EXPERIMENT NO. 12

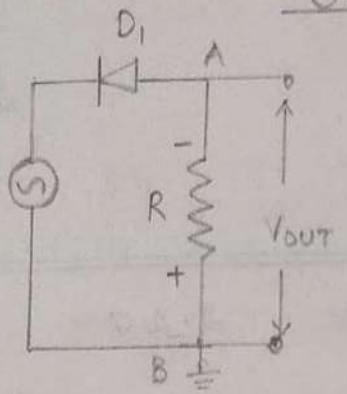
AIM → To determine the relationship between the input and output sine wave form of the diode limiter and clamper.

APPARATUS → AF generator, diodes, resistors, DC battery, CRO, bread board.

THEORY → Sometimes it is required to square-off the extremities of an ac signal or to limit an ac voltage to predetermined levels. The electronic device thus used are known as Limiters. They can transform a sine wave into a rectangular wave, can limit either the positive or negative alternation.

SERIES DIODE LIMITER – a. Consider Fig. 1. Here, an ac generator applies a sine wave V_{in} to the diode in series with a resistor R. During the positive alternation, the diode is reversed biased. Hence, no current flows in the circuit and the output across R is zero.

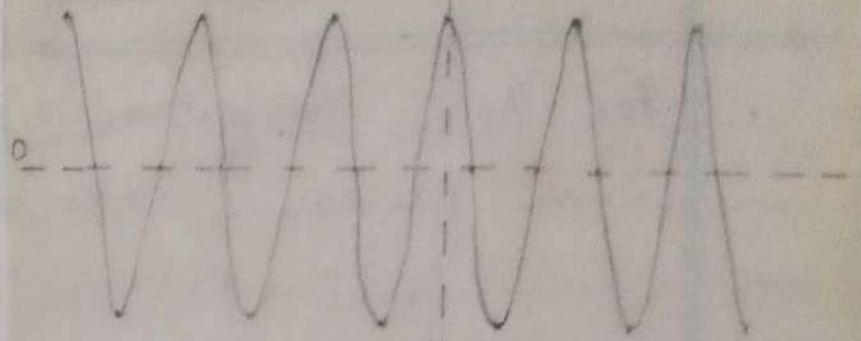
SERIES DIODE CLIPPING CIRCUIT.



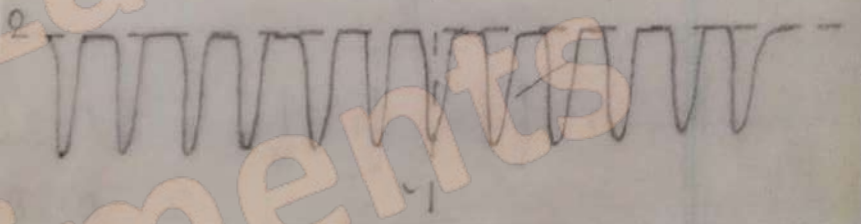
POSITIVE CLIPPER.

