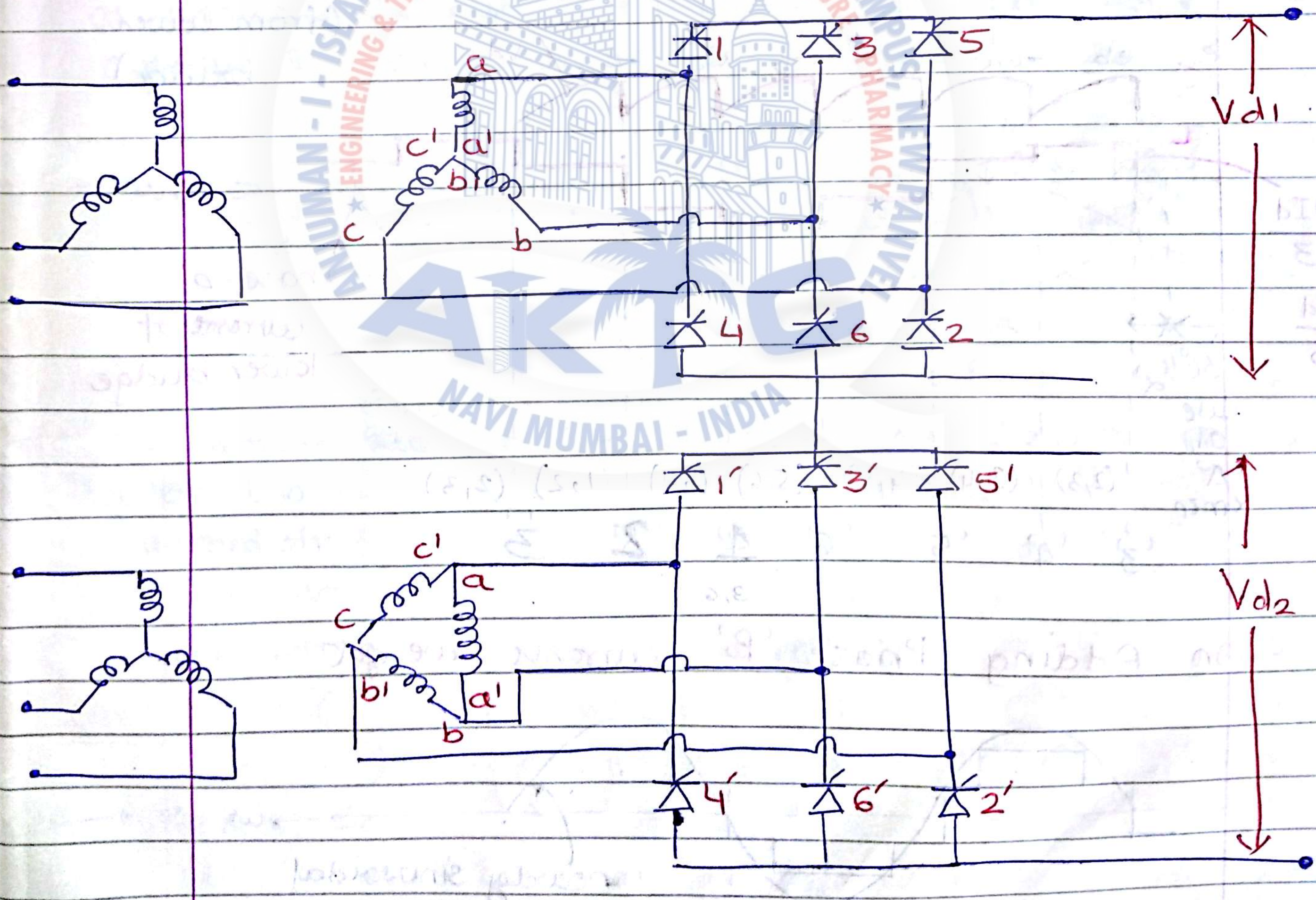
Page No.
Date: / /

* 12 pulse Bridge Converter.

