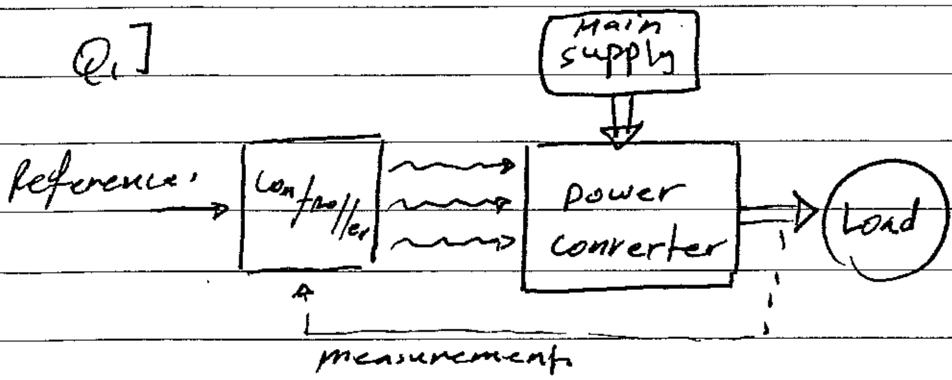
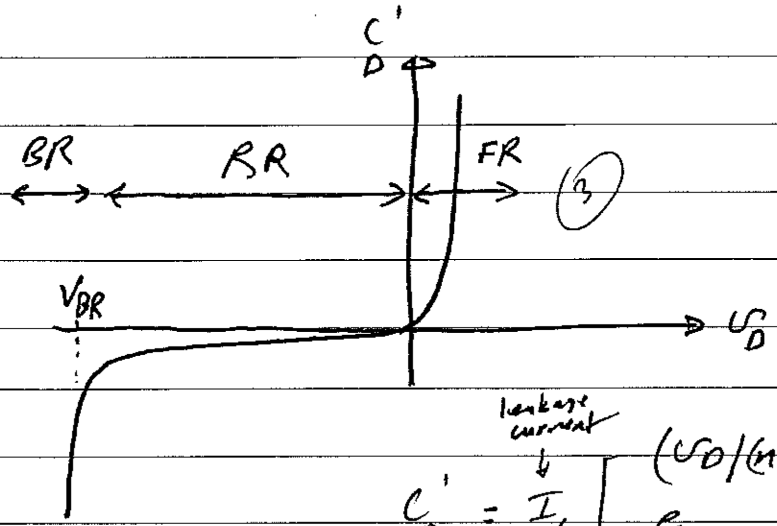
Q1]



(10)

Q2]



(3)

leakage current ↓

$$C_D' = I_s \left[e^{(v_D/(nV_T))} - 1 \right]$$ (3)

n: Ideality factor

V_T: Thermal voltage.

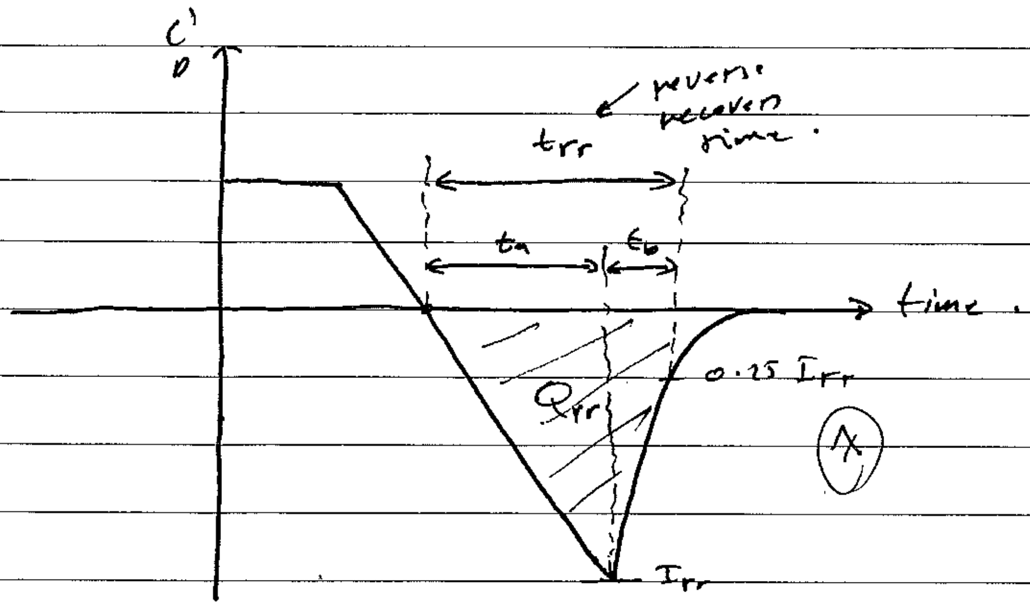
(N) Forward region → D conducts when $v_D > V_{TD}$, where V_{TD} is the threshold voltage or turn on voltage. ($C_D' \approx I_s e^{(v_D/nV_T)}$)

(N) Reverse region → D is non-conducting when $v_D < 0$ & $|v_D| > V_T$ ($C_D' \approx -I_s$)

(N) Breakdown region → v_D is high where $|v_D| > V_{BR}$ (Breakdown voltage)

C_D' increases rapidly.

