



Prifysgol Cymru
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3 ✓

2 ✓

12 Pages

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right, for the invigilator to check, and seal down (using the label provided) to hide your name.
3. The answers must be legibly written. The Examiners can either read your script or have it typed and the expense of typing is charged to the candidate.
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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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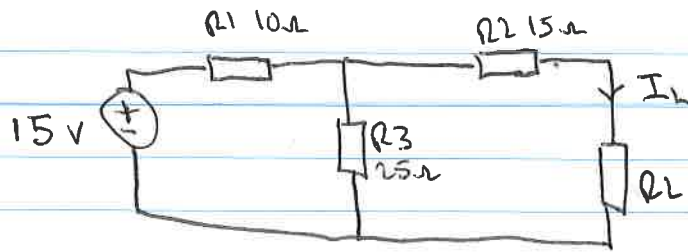
1	Student Number	2100805
2	Title of Examination Paper	Electrical and Electronic Engineering ACDA5001
3	Module Code	ACDA5001
4	Date and Time of Examination	10/05/23 9am - 11am
5	Examination Venue	Bay Campus - UWTSO
6	Seat Number	31
7	Number of Answer Books handed in	1

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

54/100 ~~40~~
five four

Q1.
a)



$$R_1 + R_3 = 35\Omega$$

$$I = \frac{15}{35} = 0.428\text{ A}$$

$$V_{TH} = 25 \times 0.428 = 10.7\text{ V}$$

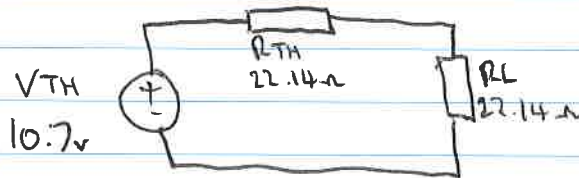
$$R_{TH} = \left(\frac{1}{\frac{1}{10} + \frac{1}{25}} \right) + 15 = 7.14 + 15 = 22.14\Omega$$

i) Load Current

$$I_L = \frac{I \times R_{TH}}{R_{TH} + R_L} = \frac{0.428 \times 22.14}{22.14 + 22.14} = 0.214\text{ A}$$

ii) The value of the load resistor at max power is equal to R_{TH}
 $\therefore R_L = 22.14\Omega$

iii)

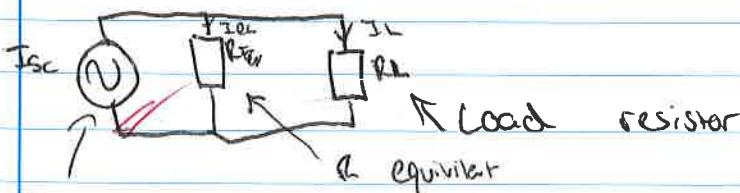


iv) $P_L = V_{TH} \times I_L$ ($V_{TH} = R_L$)

$$P_L = 10.7 \times 0.214$$

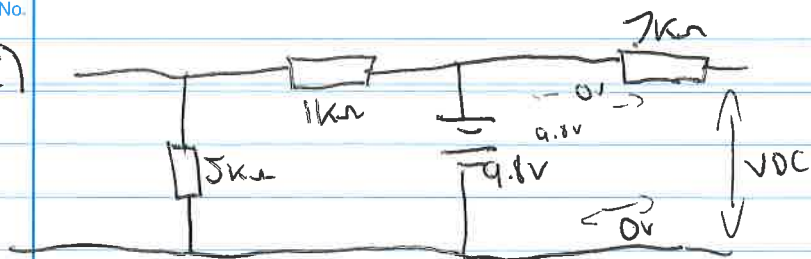
$$P_L = 2.29\text{ W}$$

b) Norton's theorem states that any ~~circuit~~ circuit can be simplified to a single current source and a single resistor, connected in parallel.



Short circuit current

Q1. C)



$$V = \frac{9.8 \times 7}{6+7} = 5.28V$$

Q1

 $3+2+1+2+3+2=13$

Q3
a)

$$V = 240$$

$$f = 50 \text{ Hz}$$

$$R = 200 \Omega$$

$$L = 318.3 \text{ mH}$$

i) inductive reactance of the coil

$$X_L = 2\pi fL$$

$$X_L = 2 \times \pi \times 50 \times (318.3 \times 10^{-3})$$

$$X_L = 99.996 \quad X_L = 100 \Omega$$

ii) impedance of the circuit

$$Z = \sqrt{R^2 + X_L^2}$$

$$Z = 223.6 \Omega$$

iii) Current in the circuit

$$I = \frac{V}{Z} = \frac{240}{223.6}$$

$$I = 1.07 \text{ A}$$

iv) Potential difference across each component

$$\text{For resistor: } 200 \times 1.07 = 214 \text{ V}$$

$$\text{For inductor: } 100 \times 1.07 = 107 \text{ V}$$

v) Circuit phase angle

$$\phi = \tan^{-1}\left(\frac{X_L}{R}\right)$$

$$\phi = \tan^{-1}\left(\frac{100}{200}\right)$$

$$\phi = 26.57^\circ$$

Q3 b) $I = 25 + j40 \text{ A}$

RMS:

