age becomes maximum when $\alpha = 0$ and the maximum output voltage V_{dm} is

$$V_{dm} = \frac{V_m}{\pi} \qquad (10.2)$$

Normalizing the output voltage with respect to V_{dm}, the normalized output voltage

Unit- III

Date

Phase Controlled Converters

To obtain controlled output voltage, phase-control thyristers are used instead of diodes. The output voltage of thyristor rectifier are is varied by controlling the delay or firing angle of thyristors.

The phase controlled rectifier can be devided into two types, depending on the input supply

1- Single-phase Converters
2- Three-phase converters
Each type are subdevided into.
(a) Semiconverter
(b) Full converter
(c) Dual Converter

→ A semiconverter is a one quadrant converter and it has one polarity of output voltage and current.

→ A full converter is a two-~~type~~ quadrant converter and the polarity of its output voltage is either positive or negative. However the output current of full converter has one polarity.

→ A dual converter can operate in four-quadrant; and both the output voltage and

Date

current can be either positive or negative. In some application converters are connected in series to operate at higher voltages and to improve the input power factor (P.F.)

Principle of operation of phase-controlled converter (Half-wave rectifier). The ckt diagram is shown in fig. 1.

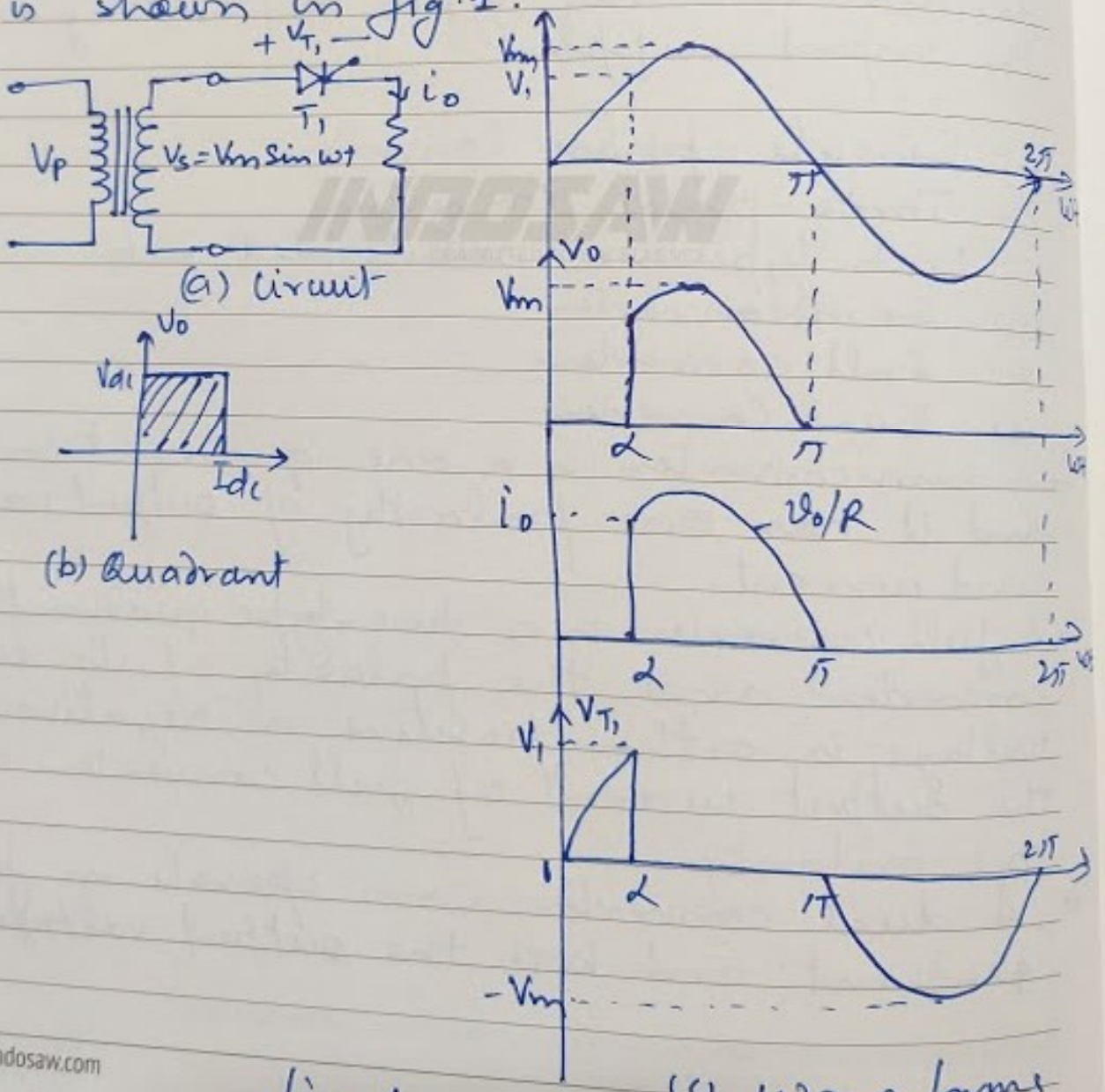

fig. 1

age becomes maximum when $\alpha = 0$ and the maximum output voltage V_{dm} is

$$V_{dm} = \frac{V_m}{\pi} \tag{10.2}$$

Normalizing the output voltage with respect to V_{dm}, the normalized output voltage

$$V_n = \frac{V_{dc}}{V_{dm}} = 0.5(1 + \cos\alpha) \tag{10.3}$$

Date

In the positive half cycle of input voltage, the thyrisn anode is positive with respect to cathode ad the thyristor is said to be forward biased. When thyristn T_1 is fired at $\omega t = \alpha$, thyristor T_1 is conduct and the input voltage appears across the load. When the input voltage starts to be negative at $\omega t = \pi$, the thyristor anod is negative with respect to cathode and thyrishn T_1 is said to be reversed biased and it is turned off. α is called the delay angle or firing angle. Fig. 1 (b) shows the region of converter operation and fig. 1(c) shows the waveforms for input voltage, output voltage, load current and voltage across T_1.

The average output voltage V_{dc} can be found from

$$V_{dc} = \frac{1}{2\pi}\int_{\alpha}^{\pi} V_m \sin\omega t \, d(\omega t)$$

$$= \frac{V_m}{2\pi}\left[-\cos\omega t\right]_{\alpha}^{\pi}$$

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

V_{dc} can be varied by varying α from 0 to π. V_{dc} can be varied from $\frac{V_m}{\pi}$ to 0. Max output voltage can be obtained at $\alpha = 0$

max output voltage $V_{dm} = \frac{V_m}{\pi}$ at $\omega t = \alpha = 0$ —

Date

Normalizing the output voltage with respect to V_{dm}, the normalized output voltage

$$V_n = \frac{V_{dc}}{V_{dm}} = 0.5(1+\cos\alpha) \quad \text{---(3)}$$

Rms value of output voltage is

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

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

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