

PRIFYSGOL CYMRU

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UNIVERSITY OF WALES

Trinity Saint David

Examination Answer Book

12 Pages

Instructions to candidates

1. Please give the information requested in the boxes below.
2. Enter your name in the space provided to the right and seal to hide your name.
3. The answers must be **legibly** written. The Examiners can either ignore illegible script 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.
7. If more books than one are used, fasten them together using the tags available from the invigilator(s).
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1	Student Number	
2	Title of Examination Paper	Electrical + Electronic Principles
3	Module Code	SGE4000
4	Date and Time of Examination	29/4/24 09:30
5	Examination Venue	Coleg Sir Gar
6	Seat Number	

7	Number of Answer Books handed in	
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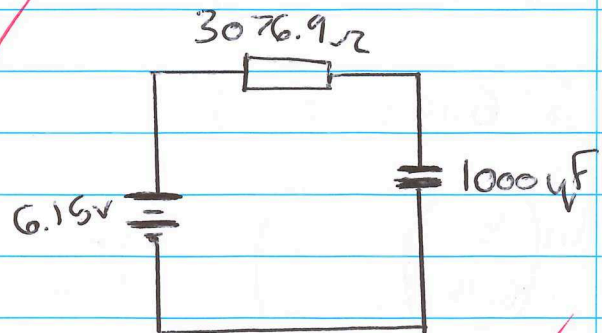
Surname Jones (Block Capitals) Forename(s) ~~GRA~~ Geron stys

Question 1 10V, 5k Ω , 8k Ω , 1000 μ F

a) $\frac{(R_1 \times R_2)}{(R_1 + R_2)} = R_k$

$$\frac{(5k \times 8k)}{(5k + 8k)} = \underline{3076.9 \Omega}$$

Voltage divider



$$\frac{(R_2)}{(R_1 + R_2)} \times V = V_s$$

$$\frac{8k}{(5k + 8k)} \times 10 = 6.15V$$

b) time constant

i) $\tau = RC$

$$\tau = 3076.9 \times (1000 \times 10^{-6})$$
$$= \underline{3 \text{ seconds}}$$

ii) $5\tau = 3 \times 5$

$$= \underline{15 \text{ seconds}}$$

c)
i) Charging

0.186

$$V_c = V_s (1 - e^{-\frac{t}{RC}})$$

$$5 = 6.15 (1 - e^{-\frac{t}{RC}})$$

$$\ln\left(\frac{5}{6.15} + 1\right) = \frac{-t}{3}$$

$$1.68 = \frac{-t}{3}$$

$$t = 1.68 \times 3$$
$$= \underline{\underline{5.04 \text{ Seconds}}}$$

ii) Discharging

$$V_c = V_s (e^{-\frac{t}{RC}})$$

$$5 = 6.15 (e^{-\frac{t}{3}})$$

$$\ln\left(\frac{5}{6.15}\right) = \frac{-t}{3}$$

$$0.207 = \frac{-t}{3}$$

$$t = 0.207 \times 3$$

$$t = \underline{\underline{0.621 \text{ Seconds}}}$$

2

2

4

d)
i) time constant

$$\tau = \frac{L}{R} \quad \tau = \frac{(250 \times 10^{-3})}{400}$$

$$\tau = \underline{\underline{0.625 \text{ mSeconds}}}$$

2

ii) Steady State Current

$$I_m = \frac{V}{R} = \frac{9}{400} = \underline{\underline{22.5 \text{ mA}}}$$

2

iii) 20mA and 10mA discharging

20mA

10mA

$$i = I(e^{-\frac{Rt}{L}})$$

$$i = I(e^{-\frac{t}{\tau}})$$

$$20 \text{ mA} = 22.5 \text{ mA} (e^{-\frac{Rt}{250 \text{ mH}}}) \quad 10 \text{ mA} = 22.5 \text{ mA} (e^{-\frac{t}{0.625 \text{ m}}})$$

$$\ln\left(\frac{20 \text{ mA}}{22.5 \text{ mA}}\right) = \frac{-Rt}{250 \text{ mH}}$$

$$\ln\left(\frac{10 \text{ mA}}{22.5 \text{ mA}}\right) = \frac{-t}{0.625 \text{ m}}$$

