TTRↆ

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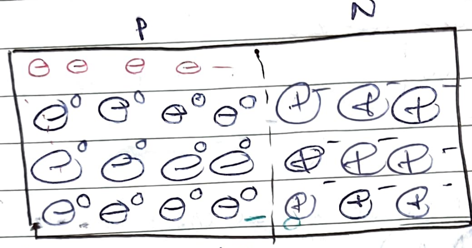
$e^- \longrightarrow$

$\longleftarrow$ I: (Conventional current)

I' → (Normal Current)

Si : 0.7V
Ge : 0.3V

⇒ P.N Junc^n Diode



Bias : application of external voltage across the terminals

1. No bias cond^n
2. Forward bias
3. Reverse :

∴ e⁻, donor ion

→ holes, acceptor ions

∴ Diffusion current (majority charge carrier)

o + e → ⊖

e + o → ⊕

due to diffusion → immobile ions will surface out. Depletion region ~~can~~ has no mobile charges but only uncovered charges.

positive layer repels hole

∴ Depletion layer is stagnant

∴ $\Delta\phi$ barrier potential is developed

∴ Drift Current due to minority charge carriers.

At steady → diffus = drift

Net = 0

$$\boxed{V_b = \frac{kT}{e}\ln\left(\frac{N_A \cdot N_D}{n_i^2}\right)}$$

$V_T = \frac{kT}{e}$ $k = 1.38066 \times 10^{-23}$ J/k

Acc conc^n — ion conc^n

Thermal voltage T : Temp (K)

n_i = intrinsic e : charge of e^-

$V_T = \frac{273+T}{11600}$

width of deplation layer:

$$W_d = \sqrt{\frac{2\varepsilon}{q}\left[\frac{1}{N_A}+\frac{1}{N_D}\right]V_B}$$

(cm)

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$\varepsilon = \varepsilon_{r_0}\varepsilon_0$ for Si = ε : 1.04×10^{-12} F/cm

D.B

Ge = $\varepsilon = 1.1244 \times 10^{-12}$ F/cm

› Forward Bias: (P–P) ∴ it will force holes → ⊖ve.

∴ deplation layer decreases

$W_d > W_d'$ ∴ $V_d \uparrow$ $W_d \downarrow$

$I_d = I_{mag} - I_s$

inc

∴ Barrier potential is decreased

› Reverse Bias (P–N)

Dep layer ⇑ $[V_d \uparrow \; W_d \uparrow]$ Barrier pot ⇑s

$I_{mg} \approx 0$

› Relⁿ b/w diode current, diode voltage

$$I_d = I_s\left(e^{\frac{kV_d}{T_k}} - 1\right)$$

I_d → diode curr

I_s → Rev sat current

V_d → voltage across diode

T_k → Temp

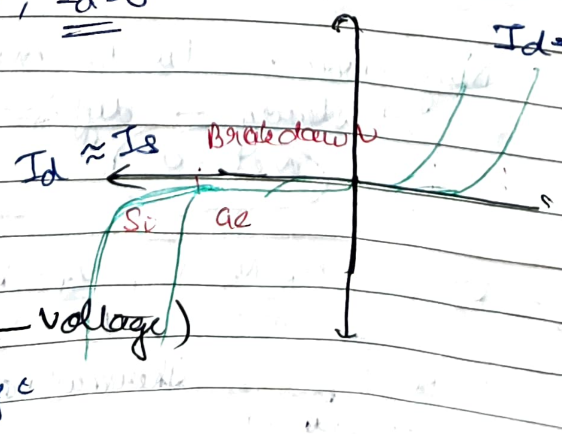
$k = 11600$; $k/T_k = 1/V_T n$

n → Ideality factor $n=1$ for Ge, $n=2$ for Si] when I_d low

$n=1$ for both] when I_d high

$$\therefore \boxed{I_d = I_s\left(e^{\frac{V_d}{nV_T}} - 1\right)}$$

› V-I when $V_d = 0$, $I_d = 0$



› PIV (Peak I— voltage)

Max voltage

Effects of temp: In case F.B the ch. of Si diode shift to left at 2.5 mV/deg centigrade
$V_d \downarrow$ with temp

