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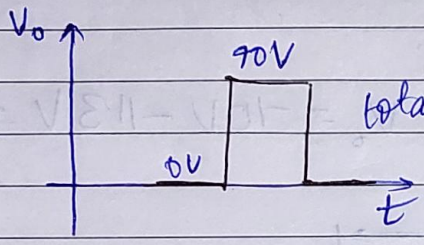
Tutorial - 3

1. (a) Starting w/ $v_i = -20V$ the diode is in the 'on' state & capacitor quickly charges to -20V. During this interval of time v_o is across the on diode (short-current eqv) & $V_o = 0$. When v_i switches to the +20V level, diode goes to 'off' state (open-ckt) &

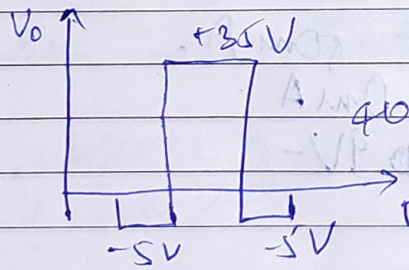
$$V_o = V_i + V_c = 20 + 20 = 40V.$$



total swing of V_o = total swing of V_i.

(b) Starting w/ $v_i = -20V$, the diode is on & capacitor quickly charges up to -15V. $V_i = +20V$ & 5V supply are additive across the capacitor. During this time interval V_o is across 'on' diode & 5V supply & $V_o = -5V$.

When v_i switches to the +20V level the diode becomes 'off' & $V_o = V_i + V_c = 35V$.

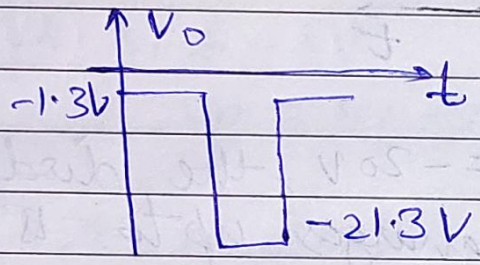


3. (a) $\tau = RC = 5.6\text{ms}$.
$\tau_2 = 28\text{ms}$.

(b) $\tau_2 = 28\text{ms} \gg \frac{T}{2} = \frac{1}{2} = 0.5\text{ms} \Rightarrow 56:1$.

(c) the pulse of V_i
Diode on & $V_o = -1.3V$
capacitor charges to $10 + 2 - 0.7 = 11.3V$

-ve pulse of V_i
Diode off & $V_o = -10V - 11.3V = -21.3V$



2. (a) In the absence of zener diode

$V_L = 9V < V_Z = 10V$ & diode non conducting

$I_L = I_R = 50\text{mA}$.
w/ $I_Z = 0\text{mA}$
$V_L = 9V$.

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(b) In the absence of zener diode

$V_L = 13.62\,V$.

$\Rightarrow V_L > V_Z$, zener diode on

$\therefore V_Z = 10V$, $V_R = 10\,V$

$I_{R_s} = V_{R_s} / R_s = 10/220 = 45.45\,mA$.

$I_L = V_L / R_L = 10/470 = 21.28\,mA$

$I_Z = I_{R_s} - I_L = 24.17\,mA$

(c) $P_Z = 400mW = V_Z I_Z = (10V) I_Z$.

$I_Z = 40\,mA$.

$I_{Z_{max}} = I_{R_s} - I_{Z_{max}} = 45.45mA - 40 = 5.45mA$.

$R_L = \frac{V_L}{I_{Z_{max}}} = 1834.86\,\Omega$

Large R_L reduces I_L & forces more of I_{R_s} to pass thru zener diode

(d) In absence of Zener diode

$V_L = 10\,V = \frac{R_L \times 20}{R_L + 220}$

$R_L = 220\,\Omega$