③ Delay angle = firing angle = α
= Triggering angle

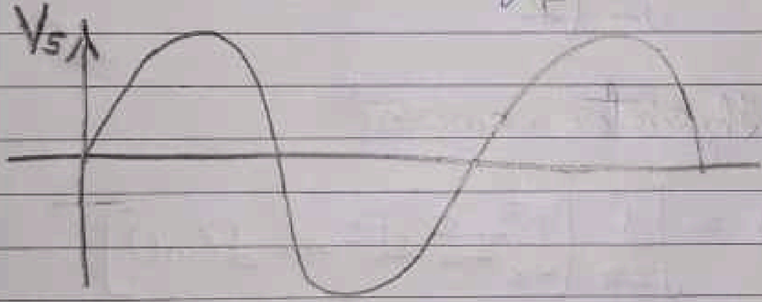
Extinction angle = β

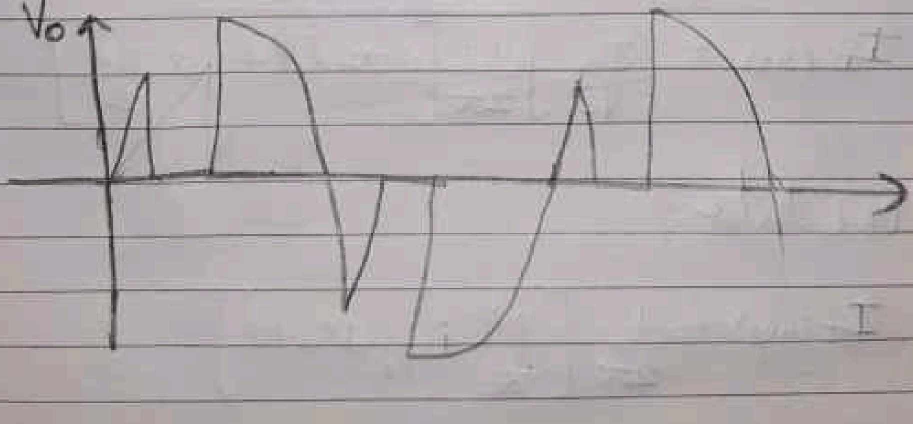
Conduction angle = $\gamma = \beta - \alpha$

$V_S = 120\,V$ $\quad f = 60\,Hz$ $\quad L = 6.5\,mH$
$R = 2.5\,\Omega$ $\quad \alpha_1 = \alpha_2 = \pi/2$

(i) $\delta = \gamma = ?$ ~~will derive later since idk β for now~~. $\delta = \beta - \alpha$

(ii) RMS output voltage = ?





$$V_{o(RMS)} = \left[\frac{1}{\pi}\int_{\alpha}^{\beta} V_m^2 \sin^2(\omega t)\, d(\omega t)\right]^{1/2}$$

$V_o = V_M \sin \omega t \quad , \quad \omega t \in (\alpha, \beta)$

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$$V_{o(RMS)} = \left[\frac{V_M^2}{\pi}\int_\alpha^\beta \frac{(1-\cos 2\omega t)}{2}\, d(\omega t)\right]^{1/2}$$

$$V_{o(RMS)} = \left\{\frac{V_M^2}{2\pi}\left[\int_\alpha^\beta d(\omega t) - \int_\alpha^\beta \cos 2\omega t\, d(\omega t)\right]\right\}^{1/2}$$

$$V_{o(RMS)} = \left[\frac{V_M^2}{2\pi}\left[(\beta-\alpha) - \frac{\sin 2\beta}{2} + \frac{\sin 2\alpha}{2}\right]\right]^{1/2}$$

$$V_{o(RMS)} = V_M\left[\frac{1}{2\pi}\left\{(\beta-\alpha) + \frac{\sin 2\alpha - \sin 2\beta}{2}\right\}\right]^{1/2}$$

$$V_{o(RMS)} = \frac{V_m}{\sqrt{2}}\left[\frac{1}{\pi}\left\{(\beta-\alpha) + \frac{(\sin 2\alpha - \sin 2\beta)}{2}\right\}\right]^{1/2}$$