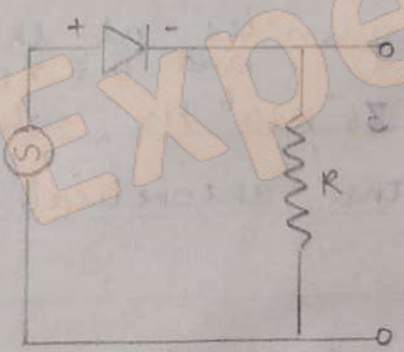
Amplitude = 1.6 ms

INPUT WAVE ① V_{IN} = 1.7 × 2 V



OUTPUT WAVE V_{OUT} = 1.4 × .5 = 0.7 V

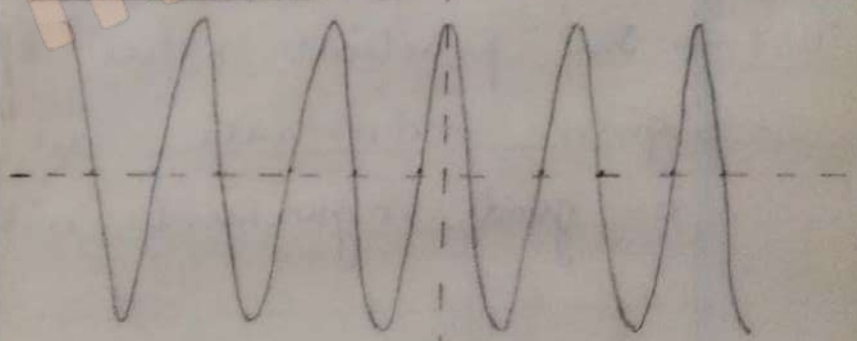




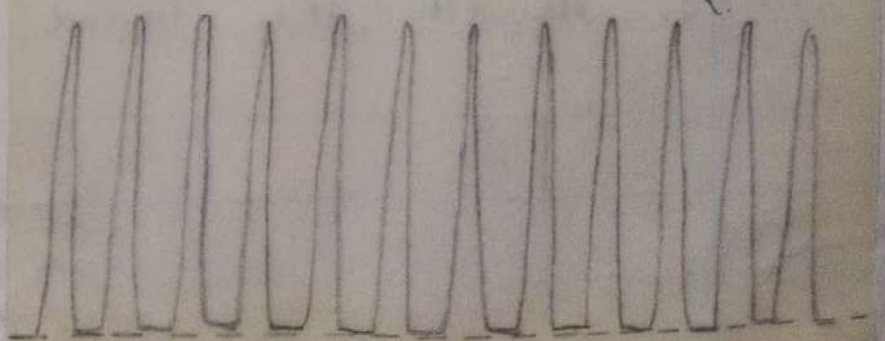
NEGATIVE CLIPPER

Amplitude = 1.6 ms

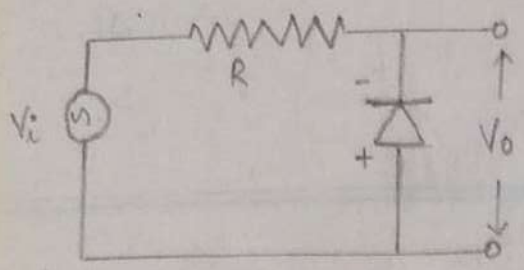
INPUT WAVE ② V_{IN} = 3.4 V



OUTPUT WAVE V_{OUT} = 3.7 × .2 V = .74 V

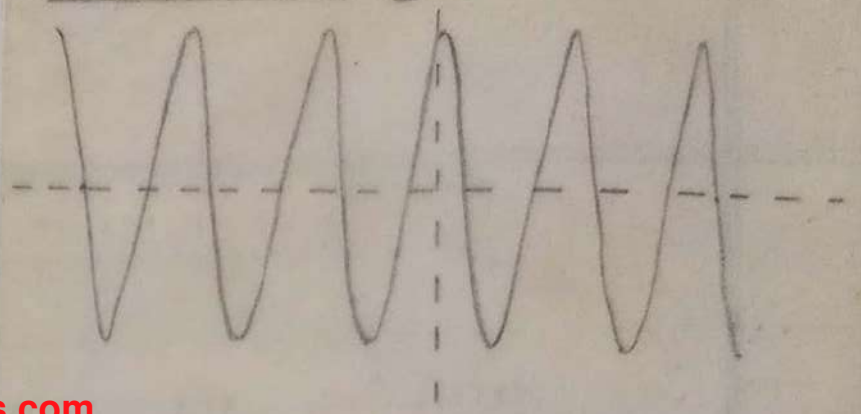


PARALLEL DIODE CLIPPING CIRCUIT.