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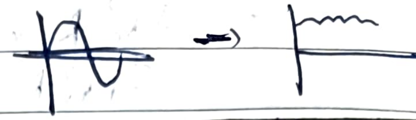
In R.B it doubles (I_s) for every $10°C$ in temp $V_{BD} \uparrow$ seg

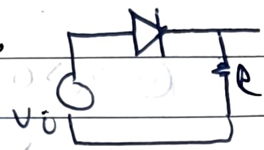
→ Rectifier alteration of A ~~ct~~



IND
$f = 50\,Hz$
$f = 60\,Hz$

transformer →	rectifier	filter	voltage regulator (zener)	load

•) ~~Half~~ Half Wave:



$$+V_i - V_B - I r_B - IR = 0$$

$$I = \frac{V_i - V_B}{r_B + R}$$

$$\therefore V_o = \left(\frac{V_i - V_B}{r_D + R}\right) \times R$$

$$\therefore V_{av} = \frac{1}{2\pi}\int_0^{\pi} V_m \sin\omega t$$

in case of other half $V_o = 0$

$$\boxed{V_{av} = \frac{V_M}{\pi} = 0.318\,V_M}$$

Av load current $= \boxed{\frac{V_{av}}{R} = \frac{0.318\,V_M}{R}}$

$I_{RMS} = \sqrt{\text{mean}(\cancel{sq}\,I)} = \sqrt{\frac{1}{2\pi}\int_0^{2\pi} I^2 \, d\omega t} = \frac{I_m}{2}$

$V_{RMS} = \frac{V_M}{2}$

•) Form factor. (Ratio of RMS load voltage, average load volt

$$\frac{V_{rms}}{V_{av}} = \frac{V_m/2}{V_m/\pi} = \underline{\pi/2} = \frac{I_{RMS}}{I_{dc}}$$

$F.F \geq 1$

•) Ripple factor: The ripple factor measures the perce of ac comp in rectified out
$(\gamma = 0.1.)$

$$\gamma = \frac{\text{rms value of ac. comp of o/p}}{\text{av. value of o/p}}$$

$I = I_{ac} + I_{dc}$

$$I_{ac})_{RMS} = \left[\frac{1}{2\pi}\int_0^{2\pi}(I - I_{dc})^2 d\omega t\right]$$

$$= \left[I_{RMS}^2 + I_{dc}^2 - 2I_{dc}^2\right]$$

$$= \sqrt{I_{RMS}^2 - I_{dc}^2}$$

ripple factor $\gamma = \sqrt{(F.F)^2 - 1} \times 100\%$

$F.F = 1.57$

$= 121\%$

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- efficiency : $\dfrac{\text{D.C power available}}{\text{input ac power}} = \dfrac{P_{load}}{P_{in}}$

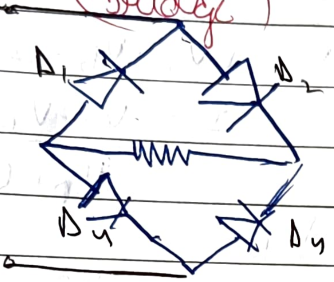
$= \dfrac{I_{dc}^2 R}{I_{RMS}^2 R} \times 100\% = \dfrac{(I_m/\pi)^2}{(I_m/2)^2}$

$= 40.56\%$

- PIV/PRV : maximum reverse voltage (I=0

$PIV = V_m$ $\boxed{PIV \geq V_m}$

Full Wave Rectifier (Bridge)



① $v_i > 0$, D_2, D_3 : FB

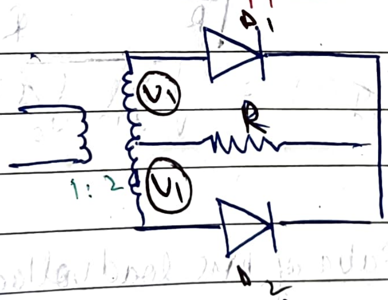
$v_0 = v_I \,/\, V_I - 2V_B \,/\, V_I - 2V_B - 2IR_f$

② $v_i > 0$. $D_1 D_4$: FB

v_0 : Same

If capacitor filtered,

Center Tapped



$\dfrac{N_p}{N_s} = \dfrac{V_p}{V_s}$

$1/2 = \dfrac{V_p}{V_s}$ $\therefore V_s = 2V_I$

one FB, other RB.

