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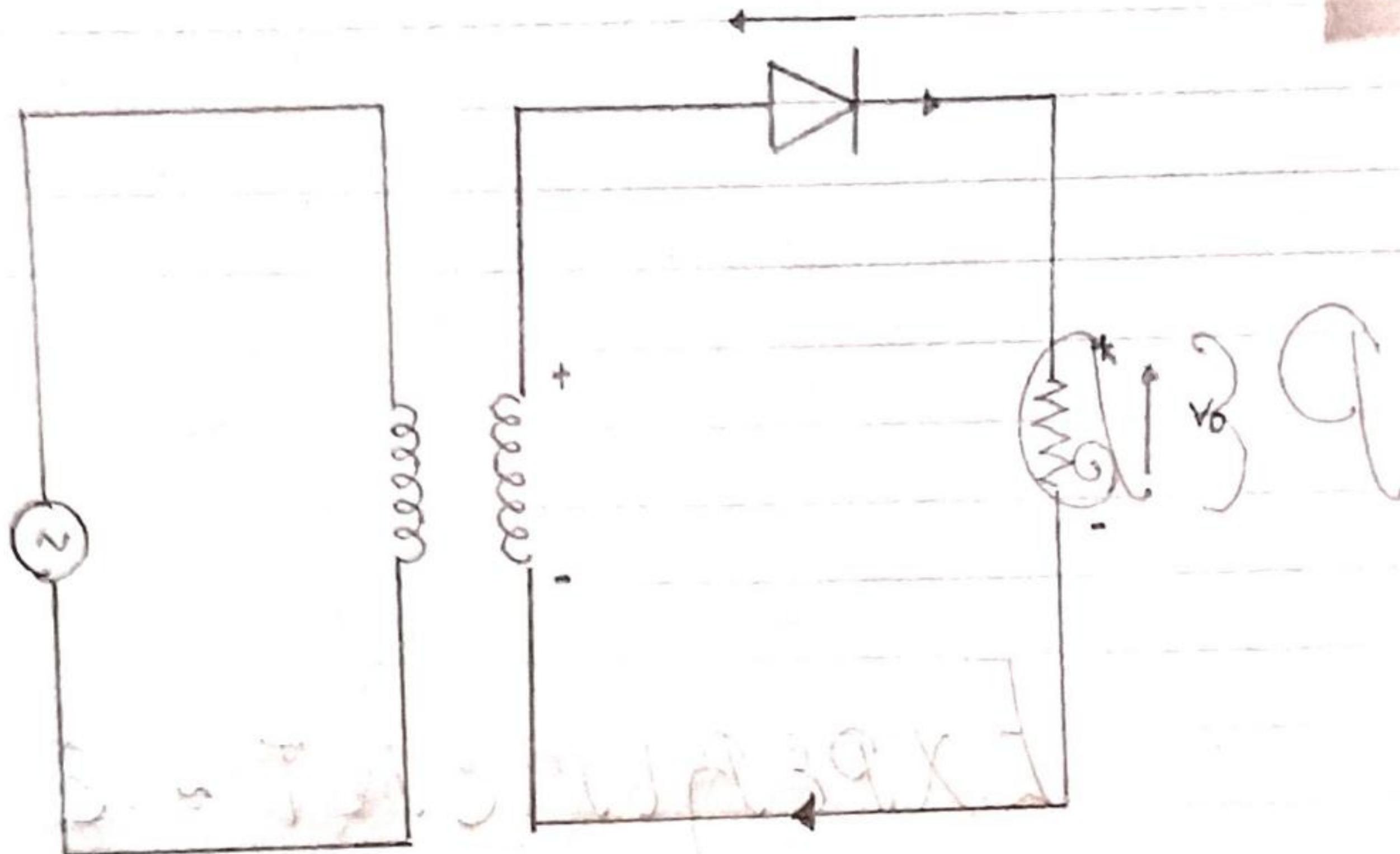
EXPERIMENT - 3

Name : RAHUL VEMURL

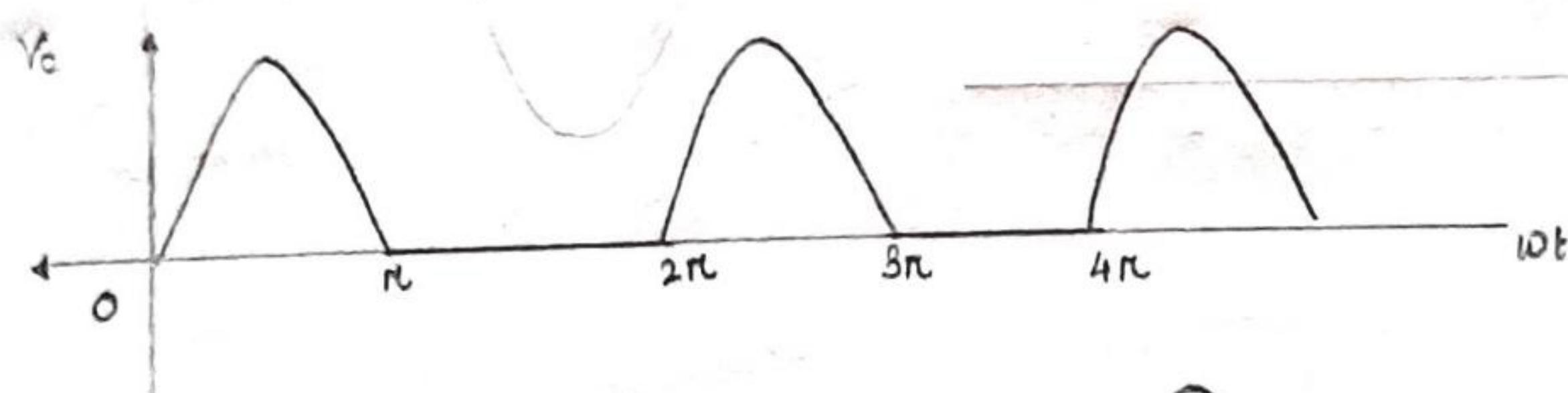
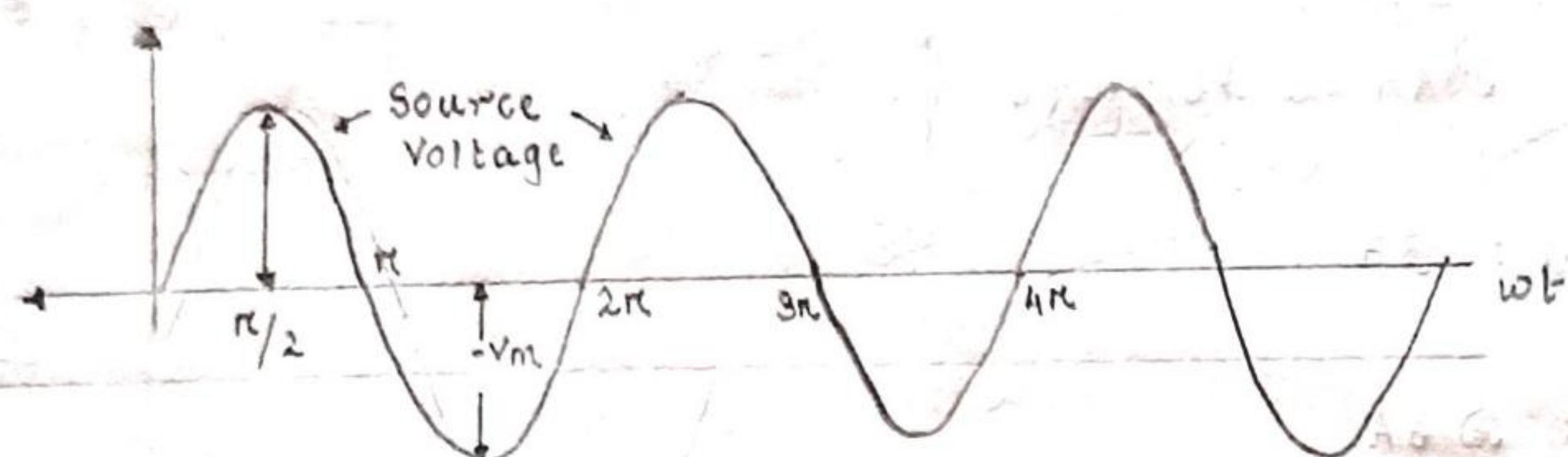
ROLL NO : 33

CLASS : 1016A

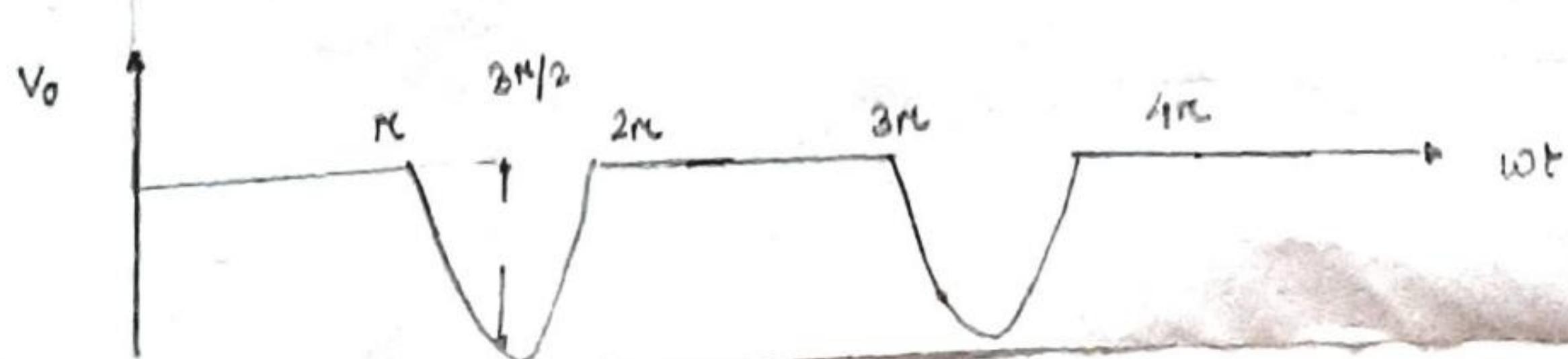
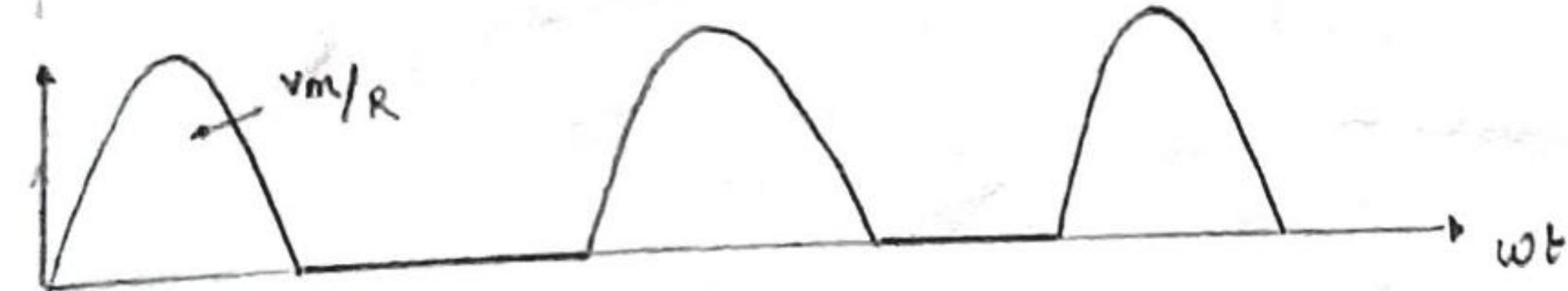
SINGLE-PHASE HALF-WAVE DIODE RECTIFIER



CKT DIAGRAM



WAVEFORMS



Aim: Simulate uncontrolled Half Wave & Full Wave Rectifier with R & RL load.

