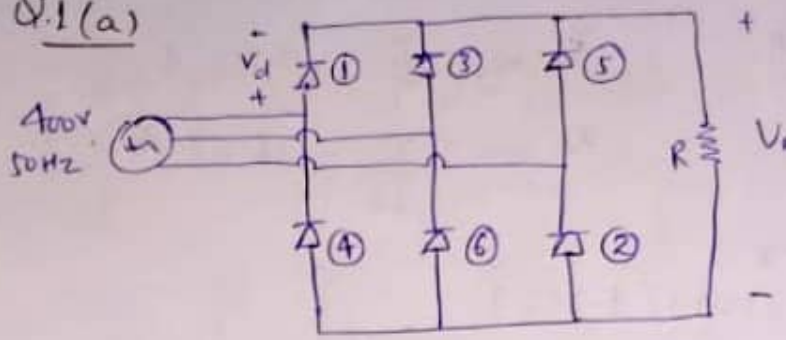
Roll no - 24M1355
ADITYA KUMAR

Assignment - 3

Q.1 (a)



$P_{out} = 15 + W$

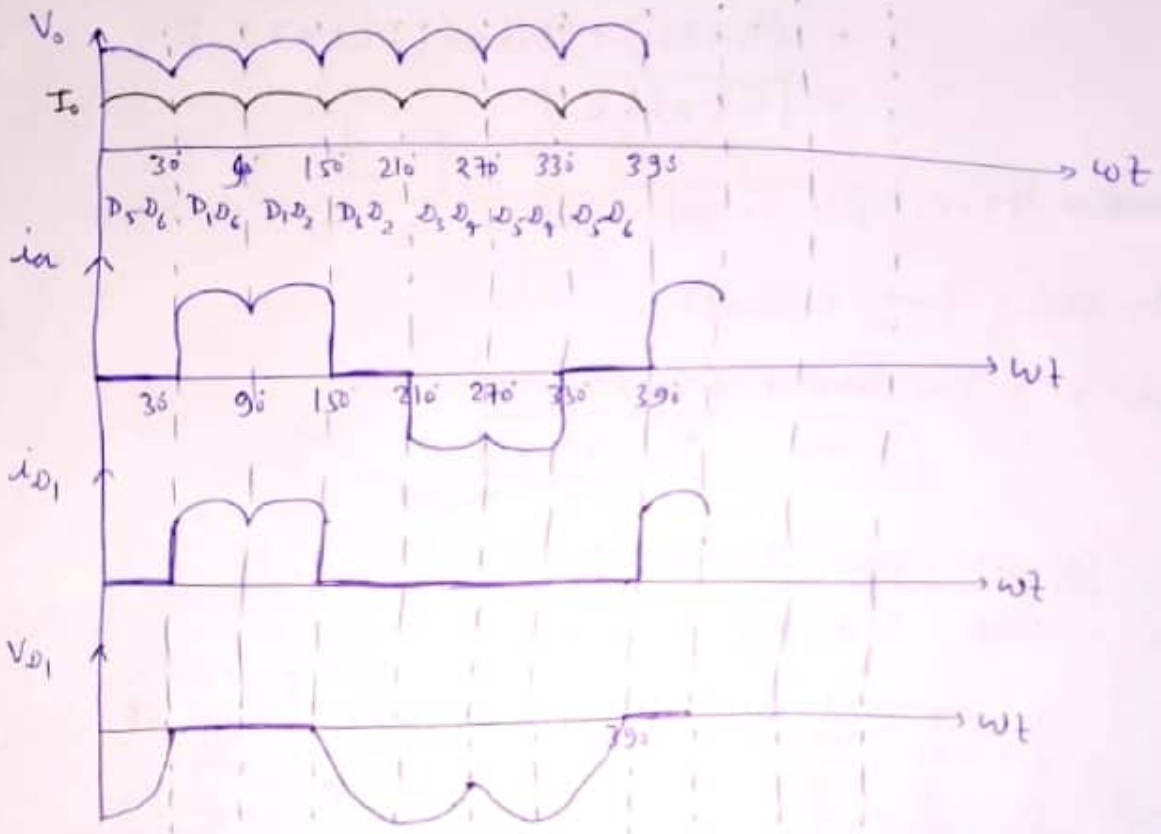
$Avg\ V_o = \frac{3V_{ml}}{\pi}$

$= \frac{3 \times 400\sqrt{2}}{\pi} = 540.189\ V$

$Avg\ I_o = \frac{15000}{540.189} = 27.768\ A$

$R = \frac{(540.189)^2}{15000} = 19.4536\ \Omega$

(2)



