



12 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, fold over and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either ignore illegible answers or have it typed and the expense of typing charged to the candidate.
4. Write your answers in ink.
5. Begin each answer on a fresh page. Do all rough work in the answer book and cross it through.
6. No part of this book is to be torn out; it must be handed in complete.
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1	Student Number	2218705
2	Title of Examination Paper	Electrical Eng.
3	Module Code	ACDA 5001
4	Date and Time of Examination	9am 10-5-23
5	Examination Venue	Room 310
6	Seat Number	28
7	Number of Answer Books handed in	1

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

80/100 ~~He~~

FIGHT 2580

Q1)
i)Find V_{TH}

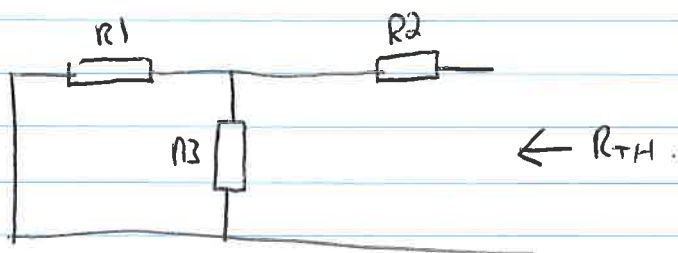
Open circuit load.

$$R_T = 10 + 25 = 35 \Omega \quad \checkmark$$

$$I = \frac{15}{35} = 0.43 A$$

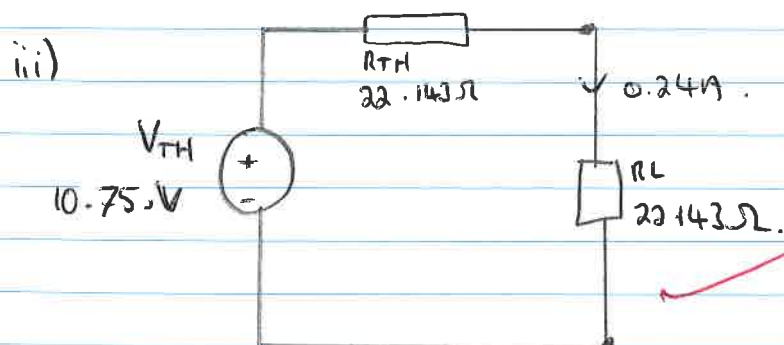
$$V_{TH} = I \times R_3 = 0.43 \times 25$$

$$V_{TH} = 10.75 V \quad \checkmark$$

Find R_{TH} 

$$R1 // R3 \quad \therefore R_{TH} = \left(\frac{1}{10} + \frac{1}{25} \right)^{-1} + 15$$

$$R_{TH} = 22.143 \Omega \quad \checkmark$$

ii) At max power transfer $R_{TH} = R_L = 22.143 \Omega$ 

$$i) I_L = \frac{V_{TH}}{R_{TH} + R_L} = \frac{10.75}{22.143 + 22.143} = 0.24 A \quad \checkmark$$

Ans

$$iv) P = I^2 R = 0.24^2 \times 22.143$$

$$= 1.28W$$

b)

Norton's theorem states that any two terminals in a network consisting of passive and active elements can be reduced to a single current source and parallel equivalent resistor. The short circuit current will be taken.

* c)

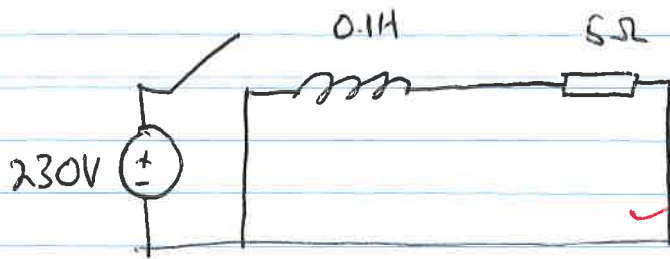
V_{CD} will equal V_{FD} as they're parallel.