Software Used: Multisim, Diode, Resistor & Inductor

Theory:

1) Half ~ Wave Rectifier:

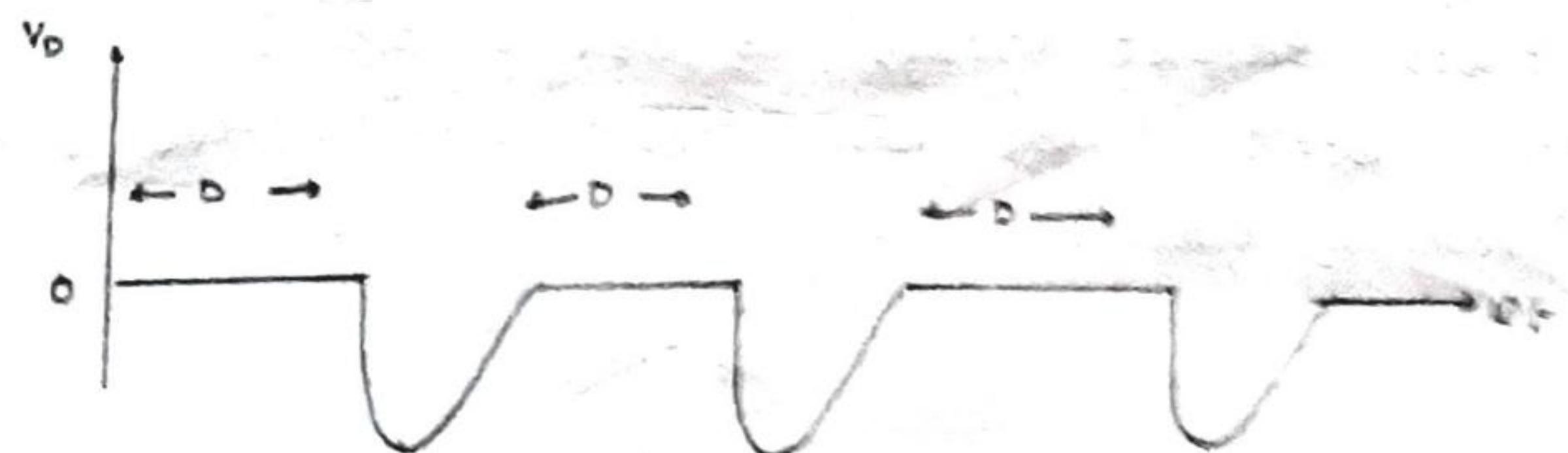
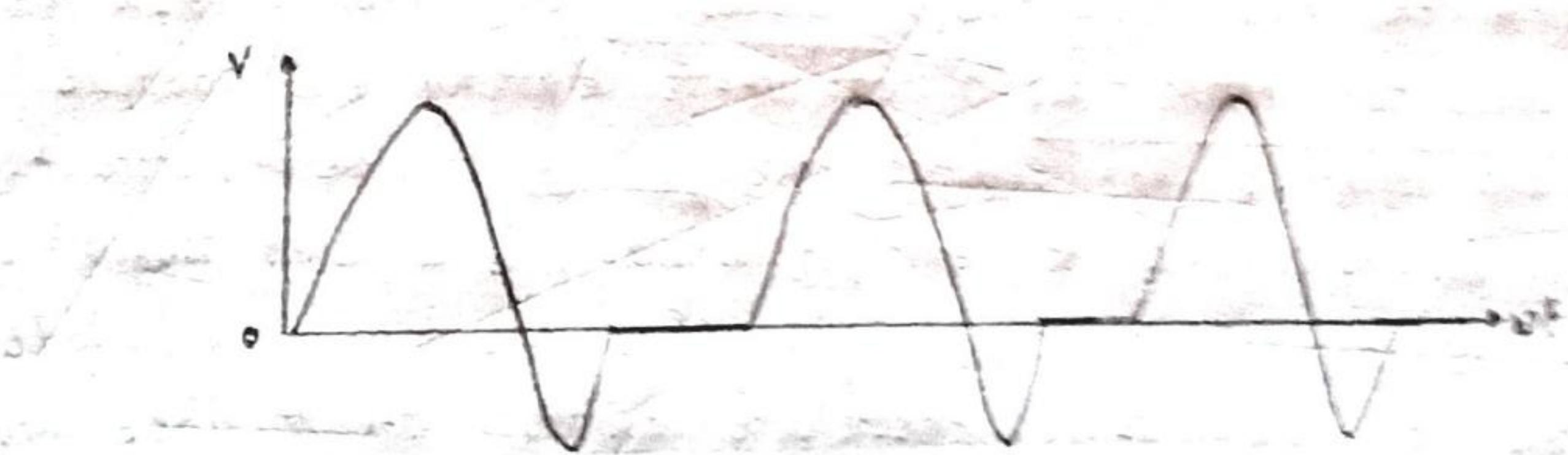
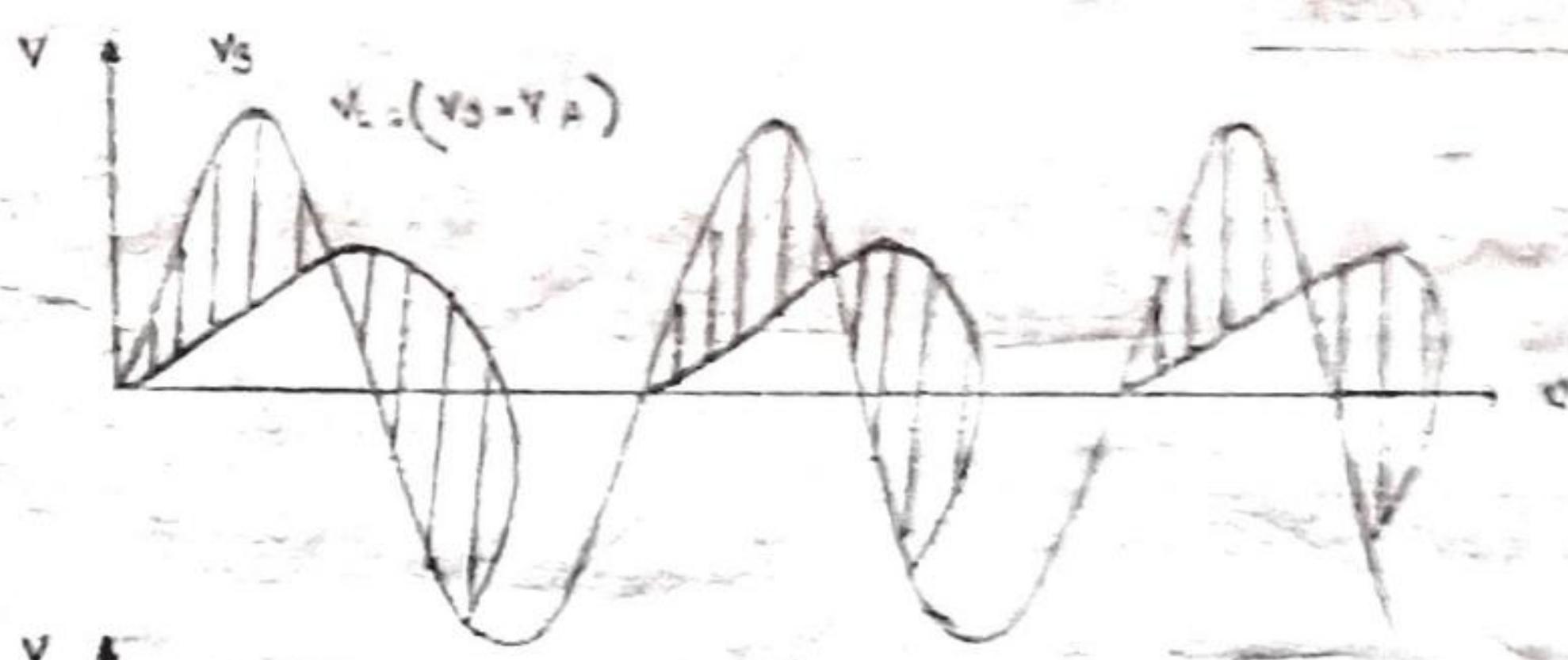
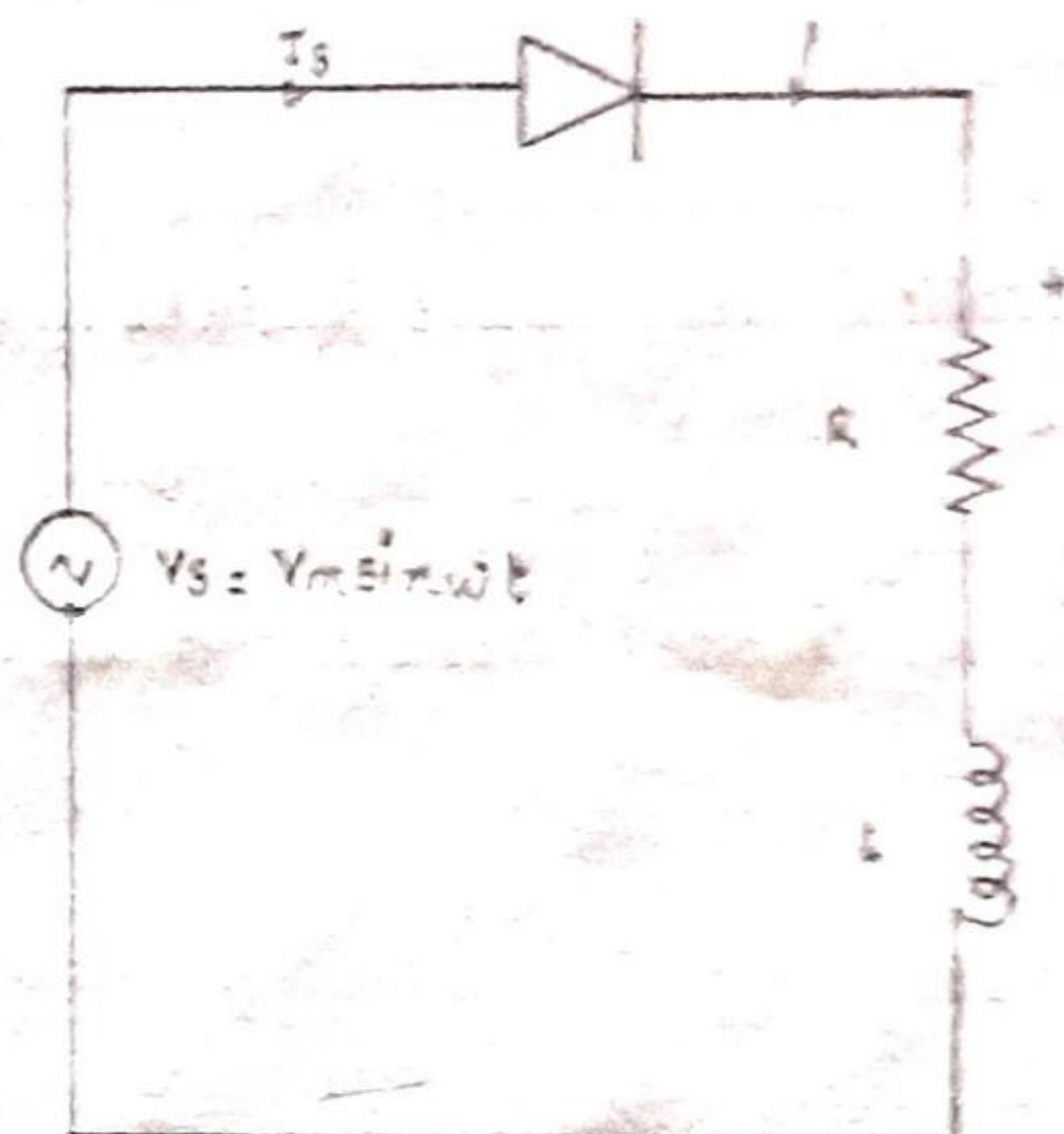
It is simple type of uncontrolled rectifier. In single-phase half-wave rectifier for one cycle of supply voltage there is one half cycle of output or voltage. As such it is also called single-phase one-pulse rectifier. The load on the output side of rectifier may be R , RL or RL with a flywheel diode.

a) R Load:

Ckt diagram of a single-phase half-wave rectifier is shown in fig a). During the +ve half cycle, diode is forward biased. It therefore conducts from $wt=0^\circ$ to $wt=\pi$. During the positive half cycle o/p voltage $V_o = \text{source voltage } V_s$ & load current $i_o = V_o/R$. At $wt=\pi$, $V_o=0$ & for R load, i_o is also zero.

As soon as V_s tends to become negative after $wt=\pi$, diode D is reverse biased, it is therefore turned off & goes into blocking state. Output Voltage as well as o/p current are zero from $wt=\pi$ to $wt=2\pi$. After $wt=2\pi$, diode is again forward biased.

SINGLE PHASE HALF WAVE DIODE RECTIFIER with filter



For a resistive load o/p current i_o has the same waveform as that of output voltage v_o . Diode voltage v_D is zero when diode conducts. Diode is reverse biased from $\omega t = \pi$ to $\omega t = 2\pi$. The waveform of v_s , v_o , i_o & v_D . Here source voltage is sinusoidal $v_s = V_m \sin \omega t$. KVL for circuit gives $v_s = v_o + v_D$.

