

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 bring 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	MA225336
2	Title of Examination Paper	Electrical Electronic Principles
3	Module Code	56-EE400
4	Date and Time of Examination	29/04/2023 9:30 - 11:30
5	Examination Venue	College Sir Gaur
6	Seat Number	

7	Number of Answer Books handed in	9
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[illegible]

Please complete this section and SEAL before the examination starts.

Surname Alvord - Bailey (Block Capitals) Forename(s) Morgan

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remove
strip, fold as
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PATENT PENDING
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407

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2

1

 $\frac{1}{2}$

光華

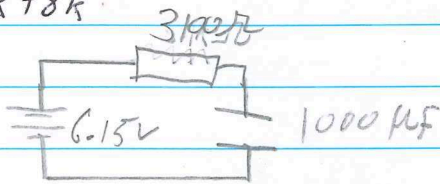
Q1

a) From circuit reduction resistors ~~are~~ in parallel -

$$\frac{(5k \times 8k)}{(5k + 8k)} = \frac{40k}{13k} = 3.1k3004 \Omega$$

now V_s form V divider

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



b) i) $\tau = CR = 10\mu \times 3.1k = 0.31s$ method ok
 ii) $5\tau = 5 \times 0.31s = 1.55s$ method ok

c) i) t_1 at $5V$ $V = V_s(1 - e^{-t/CR})$
 $5 = 6.15(1 - e^{-t/0.31})$
 $\frac{5}{6.15} - 1 = -e^{-t/0.31}$
 $\ln 0.813 = \frac{-t}{0.31}$
 $t = 0.31 \times 0.207 = 0.064175s$ method ok, knock an error

ii) $V_1 = V_s e^{-t/CR}$
 $\frac{5}{6.15} = e^{-t/0.31}$
 $\frac{-t}{0.31} = \ln\left(\frac{5}{6.15}\right) = -0.21$
 $\therefore t = 0.21 \times 0.31 = 0.0651s$ as above

(3.1k)

$$d) i) \tau = \frac{L}{R} = \frac{0.25}{400} = 6.25 \times 10^{-4} = 0.63 \text{ ms}$$

$$ii) I = \frac{V}{R} = \frac{9}{400} = 22.5 \text{ mA}$$

$$iii) I \text{ at } 20 \text{ mA}$$

$$I = I_{\text{max}} e^{-Rt/L}$$

$$\frac{20}{22.5} = e^{-\frac{400t}{0.25}}$$

$$\frac{20}{22.5} = e^{-1600t} \quad \therefore 400t = 0.8$$

$$t = \frac{-0.223}{-400} = 0.058 \text{ ms}$$

2

2

1/2

4 1/2

Q2

$$\begin{aligned}
 a) \quad Z_1 Z_2 &= (6 - j4) \times (3 + j5) \\
 &= 18 + j35 - j12 - j^2 20 = 38 - j23 \\
 Z_1 + Z_2 &= 6 - j4 + 3 + j5 \\
 &= 9 + j1
 \end{aligned}$$

$$\left(\frac{Z_1 Z_2}{Z_1 + Z_2} \right) = \frac{38 - j23}{9 + j1} \times \frac{9 + j1}{9 + j1}$$

$$= \frac{342 + 4 - j108 - j207 + j^2 23}{81 - j207 + j^2 9 - j^2 23}$$

$$= \frac{319 - j315}{58 - j306} = \underline{\underline{5.5 - j1.03}}$$

method OK

10

$$\begin{aligned}
 \left(\frac{Z_1 \times Z_2}{Z_1 + Z_2} \right) + Z_3 &= 5.5 - j1.03 + 1.61 - j0.51 \\
 &= \underline{\underline{6.71 - j1.54}}
 \end{aligned}$$

method OK

$$6) \quad V = 120V \quad L = 0.6H \quad R = 75\Omega$$

$$i) \quad X_L = 2\pi fL = 2\pi(60)(0.6) = 226.195\Omega$$

$$Z = R + jX_L = (75 + j226.195)\Omega$$

$$\text{or } 226.195 / 71.66^\circ \Omega$$

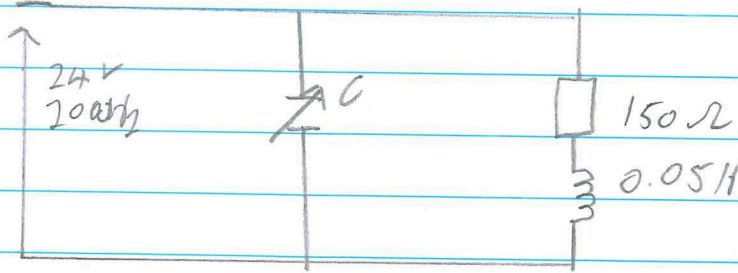
2

$$\begin{aligned}
 \theta &= \tan^{-1} \frac{X_L}{R} \\
 &= \frac{226.195}{75} \\
 &= 71.66
 \end{aligned}$$

(12)

Q4 -

a)



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

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

$$\therefore C = \frac{1}{L \left[(2\pi f_r)^2 + \frac{R^2}{L^2} \right]} = \frac{1}{0.05 \left[(2\pi \cdot 2000)^2 + \frac{150^2}{0.05^2} \right]}$$

$$= \frac{1}{0.05 (157.08 \times 10^6 + 9 \times 10^6)}$$

$$= 119.83 \text{ nF}$$

b) $R_D = \frac{L}{CR} = \frac{0.05}{157.08 \times 10^{-9} \times 150}$

$$= \frac{0.05}{2.3562 \times 10^{-8}}$$

$$= 2121.72 \Omega$$

c) Supply current at resonance 8.63

$$I_r = \frac{V}{R_D} = \frac{24}{2121.72} = 11.31 \text{ mA}$$

d) $R_r = \frac{\omega_r L}{R} = \frac{(2\pi \times 2000) \times 0.05}{150} = 4.188$

e) Bandwidth $= f_2 - f_1 = \frac{2000}{4.188} = 477.55 \text{ Hz}$

$$f) f_r = \sqrt{f_1 f_2}$$

$$f_1 f_2 = f_r^2 = 2000^2 = 4 \times 10^6 \text{ Hz}$$

$$f_1 = \frac{f_r^2}{f_2}$$

$$13 \text{ W} = f_2 - f_1 = f_2 - \frac{f_r^2}{f_2}$$

$$= 477.55 \quad f_2$$

$$477.55 = f_2^2 - 4 \times 10^6$$

$$f_2^2 - 477.55 f_2 - 4 \times 10^6 = 0$$

$$\frac{477.55 \pm \sqrt{(477.55)^2 - 4(-4 \times 10^6)}}{2}$$

$$= 2252.98 \text{ Hz}$$

$$f_1 = \frac{f_r^2}{f_2} = \frac{4 \times 10^6}{2252.98} = 1775.43 \text{ Hz}$$

$$g) Z \text{ at } -3 \text{ dB} = \frac{Z_r}{\sqrt{2}}$$

$$= \frac{2252.98}{\sqrt{2}}$$

$$= 1581.72$$

$$= 1966.97 \Omega$$