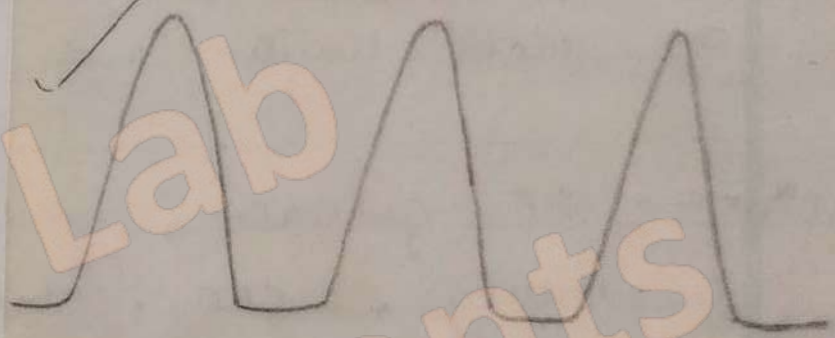


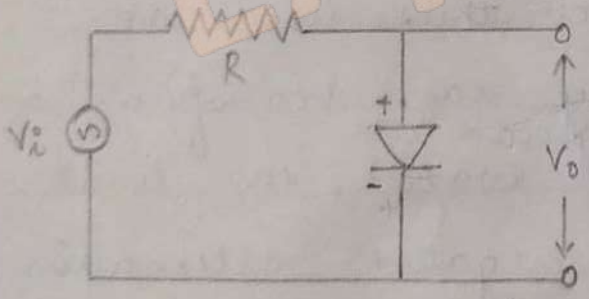
T = 1.6 x .5 ms

INPUT WAVE (3) V_{IN} = 3.4 V



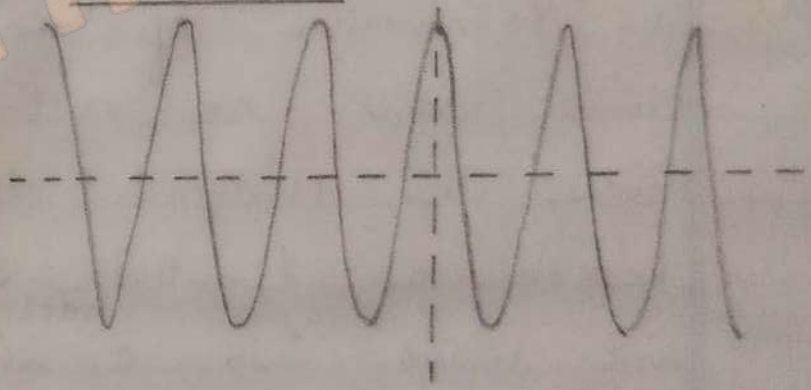
OUTPUT WAVE V_{OUT} = 2.6 V



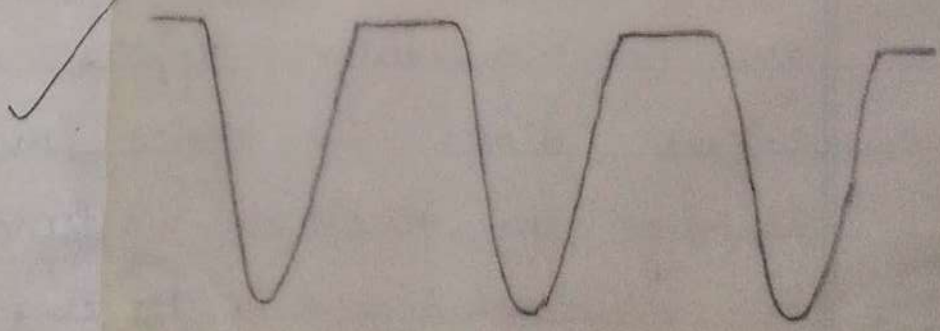


T = 1.6 x .5 ms

4. INPUT WAVE V_{IN} = 3.4 V



OUTPUT WAVE V_{OUT} = 2.6 V



Since here the positive alternation has been limited or eliminated from the output, it is called Positive series limiter.