FORMULAE :

i) Average value of output voltage

$$v_{o\text{av}} = \frac{V_m}{\pi}$$

ii) RMS value of o/p voltage

$$v_{o\text{rms}} = \frac{V_m}{\sqrt{2}}$$

iii) Average value of load current

$$I_{o\text{av}} = \frac{v_{o\text{av}}}{R} = \frac{V_m}{\pi R}$$

$$I_{o\text{rms}} = \frac{v_{o\text{rms}}}{R} = \frac{V_m}{2R}$$

Peak value of load, or diode current = $\frac{V_m}{R}$

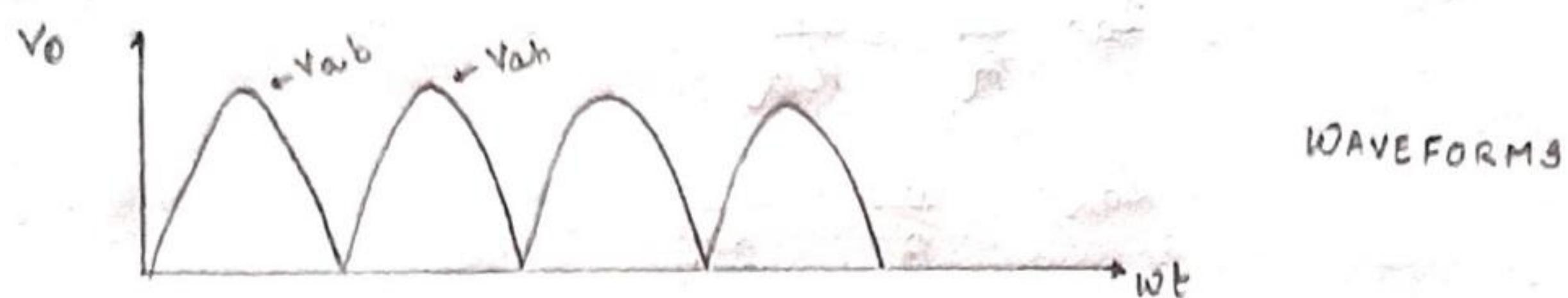
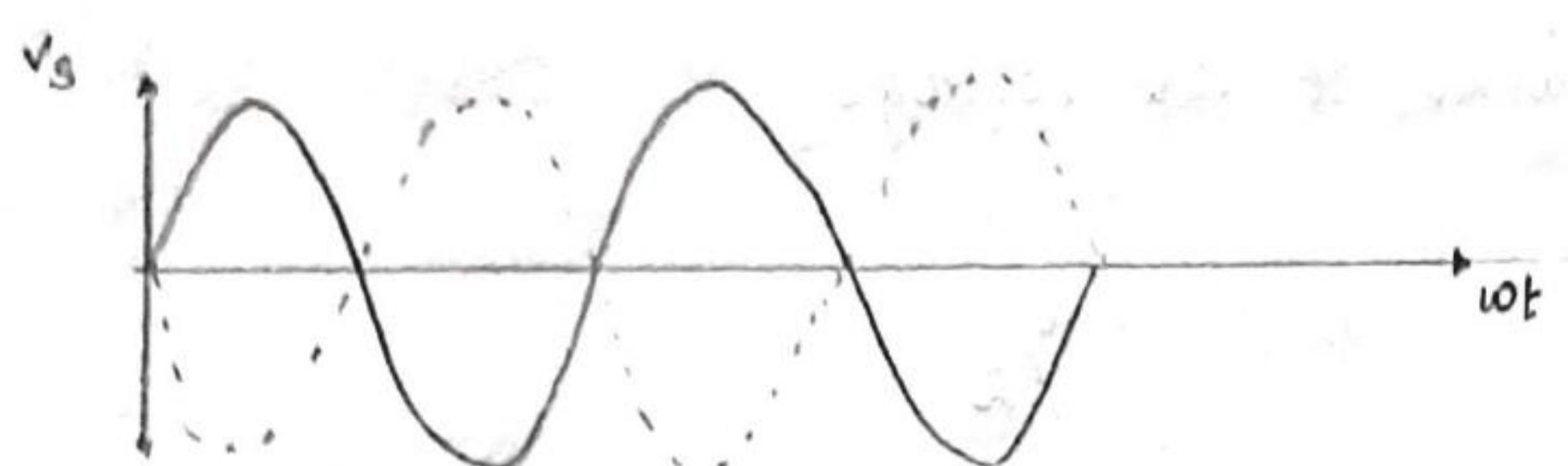
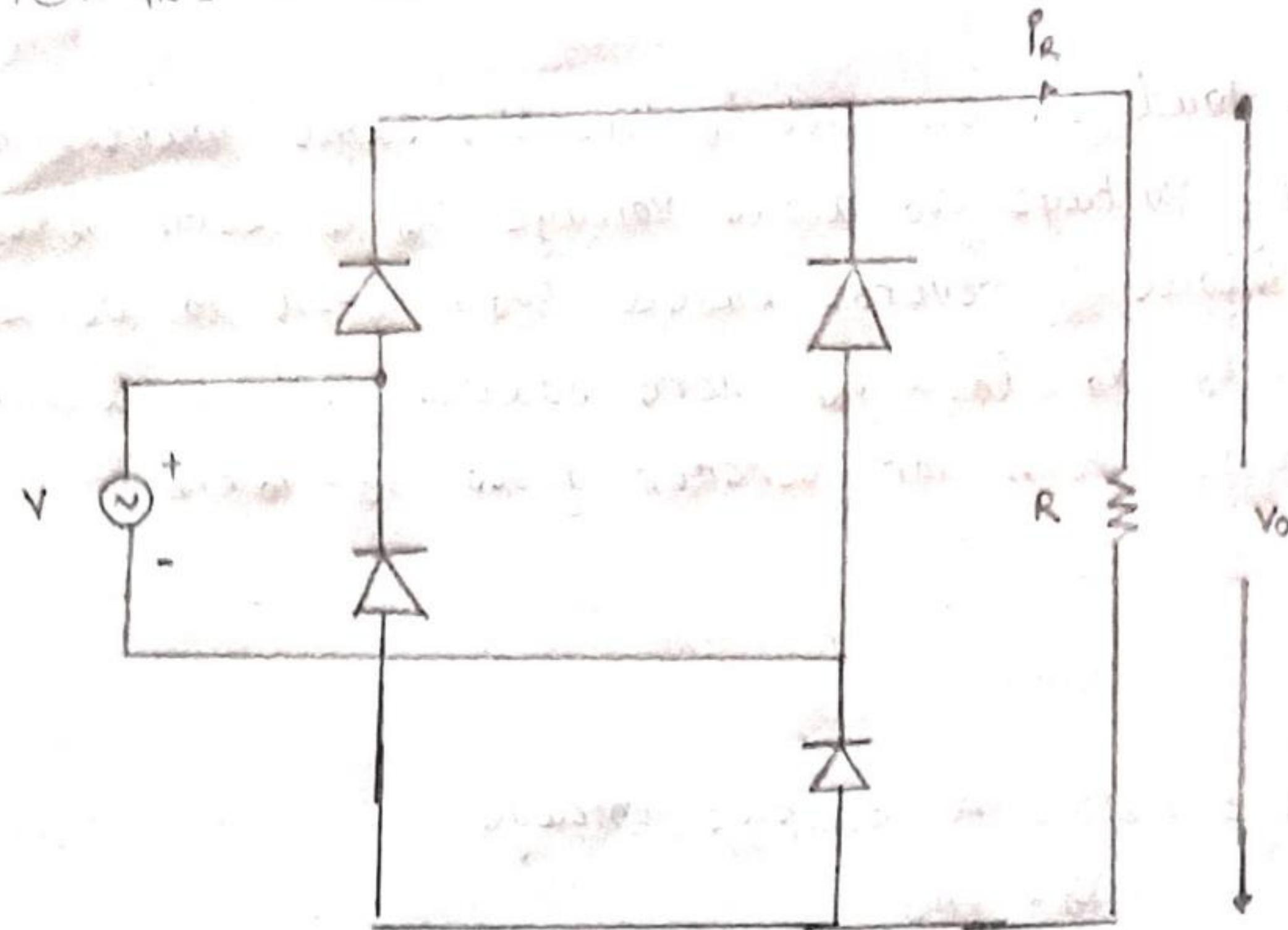
Peak Inverse Voltage (PIV) is the maximum voltage that appears across the device during its blocking state.

$\text{PIV} = V_m = \sqrt{2} V_s = \sqrt{2}$ (rms value of transform sec voltage)

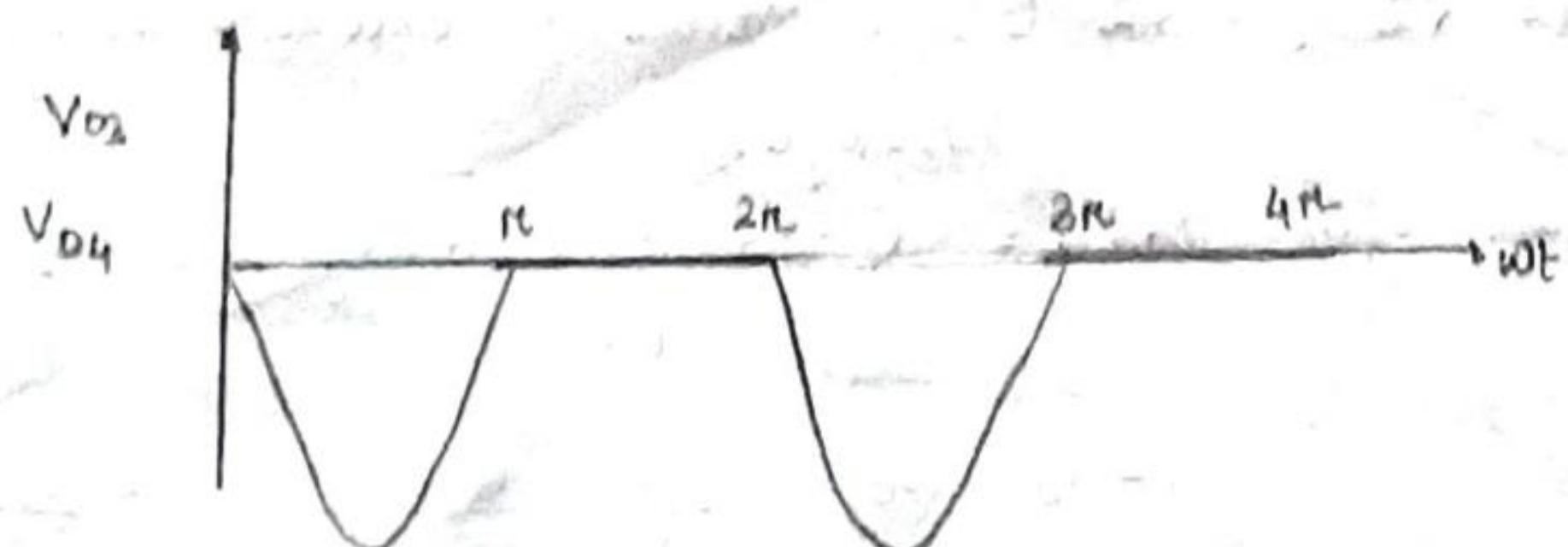
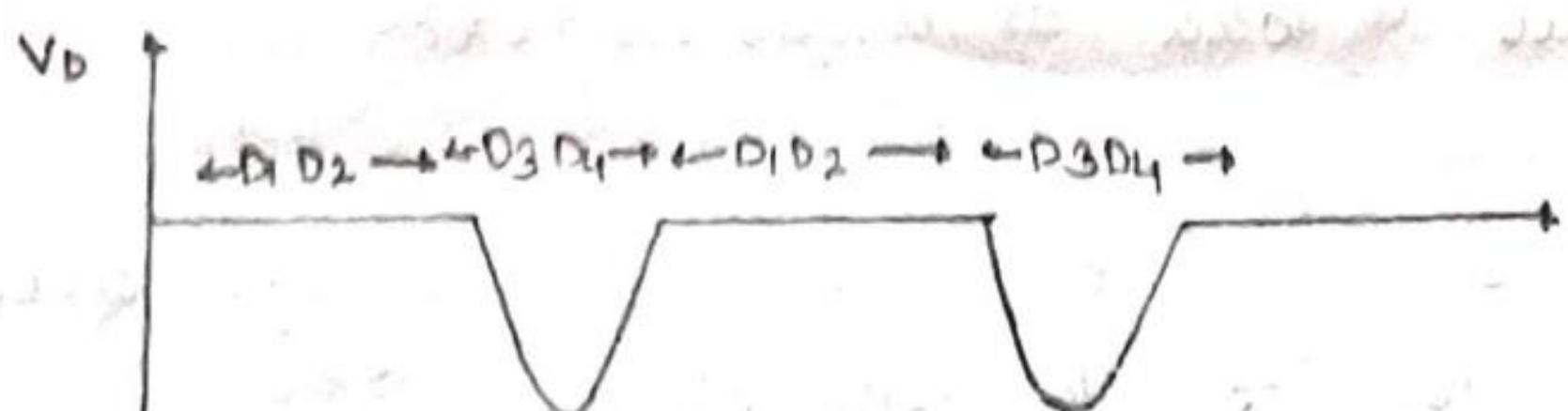
Power Delivered to resistive load = (rms load voltage) (rms load current)

$$= v_{o\text{rms}} I_{o\text{rms}} = \frac{V_m}{2} \cdot \frac{V_m}{2R} = \frac{V_m^2}{4R} = \frac{V_s^2}{2R}$$