Q2]



(b)

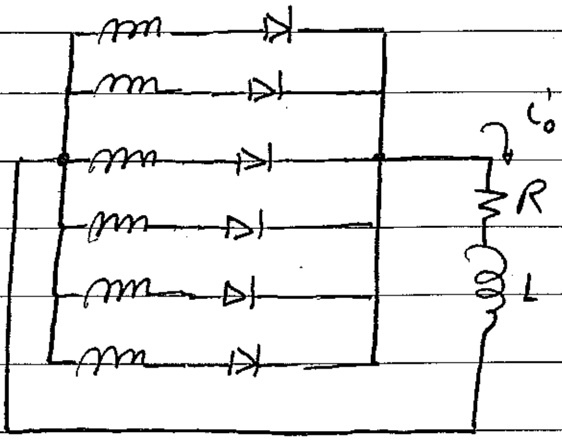
$$\frac{di}{dt} = \frac{I_{rr}}{t_a} \approx \frac{I_{rr}}{t_{rr}} \Rightarrow t_{rr} = \frac{I_{rr}}{(di/dt)} \quad \text{--- (1)}$$

$$I_{rr} \Rightarrow Q_{rr} = \frac{1}{2} t_{rr} I_{rr} \Rightarrow I_{rr} = \frac{2Q_{rr}}{t_{rr}} \quad \text{--- (2)}$$

$$(2) \to (1) \Rightarrow t_{rr} = \sqrt{\frac{2Q_{rr}}{(di/dt)}}$$

Q4]

a)



(X)

e) $RF = \frac{I_{AC}}{I_{DC}}$

$I_{DC} = \frac{0.955(170)}{200} = 0.81175\ A$

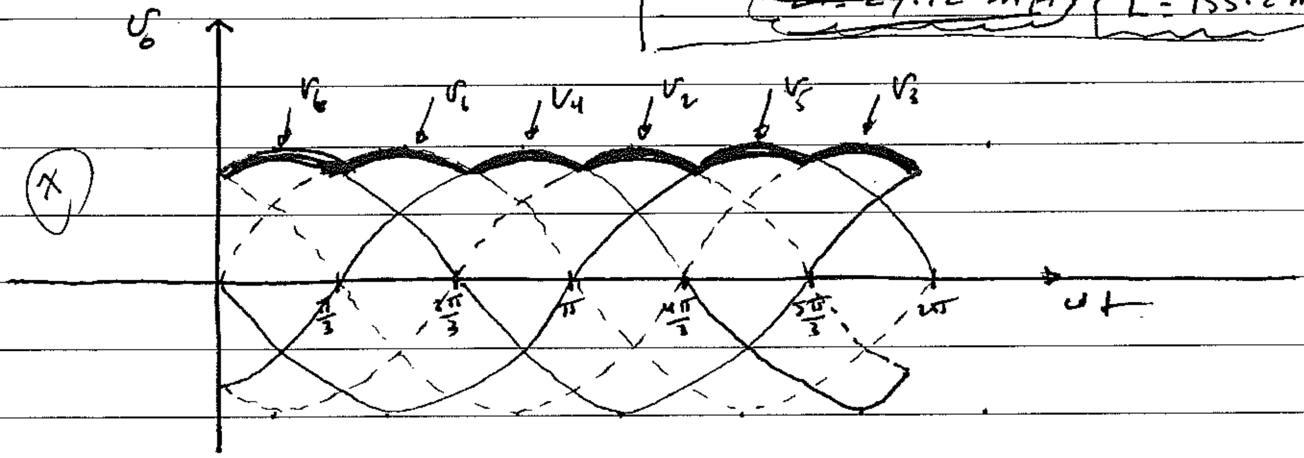
$I_{AC} = \frac{0.0546}{\sqrt{(200)^2 + (6(2\pi \times 60)L)^2}} \frac{170}{\sqrt{2}}$ (X)

$I_{AC} = \frac{6.563}{\sqrt{40000 + (2262L)^2}}$

$0.01 = \frac{6.563}{0.81175} \frac{1}{\sqrt{40000+(2262L)^2}}$

~~$L = 24.12\ mH$~~ $L = 155.2\ mH$

b)



