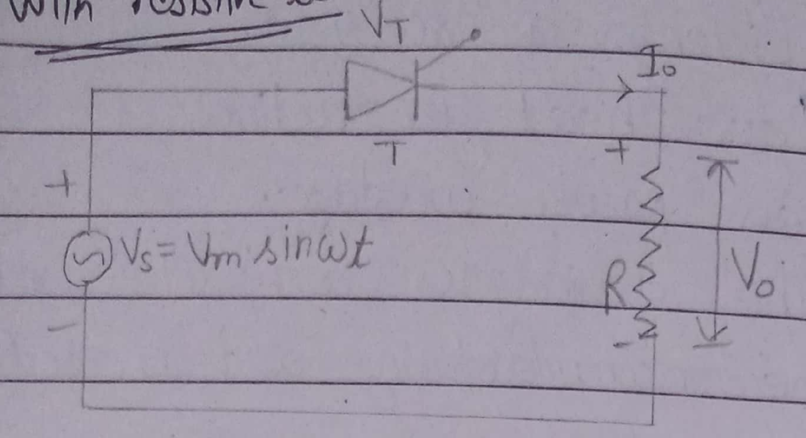
Single Phase Half-Wave Rectifiers -

With resistive load



It consists of a SCR, AC voltage source (V_s) & load. The load may be purely resistive, inductive or RL load.

A thyristor blocks the flow of load current (i_o) until it is triggered. At some delay angle (α), a +ve gate signal applied b/w gate & cathode turns on the SCR.

Immediately full supply voltage is applied to load as V_o. At the instant of delay angle (α), V_o rises upto V_s i.e., $V_m \sin\omega t$. for resistive load i_o is in phase with V_o.

But as soon as the V_s becomes zero at $\omega t = \pi, 3\pi$ etc., the load current will become zero & after $\omega t = \pi$, SCR is reversed biased & T will turn off at $\omega t = \pi$. Thyristor (T) will remain in off condition till it is fired again at $\omega t = (2\pi + \alpha)$ after delay (α).

Thyristor remains ON from $\omega t = \alpha$ to π, $(2\pi + \alpha)$ to 3π etc., during these intervals $V_T \simeq 0$. It is OFF from π to $(2\pi + \alpha)$, 3π to $(4\pi + \alpha)$ etc. during these intervals V_T has the waveshapes of V_s.

