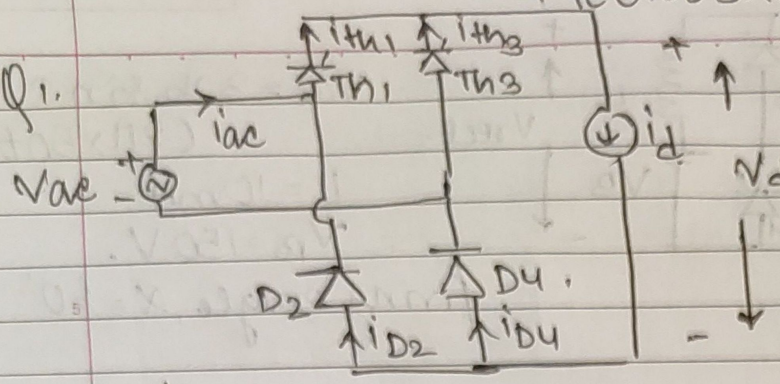
Test PE Mansi Uniyal
19EE10039.

Q1.



$V_{ac} = 325 \sin(2\pi \times 50t)$

$I_d = 20A$.

conduction voltage $|_{TH1} = 2V$

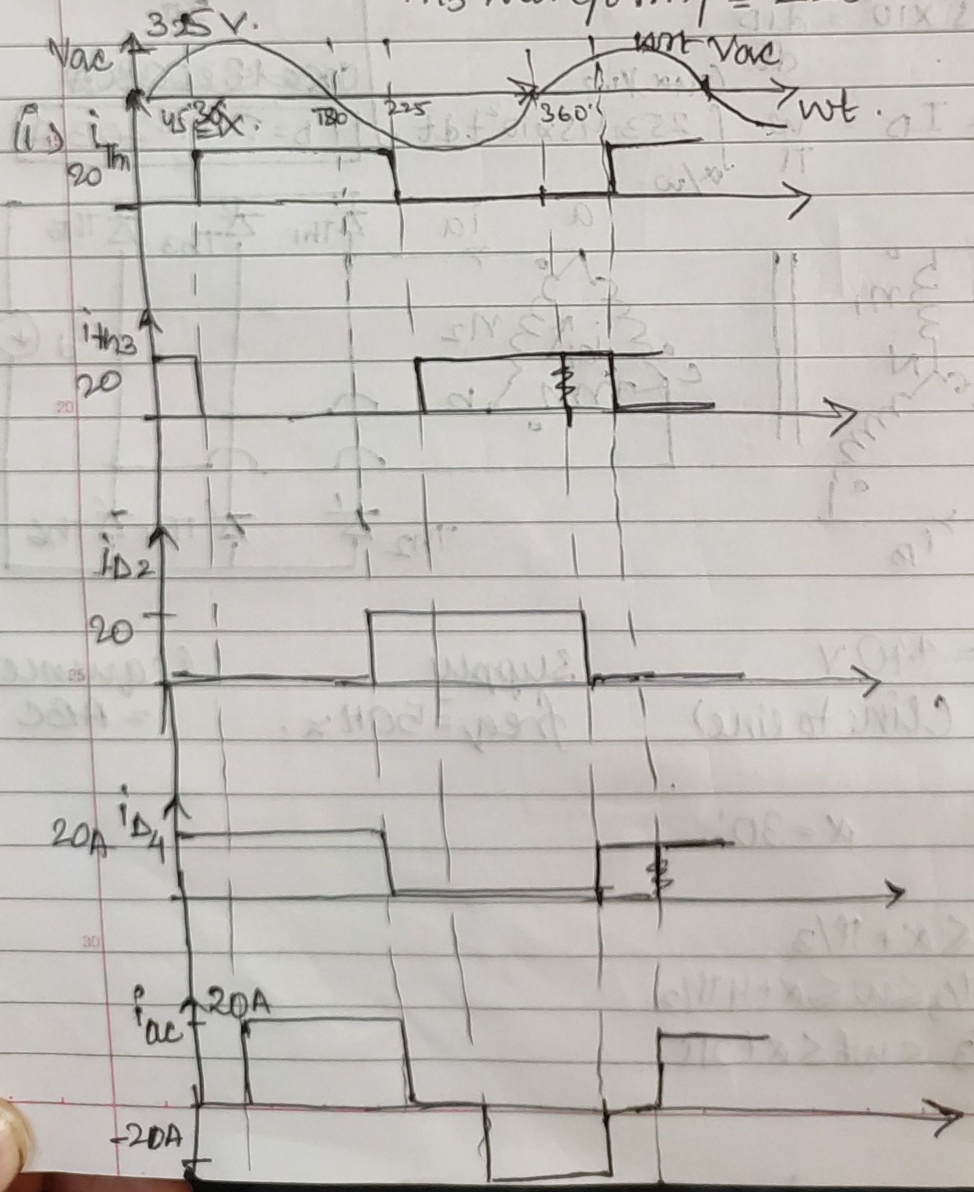
conduction voltage $|_{TH3} = 2V$.