$$I_T = \frac{V}{R} = \frac{9.8}{6000} = 1.63 \text{ mA}$$

$$V_{DC} = 9.8 - V_{FC}$$

$$V_{FC} = 1.63 \times 10^{-3} \times 7000 =$$

$$Q_1 \\ 3+2+2+3+2+3+2 = 17$$



$$I_0 = \frac{V}{R} = \frac{230}{5} = 46 \text{ A} \quad \checkmark$$

~~XXXXXXXXXXXX~~

$$i = I_0 (1 - e^{-Rt/L}) \quad \checkmark$$

$$i = 46 (1 - e^{-\frac{5 \times 0}{0.1}})$$

$$i = 46 (1 - 1) \quad \times$$

$$i = 0 \text{ A at } t = 0$$

$$\text{@ } t = 2\tau = 2 \times \frac{L}{R} = 0.04 \text{ s}$$

~~$$i = 46 (1 - e^{-\frac{R \cdot 2\tau}{L}})$$~~

~~$$i = 46 (1 - e^{-\frac{R \cdot 2(\frac{L}{R})}{L}})$$~~

~~$$i = 46 (1 - e^{-\frac{5 \times 2 \times (0.1/5)}{0.1}})$$~~

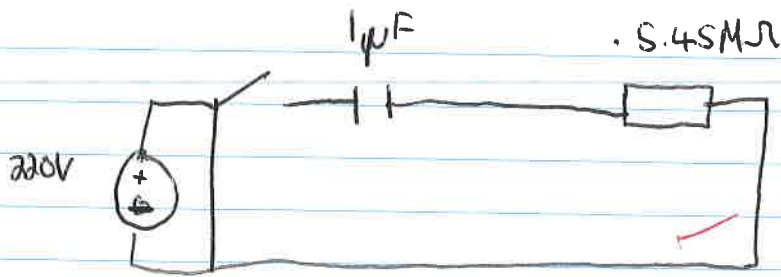
~~$$i = 46 (1 -$$~~

$$i = 46 (1 - e^{-\frac{5 \times 0.04}{0.1}})$$

$$i = 46 (1 - 0.135)$$

$$i = 39.79 \text{ A} \quad \times$$

b)



~~$$V_C = V(1 - e^{-t/\tau})$$~~

$$V_C = V(1 - e^{-t/\tau})$$

$$V_C = \frac{V}{100} \times 60 = \frac{220}{100} \times 60 = 132V \text{ @ } 60\%$$

∴

$$132 = 220 (1 - e^{-\frac{t}{1 \times 10^{-6}} \times 5.45 \times 10^6})$$

$$\frac{132}{220} = 1 - e^{-\frac{t}{5.45}}$$

$$0.6 = 1 - e^{-\frac{t}{5.45}}$$

$$e^{-\frac{t}{5.45}} = 1 - 0.6$$

take logs.

$$-\frac{t}{5.45} = \log(0.4)$$

$$t = \log(0.4) \times 5.45$$

$$t = 2.175$$

c) $V = 100 \sin \omega t$ $R = 10 \Omega$

$$V = \frac{100}{\sqrt{2}} = 70.71 \text{ V}$$

$$I = \frac{V}{R} = \frac{70.71}{10} = 7.071 \text{ A}$$

$$P = V \times I$$

$$P = 70.71 \times 7.071 = 499.99 \text{ W} \approx 500 \text{ W}$$

1+1+1+2+2+1+2+2+2

Q4)

$$V = 120 \sin(314t)$$

$$I = 10 \sin\left(314t + \frac{\pi}{6}\right)$$

$$V = \frac{120}{\sqrt{2}} = 84.85 \text{ V}$$

$$\omega = 314 = 2\pi f$$

$$I = \frac{10}{\sqrt{2}} = 7.07 \text{ A}$$

$$f = \frac{314}{2\pi} = 50 \text{ Hz}$$

$$\phi = \frac{\pi}{6} = 30^\circ$$

$$R = \frac{V}{I} = \frac{84.85}{7.07} = 12.00$$

in polar form

$$12 \angle -30^\circ$$

Cap voltage lags

$$12 \cos(-30) + 12 \sin(-30)$$

$$10.39 - j6$$

compare to $Z = R + jXC$

$$R = 10.39 \Omega \quad XC = 6 \Omega$$

$$C = \frac{1}{2\pi fXC} = \frac{1}{2\pi \times 50 \times 6}$$

$$C = 530.52 \mu F$$

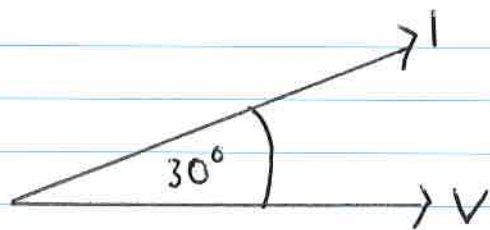
ii) $P = VI \cos \theta$

$$\theta = \tan^{-1} \left(\frac{XC}{R} \right) = \tan^{-1} \left(\frac{6}{10.39} \right) = 30$$