- Avg load current, voltage (AC)

$V_{av} = \dfrac{1}{\pi}\int_0^{\pi} V_m \sin\omega t$ $I_{av} = \dfrac{2I_m}{\pi}$

$= \dfrac{2V_m}{\pi}$

- RMS

$= \sqrt{\dfrac{1}{\pi}\int_0^{\pi} I^2 \, d(\omega t)}$ $V_{rms} = \dfrac{V_m}{\sqrt{2}}$

$= \dfrac{I_m}{\sqrt{2}}$

- R.F $= 48.1\%$

- F.F : $\dfrac{V_m/\sqrt{2}}{2V_m/\pi} = 1.11$

efficiency - $\dfrac{(2I_m/\pi)^2}{(I_m/\sqrt{2})^2} = \dfrac{8}{\pi^2} = 81.18\%$

→ PIV ⊙ Bridge: in R.B for any diode $= V_m$ → first find V_o → then KVL

⊙ Centre: → $V_o = V_m$ → $= 2V_m$ $PIV \geq 2V_m$

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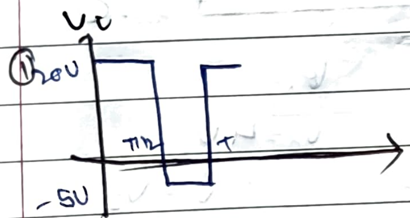
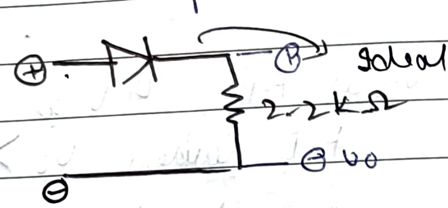
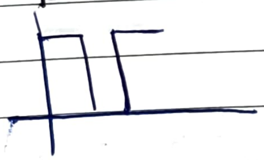
⇒ **Clippers**: Network that use diodes for ~~this purposes~~ to clip a portion of input signal without distorting the remaining part. Can be used to remove clippers

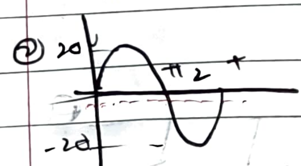
⊕⊖ ⊖⊖ ⊕⊖ ⊕⊖

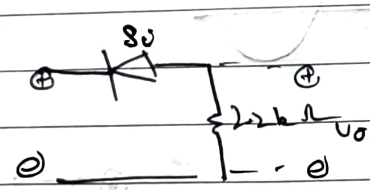
depends on which portion is clipped

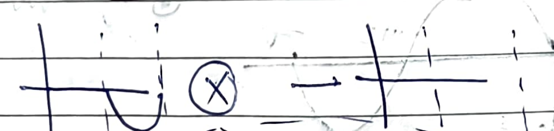








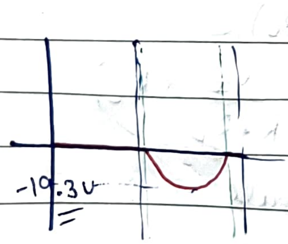


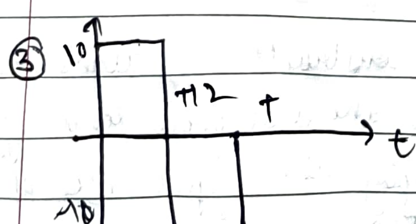


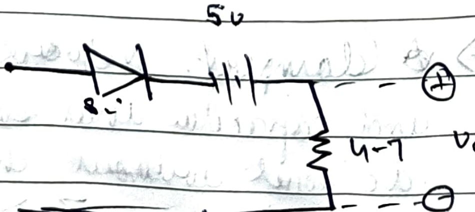
→ $+V_I + 0.7 V_0 - V_0 = 0$ / $\therefore V_0 = V_I + 0.7V$ } $V_i > V_B$