conduction voltage $|_{D_2} = 1V$

conduction voltage $|_{D_4} = 1V$.

Th1 waveform $|_{wrt\ Vac} = 45°$.

Th3 waveform $|_{wrt\ Vac} = 225°$.



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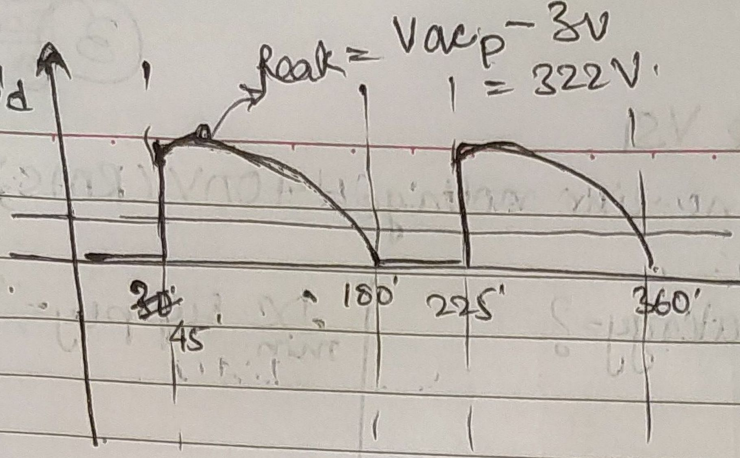
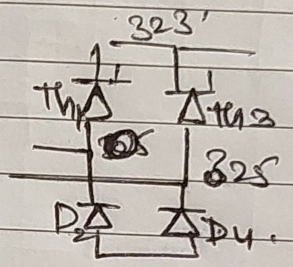
Q i (i) V_d



(ii) $V_{Th_1} = ?$
$V_{D_2} = ?$
} turnoffs.

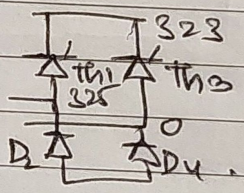
when Th_1 stops conducting

$\boxed{V_{th1} = 323V.}$



when D_2 stops conducting.

$\boxed{V_{D_2} = 322V}$



(iii) displacement factor $|_{i_{ac} \text{ wrt } V_{ac}} = ?$

$= \cos \alpha/2$.

$= \cos(45/2)^\circ$

$= 0.98$

$\boxed{= 0.9238795.}$

(1) c.

Q1 (iv) firing angle (α) = ?

if avg load power = 2000 kW.

$V_{avg} = \frac{325}{\pi}(1+\cos\alpha)$. $I_d = 20A$.

$2000 = \frac{325}{\pi} 20 (1+\cos\alpha)$.

