DELD Practice Sheet -1

B110 Krishna Pandey
U20CS110

① $V_{FB} = 0.4V$
$I_0 = 1.17\,nA$ (reverse saturation current)
$V_t = 25.2\,mV$
$n = 1$
$I_{FB} = ?$

$$I_{FB} = I_0\left(e^{V_{FB}/nV_t} - 1\right)$$

$$= 1.17\times10^{-9}\left[e^{0.4/25.3\times10^{-3}} - 1\right]$$

$$= 1.17\times10^{-9} \times 7.8\times10^{6}$$

$$\boxed{I_{FB} = 9.156\,mA}$$

② Given

$V_{FB} = 0.2V$
$I_{FB} = 0.1mA$
$n = 1.5$
$T = 25^\circ C = 298K$
$I_0 = ?$

Thermal voltage $V_t = \frac{T(K)}{11600} = \frac{298}{11600}$

$$V_t = 0.0257\,V$$

$$I_{FB} = I_0\left[e^{V_{FB}/nV_t} - 1\right]$$

$$0.1\times10^{-3} = I_0\left[e^{0.2/1.5\times0.0257} - 1\right]$$

$$10^{-4} = I_0\,[178.52]$$

$$J_0 = \frac{10^{-4}}{178.52}$$

$$\boxed{I_0 = 0.5016\ nA}$$

3 Conc. gradient $= \frac{dn}{dx} = 1.5 \times 10^{22}\ e^-/m^4$

diffusion current density $= -q \times D_n \times \frac{dn}{dx}$

$$= -[-1.6 \times 10^{-19}][0.00120][1.5 \times 10^{22}]$$

$$\boxed{I_D = 2.88 A/m^2}$$

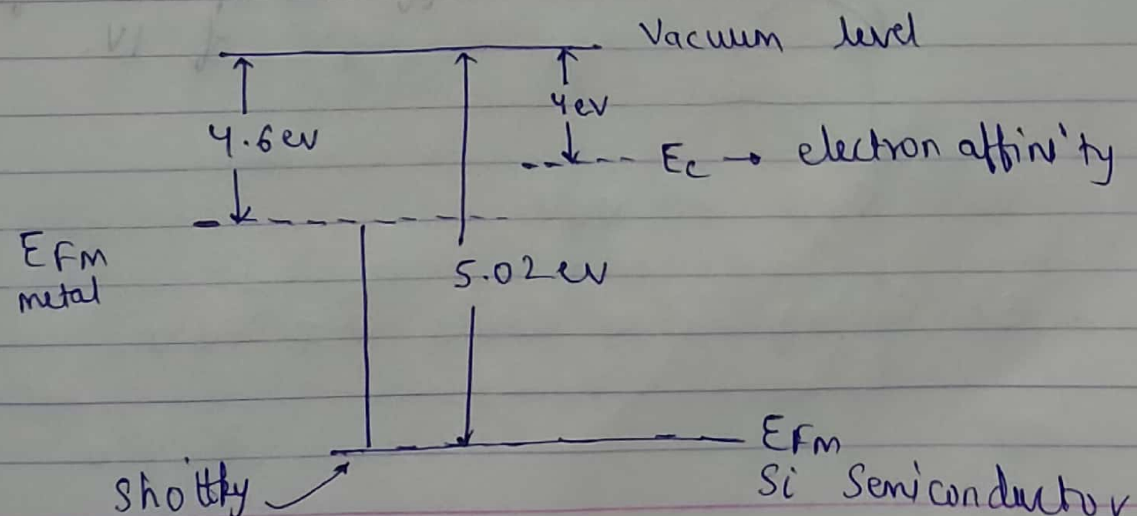
4 given

ϕ_m = work function of metal $= 4.6\ ev$

ϕ_{Si} = w.f of Si $= 5.02\ eV$

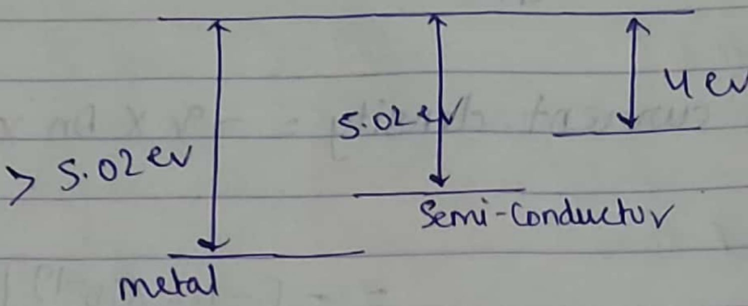
electron affinity $= 4 ev$

a The band diagram before forming the junction and under eq^m condition.