$$I_m = 25$$

$$I_{rms} = \frac{25}{\sqrt{2}}$$

$$I_{rms} = 17.68 \text{ A}$$

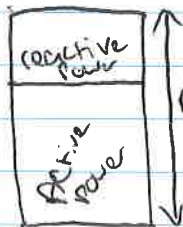
$$\text{Phase} = 40^\circ$$

$$\frac{40}{\sqrt{2}} \angle 40^\circ$$

Q3 C) Apparent power is the total power, this is Active power + reactive power.

Active power is the usable power, this is "useful power" as it can be used to power other things.

The rest of the power is reactive power, this is power that cannot be used and is considered to be "wasted power".



Apparent Power

• Active power is useable, whereas reactive power is not.

• Apparent power is split into active and reactive power.

Q3
 $2 + 2 + 2 + 4 + 2 + 3 = 15$

Q4 a) $V = 120 \sin(314t)$ and $I = 10 \sin(314t + \pi/6)$

i) $V_m = 120V$ ✓ $\omega = 314$ ✓
 $I_m = 10A$ ✓ $C = 0.265 \mu F$ ✓
 $\phi = \pi/6 = 30^\circ$ ✓
 $f = 50 \text{ Hz}$ ✓

$X_c = \frac{1}{2\pi f C}$ Rearrange to get $C = \frac{1}{2\pi f X_c}$ ✓

$\omega = 2\pi f$ ✓

$314 = 2 \times \pi \times f \therefore f = 50 \text{ Hz}$ ✓

$I_m = \frac{V_m}{X_c}$ ✓

$X_c = \frac{V_m}{I_m}$ ✓

$X_c = 12 \Omega$ ✓

$C = \frac{1}{2\pi f X_c} = \frac{1}{2 \times \pi \times 50 \times 12}$ ✓

$C = 2.6526 \times 10^{-4}$

$C = 0.265 \mu F$ ✓

$Z = \frac{V}{I} = \frac{V_m}{I_m} = R$ ✓

$R = \frac{120}{10} = 12 \Omega$

$R = 12 \Omega$

$C = 0.265 \mu F$ ✓

ii) Power Consumed

$\cos \phi = R/Z$

$\cos \phi = 12/12 = 1$

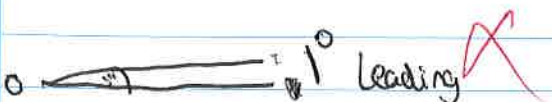
$P = VI \cos \phi$ ✓

$P = 120 \times 10 \times \cos(1)$

$P = 1199.817 W$

$P = 1.2 kW$ ✓

iii) Phasor diagram



2 ✓

1 ✓

6

3

Q5 a) ~~$V_L = 400V$, neglect losses + perfect conditions $\therefore V_P = 400V$~~

i) $V_L = 400V$ $V_L = 34.64V$

$R_L = 30\Omega$ $I_L = 6.32A$

$X_L = 40\Omega$

$I_P = \frac{400}{30} = 13.3A$

~~V_L~~

$I_L = \sqrt{3} I_P$

$I_L = \sqrt{3} \times 13.3$

$I_L = 6.32A$

$V_R = \sqrt{3} V_P$

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

$V_L = 34.64V$

ii) Output power

$P = VI \cos \phi$

$\cos \phi = \frac{I_P}{I_L}$

$\cos \phi = \cos(2.1097)$

$\phi = 1^\circ$

34.64

$400 \times 6.32 \times \cos(2.1097)$

$P = 2526.29W$ $218.71W$

$P = 2.526kW$ $218W$

iii) $KVA = 400 \times 6.32 \times \cos(2.1097)$

$KVA = 2526 = 2.5KVA$

$KVA = V \times I \times \cos \phi$

Q5 b) $200kVA$ $PF 0.8$

rated power $= 200 \times 0.8 = 160kW$

reactive power $=$ apparent power $-$ active power

$Q = VI \sin \phi = 151 \cos \phi$

$= 160kW$

Q4 6)

$$L = 0.2 \text{ H} \quad R = 60 \Omega \quad C = 20 \mu\text{F} \quad V = 20 \text{ V}$$

i) resonant frequency

$$f_r = \frac{1}{2\pi \sqrt{LC}}$$

$$f_r = \frac{1}{2\pi \times \sqrt{0.2 \text{ H}^2 \times (20 \times 10^{-6})^2}}$$