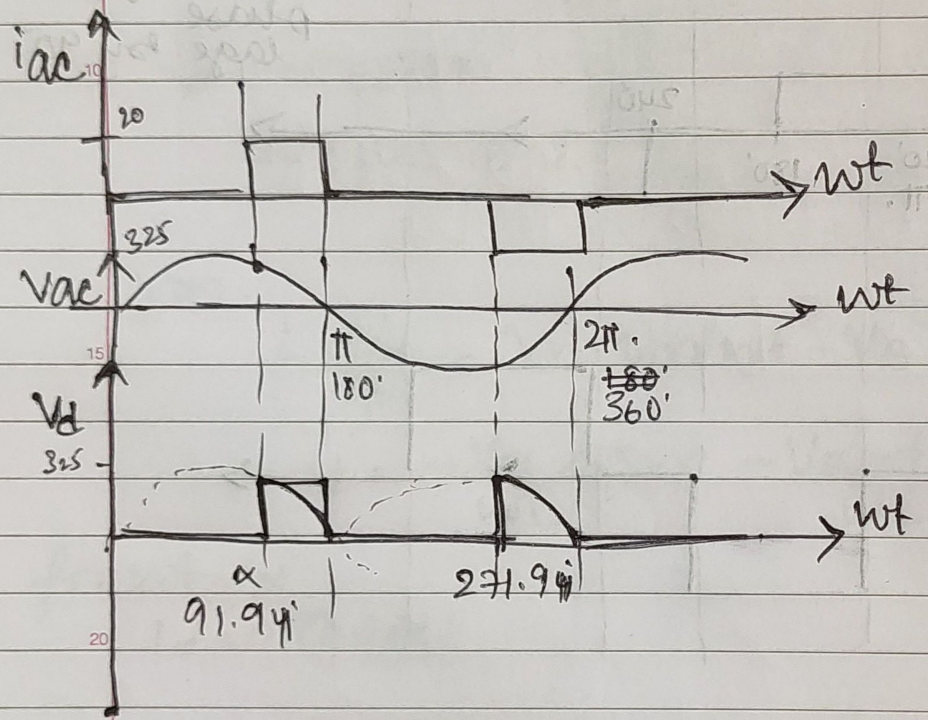
$P_o = V_{avg} I_d$.

$1+\cos\alpha = 0.966$

$\cos\alpha = -0.34$

$\alpha = 91.94°$

firing angle,



Q2 (i)

$V_{ac} = 325 \sin(2\pi \times 50t)$ $\quad V_m = 325\,V$

$L = 10\,mH$ $\quad \omega = 100\pi = 314.16.$

$V_B = 150\,V$ $\quad T = \frac{1}{50} = 0.02.$

$\alpha = 60^\circ = \pi/3 = 1.0472.$ $\quad F = 50.$

$R = 0$:

$$\frac{2V_m \cos\alpha}{\pi} = \frac{2 \times 325 \cos(\pi/3)}{\pi} = 103.45\,V.$$

$V_B > \frac{2V_m \cos\alpha}{\pi}$

$150 > 103.45\,V.$ } system in DCM.

$i_d > 0.$

$$L\frac{di_d}{dt} = V_m \sin\omega t - V_B.$$

$$i_d = \frac{-V_m \cos\omega t}{\omega L} - \frac{V_B \omega t}{\omega L} + C \quad \text{(C: integrating factor)}$$

for $\omega t = \alpha$

$I_d = 0$ (DCM)

$$0 = \frac{-V_m}{\omega L}\cos\alpha - \frac{V_B \alpha}{\omega L} + C.$$

$$C = \frac{V_m \cos\alpha}{\omega L} + \frac{V_B \alpha}{\omega L} = 101.33$$

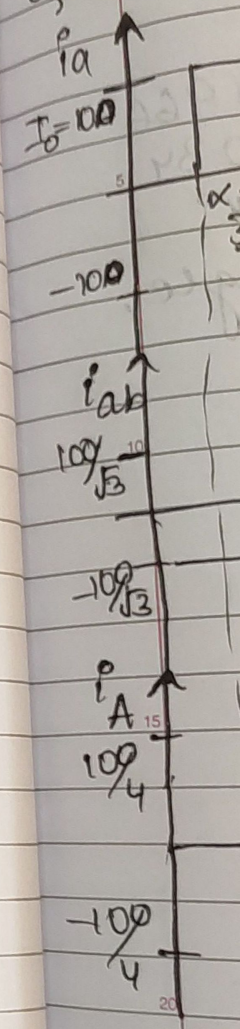
$$i_d = -103.45\cos(100\pi t) - 47.75(100\pi t) + 101.33.$$

if $\omega t = \alpha$, $i_d = 0.$

$$0 = -103.45\cos\beta - 47.75\beta + 101.33. \qquad \beta < 240^\circ.$$

$$\boxed{\beta \simeq 104^\circ}$$

Q2 (ii)



$$i_{davg} = \frac{P}{T}\int_{\alpha/\omega}^{\beta/\omega} i_d(t)\,dt.$$

$$= \frac{2}{T}\int_{\alpha/\omega}^{\beta/\omega} (-103.45\cos\omega t - 47.75\omega t + 101.33)\,dt.$$

$$i_{davg} = \frac{2}{T}\left[\frac{103.45\sin\omega t}{\omega} - 47.75\frac{\omega t^2}{2} + 101.33t\right]_{\alpha/\omega}^{\beta/\omega}$$

