PED

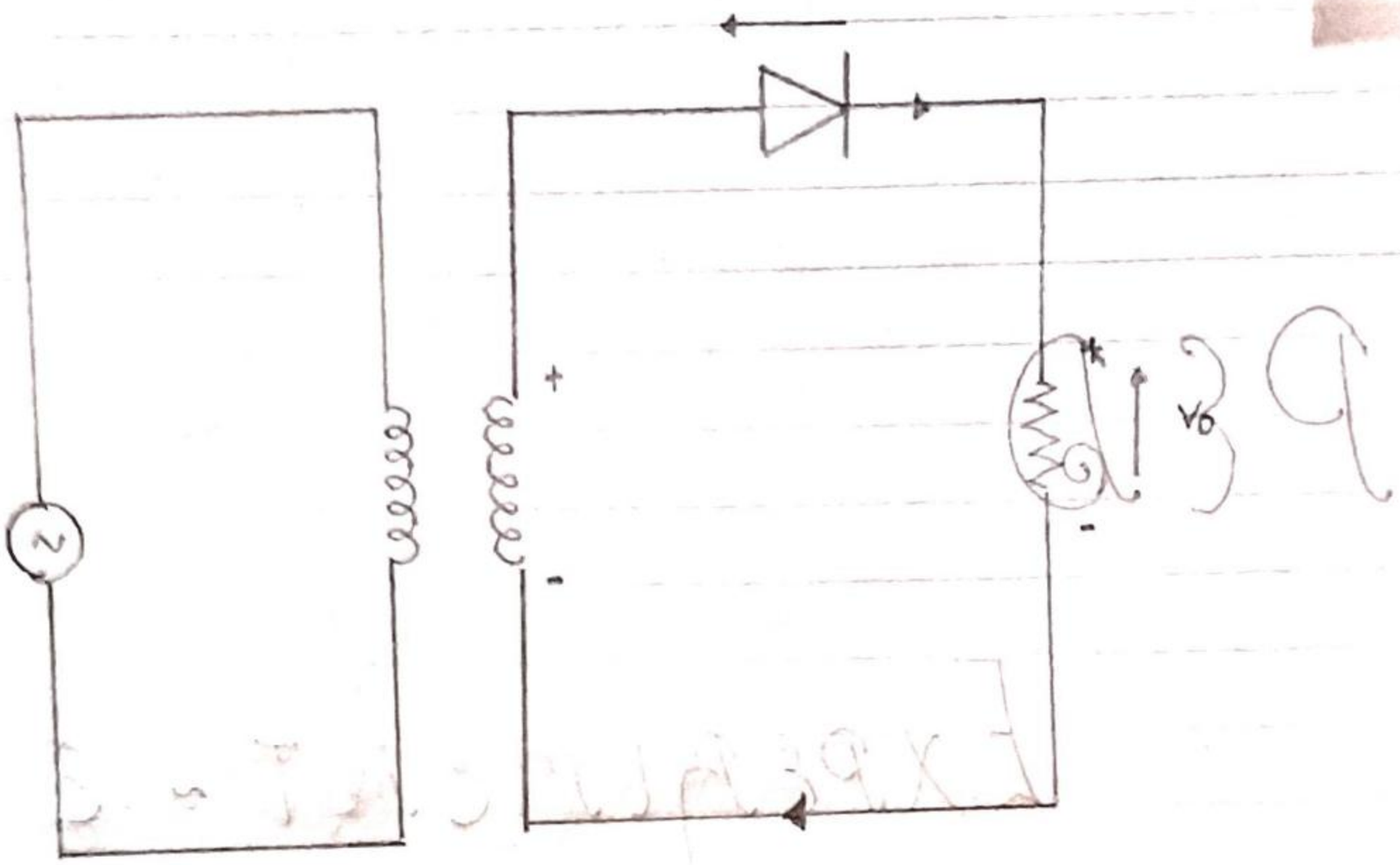
EXPERIMENT - 3

Name : RAHUL VEMURI

ROLL NO : 33

CLASS : D16A

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:

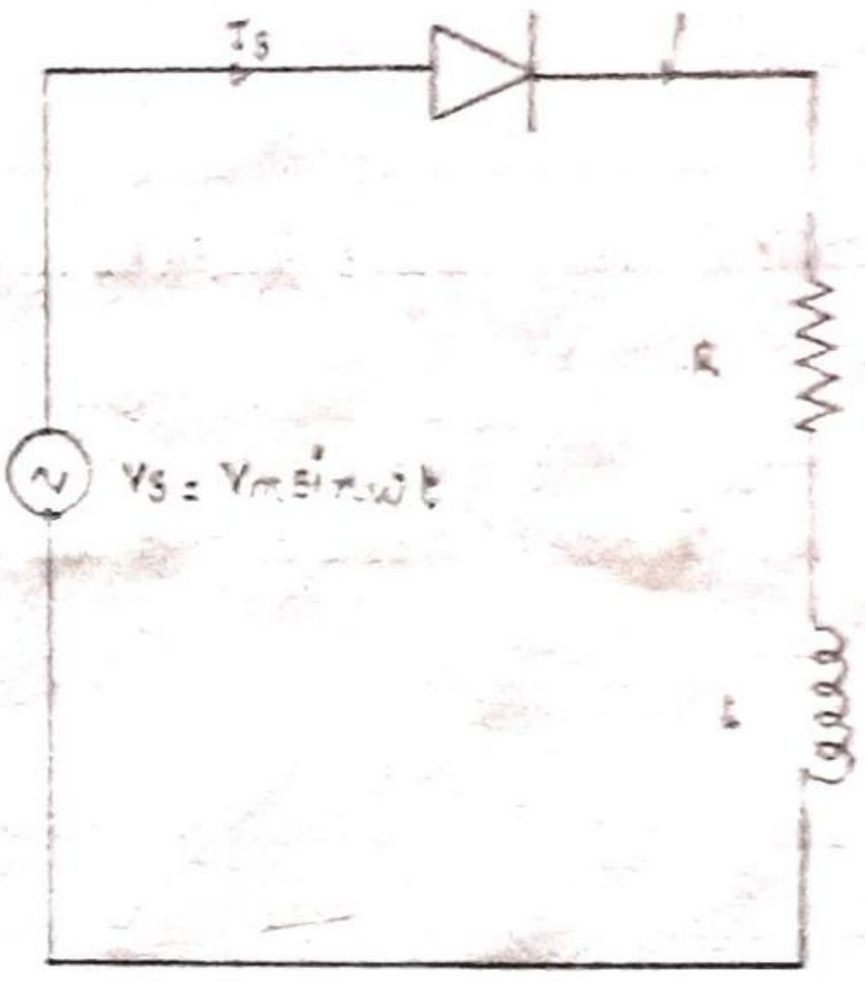
i) Half - Wave Rectifier:

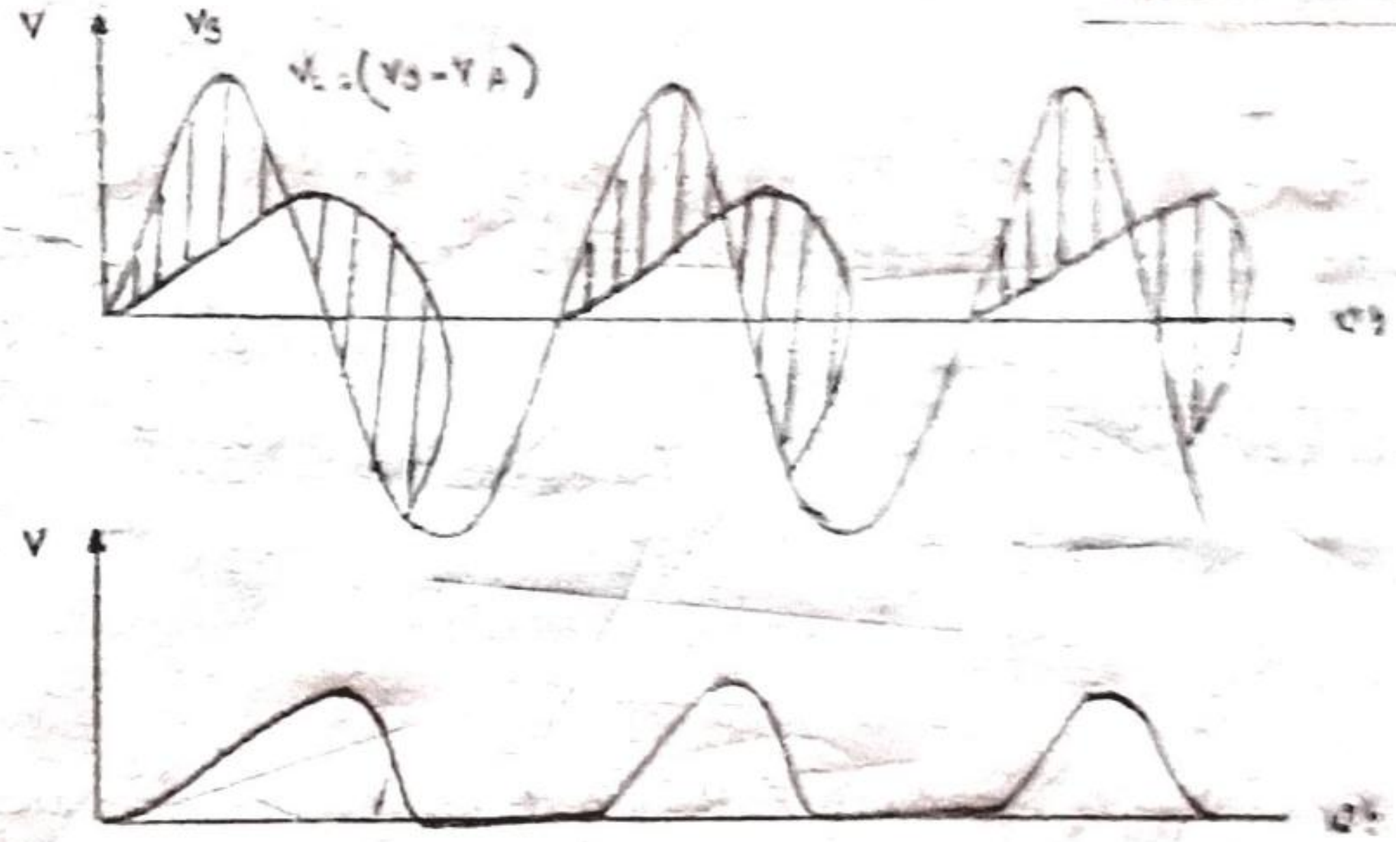
It is simples type of uncontrolled rectifier. In single-phase half-wave rectifier for one cycle of supply voltage there is one half cycle of output or voltage. As such it is also called single-phase one-pulse rectifier. The load on the output side of rectifier may be R RL or RL with a flywheel diode.