b. When the polarity of the diode is reversed, it conducts when positive alternation comes and does not conduct during negative altern-ation. Hence, the name Negative Series Limiter

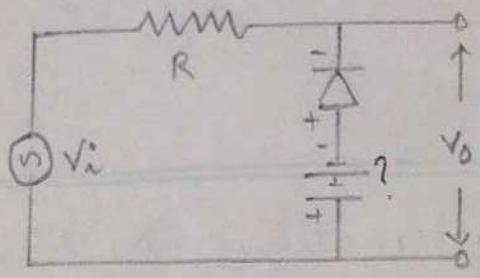
PARALLEL DIODE LIMITER - a. It is called parallel limiter because here the output is parallel with the diode. (FIG. 2)

During positive alternation, diode D_1 is reverse biased and exhibits a high reverse resistance R_R. R and R_R constitute a voltage divider. If $R << R_R$, practically, the entire positive alternation appears as the output voltage across the diode.

During negative alternation D_1 is forward biased. The diode acts as a closed switch ie.. the diode acts like a short circuit. No voltage develops across it. ∴, this is negative limiter.

When the polarity of the diode is reversed, we get the positive limiter.

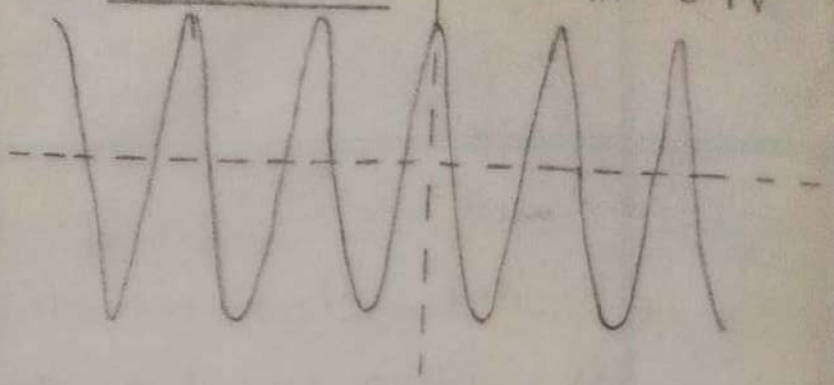
BIASED PARALLEL LIMITERS.



