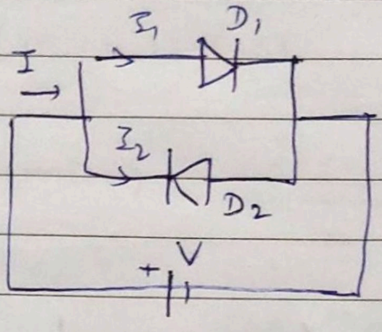
Dhairya Oza (U20CS108)

Tutorial - I

Q- (i) In the circuit below, Current voltage relationship when D_1 and D_2 are identical given by (Ge diode)



→ diode current equation is:

$$I = I_0 (e^{\frac{V_D}{nV_T}} - 1)$$

$$I_2 = I_0 \text{ (Reverse Saturation current).}$$

$$I_1 = I_0 (e^{\frac{V_D}{V_T}} - 1) \qquad (n = 1 \text{ for Ge diode})$$

Now $I = I_1 + I_2$

$$\therefore I = I_0 (e^{\frac{V}{V_T}} - 1) + I_0$$

$$\therefore I = I_0 e^{V/V_T} - I_0 + I_0$$

$$\therefore \frac{I}{I_0} = e^{\frac{V}{V_T}}$$

$$\therefore \ln\left(\frac{I}{I_0}\right) = \ln\left(e^{\frac{V}{V_T}}\right)$$

$$\therefore \ln\left(\frac{I}{I_0}\right) = \frac{V}{V_T}$$

$$\therefore V = V_T \ln\left(\frac{I}{I_0}\right) = \frac{KT}{q} \ln\left(\frac{I}{I_0}\right)$$

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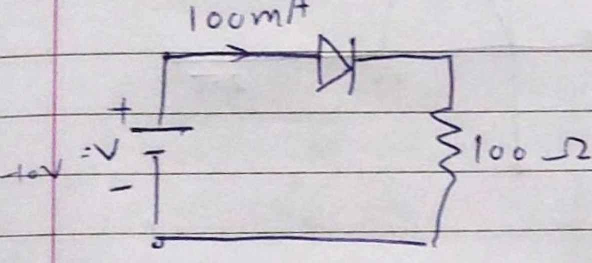
Q-(2) A PN junction with a 100 Ω resistor, forward biased so that 100 mA flows. If voltage across this combination is instantaneously reversed to 10 volts at t = 0, the reverse current flows through the diode t = 0 is approx given by.

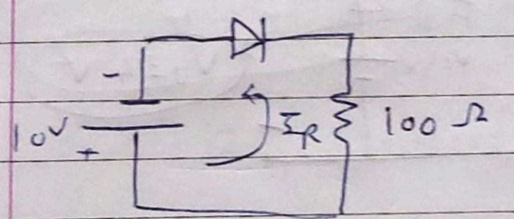
for t < 0



$V = 100 \times 100 \times 10^{-3}$

$= 10\,V$

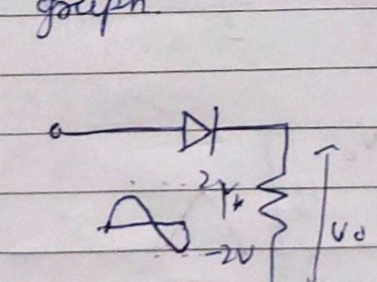
for t = 0

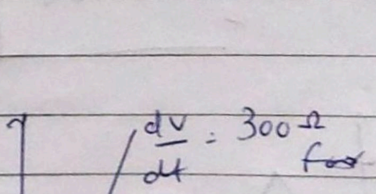


$I_R = \frac{V}{R} = \frac{10}{100} = 10^{-1} A$

$= \underline{100\,mA}$

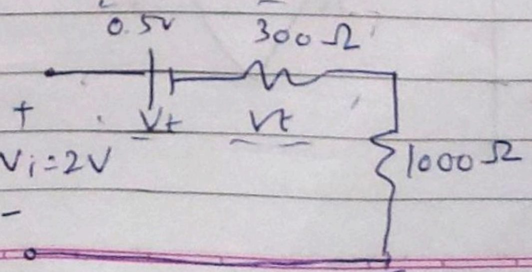
Q-(3) Consider the circuit shown in figure if the diode used here has the V-I characteristic V_0 graph.