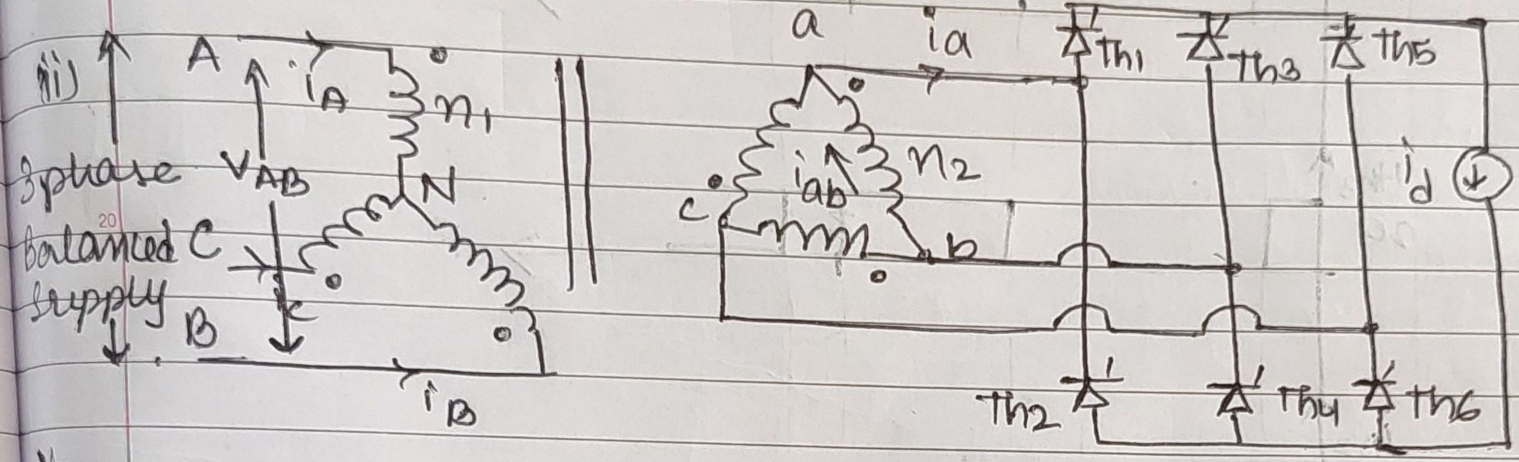
$$i_{davg} = \frac{2}{T}\left[0.497 - 0.9984 + 0.885\right].$$

$$i_{davg} = \frac{2}{T}\times\frac{3836}{10000} = \frac{100}{10000}\times 3836.$$

$$\boxed{i_{davg} = 38.36}\ A.$$

w/o

(ii)



V_{AB} Voltage supply = 440 V (line to line)

Supply freq = 50 Hz.

Sequence = ABC

$n_1 : n_2 = 4 : 1$

$I_d = 100A$ $\alpha = 30°$

$i_a = I_0$, $\alpha < \omega t \leq \alpha + \pi/3$

$i_a = -I_0$, $\alpha + 2\pi/3 \leq \omega \leq \alpha + 4\pi/3$

$i_a = I_0$, $\alpha + 5\pi/3 \leq \omega t \leq \alpha + 2\pi$

$i_a = 0$, else.