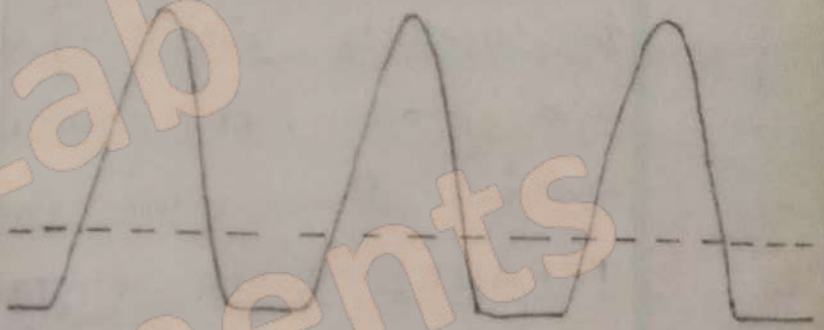
PARTIAL NEGATIVE CLIPPER

T = 1.6 x 1.5 ms

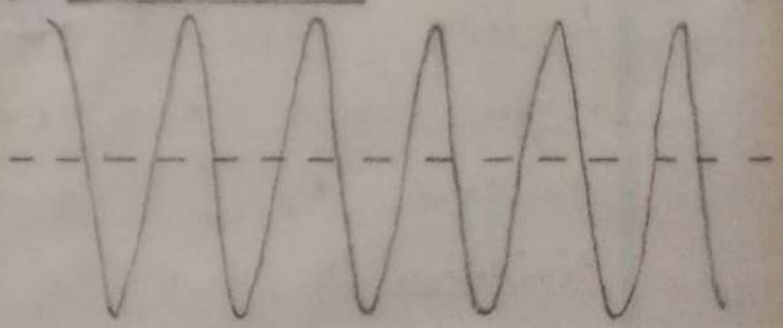
5. INPUT WAVE $V_{IN} = 3.4V$



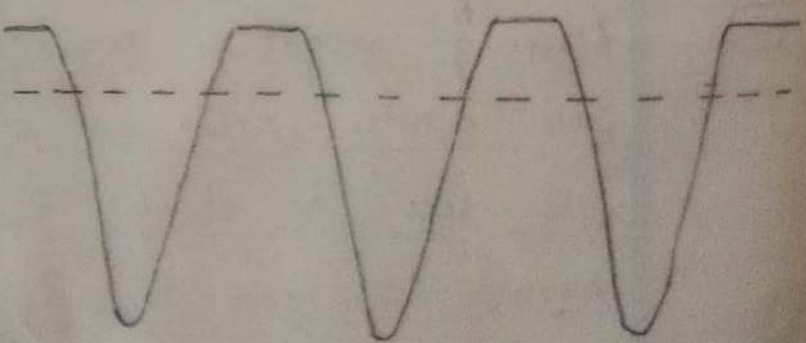
OUTPUT WAVE $V_{OUT} = 2.6V$

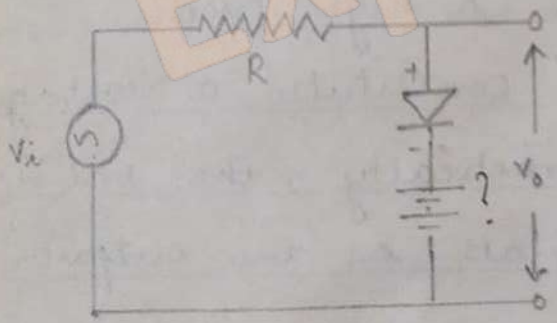


6. INPUT WAVE $V_{IN} = 3.4V$



OUTPUT WAVE $V_{OUT} = 2.6V$





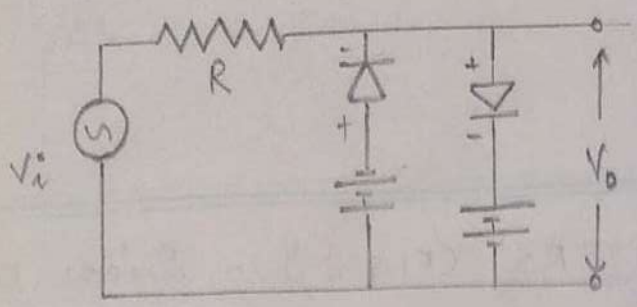
PARTIAL POSITIVE CLIPPER

T = 1.6 x 1.5ms

BIASED - PARALLEL LIMITERS (FIG 3) - Diode D_1 is reversed - biased by battery V_{AA}. During the positive alternation of the input voltage V_{in}, the cathode of D_1 is held positive. The diode acts like an open switch and the positive alternation appears in the output. During the negative alternation, the cathode is driven negative, but the diode will not conduct until V_{in} is more negative than the bias voltage V_{AA}. Hence, that part of the negative alternation which is less negative than V_{AA} appears in the output. When the negative alternation of V_{in} reaches the level where it is more negative than V_{AA}, the cathode is driven more negative than the anode and the diode conducts, limiting that portion of the negative alternation between $-V_{AA}$ and $-V_M$ peak.