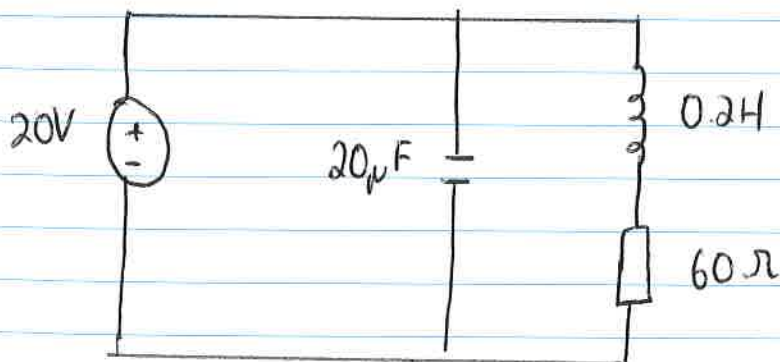
$$P = 84.85 \times 7.07 \times \cos(30)$$

$$P = 519.52 W$$

(ii)



b)



$$f_r = \frac{1}{2\pi N} \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

$$= \frac{1}{2\pi} \times \sqrt{\frac{1}{0.2 \times 20 \times 10^{-6}} - \frac{60^2}{0.2^2}}$$

$$= \frac{1}{2\pi} \times 400$$

$$f_r = 63.66 \text{ Hz}$$

ii)

$$R_D = \frac{L}{\pi C} = \frac{0.2}{60 \times 20 \times 10^{-6}} = 166.6 \Omega$$

iii)

$$I_r = \frac{V}{R_D} = \frac{20}{166.6} = 0.12 \text{ A}$$

iv)

$$Q = \frac{1}{R} \sqrt{\frac{L}{C}} = \frac{1}{60} \sqrt{\frac{0.2}{20 \mu\text{F}}}$$

$$Q = 1.6$$

Q4
3+3+2+2+4+2+2 = 18

Q5)

a)

$$V_L = 400V$$

$$R_p = 30$$

$$X_{Lp} = 40$$

i)

$$Z_p = \sqrt{R_p^2 + X_{Lp}^2} = \sqrt{30^2 + 40^2} = 50\Omega$$

in delta $V_L = V_P = 400V$.

$$I_p = \frac{V_P}{Z_p} = \frac{400}{50} = 8A$$

$$I_L = \sqrt{3} \times 8 = 13.86A$$

ii)

$$P = \sqrt{3} \times V_L \times I_L \cos \theta$$

$$\theta = \tan^{-1} \left(\frac{X_L}{R} \right) = \tan^{-1} \left(\frac{40}{30} \right) = 53.13^\circ$$

$$P = \sqrt{3} \times 400 \times 13.86 \times \cos(53.13)$$

$$P = 5761.51W$$

iii)

$$S = \sqrt{3} \times V_L \times I_L$$

$$= \sqrt{3} \times 400 \times 13.86$$

$$= 9602.49 \text{ kVA}$$

b)

$$Q = S \cos \theta$$

~~where~~

~~$$200000 = S \times \cos \theta (0.8)$$~~

~~$$S = \frac{200000}{\cos(0.8)} = 200.02 \text{ kW.}$$~~

$$200000 \div 0.8 = 250 \text{ kW.}$$

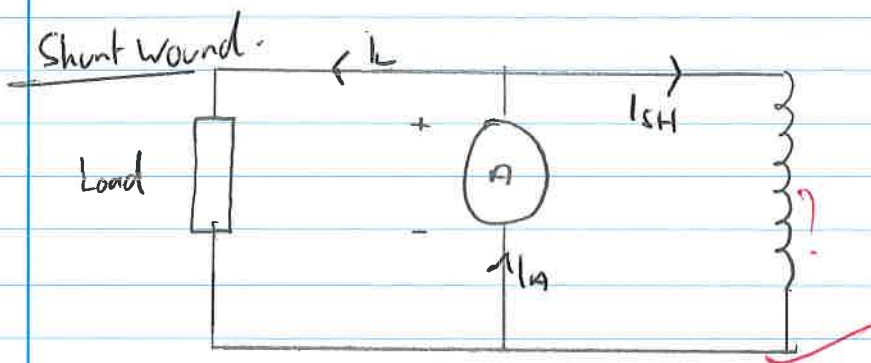
$$\therefore Q = 250000 - 200000 \\ = 50 \text{ kVA.}$$

$$Q5 \\ 1+2+2+2+1+2+3+2 = 15$$

Q6)

Generators

- Separately excited generators.
 - Self excited generators.
 - series wound.
 - shunt wound.
 - compound
 - long shunt.
 - short shunt
 - ~~cumulative~~ cumulative
 - differential
- self excited
- compound.