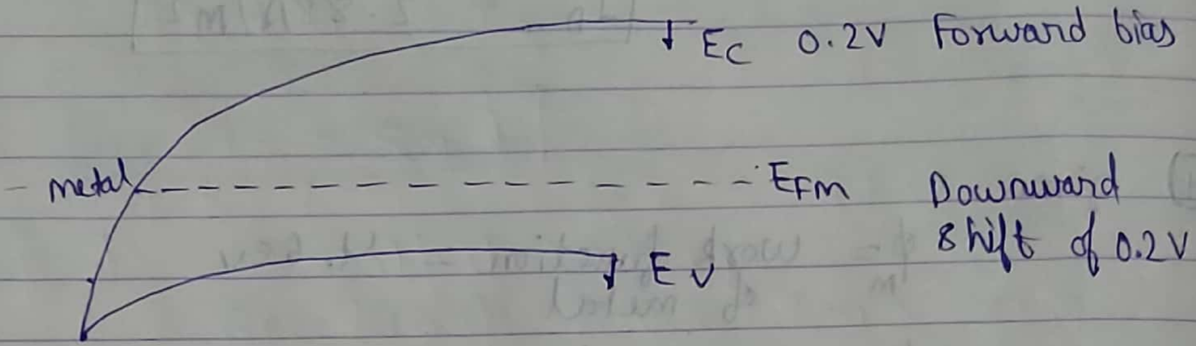


(b) It is Schotky because work function of metal is less than semi-conductor (p-type)

(c) To change the contact to ohmic, the metal should have work function more than 5.02 eV



(d)



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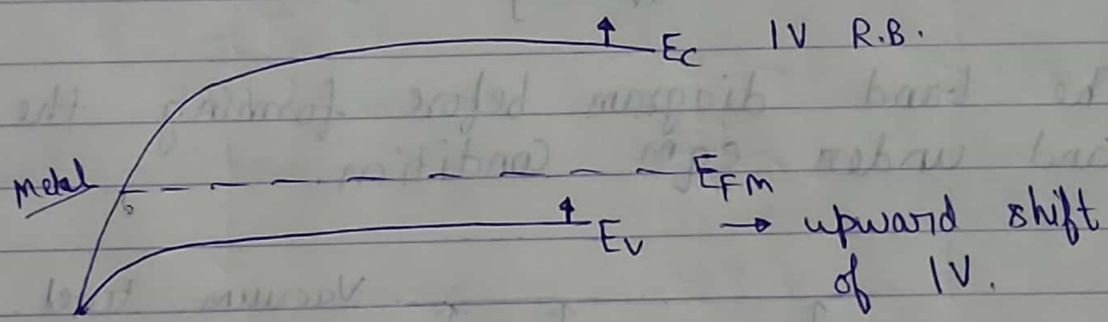

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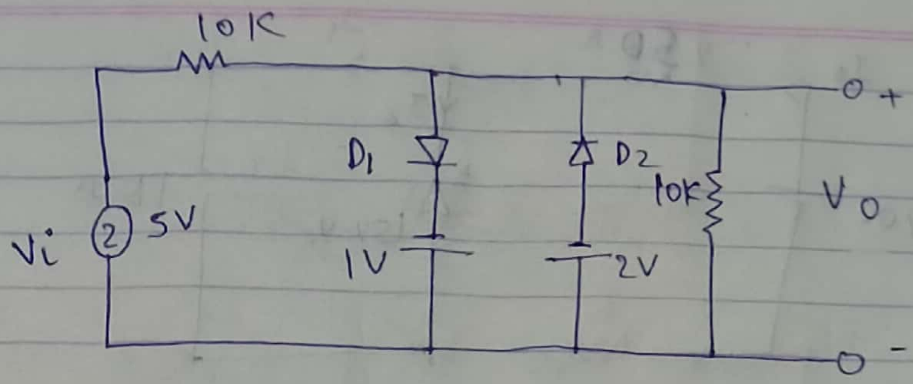