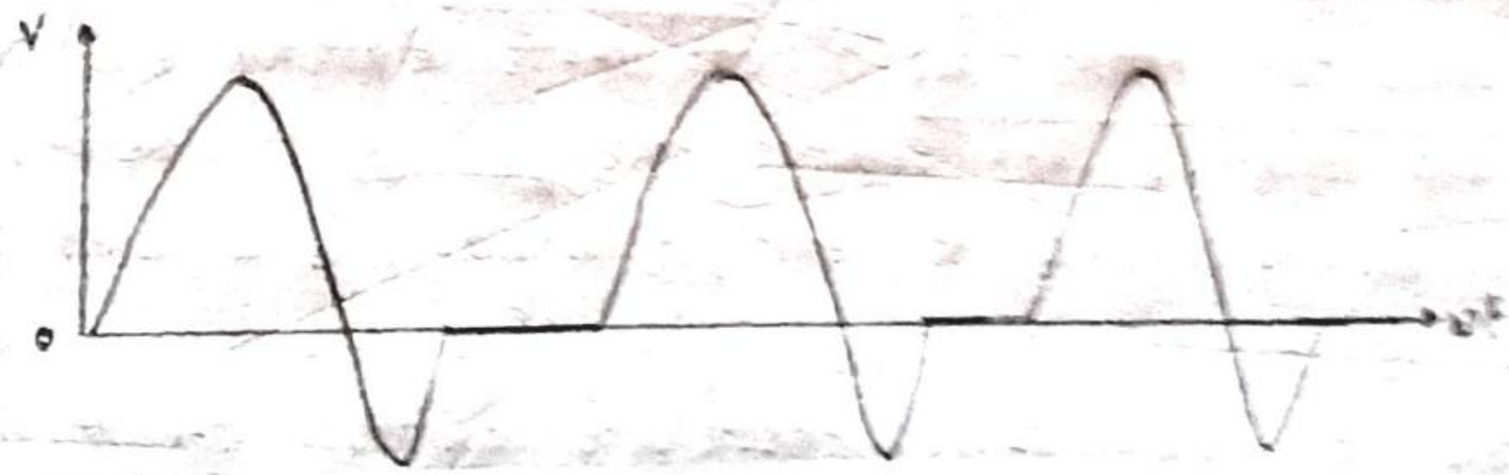
a) R Load:

