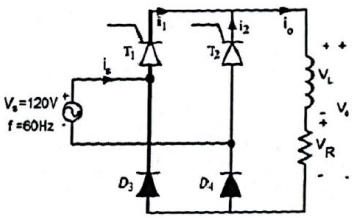
Answer the following questions:

Q:[16 Marks]

1- For the circuit shown in figure 1, $\omega L >> R$, $R=10\Omega$, *and* $\alpha=30°$.

a- Draw v_s, v_o, v_R, v_L, i_s, i_o, i_1, and i_{D4}.
b- Find the average value of v_o, and i_o.
c- Find the *rms* value of i_s, i_1, and i_{D4}.
d- Find P_L, PF, f_o, γ.



2- If a ***FWD*** is added to the circuit:

a- Draw i_s, i_o, i_1, and i_{D4}.
b- Find the *rms* value of i_s, i_1, and i_{D4}.

Fig. 1

Q2:[11 Marks]

For the circuit shown in figure2, $v_i=150\sin 2\pi 50t$ *[V]*, $R=10\Omega$, *and* $\alpha=60°$.

a- Draw v_s, v_o, v_T, i_s, i_o, and i_T.
b- Find the average value of v_o, and i_o.
c- Find the average and *rms* value of i_T.
d- Find P_L, f_o, and *PIV* for each thyristor.
e- Draw the same circuit type using 2 diodes and 2 thyristors.

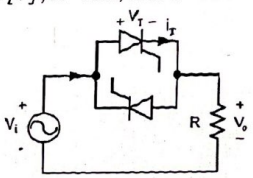


Fig. 2

Q3:[13 Marks]

a-For the circuit shown in figure 3, V_s= *200V*, $R=50\Omega$, $T=20msec$, and the voltage drop on *MOSFET* V_d= *3V*. Find the ***efficiency*** η.

b- If the output power $P=194W$, find k, T_{on}, draw v_G, and find the average value of I_Q.

c- Draw the circuit of the single phase bridge inverter.

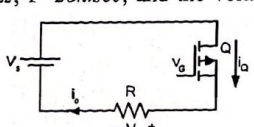


Fig. 3

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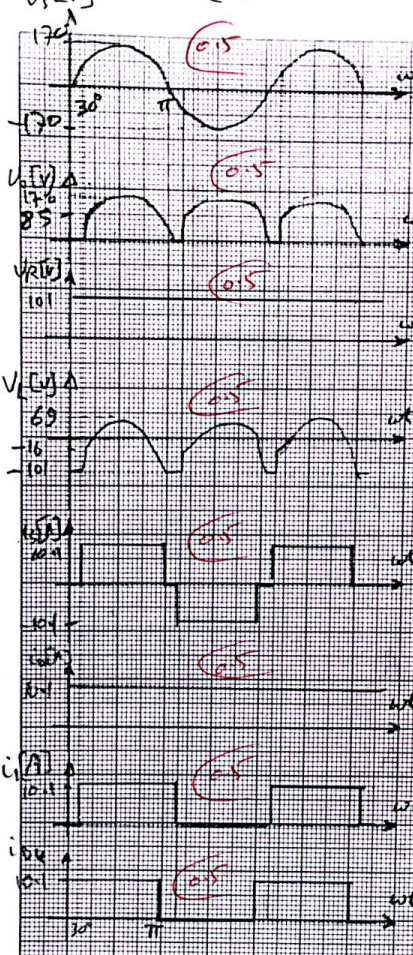
Q1:

(a)



(0.5) (0.5) (0.5) (0.5) (0.5) (0.5) (0.5) (0.5) (0.5)

(1)

$V_m = 120\sqrt{2} \cong 170\,V$

b) $V_{oav} = \frac{V_m}{\pi}(1+\cos\alpha)$ (1)

$= \frac{170}{\pi}(1+\cos 30^\circ) \cong 101\,V$ (1)

$i_{oav} = \frac{V_{oav}}{R} = \frac{101}{10} = 10.1\,A$ (1)

c) $I_{srms} = \sqrt{\frac{\pi-\alpha}{\pi}} \times 10.1 \cong 9.22\,A$ (1)

$i_{rms} = \sqrt{\frac{\pi}{2\pi}} \times 10.1 = 7.14\,A$ (1)

$I_{D_1 rms} = \frac{i_{rms}}{\sqrt{2}} = 7.14\,A$ (1)

d) $P_L = (i_{orms})^2 R =$

(0.5) $(10.1)^2 \times 10 = 1020$ watt

(0.5) $PF = \frac{P_L}{V_s I_s} = \frac{1020}{102 \times 9.22} = 0.972$ (2)

(0.5) $f_{io} = k f_i = 2 \times 60 = 120\,Hz$

(0.5) $\gamma = \pi = 180^\circ$

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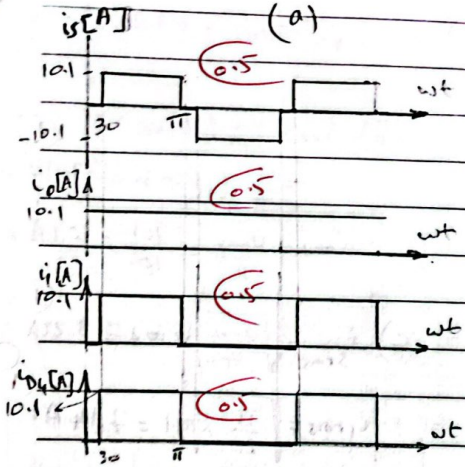
Q_1: (2)

(a)



(b).