$$0.118 = \frac{-Rt}{250 \text{ mH} \times 0.625 \text{ m}}$$

$$0.81 = \frac{-t}{0.625 \text{ m}}$$

$$Rt = 0.118 \times 0.625 \text{ m}$$

$$t = 0.81 \times (0.625 \times 10^{-3})$$

$$t = 0.074 \text{ mSeconds}$$

$$= \underline{\underline{0.506 \text{ mSeconds}}}$$

$$\underline{\underline{0.074 \text{ mSeconds}}}$$

12

Q3) $z = (8 + j12)$, $50V$, $2kHz$, 30°

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

$$I = \frac{50/30}{14.4/56.3}$$

$$I = 3.56 \angle -26.3^\circ$$

$$\sqrt{8^2 + 12^2} = 14.4$$

$$\tan^{-1}\left(\frac{12}{8}\right) = 56.3$$

ii) Active, Apparent, Reactive

$$S = VI$$

$$= 50/30 \times 3.56 \angle -26.3^\circ$$

$$= 1780 \text{ VA}$$

$$P = VI \cos \theta$$

$$= 1780 \cos(56.3^\circ)$$

$$= 987.6 \text{ W}$$

$$Q = VI \sin \theta$$

$$= 1780 \sin(56.3^\circ)$$

$$= 1480.88 \text{ VAR}$$

iii) $\cos(30^\circ) = 0.966$ lagging

$$\cos^{-1}(0.966) = 15^\circ$$

$$Q_c = \frac{P}{\cos \theta} \tan \theta$$

$$= \frac{987}{0.966} \tan(15^\circ)$$

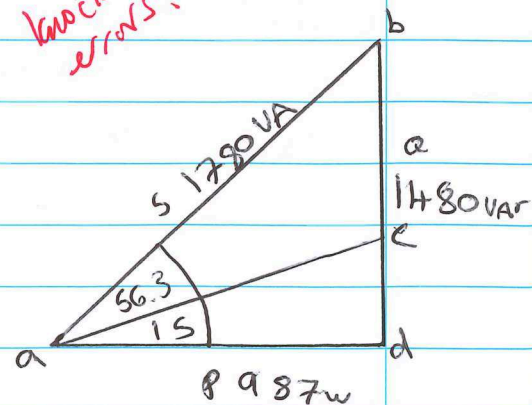
$$= 264.5$$

$$X_c = \frac{Q_c}{I}$$

$$= \frac{264.5}{50}$$

$$= 5.29 \Omega$$

method of
avoiding
errors.



2.22

1.49

15

iv) $X_C = \frac{1}{2\pi fC}$

$$C = \frac{1}{2\pi f X_C}$$

$$= \frac{1}{2\pi \times 2000 \times 5.29} \quad \times$$

$$= \underline{\underline{15 \mu F}} \quad \times$$

1

11

b) Delta balanced, 21 kw, 0.7 lagging, 415 V, 50 Hz

i) $\frac{21}{3} = 7 \text{ kW}$

$\cos^{-1}(0.7) = 45.57^\circ$

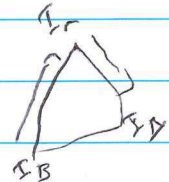
$I_{ph} = \frac{7000}{0.7}$
 $= 10 \text{ kW}$

$I = \frac{10000}{415}$ $I = 24.01 \text{ A}$

$I_R = 24.1 \angle -45.57^\circ \text{ A}$
 $= (16.87 - j17.21)$

$I_R - I_B$
 $I_Y - I_R$
 $I_B - I_Y$

$I_Y = 24.1 \angle -165.57^\circ \text{ A}$
 $= (-23.34 - j6)$



$I_B = 24.1 \angle 74.43^\circ \text{ A}$
 $= (6.47 + j23.22)$

ii) Line Current

$I_R = I_R - I_B$
 $= (16.87 - j17.21) - (6.47 + j23.22)$
 $= (10.4 - j40.43)$
 $= 41.75 \angle -75.57^\circ \text{ A}$

$I_Y = I_Y - I_R$
 $= (-23.34 - j6) - (16.87 - j17.21)$
 $= (-40.21 + j11.21)$
 $= 41.74 \angle 164.42^\circ \text{ A}$

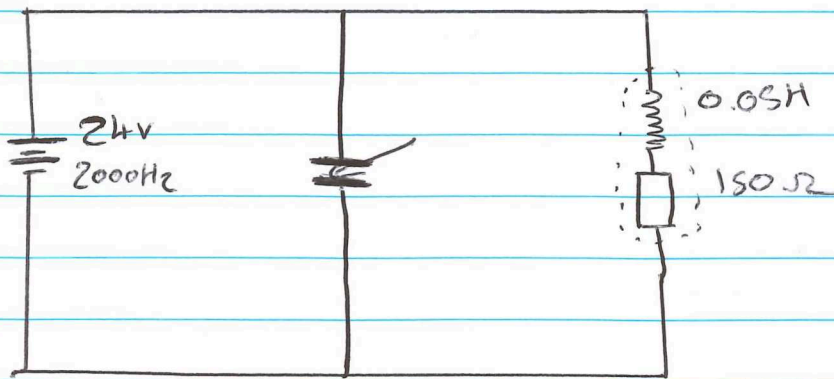
$I_B = I_B - I_Y$
 $= (6.47 + j23.22) - (-23.34 - j6)$
 $= (29.81 + j29.22)$
 $= 41.74 \angle 44.4^\circ \text{ A}$

3

2

5

Q4) $0.05H$, 150Ω , $24V$, $2000Hz$



$$a) f_r = \frac{1}{2\pi} \sqrt{\left(\frac{1}{LC} - \frac{R^2}{L^2}\right)}$$

$$C \leq \frac{1}{0.05 \left((2\pi \cdot 2000)^2 + \frac{150^2}{0.05^2} \right)}$$

$$(2\pi f_r)^2 = \frac{1}{LC} - \frac{R^2}{L^2}$$

$$C = 0.119 \mu F$$

$$(2\pi f_r)^2 + \frac{R^2}{L^2} = \frac{1}{LC}$$

$$C = \frac{1}{L \left[(2\pi f_r)^2 + \frac{R^2}{L^2} \right]}$$

$$b) R_D \leq \frac{L}{C R}$$

$$= \frac{0.05}{150 \times 0.119 \times 10^{-6}}$$

$$= 2.8 \Omega$$

$\frac{1}{2}$

$\frac{1}{2}$

c) Supply Current

$$I_r = \frac{V}{R_D}$$
$$= \frac{24}{2.8}$$
$$= 8.57 \text{ A}$$

1/2

d) Q-factor

$$Q = \frac{2\pi f_r L}{R}$$
$$= \frac{2\pi 2000 \times 0.05}{150}$$
$$= 4.19$$

1

1/2