Assignment

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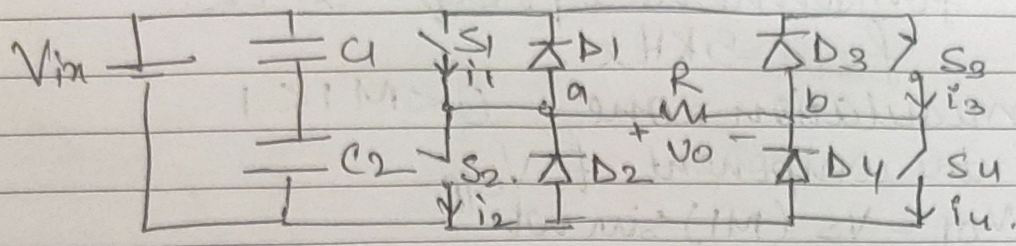
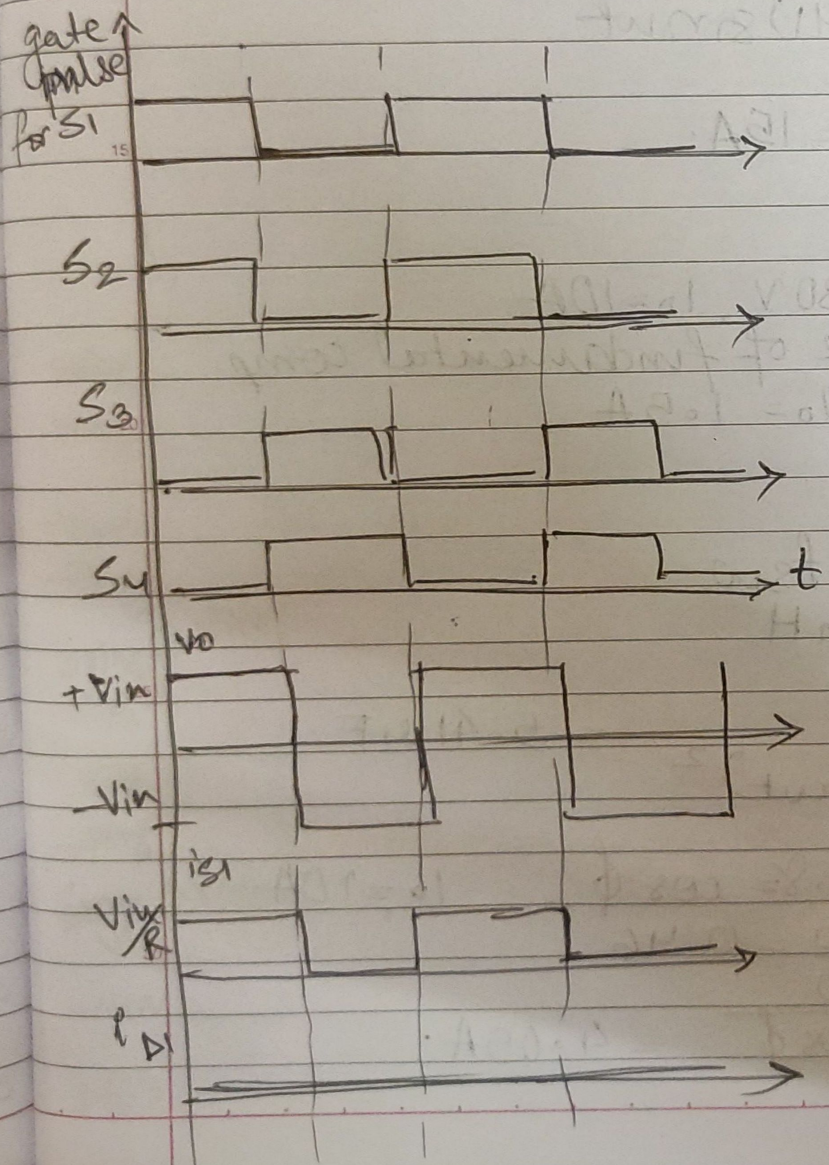
Q.1 given $(V_{o1})_{rms} = 230V$.