$$V_s = V_o + V_T$$

As we know, avg. value of funct^n $f(x)$

$$\text{Avg. value} = \frac{1}{T}\int_0^T f(x)\cdot dx$$

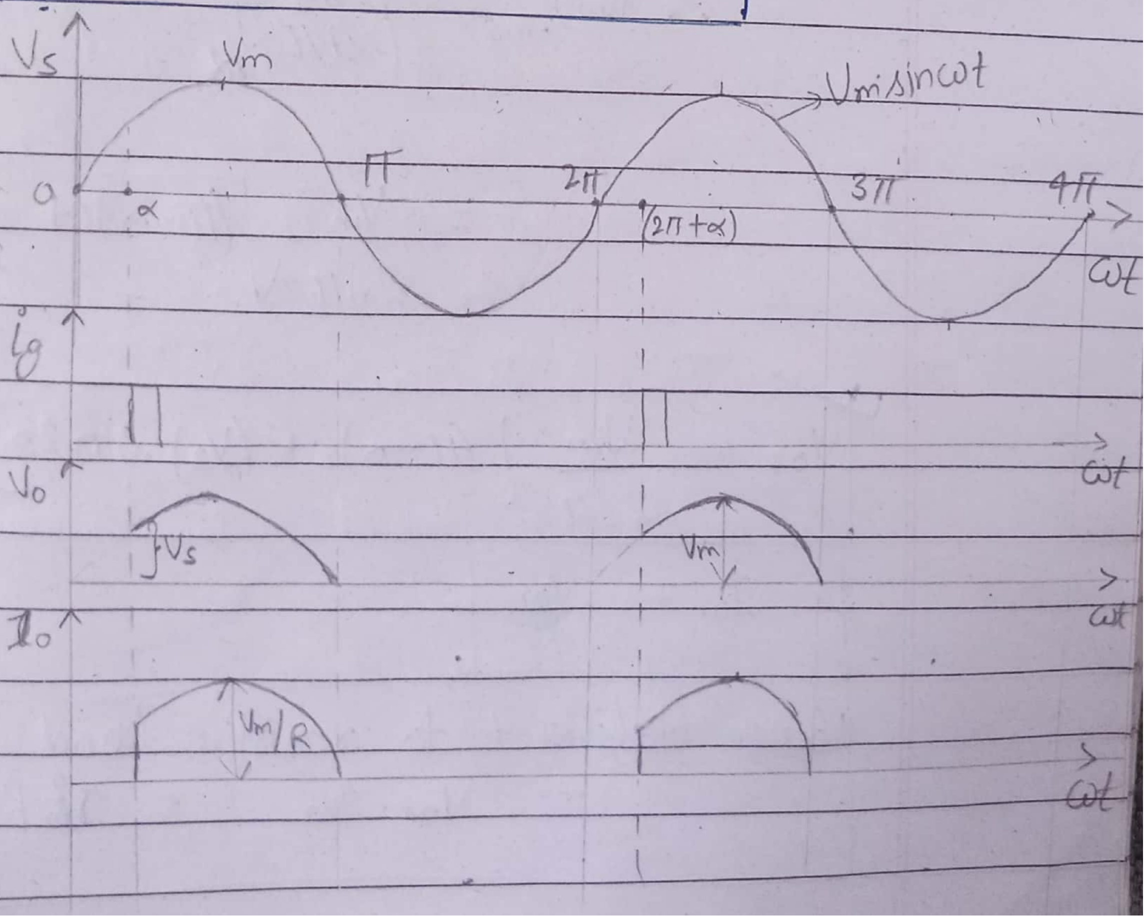
$\therefore$ Avg. value of V_o $= \frac{1}{2\pi}\int_0^{2\pi} V_m \cdot \sin\omega t \cdot d(\omega t)$

$\because$ $V_o = 0$ at $0 \le \omega t \le \alpha$ & $\pi \le \omega t \le 2\pi$

$$\therefore \text{Avg. } V_o = \frac{1}{2\pi}\int_\alpha^{\pi} V_m \cdot \sin\omega t \cdot d(\omega t)$$

$$= \frac{V_m}{2\pi}(1+\cos\alpha)$$

$$\boxed{(V_o)_{avg.} = \frac{V_m}{2\pi}(1+\cos\alpha)}$$



RMS value of $funct^n$ $f(x)$

$$f(x)_{rms} = \sqrt{(1/T) \int_0^T [f(x)]^2 \cdot dx}$$

$$\therefore (V_o)_{rms} = \sqrt{\frac{1}{2\pi} \int_0^{2\pi} V_m^2 \sin^2\omega t \cdot d(\omega t)}$$

$$= \left[\frac{V_m}{4\pi} \int_0^{2\pi} (2\sin\omega t)^2 \cdot d(\omega t)\right]^{1/2}$$

$$= \left[\frac{V_m}{4\pi} \int_0^{2\pi} [1-\cos 2\omega t] \cdot d(\omega t)\right]^{1/2}$$

$\because V_o = 0$ at $0 \leq \omega t \leq \alpha$ & $\pi \leq \omega t < 2\pi$

$$\therefore (V_o)_{rms} = \left[\frac{V_m}{4\pi} \int_\alpha^{\pi} (1-\cos 2\omega t) \cdot d(\omega t)\right]^{1/2}$$