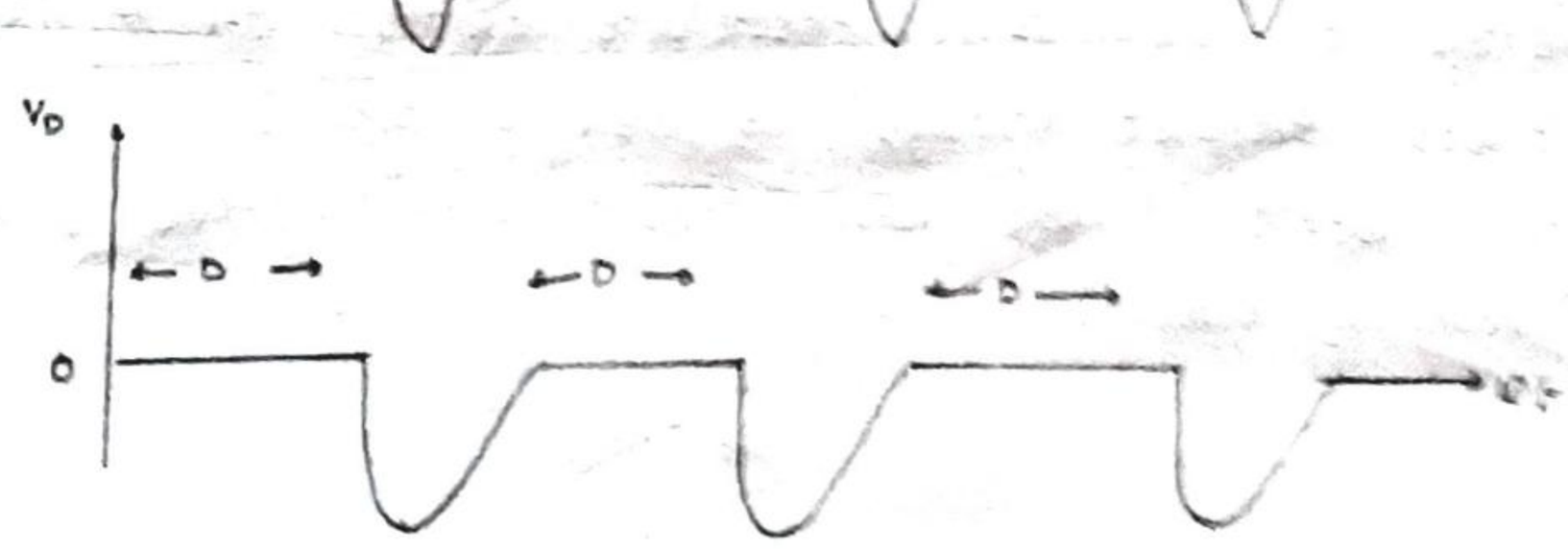
CKt diagram of a single-phase half-wave rectifier is shown in fig a) During the +ve half cycle, diode is forward biased. It therefore conducts from $wt = 0°$ to $wt = \pi$. During the positive half cycle o/p voltage V_o = source voltage V_s & load current $i_o = V_o/R$ At $wt = \pi$, $V_o = 0$ & for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