$V_{o1}_{rms} = \frac{4}{\sqrt{2}} \frac{V_{in}}{\pi}$ $\quad V_{in} = 255.465V$.

$I_{s1}{}_{max} = \frac{V_{in}}{R} = 127.73A$.



for R load with $R = 2\Omega$

(a) $I_{o1}{}_{rms} = \frac{230}{2} = 115A$

$I_{s1}{}_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{\pi}(I_m \sin(\omega t))^2 d\omega t}$

$= \frac{I_m}{\sqrt{2\pi}}\sqrt{\int_0^{\pi}(1-\cos 2\omega t)\, d\omega t}$

$= \frac{I_m}{2} = \frac{115\sqrt{2}}{2} = 81.33A$.

$I_{D1}{}_{rms} = 0$.

(b) for RLC load with $R = 2\Omega$, $X_L = 8\Omega$, $X_C = 6\Omega$

$I_{s1}{}_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{3\pi/4}(I_m \sin\omega t)^2 d\omega t}$

$= \frac{I_m}{\sqrt{2\pi}}\sqrt{\left(\omega t - \frac{\sin 2\omega t}{2}\right)_0^{3\pi/4}}$

$= 54.82A$.

$I_{D1}{}_{rms} = \sqrt{\frac{1}{2\pi}\int_0^{\pi/4}(I_m \sin\omega t)^2 d\omega t}$

$= 17.328A$.

Q2. half bridge inverter with SPWM.

$V_s = 600V$, $R = 8\Omega$, $X_L = 6\Omega$.

fundamental freq = 50Hz.

$f_{sw} = 5kHz$.

(i). linear modulation zone, $0 < M1 < 1$

fundamental component of $V_{o/p}$

$$V_{o1} = \frac{V_s}{2}(M1)\sin\omega t$$

$$V_{o1}{}_{max} = \frac{V_s}{2} = 300V.$$

(ii) $Z = \sqrt{8^2 + 6^2} = 10\Omega$.

fundamental comp. of load current

$$i_{o1} = \frac{V_{o1}}{Z} = \frac{V_s(M1)\sin\omega t}{2Z}$$

$$i_{o1}{}_{peak} = \frac{600 \times 0.5}{20} = 15A.$$

Q3. $V_{dc} = 500V$, $v_o = 230V$, $I_o = 10A$

$V_o, I_o \rightarrow$ peak value of fundamental comp.

(a) $(\Delta i_{ripple})_{max}$ = 15% of I_o = 1.5A

$$= \frac{V_{dc}}{4(L_f) f_{sw}}$$

$\therefore L_f = 8.33mH$

$f_{cut} = 750Hz$.

$$C_f = \frac{1}{L_f(2\pi f_{cut})^2} = 5.41\mu F.$$

(b) Load power factor = 0.8 = cos ϕ, $I_o = 10A$

$$m_a = \frac{(V_o)_{max}}{V_{dc}} = \frac{230}{500} = 0.46.$$

$$I_{s1}{}_{rms} = I_o\sqrt{\frac{1}{8} + \frac{m_a \cos\phi}{3\pi}} = 4.05A.$$

$$I_{S1_{avg}} = I_0\left(\frac{1}{2\pi} + \frac{m\alpha\cos\phi}{8}\right) = 2.05A.$$

$$I_{D1_{rms}} = I_0\sqrt{\frac{1}{8} - \frac{m\alpha\cos\phi}{3\pi}} = 2.92A.$$

$$I_{D1_{rms}} = I_0\left(\frac{1}{2\pi} - \frac{m\alpha\cos\phi}{8}\right) = 1.8A.$$