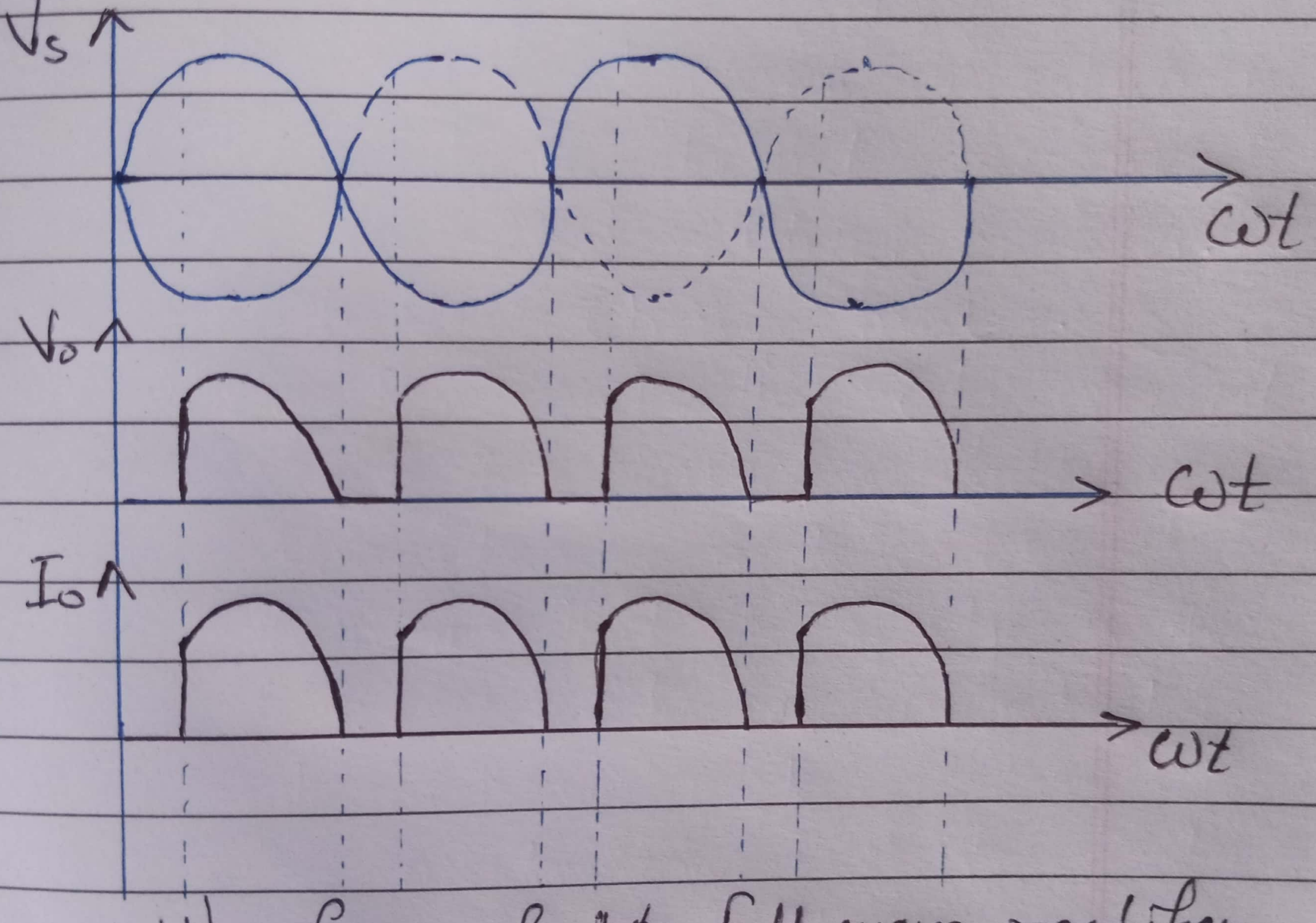
$$= \frac{V_m}{2\sqrt{\pi}} \sqrt{(\pi-\alpha) + \frac{1}{2}\sin 2\alpha}$$

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

$$\boxed{I_{or} = \frac{V_{or}}{R}}$$

Power delivered to resistive load

$= V_{or} \cdot I_{or} = I_{or}^2 R$



Waveform of 1ϕ full wave rectifier.