iii) RMS Thyristor current

$$I_{T(RMS)} = \sqrt{\frac{1}{2\pi}\left[\int_\alpha^\pi I_m^2 \sin^2\omega t\, d(\omega t)\right]}$$

$$I_{T(RMS)} = \frac{I_m}{\sqrt{2}}\sqrt{\frac{1}{2\pi}\left[(\pi-\alpha) + \frac{\sin 2\alpha}{2}\right]}$$

iv) Done later

v) $I_{T(avg)} = \frac{1}{2\pi}\left[\int_\alpha^\beta i_{T_1}\, d(\omega t)\right]$

$$\Rightarrow \frac{1}{2\pi}\left(\int_\alpha^\beta \frac{V_m}{Z}\left[\sin(\omega t - \phi) - \sin(\alpha - \phi)\, e^{-\frac{R}{\omega L}(\omega t - \alpha)}\right] d(\omega t)\right)$$

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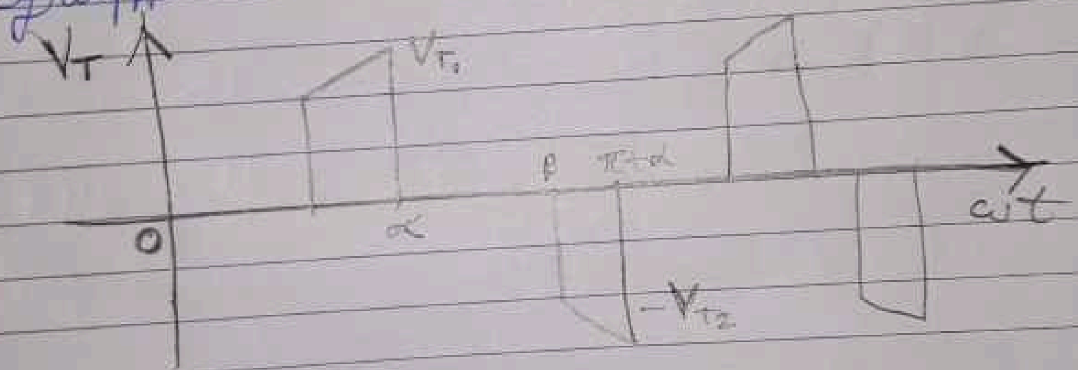
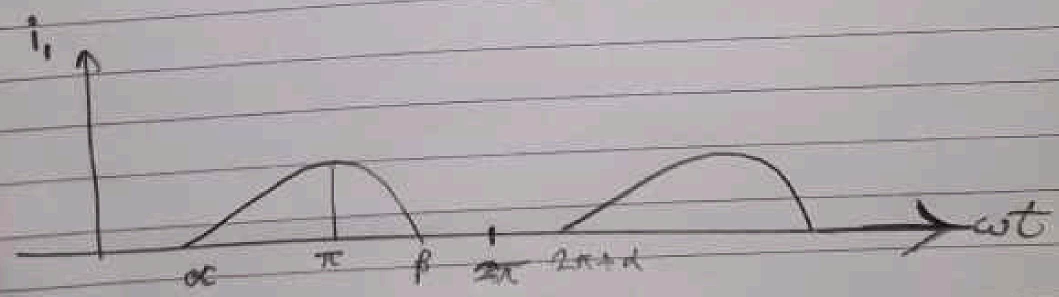
$$I_{T(avg)} = \frac{V_m}{2\pi Z}\left[\int_{\alpha}^{\beta} \sin(\omega t-\phi)\, d(\omega t) - \int_{\alpha}^{\beta} \sin(\alpha-\phi)\, e^{-\frac{R}{\omega L}(\omega t-\alpha)}\, d(\omega t)\right]$$

(iv) $$I_{T(RMS)} = \sqrt{\left[\frac{1}{2\pi}\int_{\alpha}^{\beta} i_{T_1}^2\, d(\omega t)\right]}$$

Graphs →





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