SINGLE-PHASE FULL-WAVE DIODE BRIDGE RECTIFIER



WAVEFORMS



$$\text{Input Power factor} = \frac{\text{Power delivered to load}}{\text{Input } V_A} = \frac{V_{o\text{r}} I_{o\text{r}}}{V_A} = \frac{V_{o\text{r}}}{V_A} = \frac{V_{o\text{r}}}{V_S} = 0.707 \log$$

AL load : A single phase one-pulse diode rectifier feeding R_L load. current continues to flow even after source voltage V_S has become negative, because of presence of inductance L in the load circuit voltage $V_A = i_o R$ has the same waveshape as that of i_o . Inductor voltage $V_L = V_S - V_A$. The current i_o flows till 2 areas A & B are equal. Area A represents the energy stored by L & area B the energy released by L . It must be noted that average value of voltage V_L across inductor L is zero when $i_o = 0$ at $\omega t = \beta$; $V_L = 0$, $V_A = 0$ & voltage V_S appears as reverse bias across diode as shown. At β , voltage V_D across diode jumps from zero to $V_m \sin \beta$ where $\beta > \pi$. Here $\beta = \gamma$ is also the conduction angle of the diode.

$$\text{Average value of o/p voltage} = \frac{V_m (1 - \cos \beta)}{2\pi}$$

$$\text{Average value of load or o/p current} I_o = \frac{V_o}{R} = \frac{V_m (1 - \cos \beta)}{2\pi R}$$

ii) Full-wave Rectifier: A single-phase full wave bridge rectifier employing diodes is shown. When 'a' is +ve wrt 'b', diodes D_1, D_2 conduct together so that o/p voltage is V_{ab} . Each of the diodes D_3 & D_4 is subjected to reverse voltage of V_S . When 'b' is +ve wrt to 'a', diodes D_3, D_4 conduct together & output voltage V_{ba} . Each of the 2 diodes D_1 & D_2 experiences a reverse voltage of V_S .

FORMULAE: Average value of o/p is given by

$$V_o = \frac{1}{\pi} \int_0^{\pi} V_m \sin \omega t d\omega t = \frac{V_m}{\pi} (1 - \cos \omega t_{rr})$$

Conclusion: Simulation of uncontrolled half & full wave rectifier have been executed successfully on Multisim and are well comprehended.

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Roll No:33

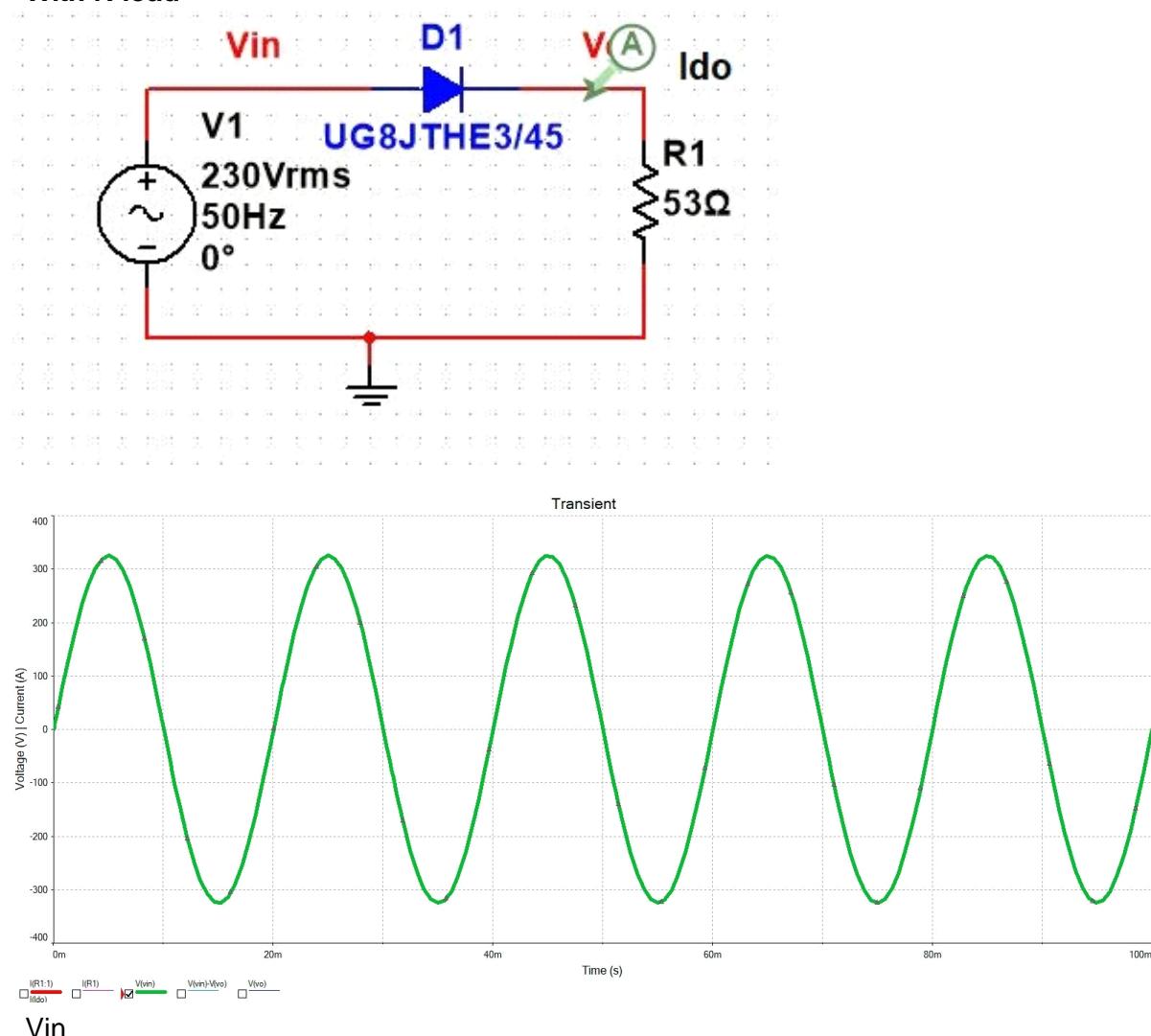
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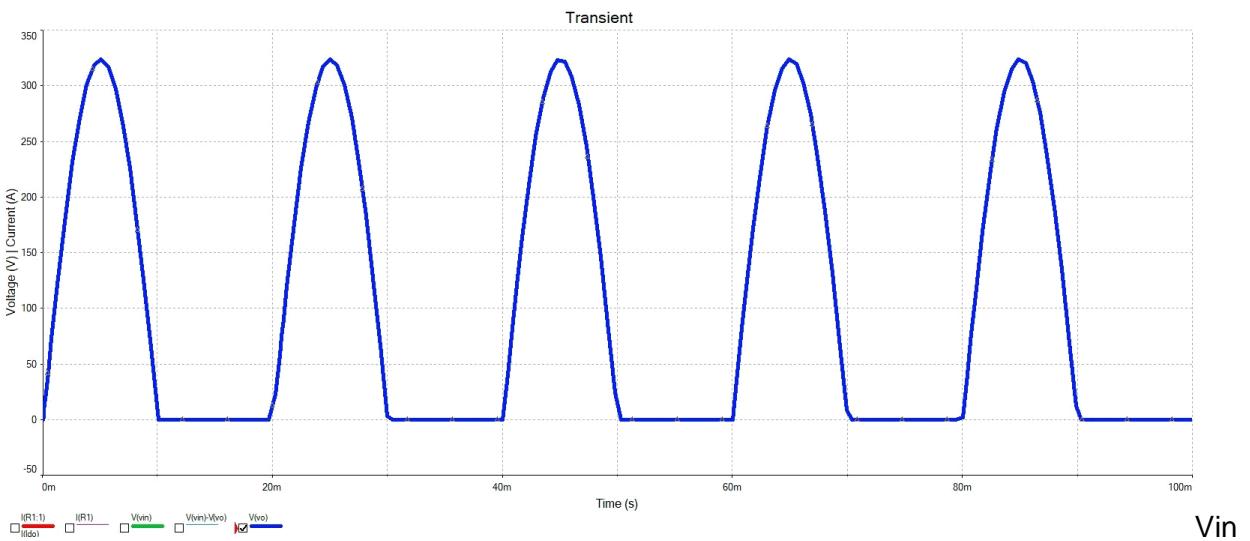
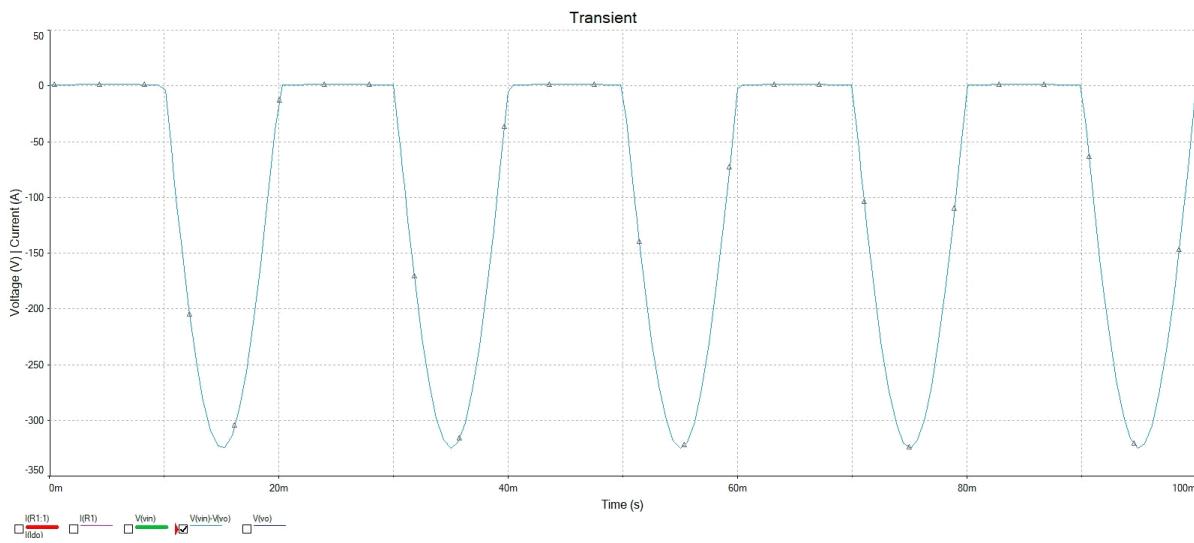
Experiment No. 3

Aim: - To Simulate half wave and full wave uncontrolled rectifier with R and RL load