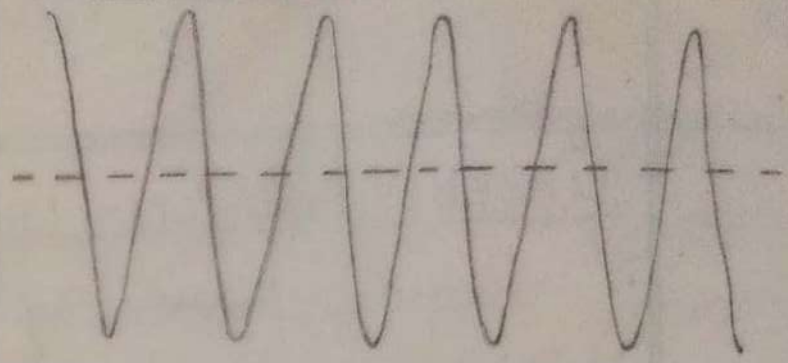
When the diode polarity is reversed we get partially limiting positive alternation.

BIASED DOUBLE DIODE LIMITER.

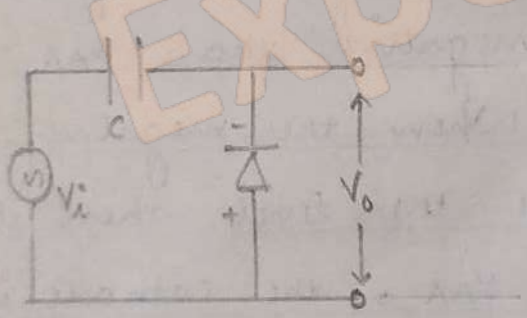


T = 1.6 x .5 ms

7. INPUT WAVE $V_{IN} = 4V$



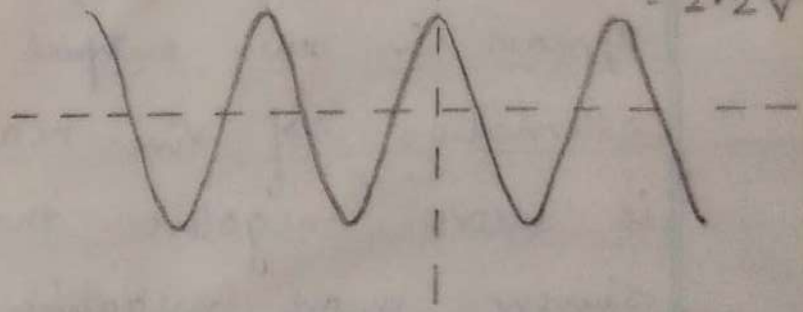
OUTPUT WAVE $V_{OUT} = 3.4V$



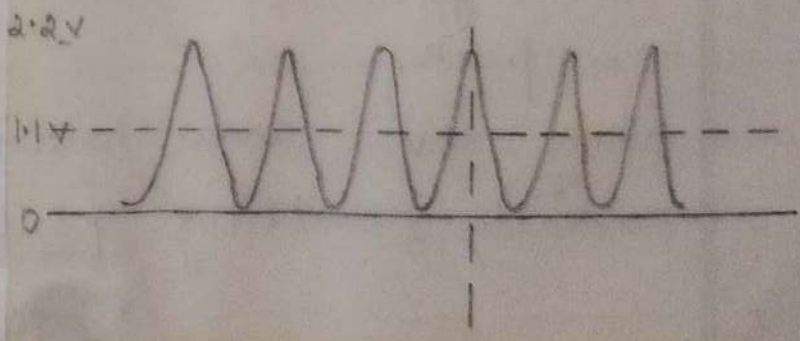
POSITIVE CLAMPER

T = .8 x .5 ms

8. INPUT WAVE $V_{IN} = 1.1 \times 2 = 2.2V$



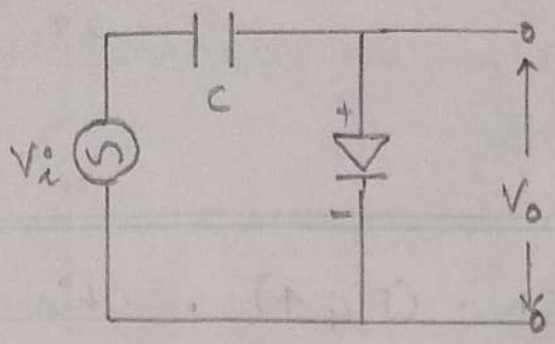
OUTPUT WAVE $V_{out} = 2.2V$



BIASED DOUBLE DIODE LIMITER - (FIG 4). This circuit acts as a partial limiter of both the positive and negative alternations. Diode D_1 conducts when the voltage V_{in} reaches a higher negative value than V_{KK1}, thus limiting the negative alternation to the value of V_{KK1}. Diode D_2 conducts when V_{in} reaches a higher positive value than V_{AA2}, limiting the positive alternation to the value V_{AA2}.