$$f_r = 39788.73 \text{ Hz}$$

$$f_r = 39.8 \text{ KHz}$$

ii) Dynamic resistance

$$R_D = \frac{V}{I_r} = \frac{L}{RC}$$

$$R_D = \frac{L}{RC} = \frac{0.2}{60 \times 20 \times 10^{-6}}$$

$$R_D = 166.666 \Omega$$

$$R_D = 166.7 \Omega$$

iii) Current at resonance

$$I_r = \frac{V}{R_D}$$

$$I_r = \frac{20}{166.67}$$

$$I_r = 0.12 \text{ A}$$

iv) Circuit Q factor at resonance

$$Q = \frac{1}{R} \sqrt{\frac{L}{C}} = \frac{1}{20} \sqrt{\frac{0.2}{20 \times 10^{-6}}}$$

$$Q = 1.6667$$

Q4

$$2+1+2+2 = 7$$

7

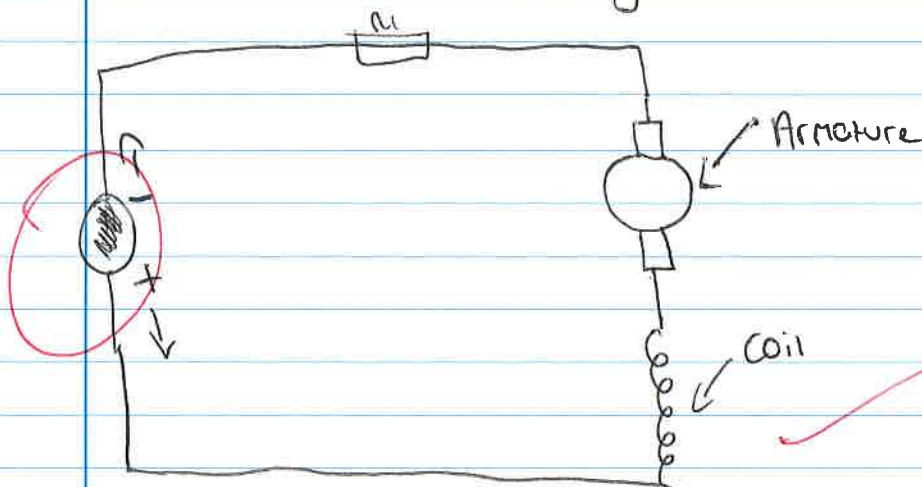
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Q6

a) Types of DC generators

- Separately excited generator ✓
- Self excited generator ✓
- Shunt generator ✓
- Series generator ✓
- Compound generator ✓
 - Short Shunt compound generator ✓
 - Long Shunt Compound generator ✓
 - Cumulative Compound generator ✓
 - Differential Compound generator. ✓

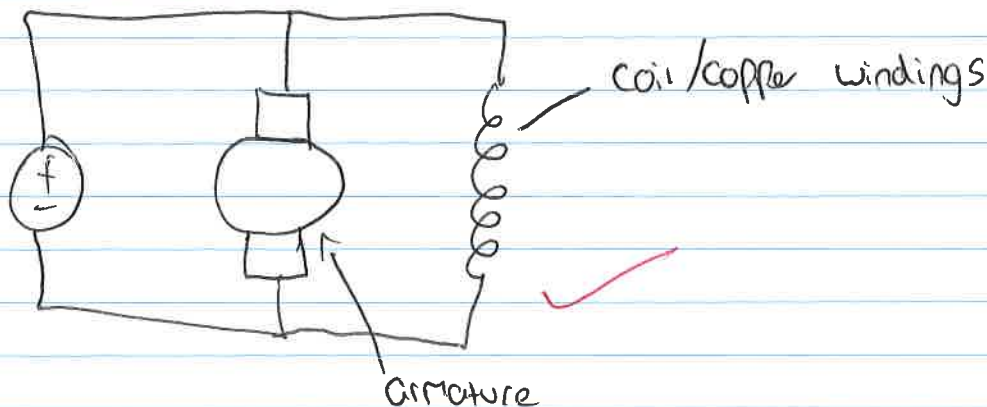
Self excited Series generator



In a Self excited Series generator, the armature and the coil/copper winding is located in series with one another. As a current flows through the coil, it induces an electromagnetic field, this then causes the magnets within the armature to spin, brushes are then used to generate / convert the rotational force into electrical energy. The coil and armature are in the same circuit as it is a 'Self excited' Series generator. EMF generated by the coil in series with the armature.



Self excited Shunt generator



In a Self excited Shunt generator, the armature and coil are parallel to one another. This functions in a similar way where the coil induces an electromagnetic field. When a current flows through it, the armature magnets then cause it to rotate which is then converted into electrical energy. The power supply is in the same circuit and the coil and armature are in the same circuit as this is a 'Self excited' shunt generator. EMF generated by the coil is parallel to the armature.

b) 8:1 ratio 3A 240V

$$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$$

$$\frac{N_1}{N_2} = \frac{8}{1}$$

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

$$240/8 = V_2$$

$$V_2 = 30V$$

The Secondary voltage is 30V

26
5+3+3+1+4=16