→ For output waveform,

① Positive cycle → $V_o = -1V$

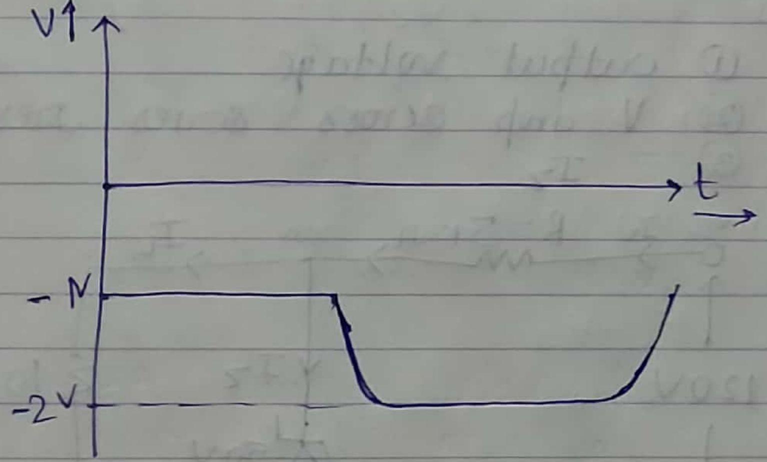
$D_1 \to$ FB

$D_2 \to$ RB

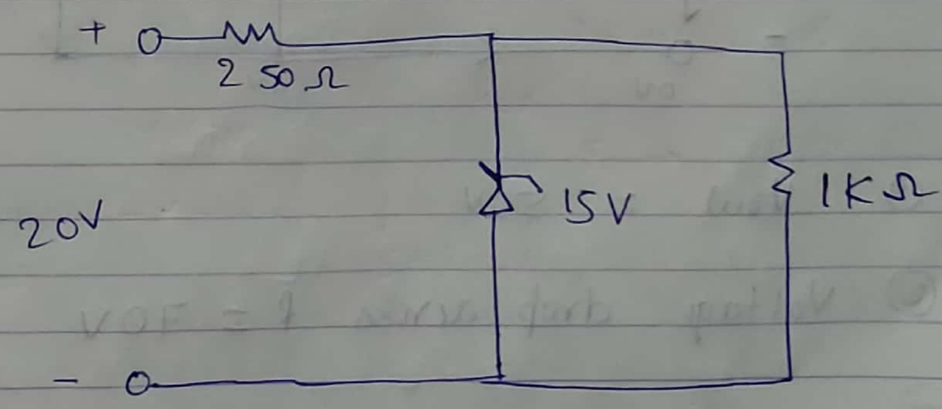
② Negative cycle → $V_o = -2V$

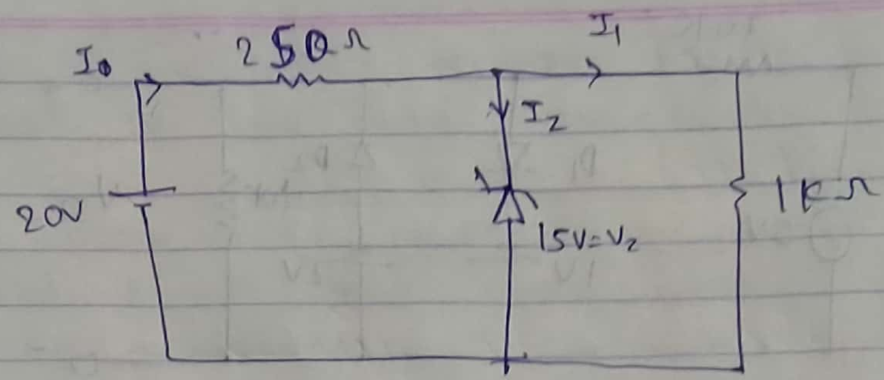
$D_1 \to$ RB

$D_2 \to$ FB



(6)





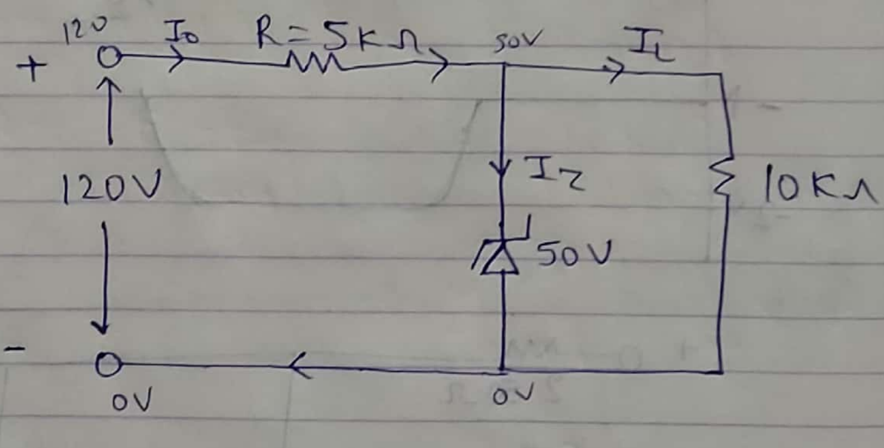
$$I_0 = \frac{20-15}{250} = 20\,mA$$

$$I_1 = \frac{15}{1000} = 15\,mA$$

$$I_z + I_1 = I_0$$

$$\boxed{I_z = 5\,mA}$$

7 to find
1. output voltage
2. V drop across series resistance
3. I_z



1. $V_{out} = 50V$

2. Voltage drop across $R = 70V$

3.

