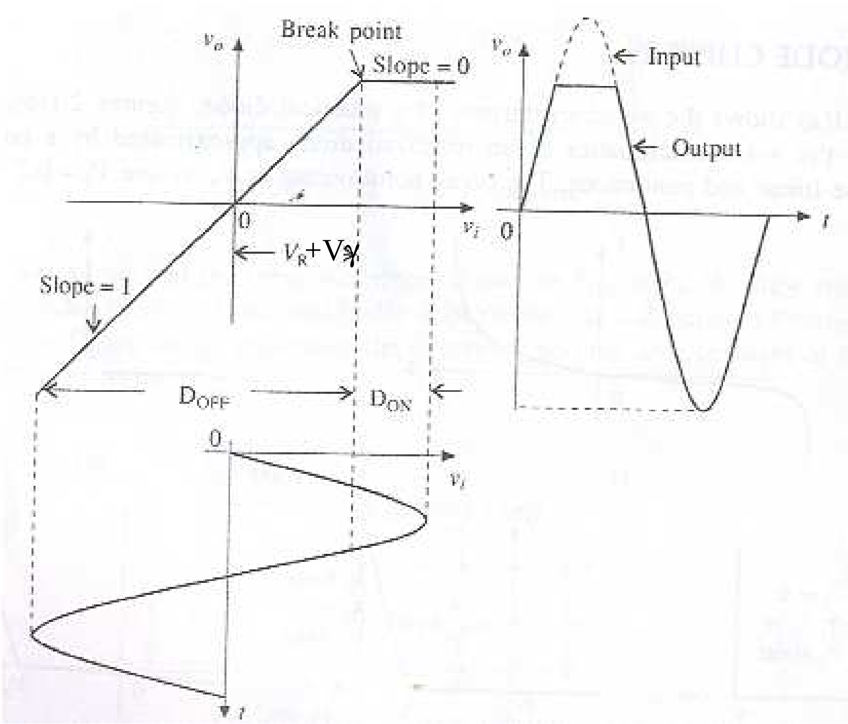
If $V_i < (V_R + V_\gamma)$, V_D =negative value so diode is in OFF state(replaced with open circuit)

Then V_O = Vi Here the input waveform above the level $V_R + V_\gamma$ has been clipped means positive peak(negative base)of the input signal is clipped.

Transfer characteristics:

If $V_i > (V_R + V_\gamma)$, Then $V_O = (V_R + V_\gamma)$ so slope of transfer characteristics curve is zero(since output is independent of input).

If $V_i < (V_R + V_\gamma)$, Then $V_O = V_i$ so slope of transfer characteristics curve is one.



Case (iii) : consider for a diode $R_f \neq 0$, $R_r = \infty$, $V_\gamma \neq 0$ (by replacing diode with piece wise linear equivalent circuit)
Now for the given circuit, $V_D = V_i - (V_R + V_\gamma)$
If $V_i > (V_R + V_\gamma)$, V_D = positive value so diode is in ON state(replaced with short circuit)
Then $V_O = (V_R + V_\gamma) + i\,R_f$

$V_O = (V_R + V_\gamma) + (R_f /R + R_f)\,[V_i - (V_R + V_\gamma)]$

$V_O = (V_R + V_\gamma)(R /R + R_f) + V_i\,(R_f /R + R_f)$

$V_O = (V_R + V_\gamma) + V_i\,(R_f /R + R_f)$ by considering R is large.

If $V_i < (V_R + V_\gamma)$, V_D =negative value so diode is in OFF state(replaced with open circuit)
Then V_O = Vi Here the input waveform above the level $V_R + V_\gamma$ may not be clipped completely. means positive peak(negative base)of the input signal is not clipped totally.

Transfer characteristics:

If $V_i > (V_R + V_\gamma)$, Then $V_O = (V_R + V_\gamma) + V_i (R_f / R + R_f)$ so slope of transfer characteristics curve is $R_f / R + R_f$

If $V_i < (V_R + V_\gamma)$, Then $V_O = V_I$ so slope of transfer characteristics curve is one.