(X)

c) $v_{o,6} = \frac{6}{\pi} \sin(\pi/6) \left(\frac{2}{35}\right) V_m \cos(6\omega t) = 0.0546 V_m \cos(6\omega t)$

(X) $i'_{o,1} = \frac{0.0546}{\sqrt{R^2 + (6\omega L)^2}} V_m \cos\left(6\omega t - \tan^{-1}\left(\frac{6\omega L}{R}\right)\right)$

d) $V_{DC} = \frac{6}{\pi} \sin(\pi/6) V_m = \frac{3}{\pi} V_m = 0.955\ V_m$

(X) $V_{RMS} = \sqrt{\frac{2(6)}{2\pi} \int_0^{\pi/6} V_m^2 \cos^2(\omega t)\, d(\omega t)} = \sqrt{\frac{6}{\pi} \frac{V_m^2}{2} \left(\frac{\pi}{6} + \frac{1}{2}\sin\left(\frac{\pi}{3}\right)\right)}$

$V_{RMS} = 0.956\, V_m$

$FF = \frac{V_{RMS}}{V_{DC}} = 1.00112$ $RF = \sqrt{FF^2 - 1} = 4.74\%$

1.00088 or 4.197% or

Q5] a) $v_a(t) = L\frac{di_a'}{dt}$

$$V_m \sin(\omega t)\,dt = L\,di_a'$$

$$\int_0^{\omega t} V_m \sin(\omega t)\,d(\omega t) = L\omega \int_{i_a'(0)}^{i_a'} di_a'$$

(4)

$$i_a' - i_a'(0) = \frac{V_m}{\omega L}\left[1 - \cos(\omega t)\right]$$

$$i_a' = -I - \frac{V_m}{\omega L}\left[\cos(\omega t) - 1\right]$$

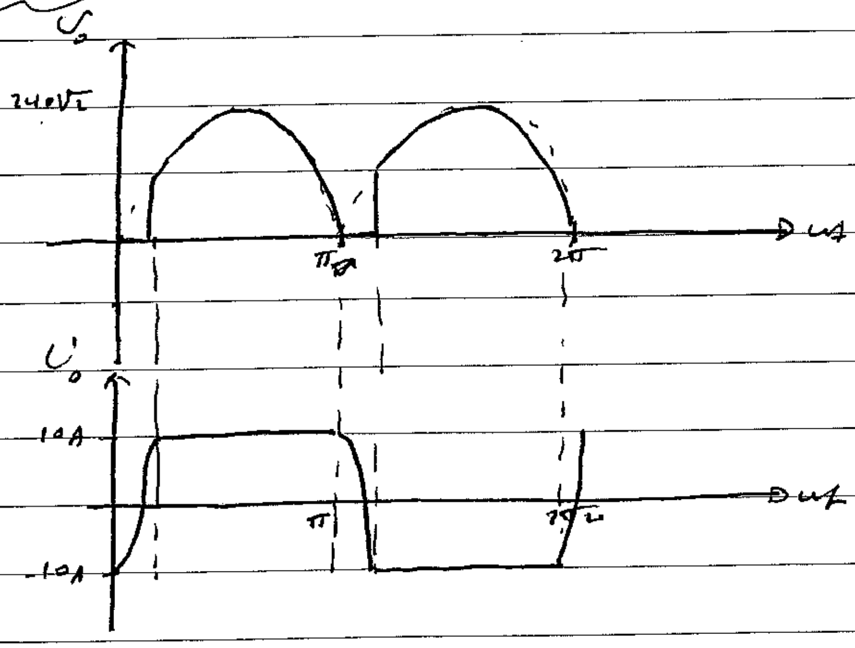
b) $i_a'(\mu) = I = -I - \frac{V_m}{\omega L}\left[\cos(\mu) - 1\right]$

$$\mu = \cos^{-1}\left[1 - \frac{2\omega L I}{V_m}\right]$$

(6)

$\mu = 13.5^\circ$

c)



(4)

d) $i_{a1}' = a_1 \cos(\omega t) + b_1 \sin(\omega t)$

$$a_1 = \frac{2}{\pi}\int_0^{\pi} 10\cos(\omega t)\,d(\omega t) = 0$$

$$b_1 = \frac{2}{\pi}\int_0^{\pi} 10\sin(\omega t)\,d(\omega t) = \frac{20}{\pi} \times 2 = \frac{40}{\pi}$$

(4)

$i_{a1}' = \frac{40}{\pi}\sin(\omega t)$ A. $= 12.732\sin(\omega t)$ A. $I_{a1} = \frac{40}{\pi}$ A