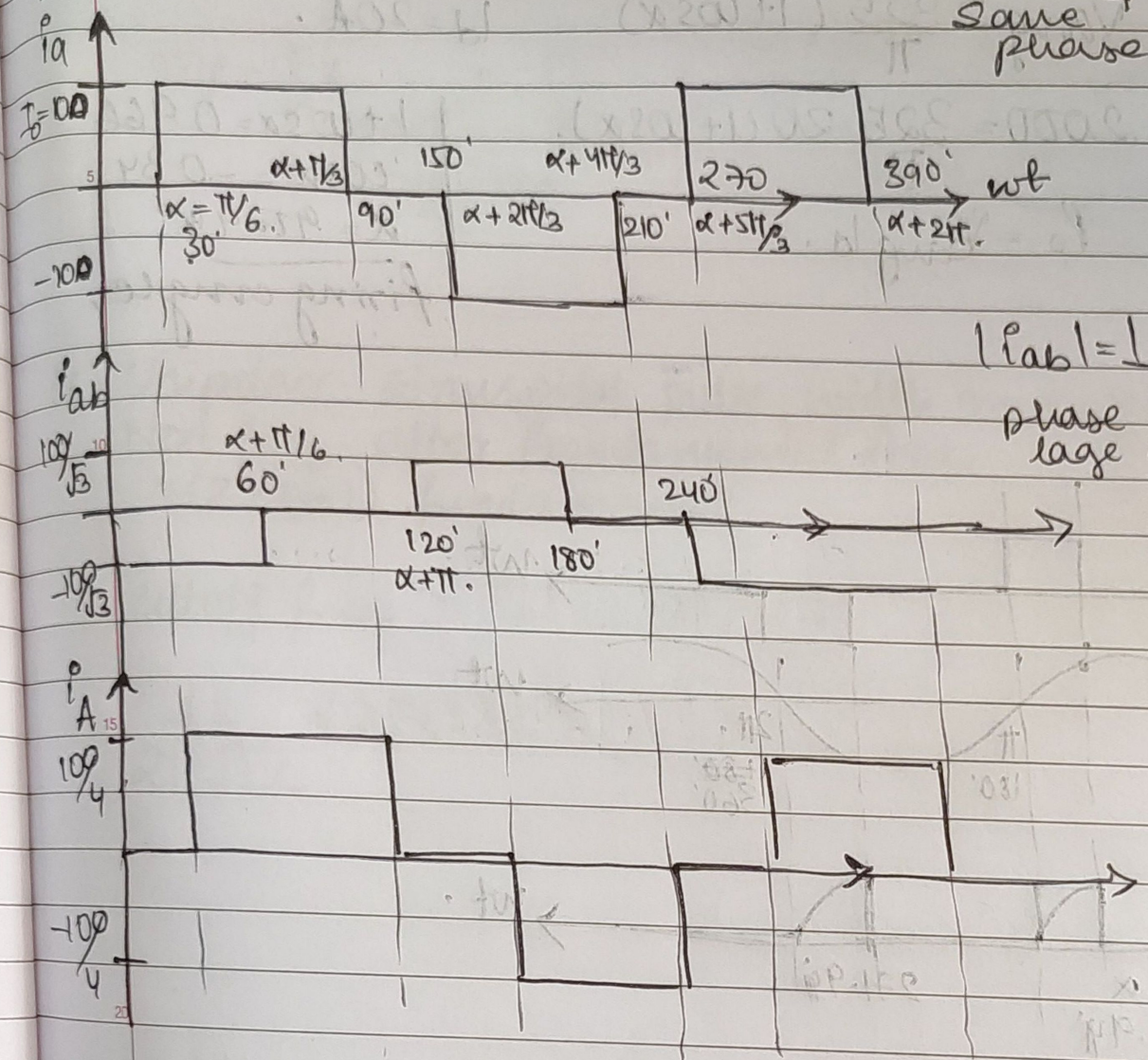
(2) 13

$\frac{i_A}{i_a} = \frac{n_s}{n_p} = 1/4.$

Q2 (ii).