$r_t = 300\,\Omega$

$V_t = 0.5\,V$



So, $V_o = 1.15$ volt

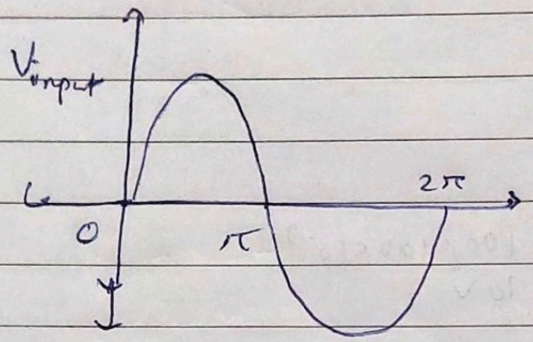
here $i = \frac{V_i - 0.5}{1300}$

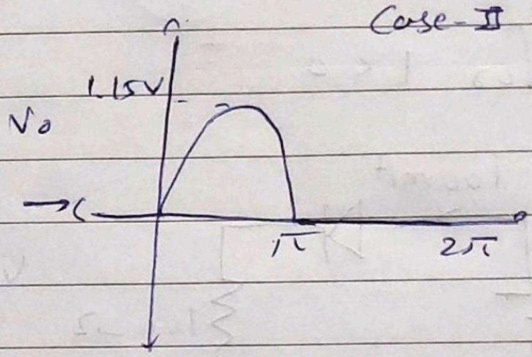
$$\boxed{i = \frac{1.5}{1300} = 1.15mA}$$