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

$$v_o = V_m/\pi$$

ii) RMS value of o/p voltage

$$V_{OR} = V_m/2$$

iii) Average value of load current

$$I_o = \frac{V_a}{R} = \frac{V_m}{\pi R}$$

$$I_{OR} = \frac{V_{or}}{R} = \frac{V_m}{2R}$$

Peak value of load, or diode current = V_m/R

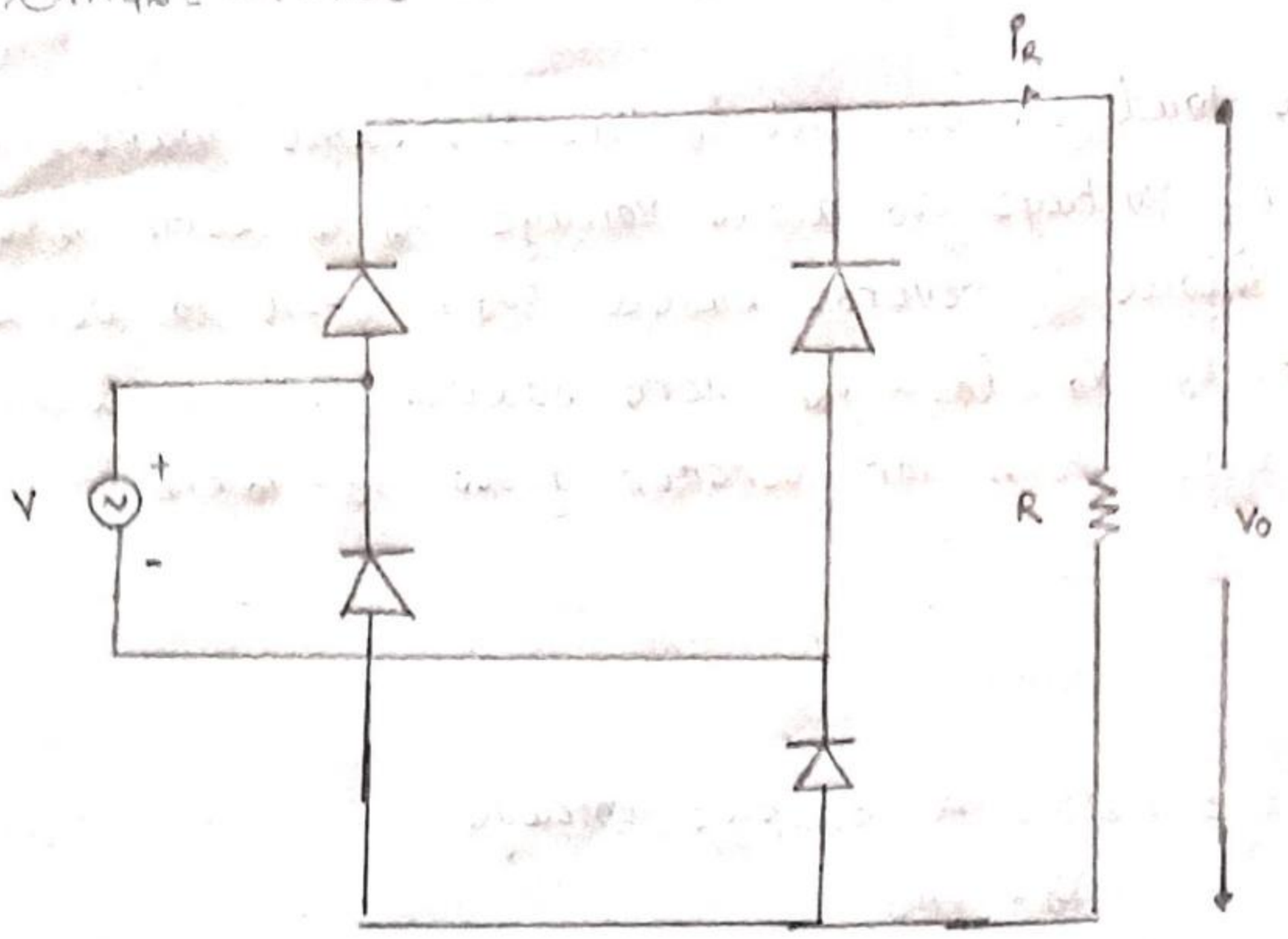
Peak Inverse voltage (PIV) is the maximum voltage that appe across the device during its blocking state.

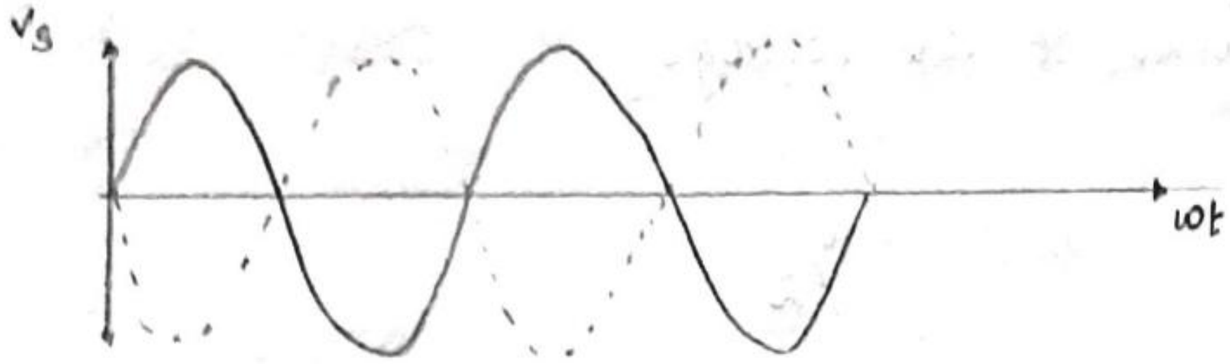
PIV = $V_m = \sqrt{2}\, V_s$ = $\sqrt{2}$ (rms value of transform secon voltage)