$$i_{srms} = \sqrt{\frac{\pi - \alpha}{\pi}} \times 10.1 = 9.22\ A \quad (1)$$

$$i_{1rms} = \sqrt{\frac{\pi - \alpha}{2\pi}} \times 10.1 = 6.52\ A \quad (1)$$

$$i_{D_{4rms}} = i_{1rms} = 6.52\ A. \quad (1)$$

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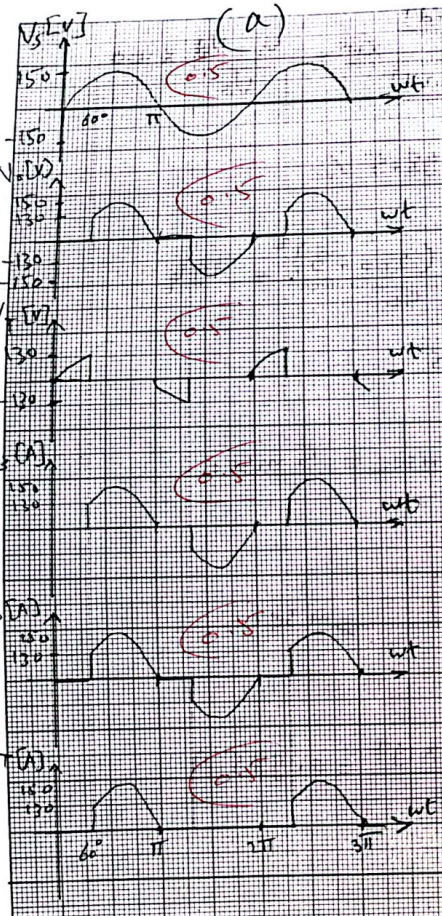
Q2:

(a)



$V_m = 150V$, $f = 50\,Hz$

$I_m = \frac{V_m}{R} = \frac{150V}{10} = 15A$

b- $V_{oav} = 0V$ (0.5)

$i_{oAV} = 0\,A$ (0.5)

c- $I_{T_{av}} = \frac{I_m}{2\pi}(1+\cos\alpha)$

$= \frac{15}{2\pi}(1+\cos 60) = 3.5$ (1)

$I_{T_{rms}} = \frac{I_m}{2}\sqrt{1-\frac{\alpha}{\pi}+\frac{\sin 2\alpha}{2\pi}}$

$= \frac{15}{2}\sqrt{1-\frac{60}{180}+\frac{\sin 120}{2\pi}}$

$= 6.73\,A$ (1)

d) $I_{orms} = \frac{I_m}{\sqrt{2}}\sqrt{1-\frac{\alpha}{\pi}+\frac{\sin 2\alpha}{2\pi}}$

$= \sqrt{2}\, I_{T_{rms}} = 9.52\,A$ (1)

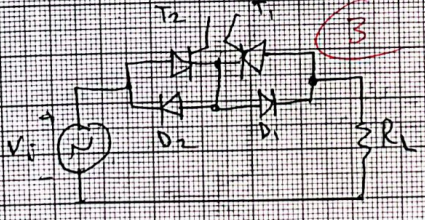
$P_L = (I_{orms})^2 R$

$= (9.52)^2 \times 10 = 906\,watt$

$f_o = f_i = 50\,Hz$ (0.5)

$PIV = 150V = V_m$ (0.5)

e)



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Q3:

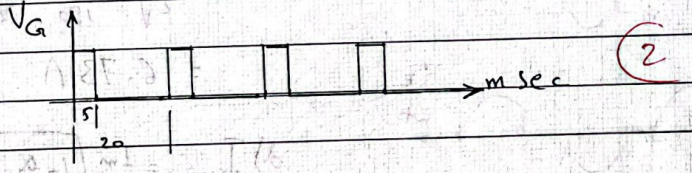
a) $\eta = \frac{P_L}{P_S} \times 100 = \frac{\frac{k(V_s - V_d)^2}{R}}{\frac{k V_s (V_s - V_d)}{R}} \times 100 = \frac{V_s - V_d}{V_s} \times 100$

$\eta = \frac{200-3}{200} \times 100 = 98.5\ \%$ (2)

b) $P_L = \frac{k(V_s - V_d)^2}{R} = \frac{k(200-3)^2}{50} = 194$

$k = \frac{194 \times 50}{(197)^2} = 0.25$ (2)

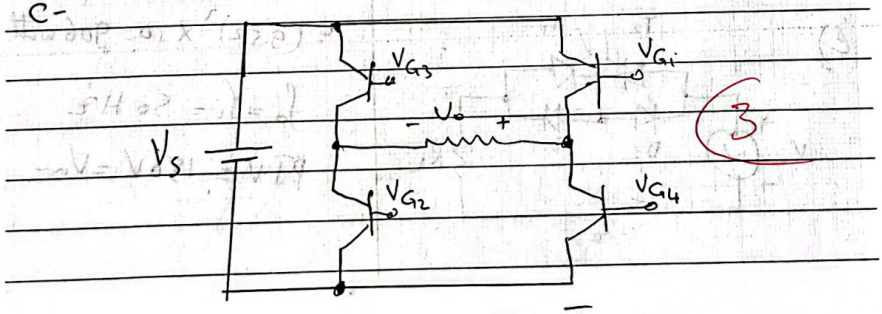
$T_{on} = kT = 0.25 \times 20\text{msec} = 5\ \text{msec}$ (2)



(2)

$I_{Q\,av} = \frac{k(V_s - V_d)}{R} = \frac{0.25 \times 197}{50} = 0.985\ A$ (2)

c-



(3)

$V_{G1} = V_{G2} = \overline{V}_{G3} = \overline{V}_{G4}$

4/4

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