→ $V_I + V_0 - 0.7V = 0$ \ $\therefore V_0 = 0.7 - V_I$

↳ already consider $V_0 = -ve$



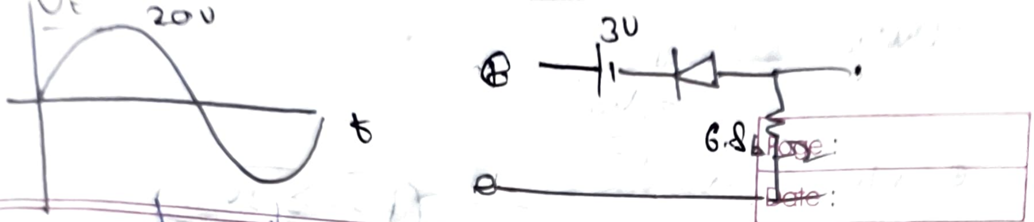


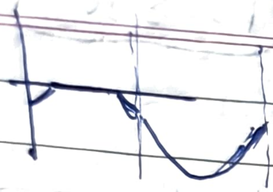


→ first find state of diode — F.B / — R.B

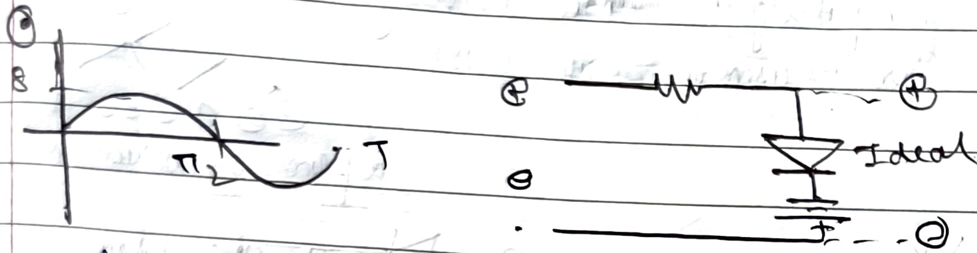
① $V_I + 5 - 0.7V = V_0 = 14.3V$

② $V_0 = 0$ / No current





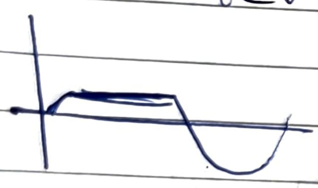
→ Parallel

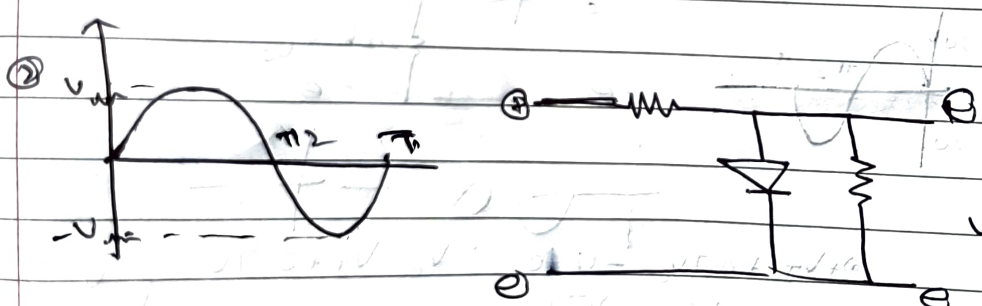


V_I is F-B, 4V is R-B V_0

∴ F-B when $(V_i > 4)$ $V_0 = 4V$

R-B $V_i < V$ $+V_0 - V_i = 0$ ∴ $V_0 = V_I$





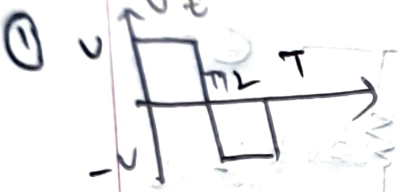
When (R-B) = $V_I - I(R+R_L)$

∴ $V_0 = \dfrac{V_I}{R+R_L} \times R_L$

when R small

⟹ Clampers: Network constructed of diode, resistor and capacitor that shift the waveform to a different dc level without changing the appearance of applied