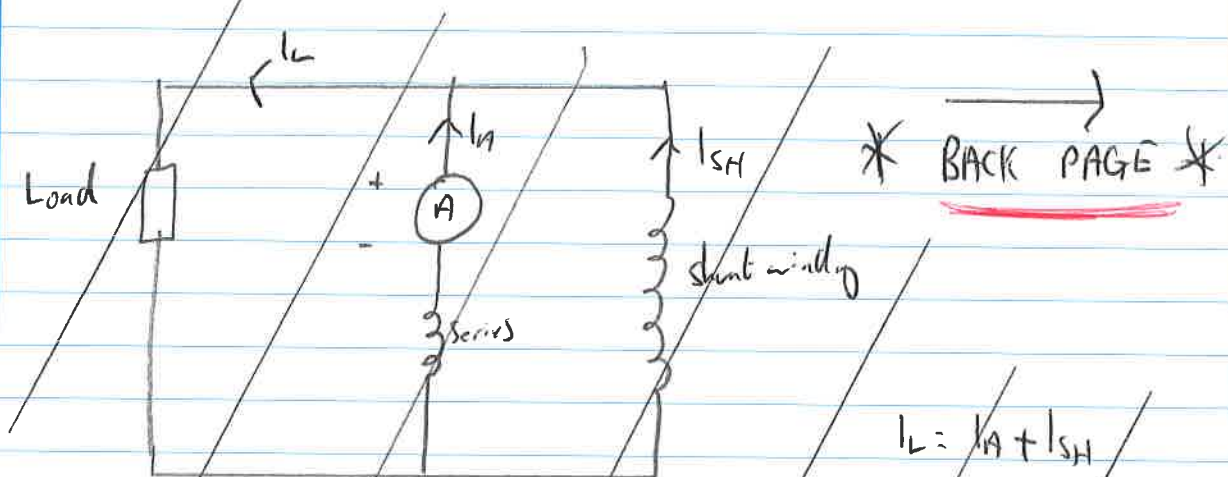


Field winding is parallel to armature. ✓

Field is much lower current and consists of many turns of thinner wire. ✓

$$I_L = I_A + I_{SH}$$

long shunt.



shunt winding is parallel to both armature and series winding

I_{SH} is much lower than I_A .

b)

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{12}{11}$$

$$240 \div 8 = V_2 = 30V$$

$$\frac{8}{1} = \frac{240}{V_2} = \frac{12}{3}$$

$$8 = \frac{240}{V_2}$$

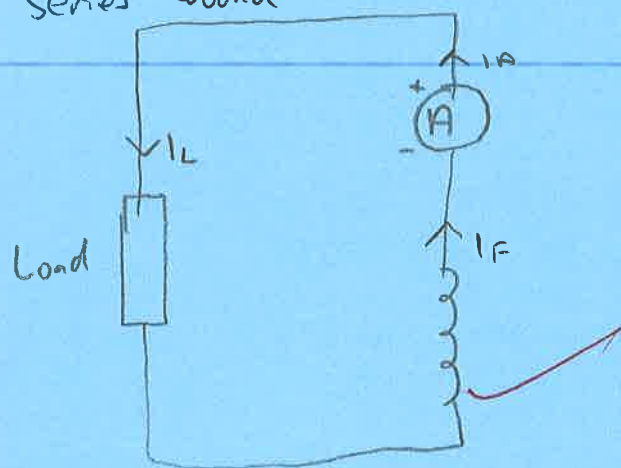
$$V_2 = \frac{V_1 \times N_1}{N_2}$$

$$V_2 = \frac{240}{8}$$

$$V_2 = 30V$$

Q6
5P 3P 5P 3

Q6) Series wound



- Fields in series with armature.
- $I_F = I_A = I_L$
- Fields consist of thick windings with fewer turns as current = Load.

3

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