DIODE CLAMPER - They do not change the shape of input waveform but they add a dc level to it. Hence, they are known as dc restorers.

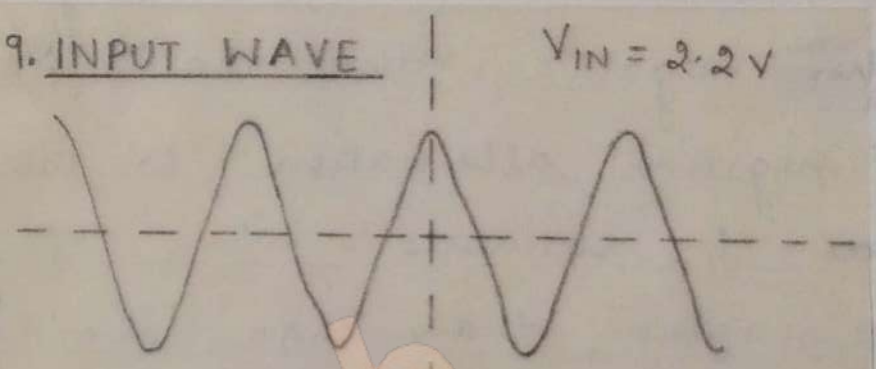
POSITIVE CLAMPKER (FIG 5). - On the negative alternation of some voltage peak-to-peak, input sine wave, the cathode of the diode D is driven negative relative to its anode. ∴, D conducts, charging the capacitor through the low resistance of the forward biased diode. Capacitor C will get charge to the peak of of the negative alternation, with the polarity as



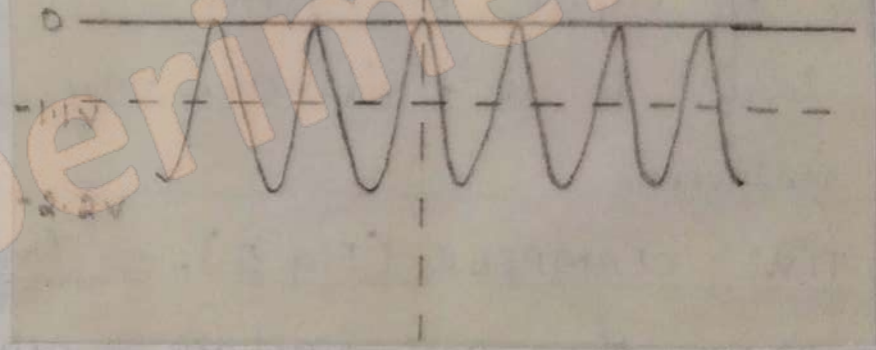
NEGATIVE CLAMPER.

9. INPUT WAVE $V_{IN} = 2.2\,V$

$T = 0.8 \times 1.5\,ms$



OUTPUT WAVE $V_{OUT} = 2.2\,V$



shown. On the positive alternation, D is cut off since its cathode is positive relative to the anode. The capacitor holds the same charge with the result that when the negative alternation of the second cycle comes along, the positive voltage on C will cancel the negative input voltage and the diode D will not conduct.

A negative clamper adds a negative dc level to an ac signal. This is accomplished by reversing the polarity of the diode.

PRECAUTIONS → 1. The circuit should be tight.

2. The readings of voltage and time period should be noted carefully.

RESULT → The traces of the various clipping and clamping circuits are shown and the results are as required.