$|i_A| = \frac{|i_a|}{4}$

same phase



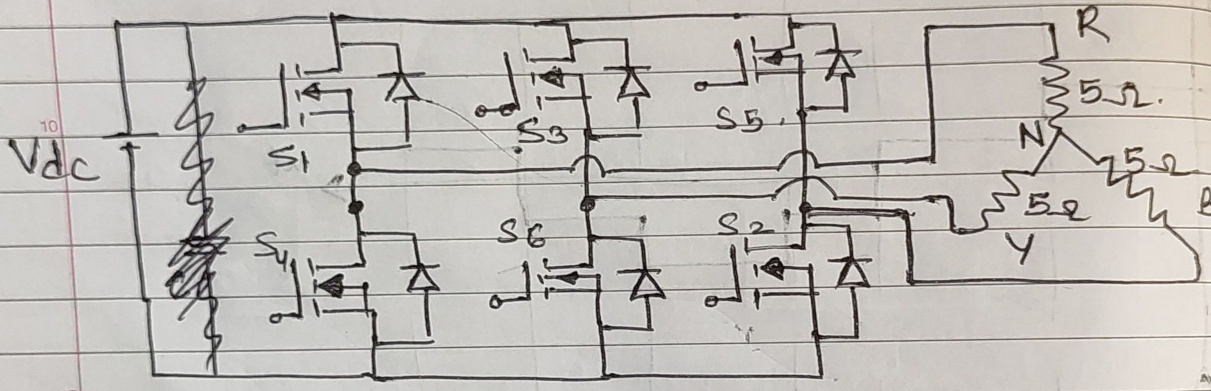
$|i_{ab}| = \frac{|i_a|}{\sqrt{3}}$

phase lage by 90°.

(3) A

Q3. (i) 3phase VSI 120° conduction mode (star).
R_L = 5Ω/phase.
desired phase sequence → RYB.
freq. of inverter o/p voltage = 50 Hz.
DC supply = 220V