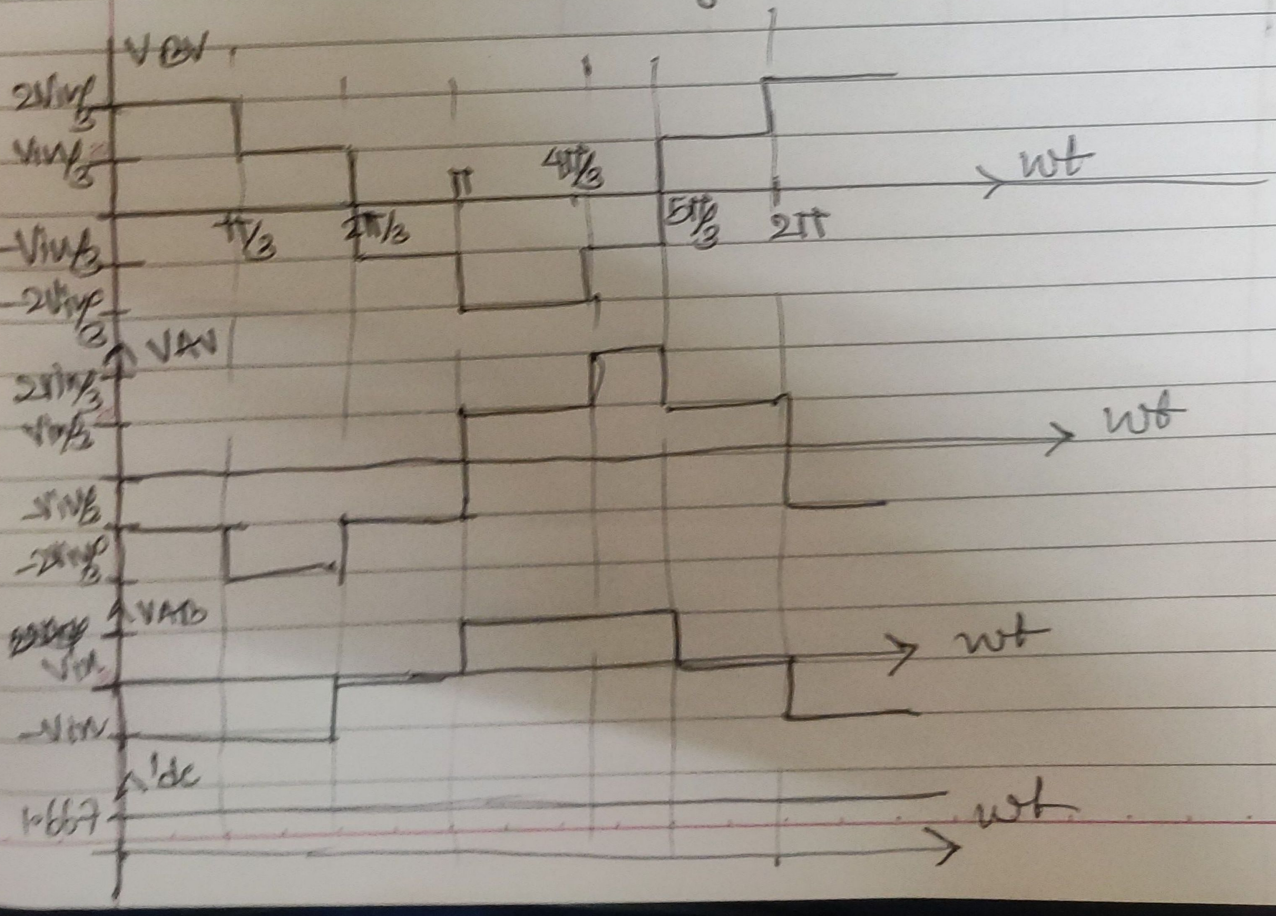
Q4. $V_{dc} = 600V$, $V_{AB1_{rms}} = 250V$, $I_{D1_{rms}} = 10A$.