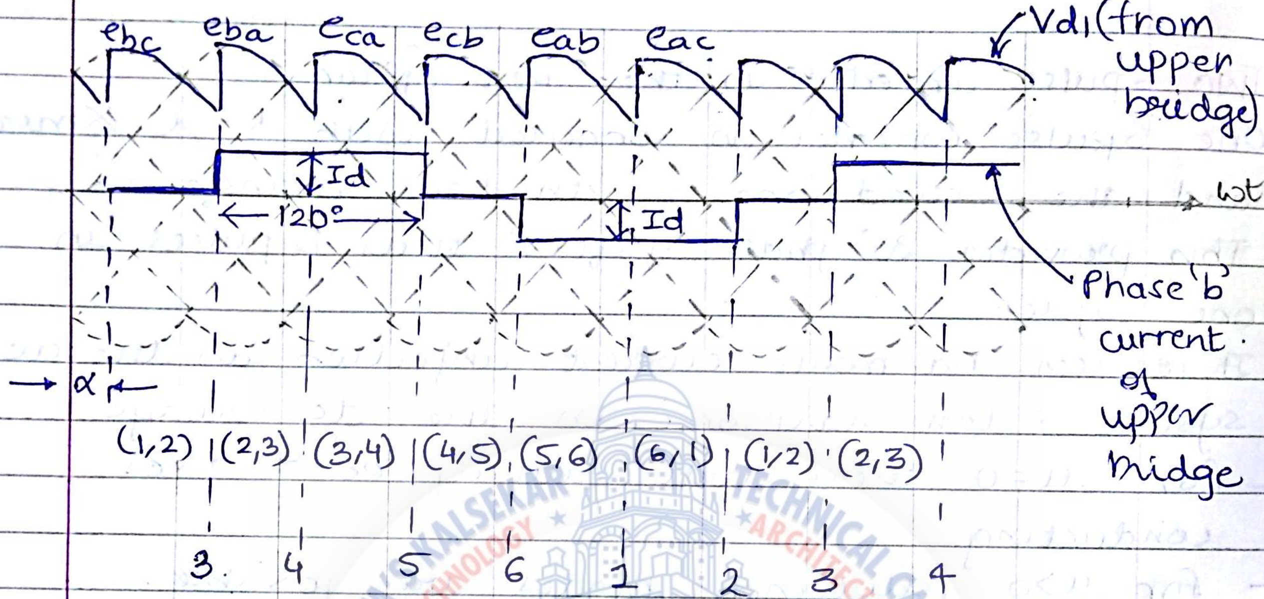
- Two 6 pulse converter is the best option
- One 6 pulse converter is connected with λ-λ Xmer and the second one with λ-Δ transformer
- This provides 30° phase shift & thus 12 pulses in one cycle.
- It reduces harmonic current injection in the ac system & less harmonic in the dc voltage.
- for $u=0$ there will always be 4 valves conducting
- for $u>0$ following modes are possible.