$\tau_{ca} = (RC)$ $\tau >> T/2$

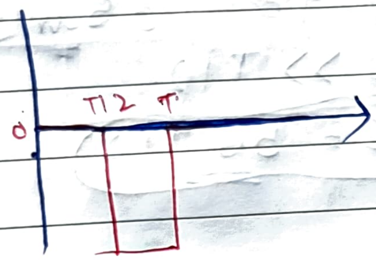
①  ⇒ 

$0 - T/2 \rightarrow$ F.B $[V_0 = 0]$ in loop $R = 0$ $\therefore Z = 0$

$V_c = V$

$T/2 - T \rightarrow$ R.B $+V_I + V_0 + V = 0$ $\therefore V_0 = (-V_0 - V)$

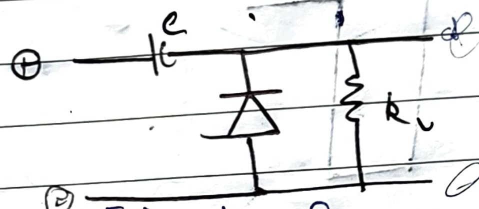
$= -2V$



① RMS remains same

② Peak value changes

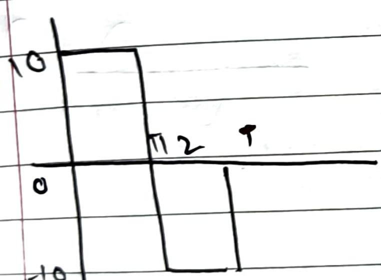
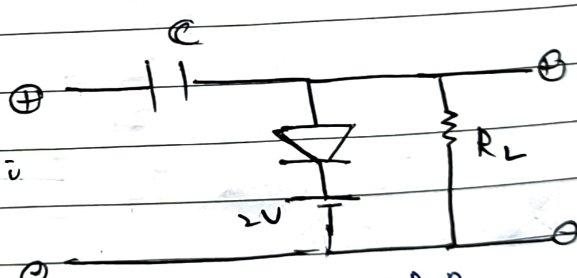
⇒ Negative Clamper

②  

$0 - T/2$ $V_I = -V$: F.B $V_0 = 0$ $V_c = V_I = V$

$T/2 - T$ $V_0 = V_I + V_c$ $= 2V$

$d.t = 5\tau \rightarrow 0 \rightarrow \therefore$ won't discharge

③  

2V → R-B

$0 - T/2$: $V_I = 10V$ $\therefore$ F.B since $V_i > 2$

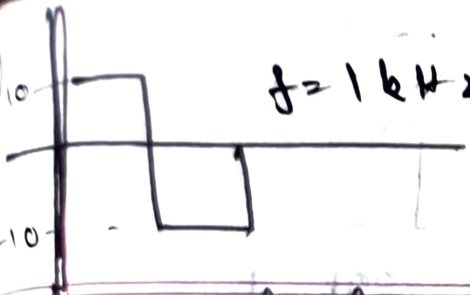
$V_0 = 2V$, $V_c = (V - 2) = 8V$

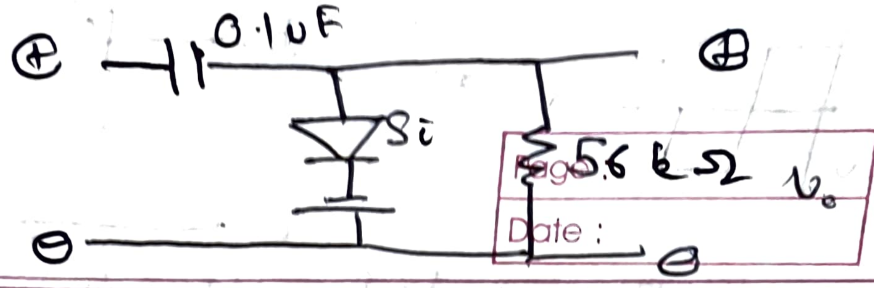
$T/2 - T$ $V_I = -10V$

$V_I + V_0 + V_c = 0$ $\therefore V_0 = -V_I - V_c$

$= -10V - 8V$

$= \underline{-18V}$





- Calculate 5τ
- Compare 5τ to half time period
- Sketch V_o.

$5\tau = 28$ msec

$T/2 = 10^{-4} \times 8 = 0.5$ msec

$\therefore 5\tau >> T/2$

$5\tau = 56\ T/2$