Half Wave rectifier

With R load

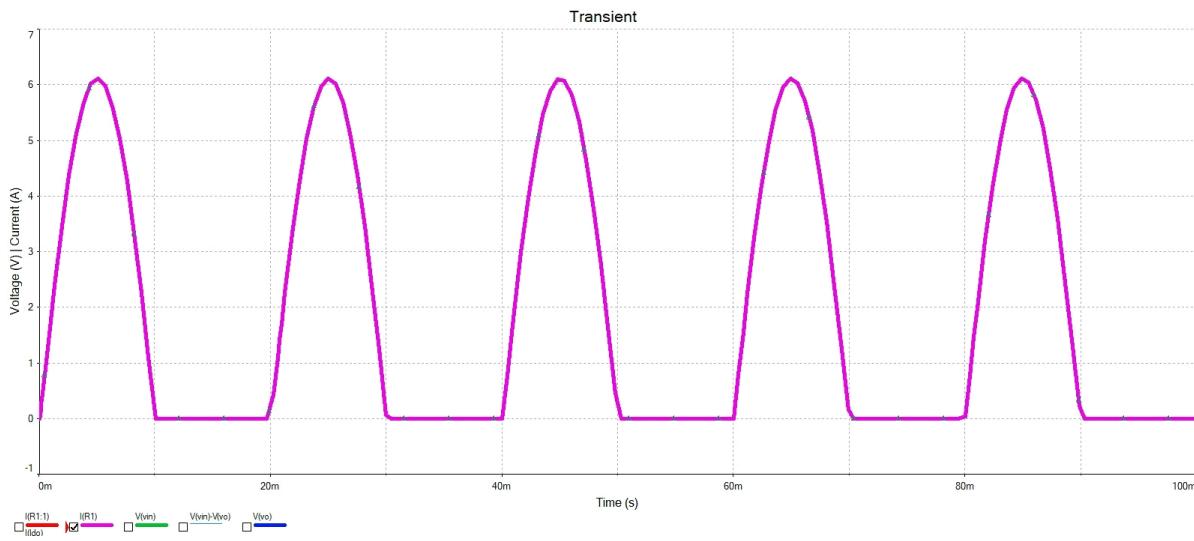




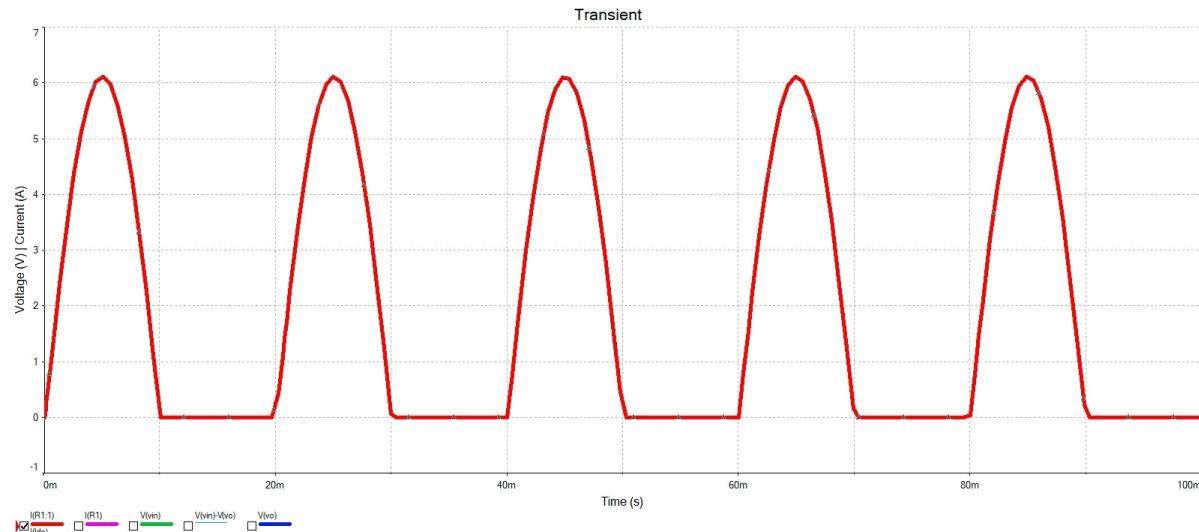
V_{in}

-VO

V_o

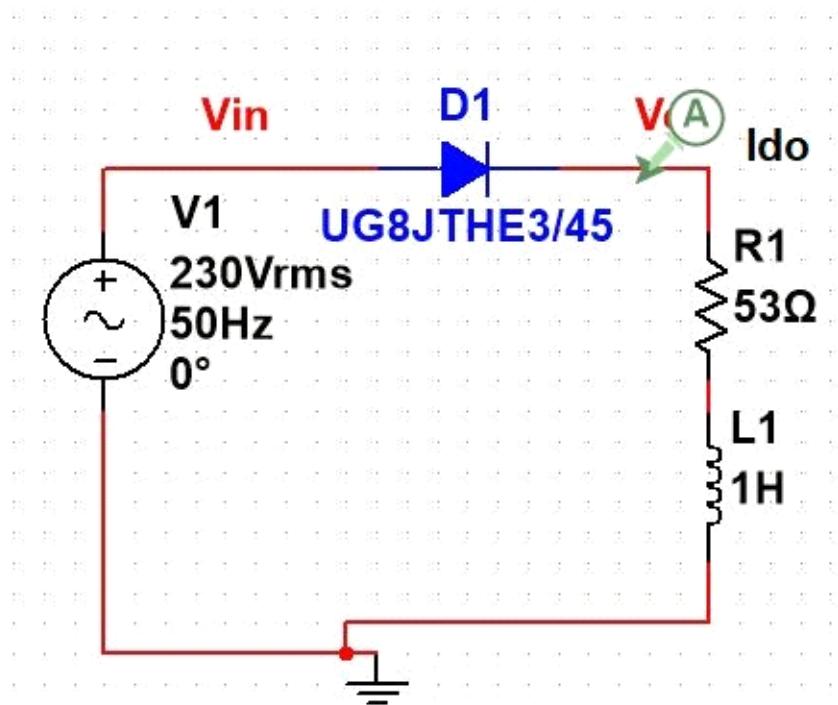


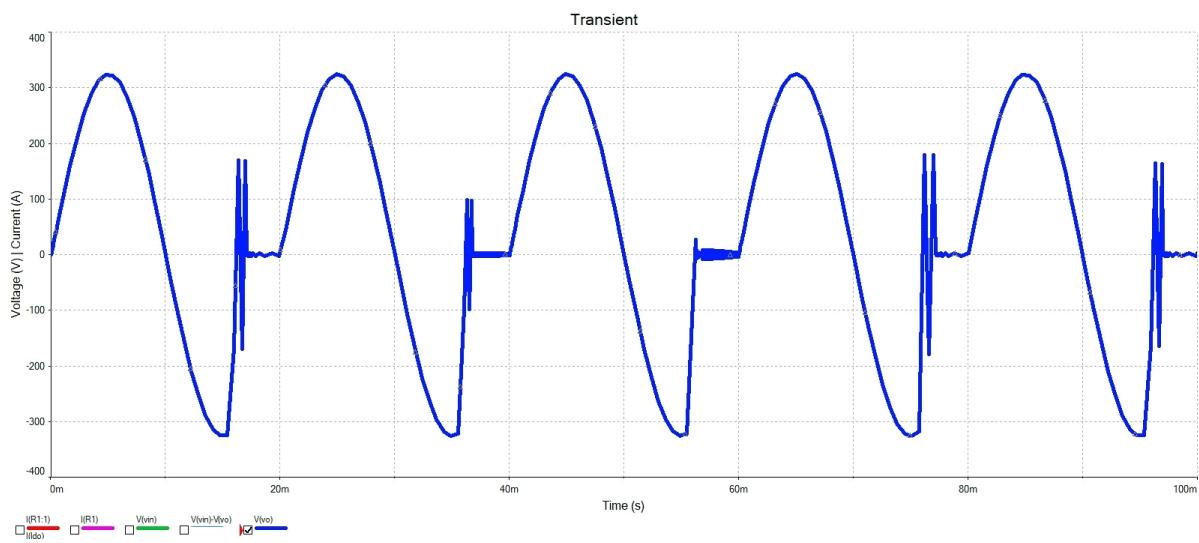
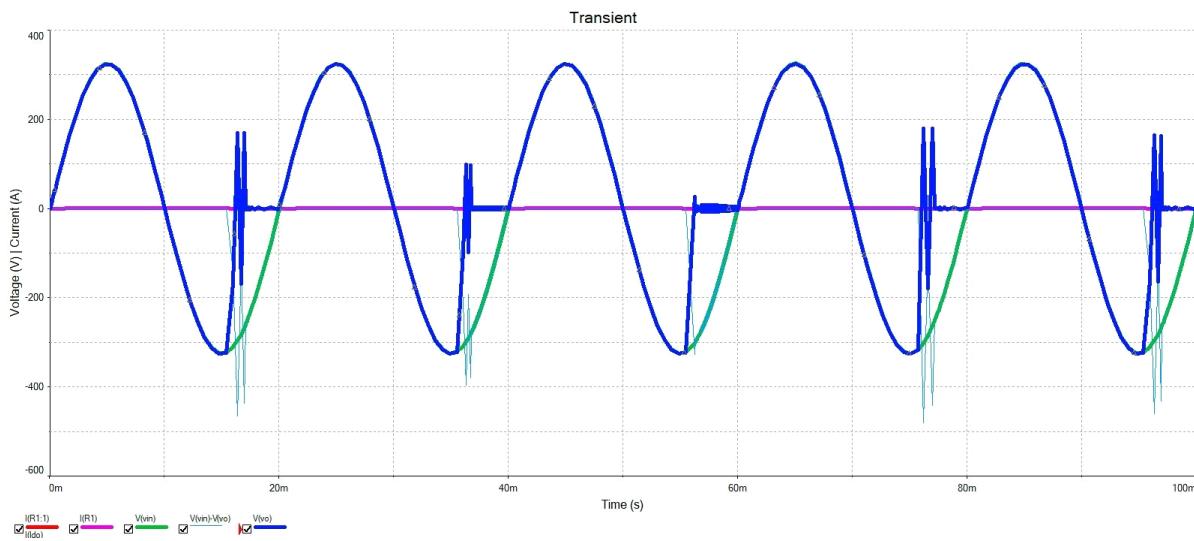
|r1



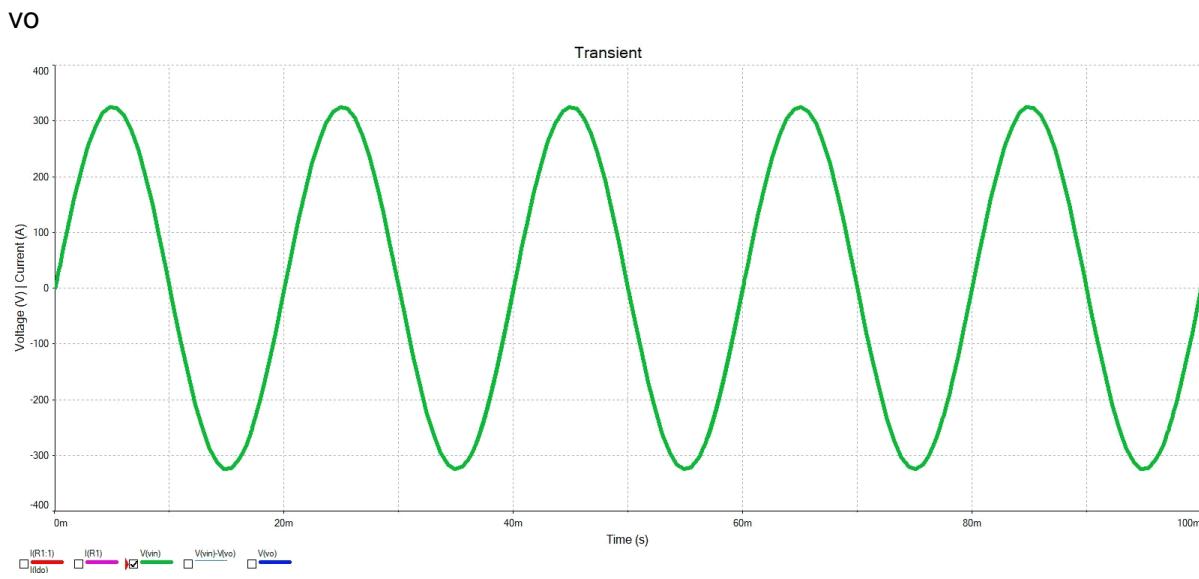
id0

With RL load

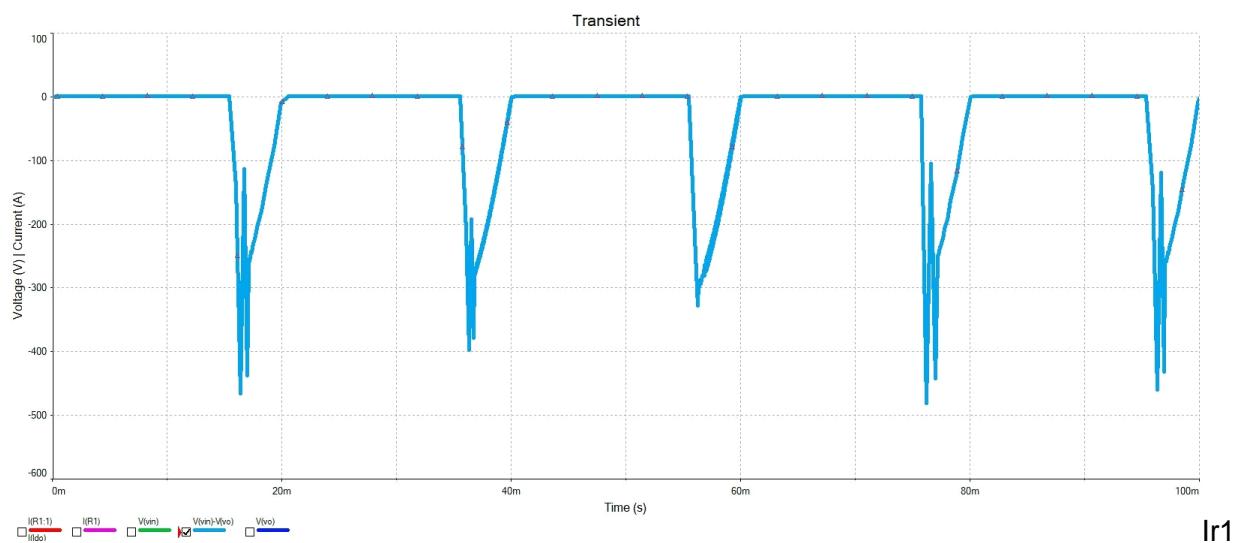
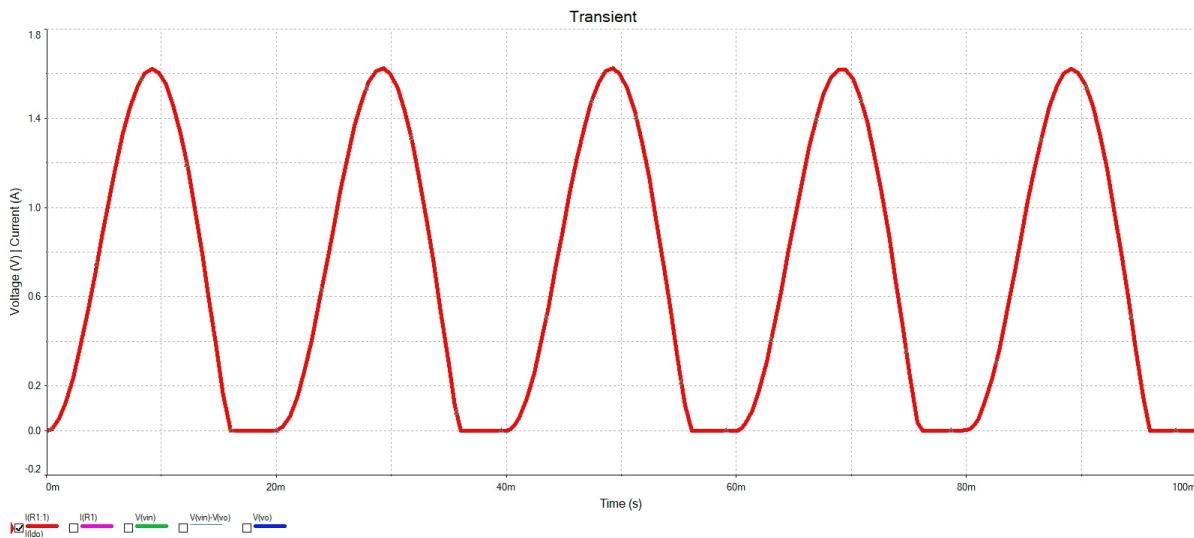