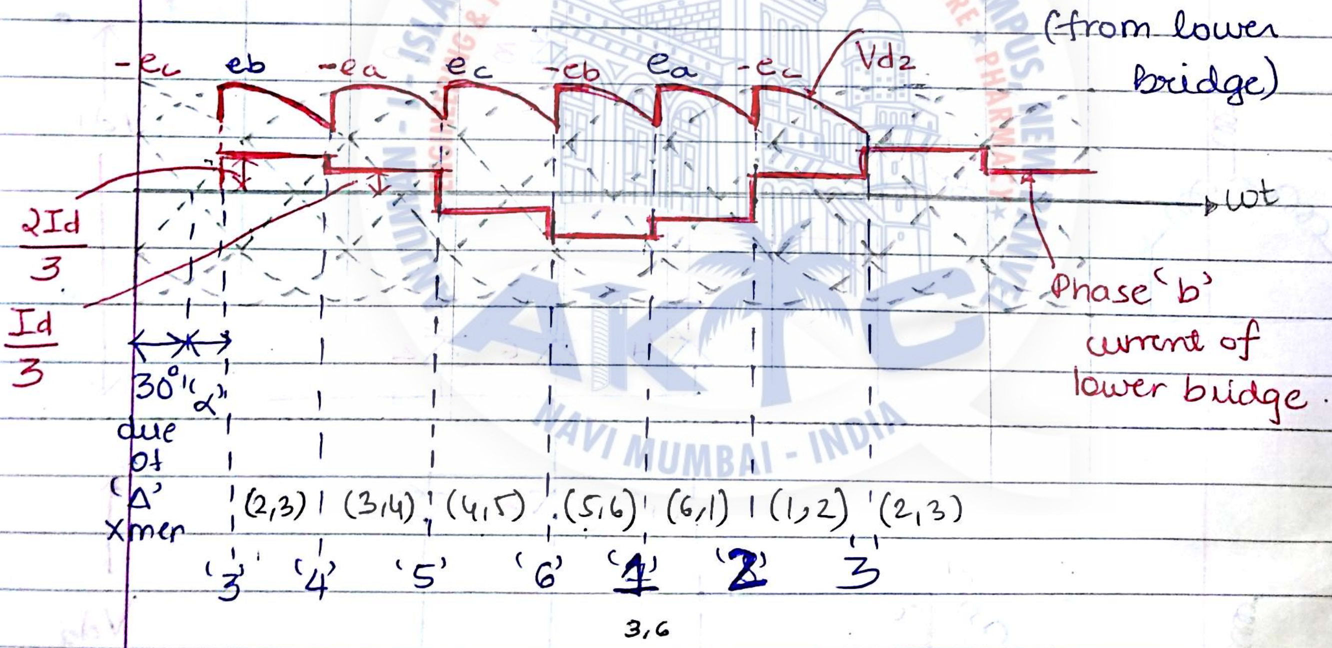


Page No.
Date: / /

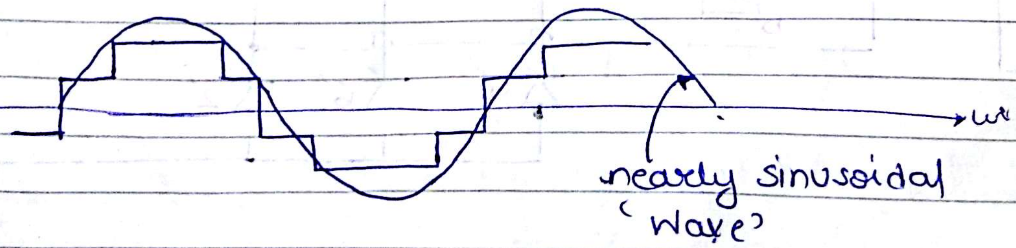
Consider;

$\alpha = 15^\circ \; ; \mu = 0^\circ$





→ On Adding Phase 'B' currents we get



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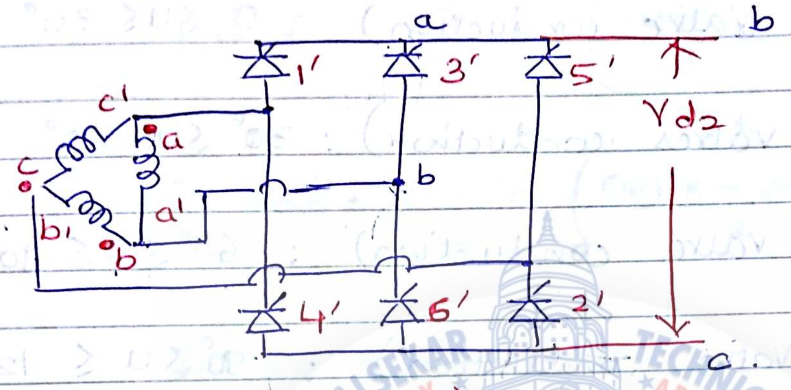
Page No. 39.1/2
Date: / /

- To calculate 'Vd2', to drawn waveform just consider 2nd half of the converter



CASE I (2 & 3 conducts)

- When 3' conducts; voltage at cathode of 3' is ea & at anode is ea but we take voltage from anode to cathode so -ea appears across valve 3'

∴ $e_{ba} = -e_a$ (from a' to •a it is -ve polarity)
(consider dotted polarity)

∴ o/p voltage e_{bc} = e_b (from •b to b' it is +ve polarity)
(Here 1 is turned off & 2 & 3 are conducting)

CASE II : (3 & 4 conducts)

→ $e_{ca} = e_c$.

→ o/p voltage $e_{ba} = -e_a$.