$V = 1.1mA(1000)$
$= 1.15$

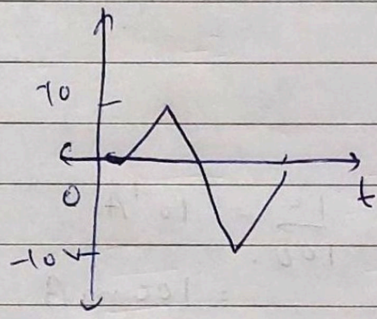
and $V_0 = 0$ for π to 2π

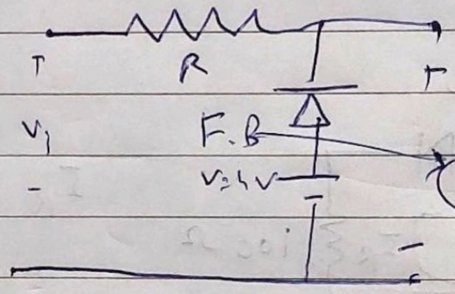
Case-II





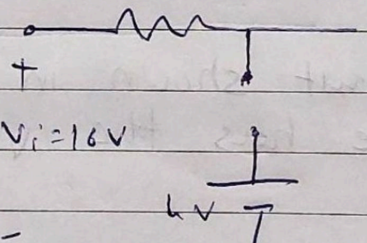
Q-4





$V_0 = 4\ V$

for R.B



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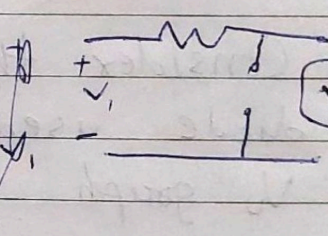
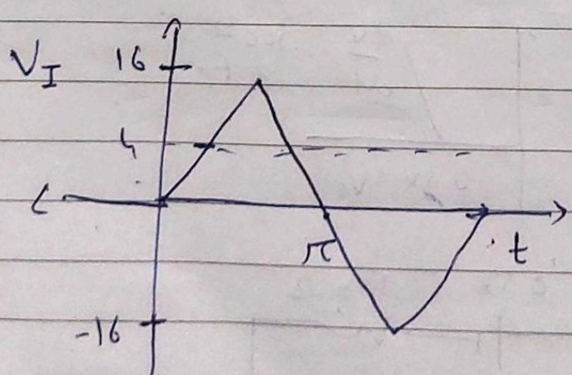
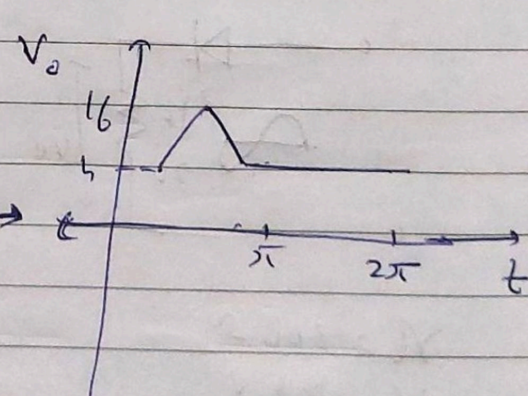
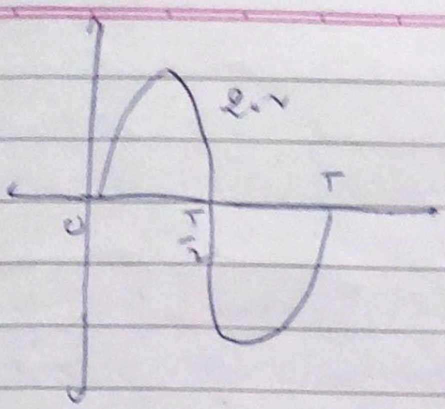
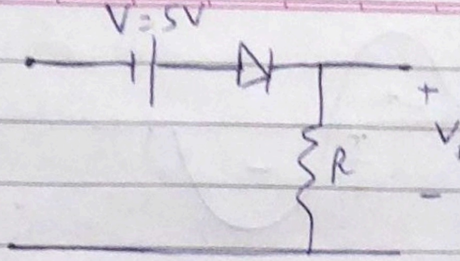


