Solution

A.1 (a) Latching current: Related to turn on process
Minimum value of anode current such that after reaching this value, gate looses control over the device

(b) Holding current :- Related to turn off process
Minimum value of Ia that if the anode current get below that value, thyristor is in OFF

(c) Firing angle :- Angle at which thyristor gate is fired

A.2 Switching characteristics of IGBT

(A) $T_{on} = t_d + t_r$

(a) t_d (delay time) :- Time during which collector to emitter voltage (V_{CE}) falls 10%, it means V_{CE} to 90% of V_{CE}

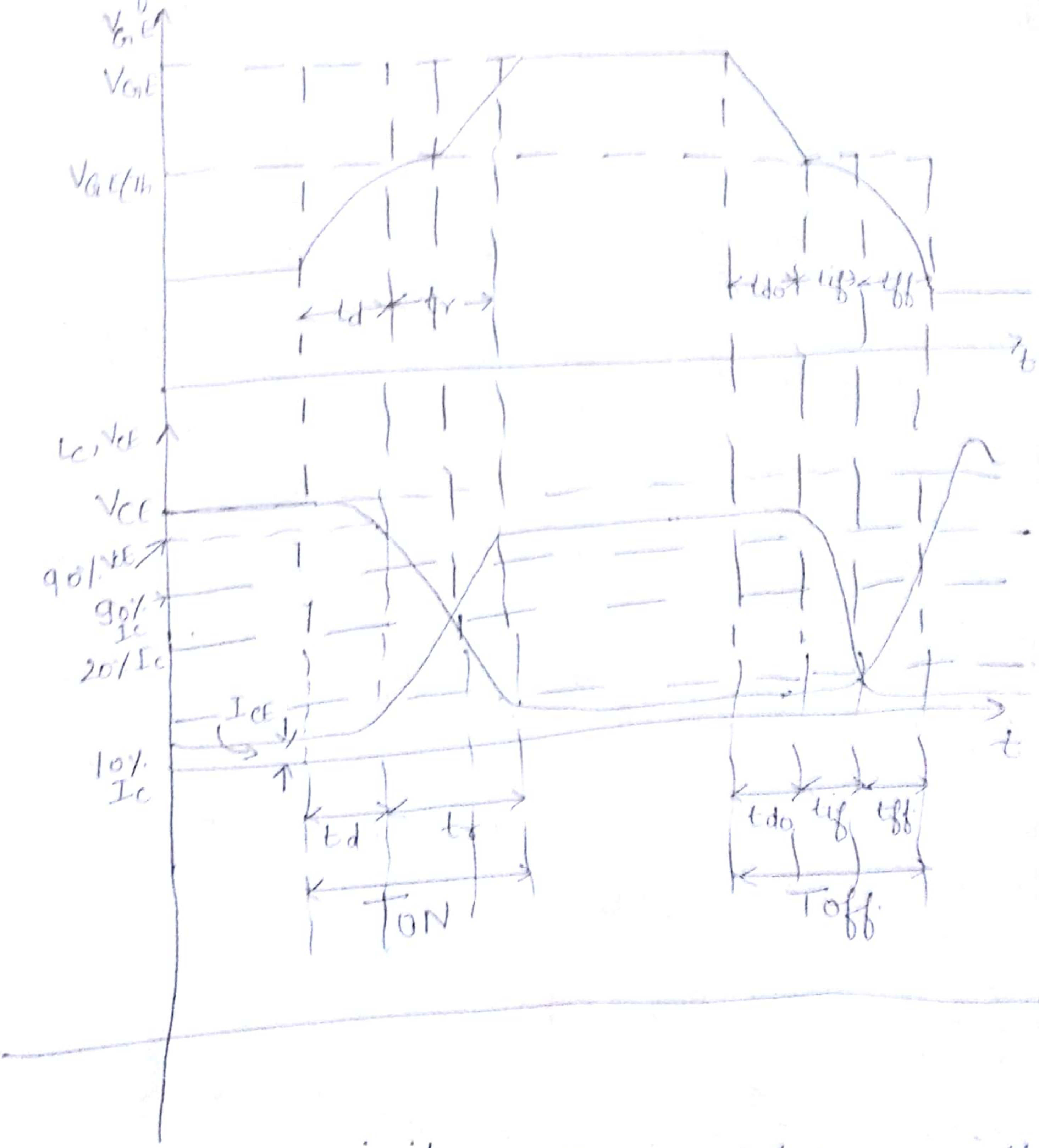
(b) t_r (rise time) :- Time during which collector current from it initial leakage current (I_{CE}) to 10% of I_C