Page No.
Date: / /

* Modes of operation

- Mode 1 (4/5 Valve conduction) : $0 \leq u \leq 30°$
- Mode 2 (5/6 valves conduction) : $30° \leq u \leq 60°$
- Mode 3 (6/7 valve conduction) : $60° \leq u \leq 90°$
- Mode 4 (7/8 Valve conduction) : $90° \leq u \leq 120°$

* Relationship between ac & dc quantities

We know that ;

$$V_d = V_{do}\left(\frac{\cos\alpha + \cos\delta}{2}\right) \quad \text{--- (1)}$$

$$= \frac{3\sqrt{3}\,E_m}{\pi}\left(\frac{\cos\alpha + \cos\delta}{2}\right)$$

→ for lossless converter;

$$P_{ac} = P_{dc}$$

- $P_{ac} = \sqrt{3}\,E_{LL} I_1 \cos\phi$
- $P_{dc} = V_d I_d = \frac{3\sqrt{3}E_m}{\pi}\left(\frac{\cos\alpha + \cos\delta}{2}\right)(I_d)$

$$= \frac{3\sqrt{3}}{\pi}\left(\frac{\sqrt{2}\,E_{LL}}{\sqrt{3}}\right)\left(\frac{\cos\alpha + \cos\delta}{2}\right)(I_d)$$

Page No.
Date: / /

$$\sqrt{3}\, E_{LL}\, I_1 \cos\phi = \frac{3\sqrt{2}}{\pi} E_{LL} \left(\frac{\cos\alpha + \cos\delta}{2}\right)(I_d)$$

$$\therefore I_1 \cos\phi = \frac{3\sqrt{2}}{\sqrt{3}\,\pi} \left(\frac{\cos\alpha + \cos\delta}{2}\right) I_d.$$

$$\therefore I_1 \cos\phi = \frac{\sqrt{6}\, I_d}{\pi} \left(\frac{\cos\alpha + \cos\delta}{2}\right).$$

With ; $\mu = 0$

$$I_1 \cos\phi = \frac{\sqrt{6}}{\pi} I_d \left(\frac{\cos\alpha + \cos(\alpha+0)}{2}\right)$$

$$I_1 \cos\phi = \frac{\sqrt{6}}{\pi} I_d \left(\frac{2\cos\alpha}{2}\right)$$

$$I_1 \cos\phi = \frac{\sqrt{6}}{\pi} I_d \cos\alpha.$$

$$\therefore \boxed{I_1 = \frac{\sqrt{6}}{\pi} I_d} \quad (\cos\phi = \cos\alpha)$$

→ Now we can say that ;

$$\cos\phi \cong \frac{\cos\alpha + \cos\delta}{2}.$$

$$\therefore V_d \cong V_{do} \cos\phi \quad (\text{from } (1))$$

$$\therefore \cos\phi \cong \frac{V_d}{V_{do}} \cong \frac{V_{do}\cos\alpha - R_c I_d}{V_{do}}$$

$$\boxed{\cos\phi \cong \cos\alpha - \frac{R_c I_d}{V_{do}}.}$$

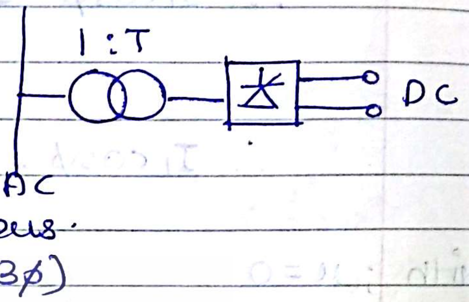
Page No.
Date: / /

*Relationship between AC & DC Quantities, with multiple bridges:

let;

B = no of Bridges in series

T = Transformer ratio.



→ The ideal no load voltage for multiple bridge;

$$V_{do} = \frac{3\sqrt{3}\,E_m}{\pi}(B)(T)$$

$$= \frac{3\sqrt{3}}{\pi} \times \frac{\sqrt{2}\,E_{LL}}{\sqrt{3}}(B)(T)$$

$$= \frac{3\sqrt{2}}{\pi}E_{LL}(B)(T)$$

→ Voltage drop/bridge $= \left(\frac{3\omega L}{\pi}\right) I_d$

∴ for B bridges $= B\left(\frac{3\omega L}{\pi}\right) I_d$.

→ Therefore the dc voltage is

$$V_d = V_{do}\cos\alpha - I_d(B)\left(\frac{3\omega L}{\pi}\right)$$

or

$$V_d = V_{do}\cos\gamma - I_d(B)\left(\frac{3\omega L}{\pi}\right)$$

→ Also; in terms of p.f;

$V_d \cong V_{do} \cos\phi$.

→ The average dc o/p voltage of 12 bridge is twice of the 6 pulse bridge converter.

→ Also;

$$I_1 = \frac{\sqrt{6}}{\pi} (B) I_d.$$