$30 < \omega t < 90$	Diode ON $V_{D_1} = 0$
$90 < \omega t < 150$	Diode ON : $V_{D_1} = 0$
$150 < \omega t < 210$	$V_{D_1} = V_b - V_a = -V_{ab}$
$210 < \omega t < 270$	$V_{D_1} = V_b - V_a = -V_{ab}$
$270 < \omega t < 330$	$V_{D_1} = V_c - V_a = +V_{ca}$
$330 < \omega t < 390$	$V_{D_1} = V_c - V_a = +V_{ca}$

(3) Power loss in complete diode bridge module = ?

$\begin{cases} V_{th} = 1.04 \\ R_{D,ON} = 6\,m\Omega \end{cases}$ at $I = 20\,A$

$i_{D,avg} = \frac{I_o}{3} = 9.256\ A$

$i_{D,rms} = \frac{I_o}{\sqrt{3}} = 16.03\ A$

$P_{Cond.} = I_{D,rms}^2 R_{ON} + V_D \cdot I_{D,avg}$

$= (16.03)^2 \cdot (0.006) + (1.04)(9.256)$

$= 11.168\ W$

$P_{sw} = 0$ $\quad \therefore P_{total} = 11.168\ W$ (for 1 diode)

$P_{total\ bridge} = 11.168 \times 6 = \boxed{67.010\ W}$ Ans

Junction temp $T_j = T_a + P \cdot R_{thermal}$ $\quad \cdots \{T_a = 40^\circ C\}$

$= (40 + 273) + (11.168)(1.1 + 0.07)\ K$

$= \boxed{53.066^\circ C}$

(4) ~~Matlab~~ PLECS file is uploaded.

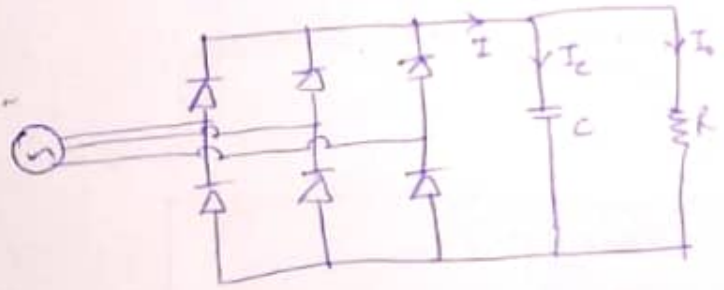
(5) In case 1 (only R load)

