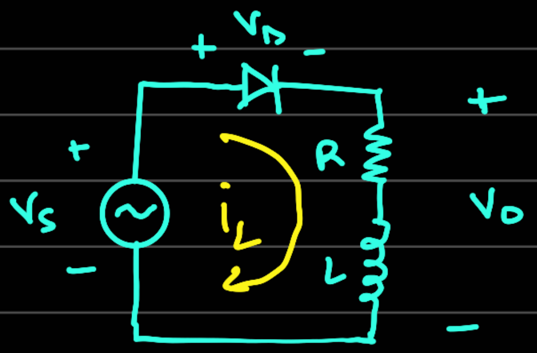
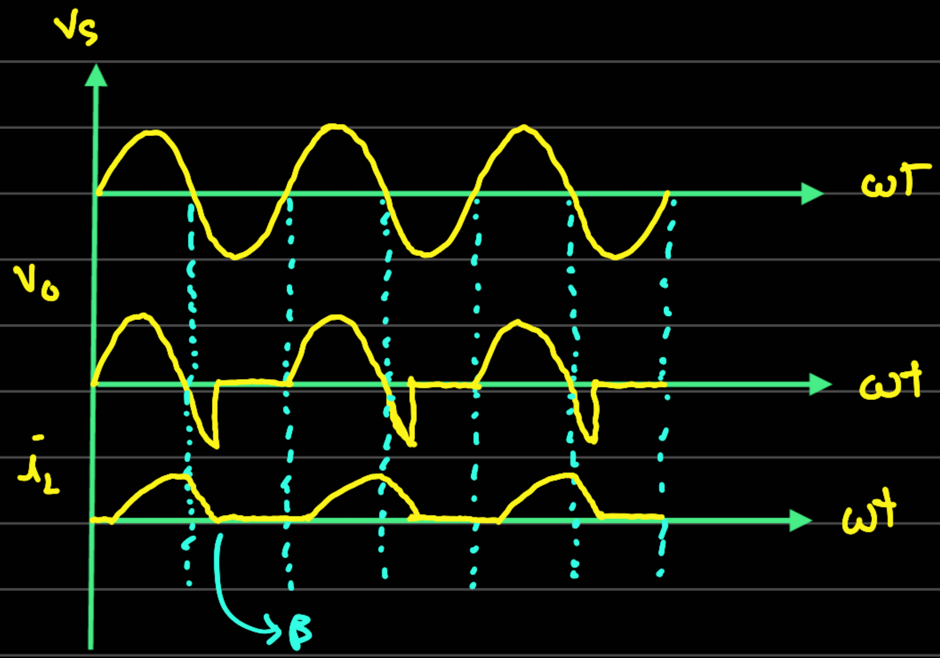
Day - 4

→ Half-wave rectifier (RL) -





$i_L(t) = ?$

$V_s(t) = V_m \sin\omega t$

when diode is conducting,

$$i_L(t) = \frac{V_o}{Z} = \frac{V_m \angle 0^\circ}{\sqrt{R^2+(\omega L)^2}\angle\theta} \qquad \left(\theta = \tan^{-1}\frac{\omega L}{R}\right)$$

$$= \frac{V_m}{\sqrt{R^2+(\omega L)^2}}\angle -\theta$$ (NO! THIS IS STEADY STATE)

$$= \frac{V_m \sin(\omega t-\theta)}{\sqrt{R^2+(\omega L)^2}} + \frac{V_m \sin\theta}{\sqrt{R^2+(\omega L)^2}} e^{-Rt/L}$$

Now, at $\omega t = \beta$,

$$\frac{V_m \sin(\beta - \theta)}{\sqrt{R^2 + (\omega L)^2}} + \frac{V_m \sin\theta}{\sqrt{R^2 + (\omega L)^2}} e^{-\frac{R\beta}{\omega L}} = 0$$

Let $R = 100\,\Omega$, $L = 0.1\,H$, $f = 60$ Hz,
$V_m = 100\,V$

$$\theta = \tan^{-1} \frac{2\pi \times 60 \times 0.1}{100}$$

$$= \tan^{-1} 0.12\pi$$

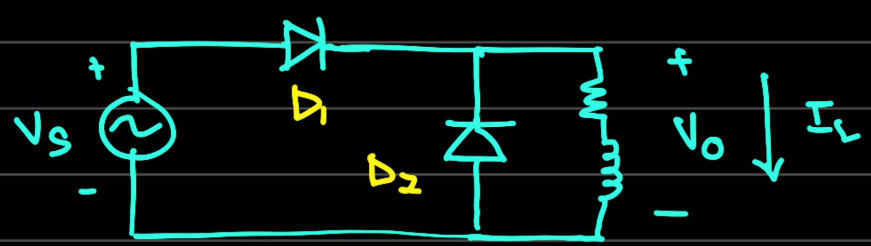
So $\sin(\beta - \theta) + \sin\theta \, e^{-\frac{100\beta}{12\pi}} = 0$

$\Rightarrow \beta = 3.5$ Rad

→ $I_{dc} = 0.308$ A,
$I_{rms} = 0.474$ A
$P_0 = I_{o\,rms}^2 R = 22.5\,W$

$$P.f = \frac{22.5}{\frac{100}{\sqrt{2}} \times 0.474} = 0.671$$

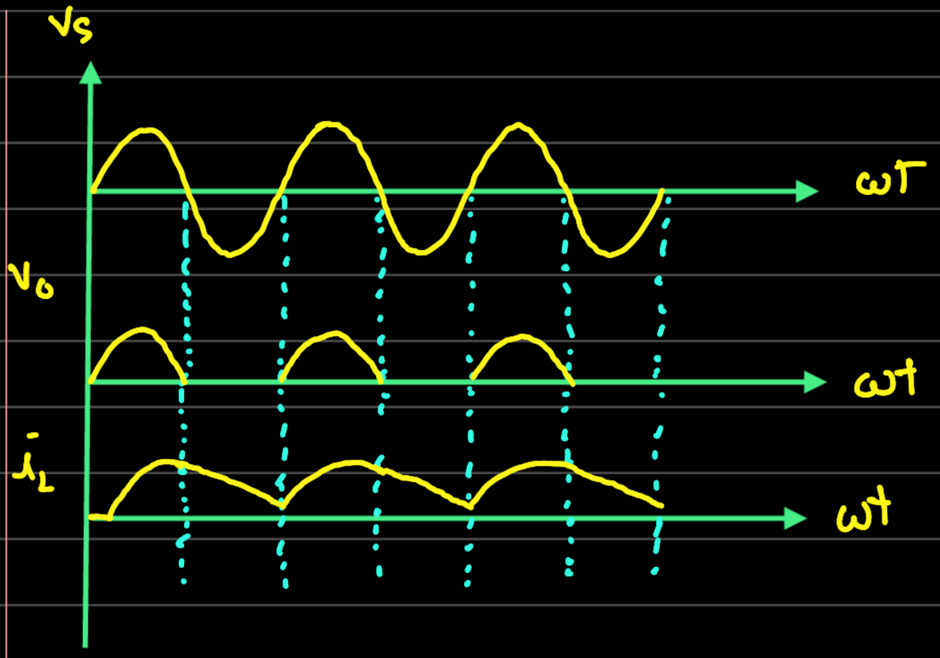
→



Draw waveforms of

(i) V_0
(ii) I_L

Ans:)



($\omega L >> R$ in practical ckt)

$$V_{o,avg} = \frac{V_m}{\pi}$$

If $L \longrightarrow \infty$, $i_{L,avg} = \frac{V_m}{\pi R}$