All

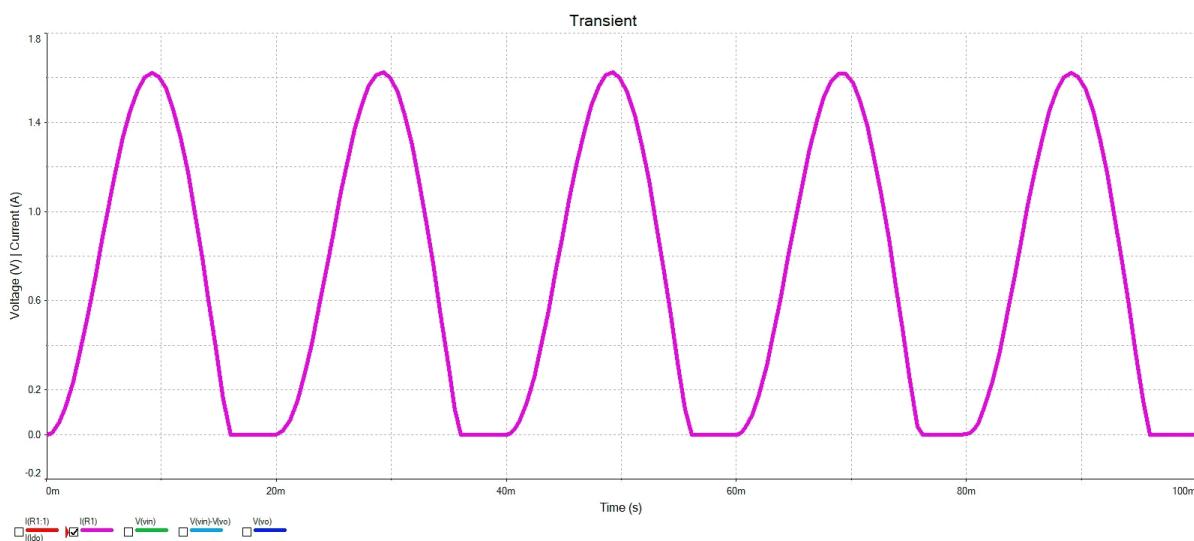


vin



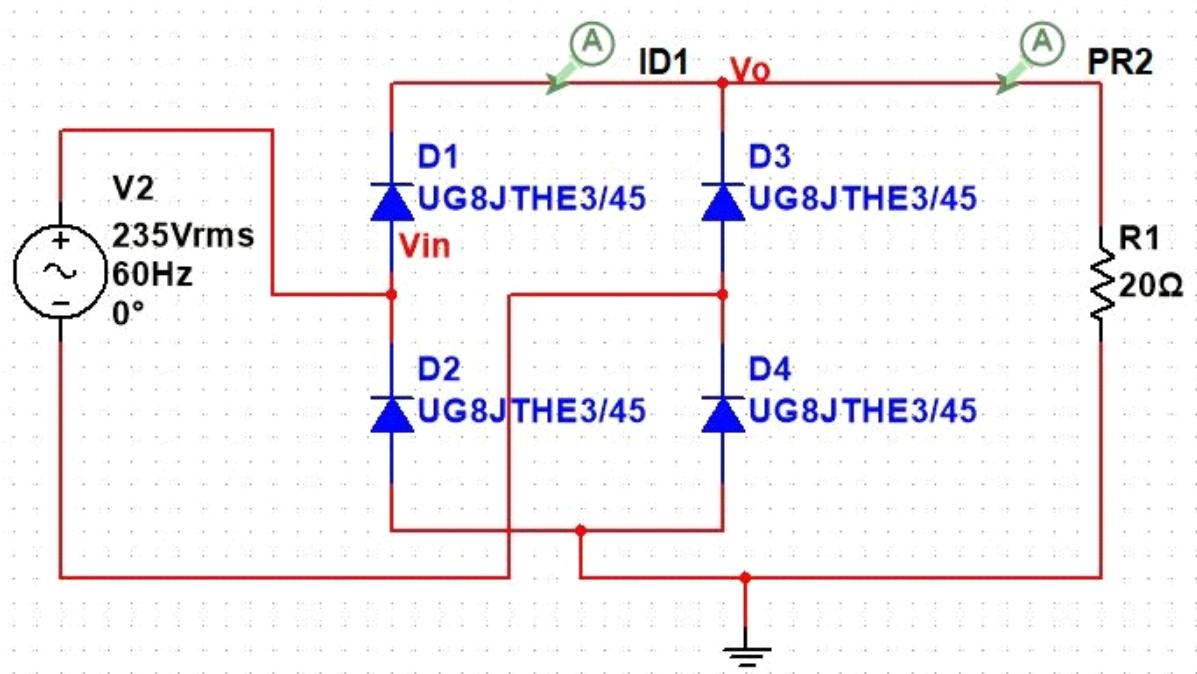
Ir1

vin-vo

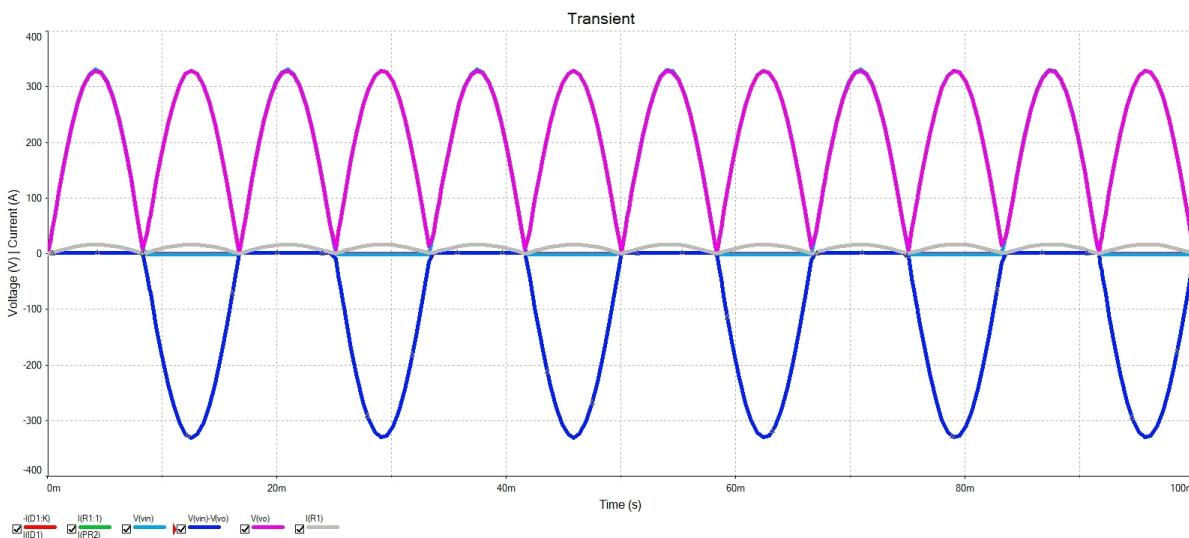


ir1

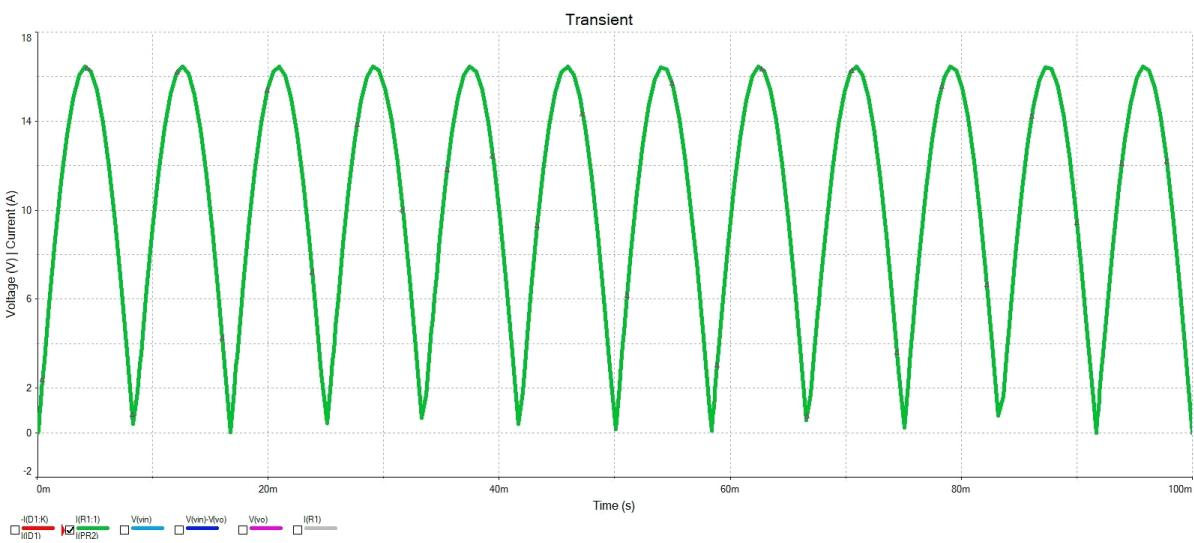
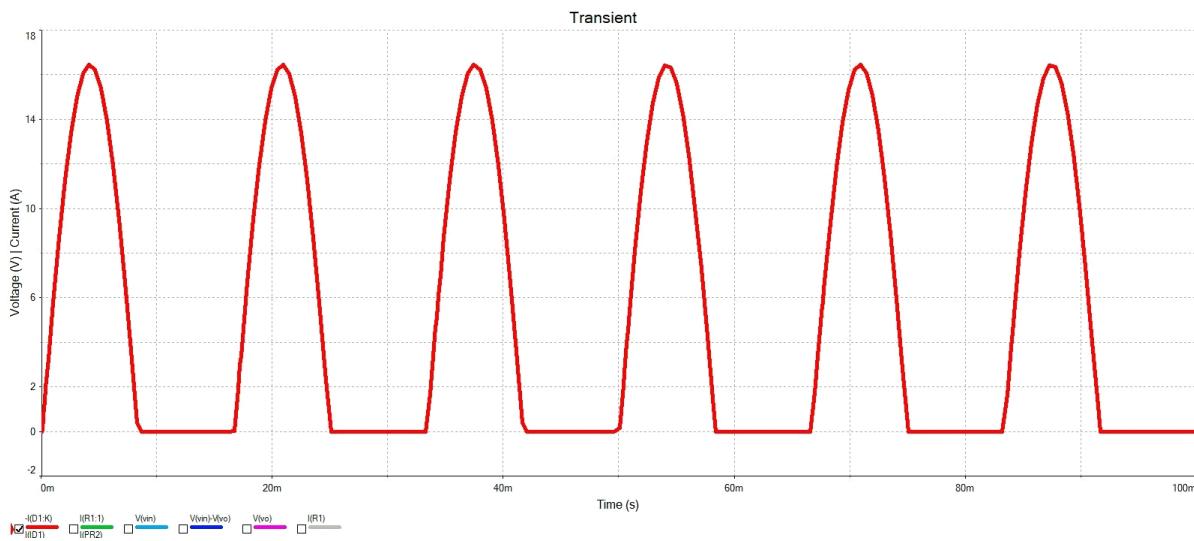
Full Wave rectifier