Total RMS line current from AC source

$\boxed{I_{s,rms} = 22.693\ A}$ Ans

Case-b Capacitor across the DC link :-

Given. Peak to peak ripple = 10 V

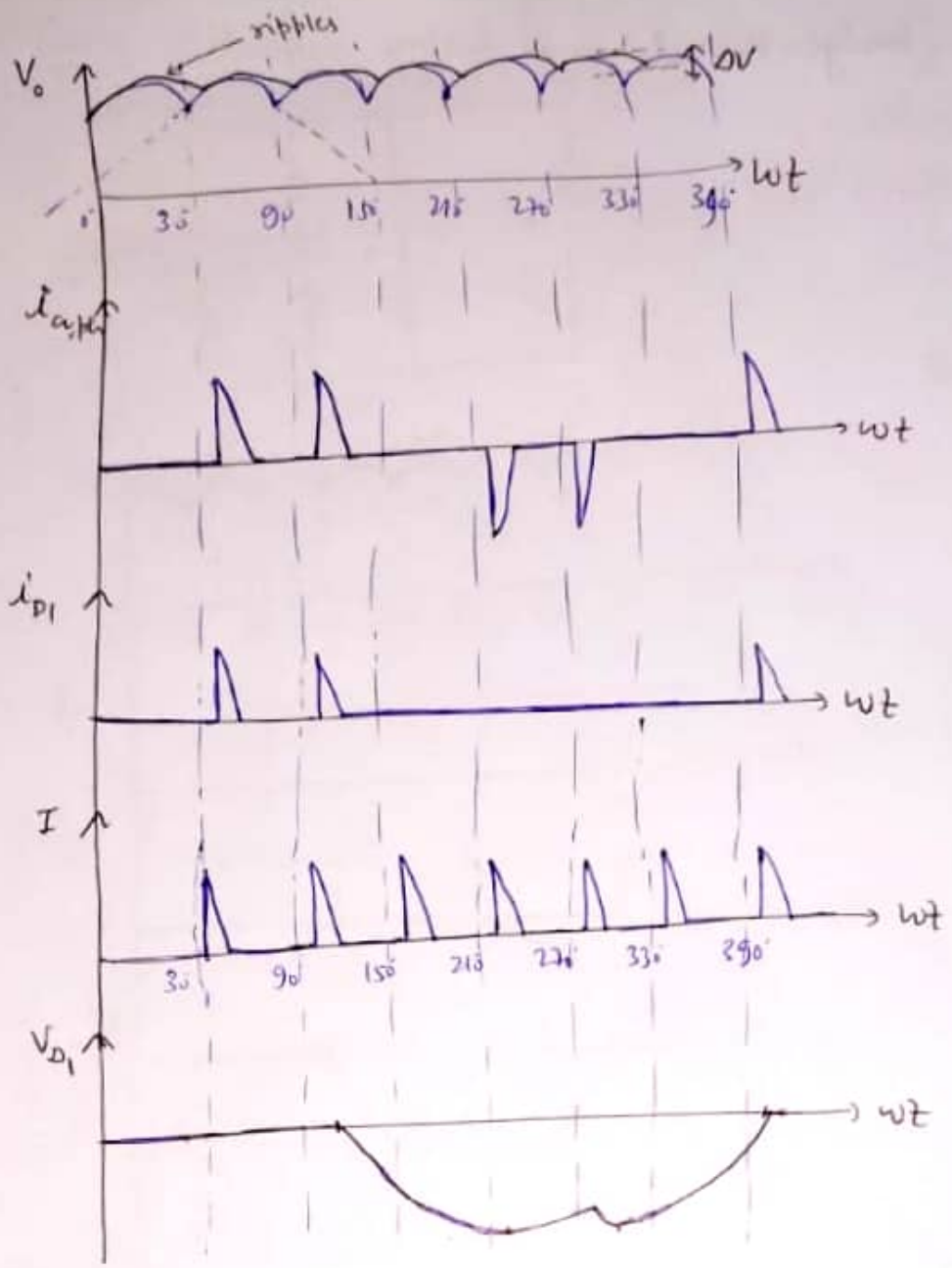


$I_c = C\frac{dV_c}{dt}$

$C = \frac{I_c}{\Delta v \cdot 6f}$

$= \frac{27.76}{10 \times 6 \times 50}$

$\boxed{C = 9.253\ mF}$



$30^\circ < \omega t < 90^\circ$ $\quad V_{D_1} = 0$

$210^\circ < \omega t < 330^\circ$ $\quad V_{D_1} \simeq -V_{ac}$

$$V_{D_1} + V_{D_4} = -V_o \quad \text{—} (1)$$

$$V_{D_3} + V_{D_5} = -V_o \quad \text{—} (2)$$

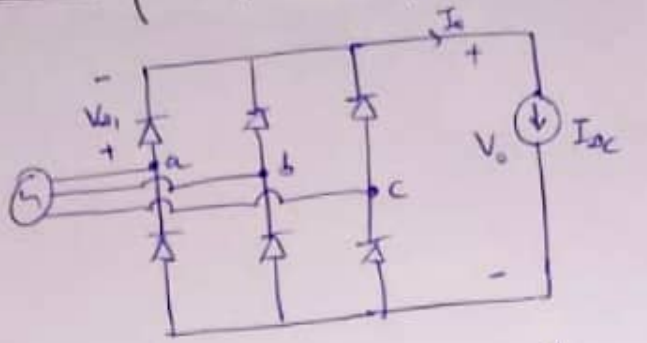
$$V_{D_5} + V_{D_6} = -V_o \quad \text{—} (3)$$