$V_0 = V_i = 16V$

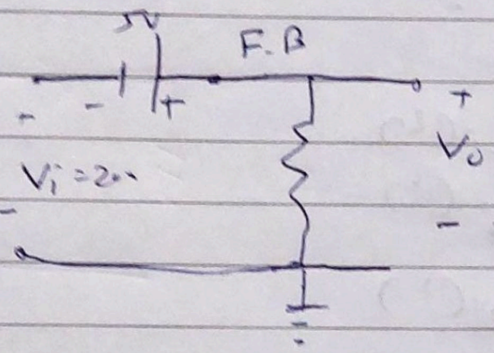






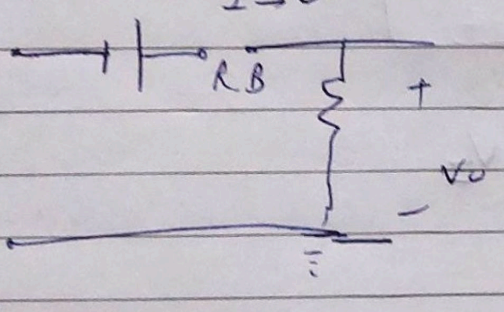


Case 1 - from 0 to $\frac{T}{2}$ F.B



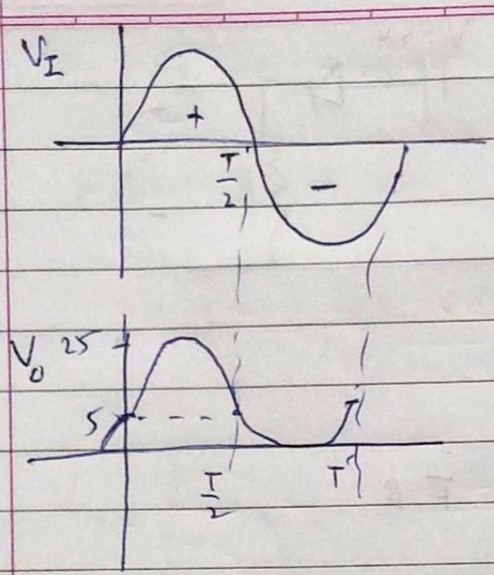
$V_0 = V_i + V = 20 + 5 = 25V$

Case 2 - from $\frac{T}{2}$ to T R.B



$V_0 = 0V$

25↑

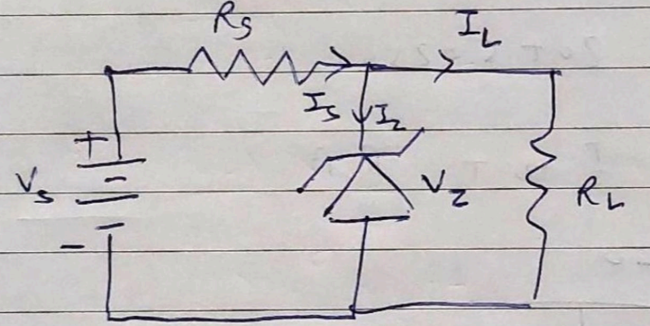


Q - 5 $R_S = 240\,\Omega$ $V_L = (2)$

$V_S = 30\ V$ $V_{R_S} = (1)$

$V_Z = 12\ V$

$R_L = 500\,\Omega$ $I_Z = (2)$



→ $I_S = I_L + I_Z$

→ V_L is equal to V_Z

$\therefore V_L = V_Z = 12\ V$

→ Now V_{R_S} is basically,

$\cancel{I_S = I_L + I_Z}$ $I_S = \dfrac{V_S - V_Z}{R_S}$

$= \dfrac{30 - 12}{240} = \underline{0.075\ A}$

$\therefore$ $V_{RS} = I_S \cdot R_S$

$= 0.075 \times 240$

$= \underline{18\ V}$

$\therefore$ $I_S = 0.075\ A = 75\ mA$

$\therefore$ $I_L = \frac{12}{500} = 24\ mA$

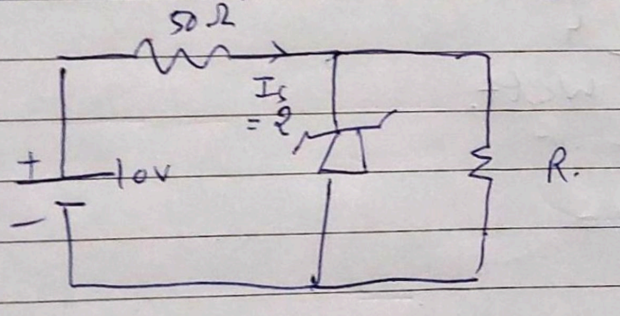
$\therefore$ $I_Z = I_S - I_L$

$= 75 - 24$

$= 51\ mA$

$\therefore$ $\boxed{V_L = 12,\ V_{RS} = 18\ V,\ I_Z = 51\ mA}$

Q-6 The 6 volts zener diode shown in figure has zero zener resistance and knee current of 5 mA. Rmin so that Voltage across it does not fall below 6 volts.



$V_Z = 6\ V$

$I_Z = 5\ mA$

$I_S = \frac{10-6}{50}$

$= \frac{4}{50}$

$= 80\ mA$

$I_R = 80 - 5 = 75\ mA$

$R_{min} = \frac{V}{I_R} = \frac{6}{75 \times 10^{-3}} = 80\ \Omega$ So Rmin = 80

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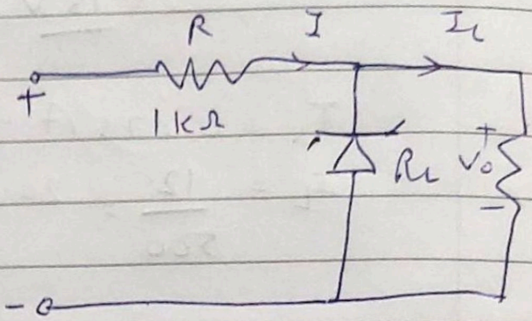
Q-7 Find the range of load current and resistance that will maintain $V_0 = 10V$, Power Max across zener diode



given → $V_i = 50V$
$V_0 = 10V$

→ $I = \frac{50-10}{1\times10^{-3}} = 40\ mA$

$I_L = 4(0 - I_0)\ mA$

$P = I_L^2 R = (40 - I_z)^2 R$

R → $V = I \times R$
$10 = 40 \times R$
$R = 0.25\ k\Omega$

— $P = (10)^2 \times \frac{10^3}{4}$
$= 4 \times 10^5$ Watt.