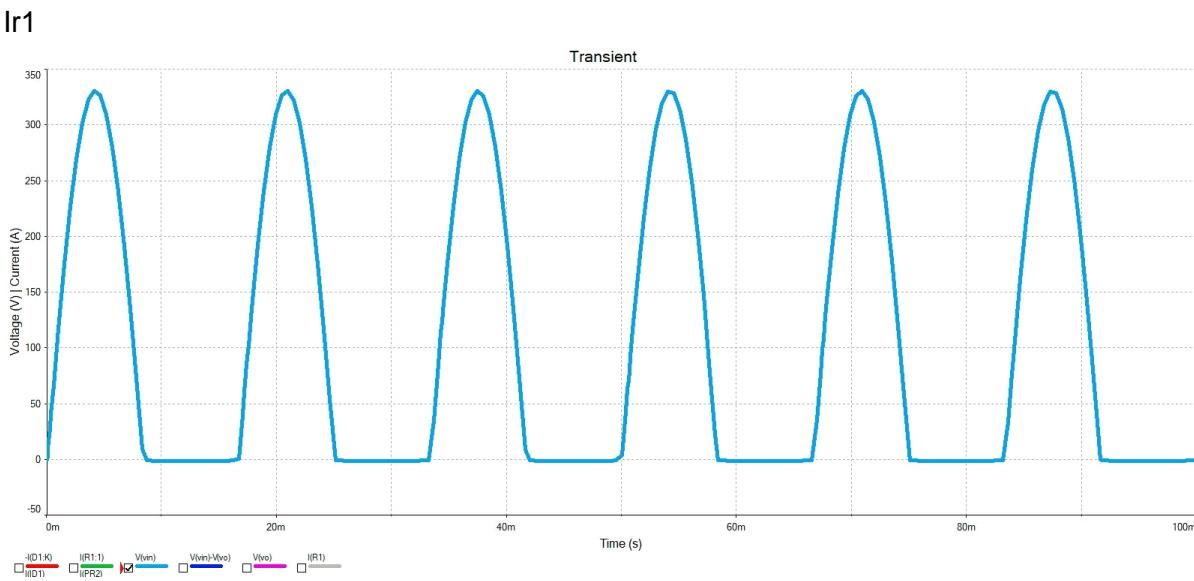
With R load



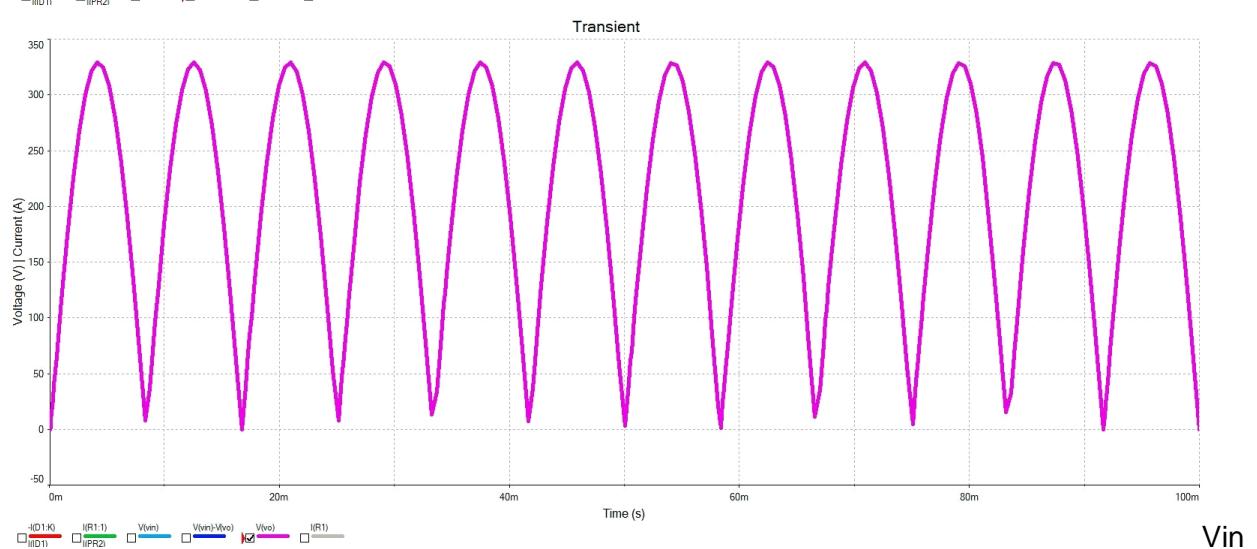
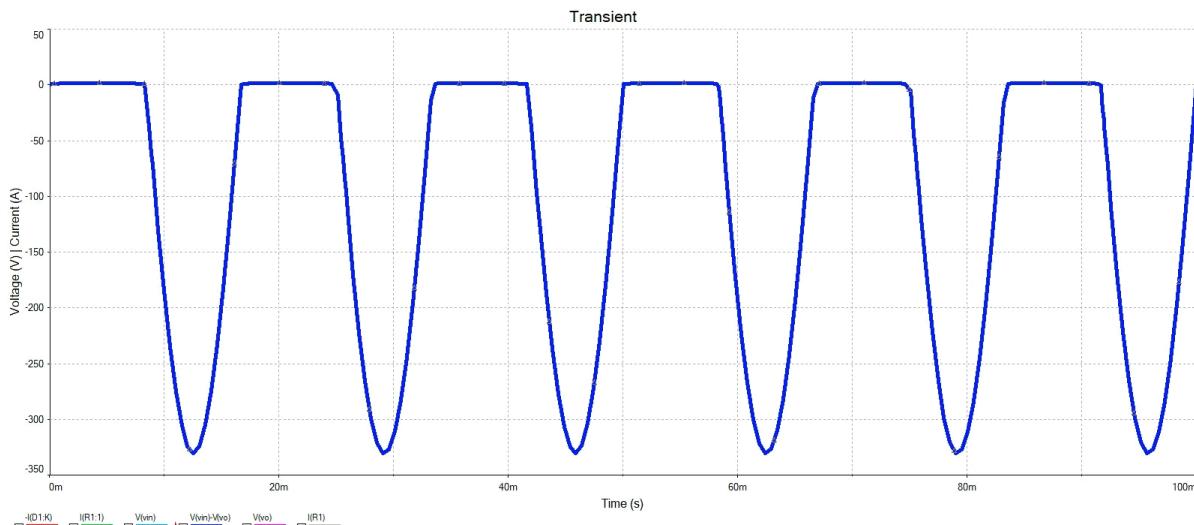
All