(B) $T_{off} = t_{do} + t_{if} + t_{ff}$

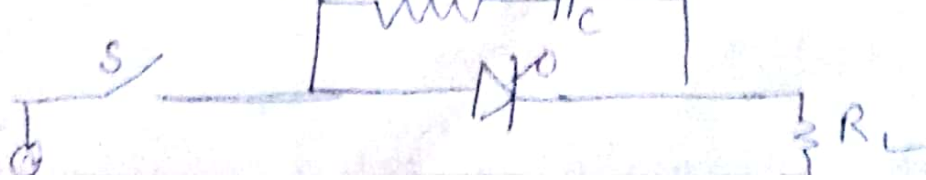
(i) t_{do} (delay off time) :- Time during which the gate voltage fall from V_{CE} to threshold voltage $V_{GE(Th)}$.

(ii) t_{if} (initial fall time) :- I_C falls from 90% to 20% of initial value of I_C & V_{CE} rises from on state forward drop to 10% of V_{CE}.

(iii) t_{ff} (final fall time) :- I_C falls from 20% to 10% of initial value of Ic and Vce rises from 10% of Vce to final value of Vce



A.3 <u>Snubber circuit</u> :- R connected in series with C which is parallel to SCR.

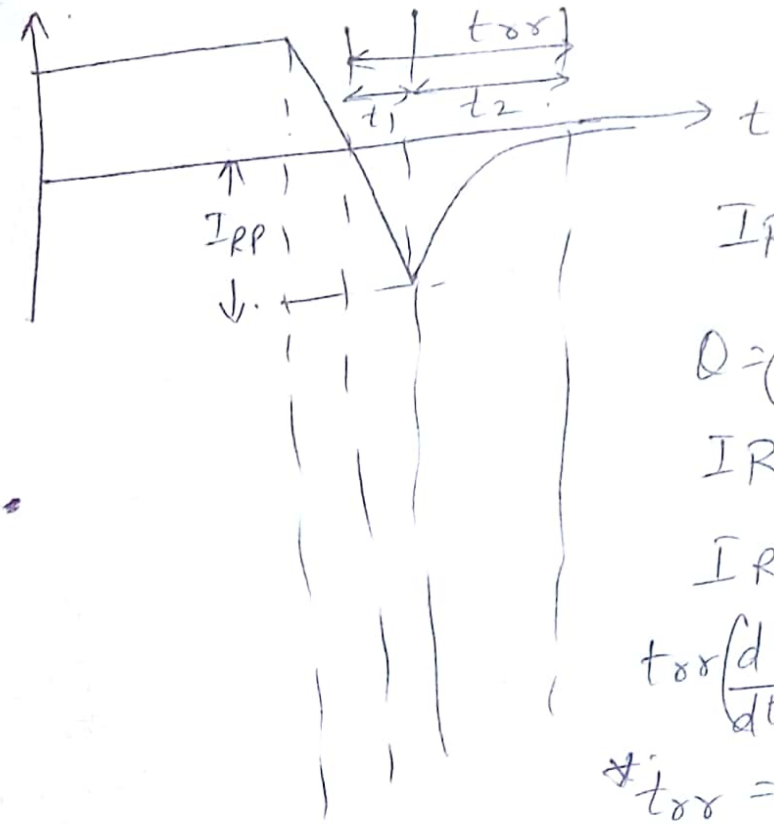


When thyristor current is zero, switch S will be considered as open switch with the passage of time capacitor C gets charged at a slow rate such that dv/dt across capacitor and ∴ SCR is less than the specified maximum dv/dt rating of the device. Thus the capacitor protect the SCR against high voltages and high dv/dt

→ Resistance R limits the discharge current of capacitor at the instant of firing of SCR.

OR

Reverse recovery characteristics of Power diode



$$I_{RP} = t_1 \cdot \frac{di}{dt}$$

$$Q = \left(\frac{1}{2}\right)(I_{RP})(t_{rr})$$

$$I_{RP} = \frac{2Q}{t_{rr}}$$

$$I_{RP} = t_{rr}\left(\frac{di}{dt}\right)$$

$$t_{rr}\left(\frac{di}{dt}\right) = \frac{2Q}{t_{rr}}$$

$$* \; t_{rr} = \left[\frac{2Q}{di/dt}\right]^{\frac{1}{2}}$$

* If $t_1 = t_{rr} \Rightarrow I_{RP} = \left[2Q\left(\frac{di}{dt}\right)\right]^{1/2}$