$$I_0 = \frac{70}{5000} = 14\,mA$$

$$I_L = \frac{V_z}{10000} = \frac{50}{10K} = 5\,mA$$

$$I_Z + I_L = I_0$$

$$\boxed{I_Z = 9\,mA}$$

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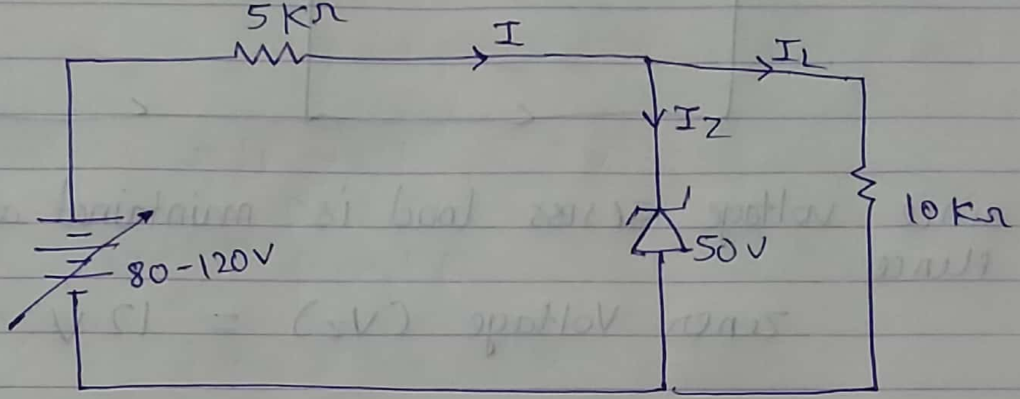

1 For $V_{out} = 80V$

$$I = \frac{80-50}{5K} = 6\,mA$$

$$I_L = \frac{50}{10K} = 5\,mA$$

$$\boxed{I_Z = I - I_L = 1\,mA}$$

2 For $V_{out} = 120V$

$$I = \frac{120-50}{5K} = 14\,mA$$

$$\boxed{I_Z = I - I_L = 9\,mA}$$

$$\therefore \boxed{\begin{aligned}(I_z)_{max} &= 9\,mA \\ (I_z)_{min} &= 1\,mA\end{aligned}}$$

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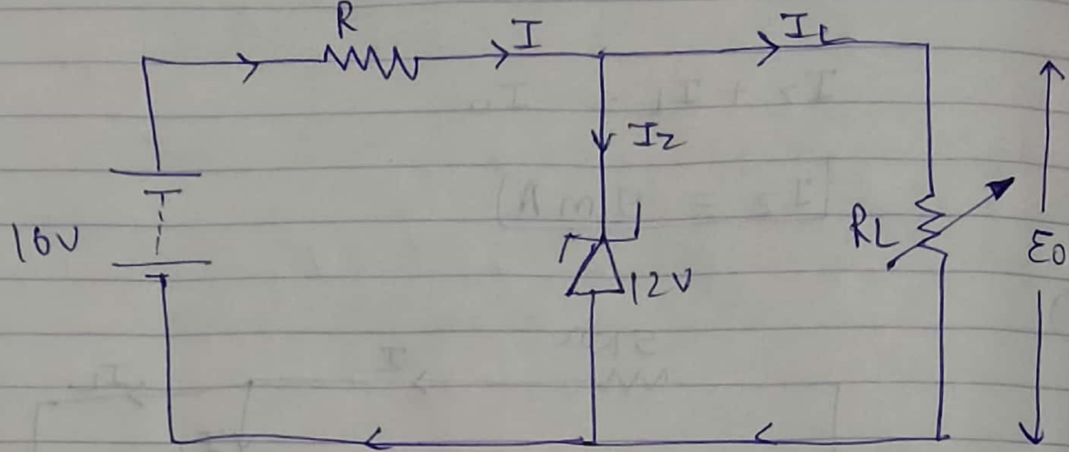

since voltage across load is maintained at 12V
Hence

$$\text{Zener Voltage } (V_z) = 12\,V$$

$$\text{Voltage across } R = 4\,V$$

load current varies form 0 - 200 mA

$$R = \frac{E_i - E_o}{I_{zmin} + I_{max}} = \frac{16-12}{(200-0)\,mA}$$

$$= \frac{4}{200\,mA} = \frac{1}{50} \times 10^3$$

$$= 20\,\Omega$$

Max. voltage rating = $(P_z)_{max}$

$$(P_z)_{max} = V_z (I_z)_{max} = 12 \times 200\,mA$$
$$= 2.4\,W$$