Id1



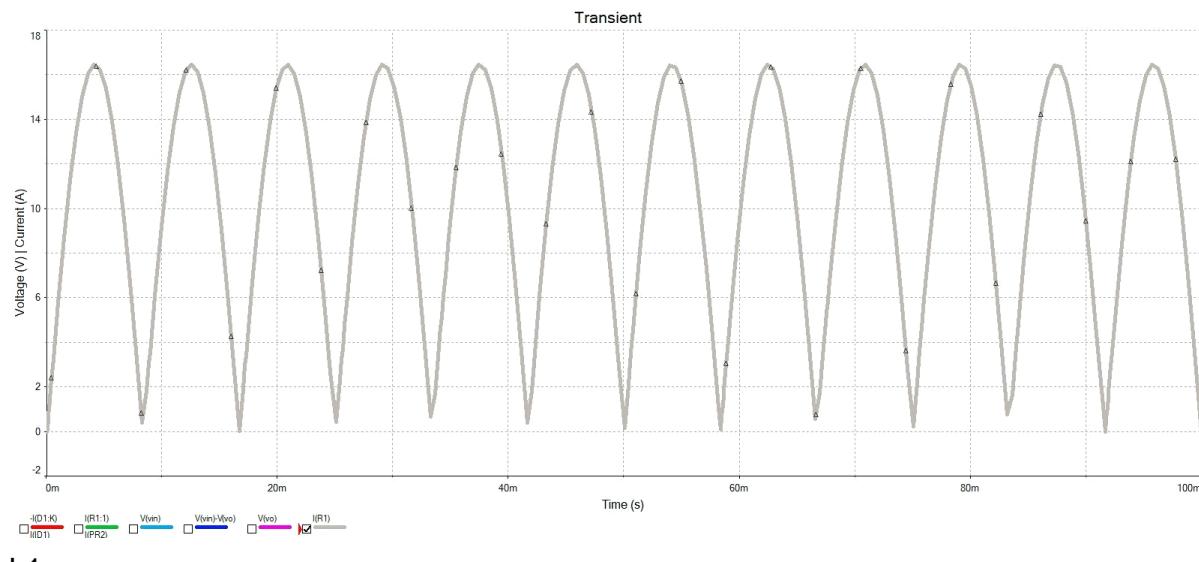
Vin



- V_o

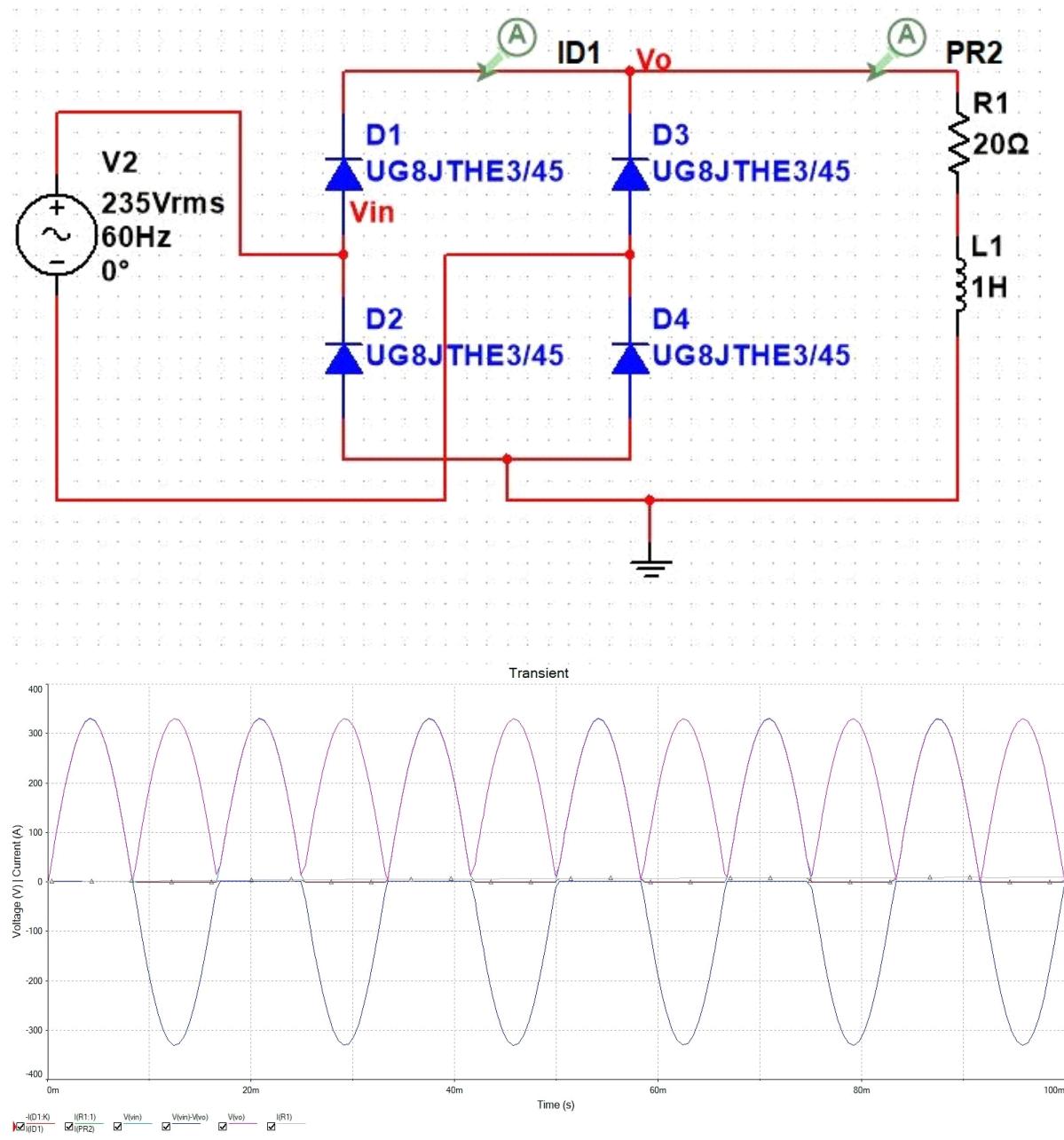
V_o

V_{in}

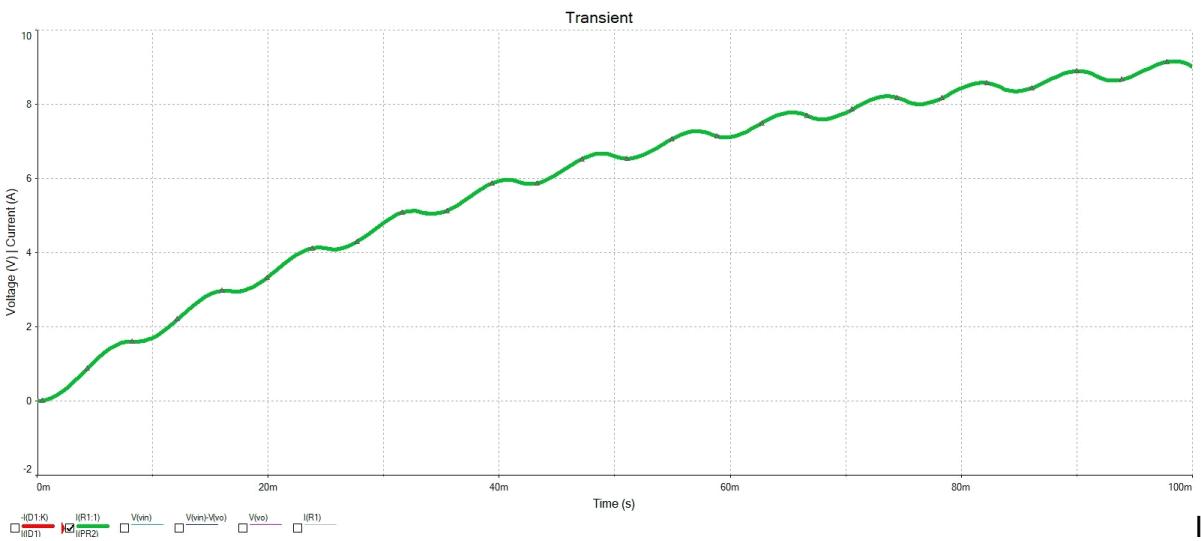
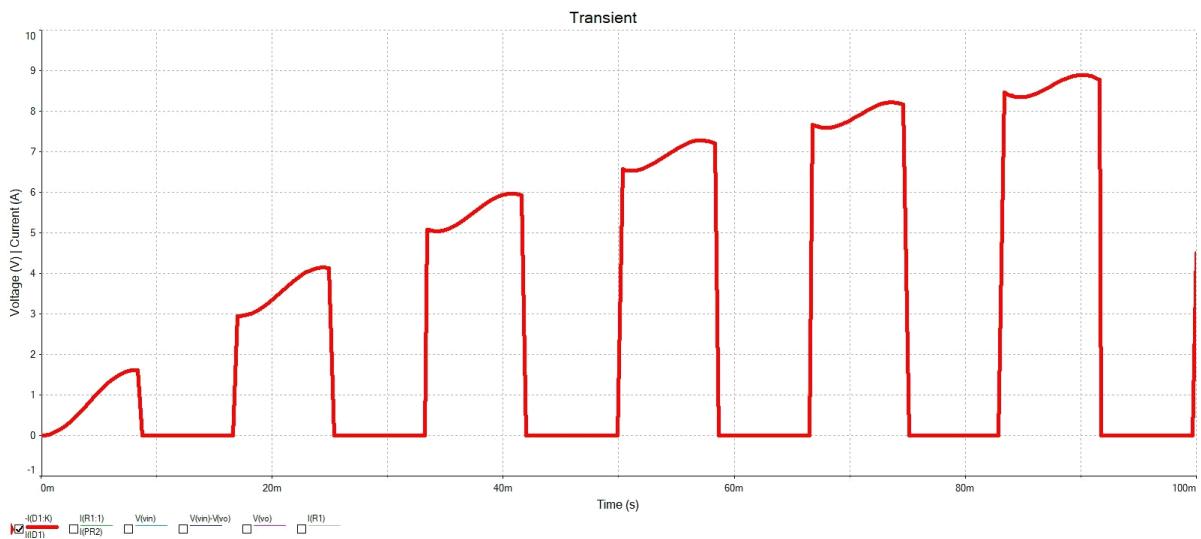


|r1

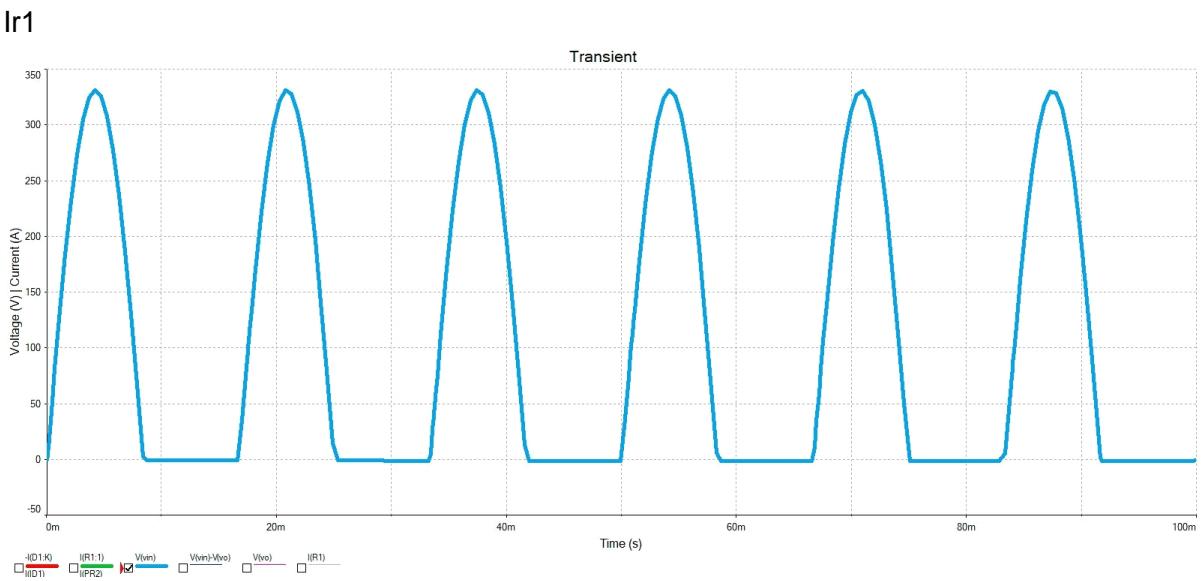
With RL load



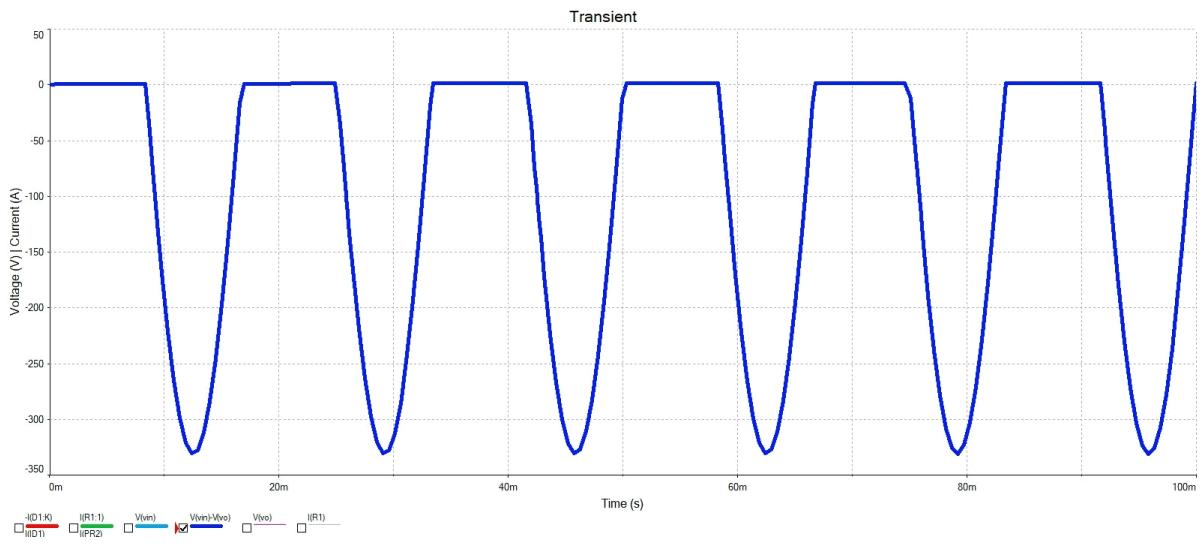
All



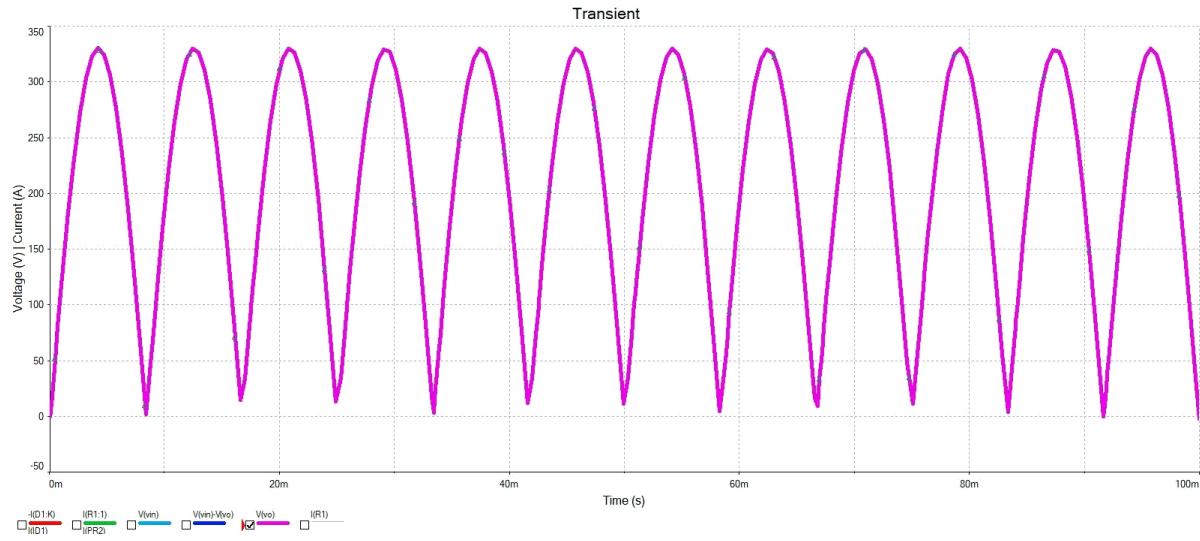
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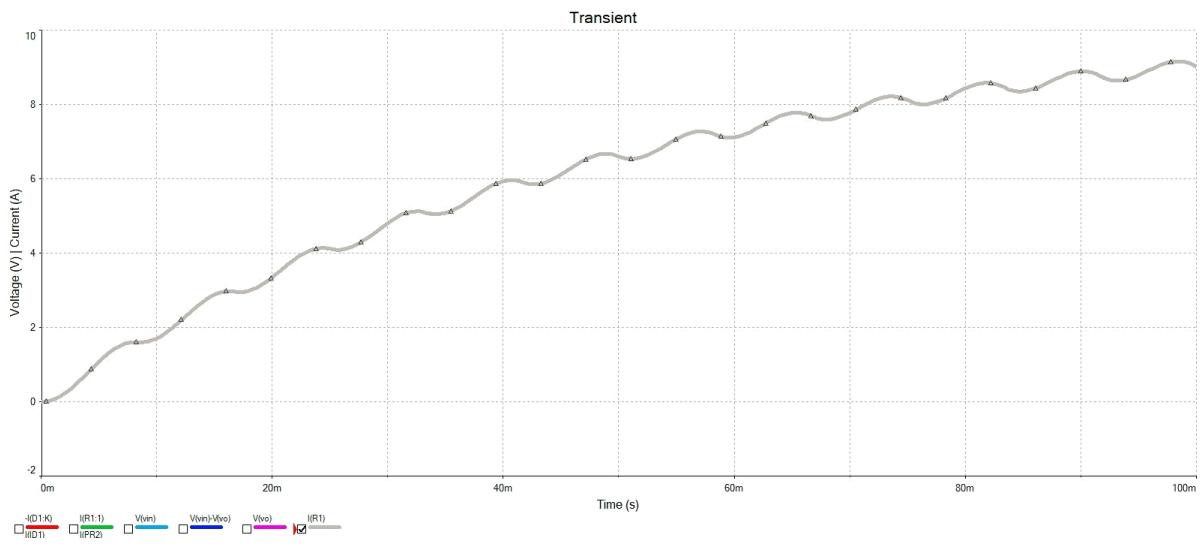
Vin



$V_{in} - V_o$



V_o



|r1