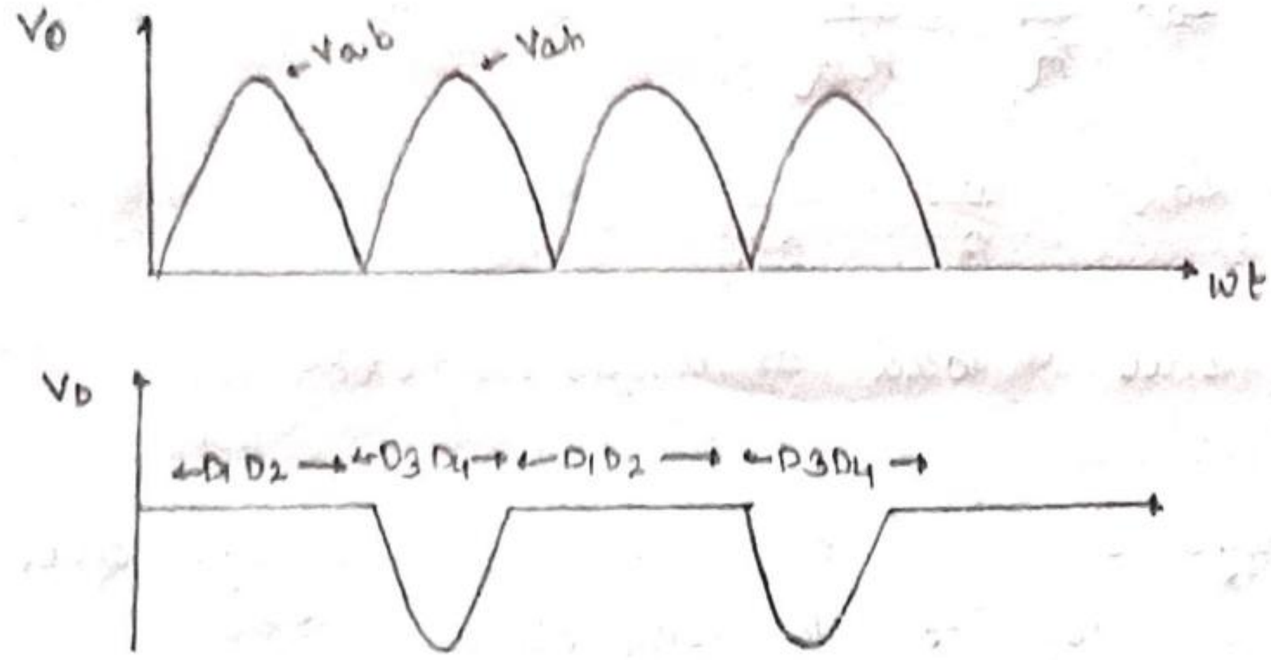
Power Delivered to resistive load = (rms load voltage) (rms loa current)

$$= V_{or}\, I_{or} = \frac{V_m}{2}\,\frac{V_m}{2R} = \frac{V_m^2}{4R} = \frac{V_s^2}{2R} =$$

SINGLE-PHASE FULL-WAVE DIODE BRIDGE RECTIFIER







WAVEFORMS

Input Power factor = $\frac{\text{Power delivered to load}}{\text{Input } V_A} = \frac{V_{or} I_{or}}{V_s I_{or}} = \frac{V_{or}}{V_s} = 0.707$ log

RL load : A single phase one-pulse diode rectifier feeding RL Load. current continues to flow even after source voltage v_s has become negative, because of presence of inductance L in the load ckt voltage $v_R = i_o R$ has the same waveshape as that of i_o Inductor voltage $v_L = v_s - v_R$ 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 wt = β ; $v_L = 0$, $v_R = 0$ & 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.

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

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

ii) Full-wave Rectifier : A single-phase full wave bridge rectifier employing diodes is shown. when 'a' is +ve w.r.t 'b', diodes D1, D2 conduct together so that o/p voltage is v_{ab}. Each of the diodes D3 & D4 is subjected to reverse voltage of v_s. when 'b' is +ve w.r.t to 'a', diodes D3, D4 conduct together & output voltage v_{ba}. Each of the 2 diodes D1 & D2 experiences a reverse voltage of v_s.

FORMULAE : Average value of o/p is given by

$$V_r = \frac{1}{\pi} \int_0^{t_{r0}} V_m \sin\omega t \, d\omega t = \frac{V_m}{\pi}(1 - \cos\omega t_{rr})$$

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