$$V_{D_1} - V_{D_3} = V_{ab} \quad \text{—} (4)$$

$$V_{D_3} - V_{D_5} = V_{bc} \quad \text{—} (5)$$

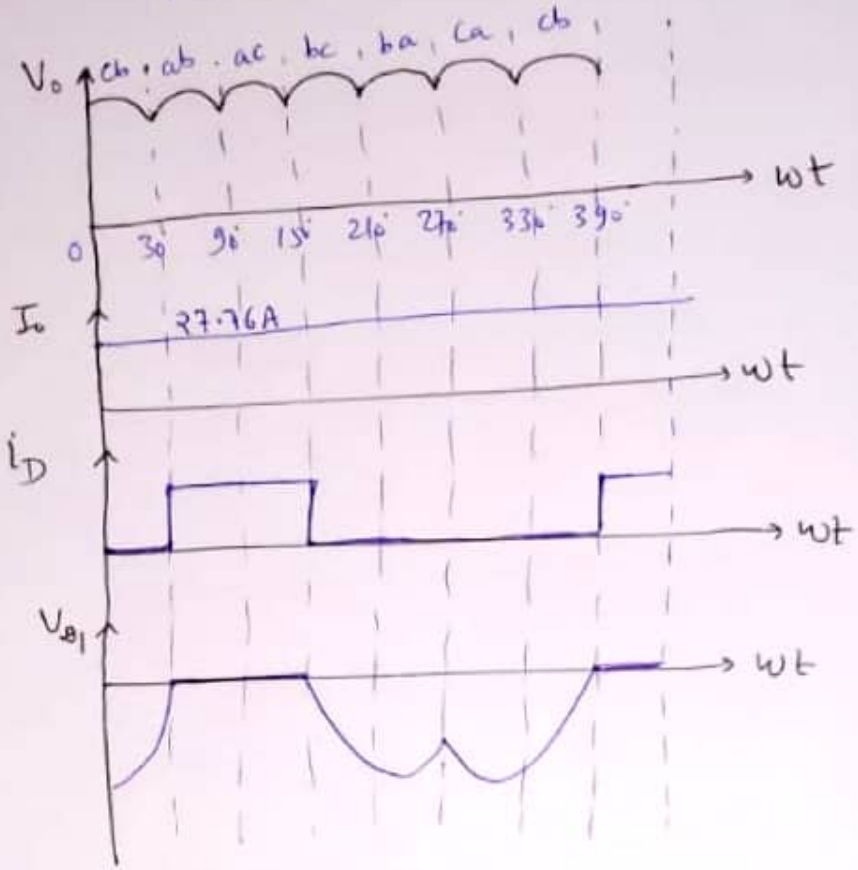
$$V_{D_1} - V_{D_5} = V_{ac} \quad \text{—} (6)$$

Case-c (Rectifier output current = Constant)



$V_s = 540.189$ V

$I_o = 27.76$ A (fixed)



$I_{D1} = I_o$ for $30 < \omega t < 150$

$I_{D1,avg} = \frac{I_o}{3} = 9.256$ A

$I_{D1,rms} = \frac{I_o}{\sqrt{3}} = 16.03$ A

$V_{th} = 1.04$ at $I = 20mA$

$R_{D,on} = 6 m\Omega$

↳ from datasheet

$P_{cond} = V_{th} \cdot I_{avg} + I_{rms}^2 \cdot R_{on}$

$= 1.04 \times 9.256 + (16.03)^2 \times 0.006$

$= 11.168$ W

$P_{sw} \simeq 0$

$P_{total\ bridge} = 6 \times 11.168 = \boxed{67.01\ W}$ Ans

$T_j = T_a + R_{thermal} \cdot P = \boxed{53.066^\circ C}$ Ans

$30 < \omega t < 90$	Diode ON $V_{D1} = 0$
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$210 < \omega t < 270$	$V_{D1} = V_b - V_a = -V_{ab}$
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$330 < \omega t < 390$	$V_{D1} = V_c - V_a = +V_{ca}$

- RMS line current from source = $\boxed{22.67\ A}$ Ans