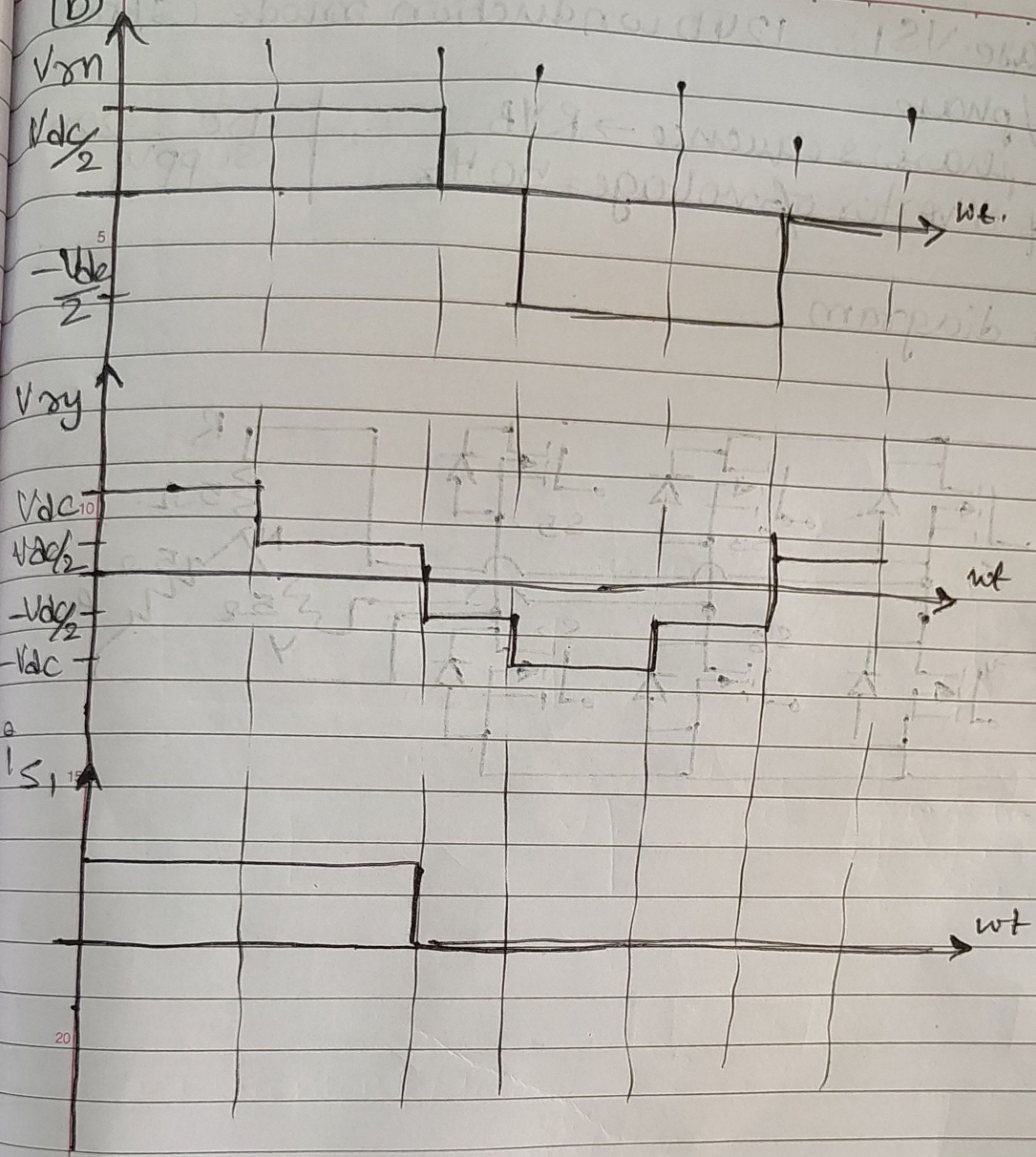
(a) circuit diagram



Q3. waveforms.

(3)

(b)



Q3. (b) 3phase VSI.

Rated line-line voltage = 400V (RMS).

Switching stoategy = ?.	DC supply = ?. min.

(ii) 2applications of AC-AC converters + type.

- Speed controlling of machines for low freq. and variable magnitude applications. — circuit diagram

- AC voltage controller; Lighting control, Speed of FAN, Static AC switches (Temp control) Pump / Hoist Drivers.

(4) B

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Qu. (i)

(b) Bi polar sinusoidal pulse width modulation scheme

$$m_f = \frac{F_s}{F_{control}} = \frac{F_s}{50}$$

$F_{control} \hookrightarrow F_{desired}$ o/p.

F_s → cut off freq.

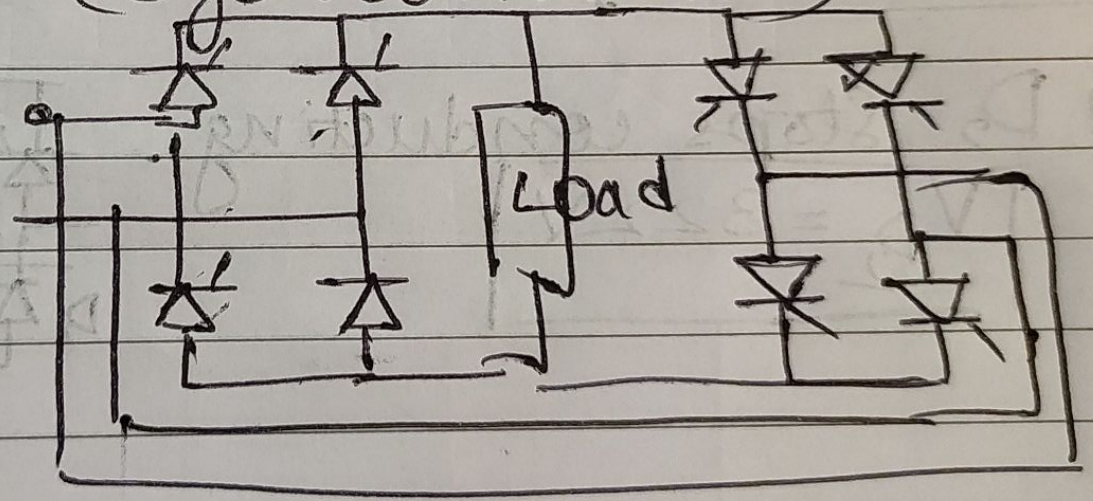
(c) Unipolar sinusoidal pulse width modulation scheme.

Next freq. after fundamental freq $= (2m_f \pm 1)$ fundamental.

cutoff freq. $= (2F_s \pm 50)$ Hz.

$$\frac{1}{2\pi\sqrt{LC}} = (2F_s \pm 50).$$

① Speed controlling Induction motor (cycloconverter)



② voltage source inverter.

(ii) 2 applications of AC-AC converters + type.