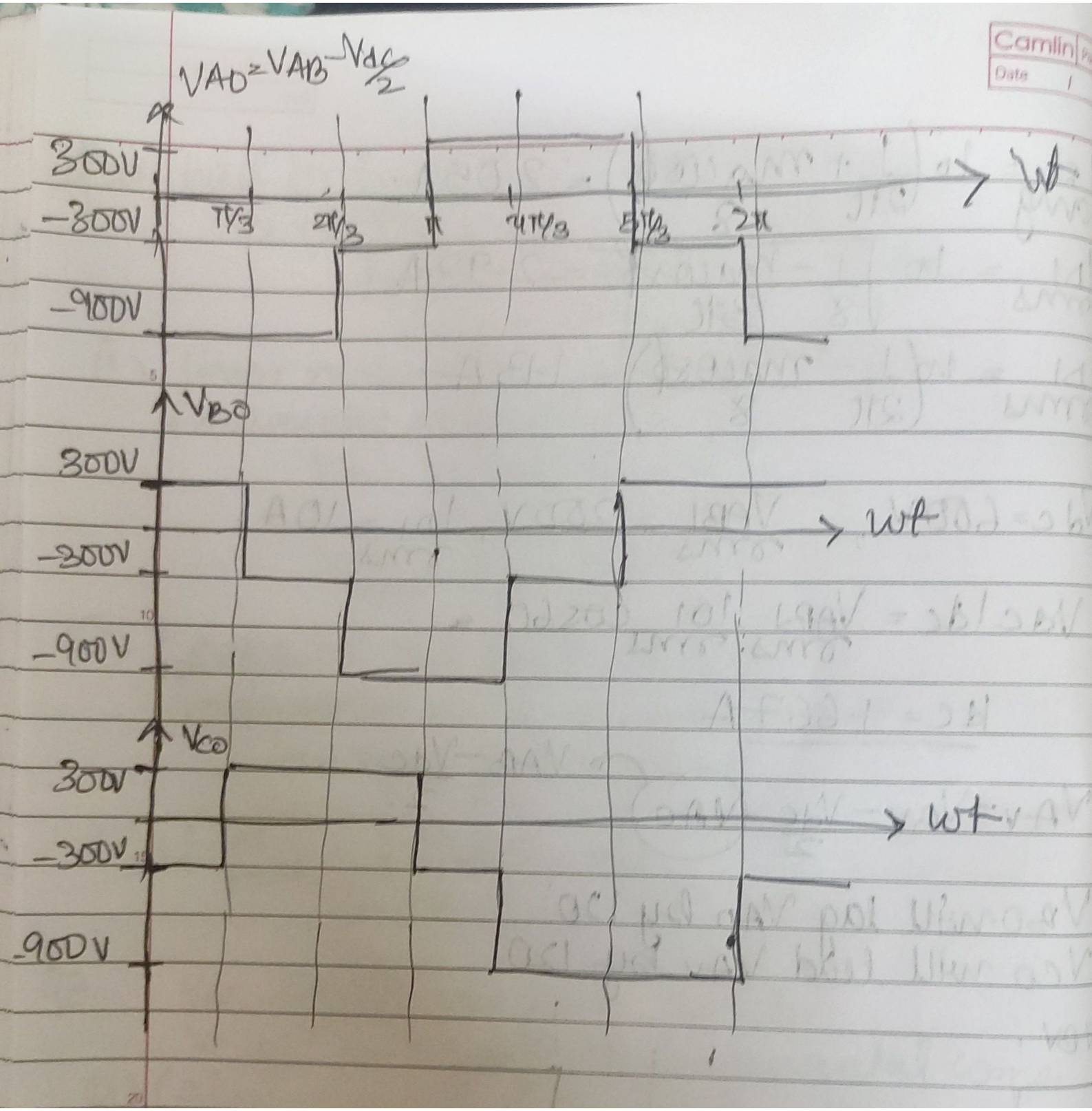
$$V_{dc}I_{dc} = V_{AB1_{rms}} I_{D1_{rms}} \cos 60$$

$$I_{dc} = 1.667A$$

$$V_{AN} - V_{BN} - \frac{V_{dc}}{2} = V_{AO} \rightarrow V_{AB} - \frac{V_{dc}}{2}$$

V_{BO} will lag V_{AO} by 120°
V_{CO} will lead V_{AN} by 120°




VAO = VAB − Vdc/2
300V
−300V
−900V
π/3
2π/3
π
4π/3
5π/3
2π
ωt
VBO
300V
−300V
−900V
ωt
VCO
300V
−300V
−900V
ωt