

PRIFYSGOL CYMRU

Y Drindod Dewi Sant

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).
8. **Every book must be handed in. In no circumstances may answer books, used or unused, be taken out of the examination venue.**

1	Student Number	
2	Title of Examination Paper	Electrical 3 Electronic principles
3	Module Code	SGEE 4000
4	Date and Time of Examination	9.30 29/4/24
5	Examination Venue	G43 Coley Sir Gar.
6	Seat Number	

7	Number of Answer Books handed in	
---	----------------------------------	--

[illegible]

Complete
section,
remove
strip, fold as
indicated
and SEAL

Please complete this section and SEAL before the examination starts.

Surname Summeß (Block Capitals) Forename(s) James

PATENT PENDING
INTECSEE®

(Gweler yr ochr arall am y fersiwn Cymraeg)

67%

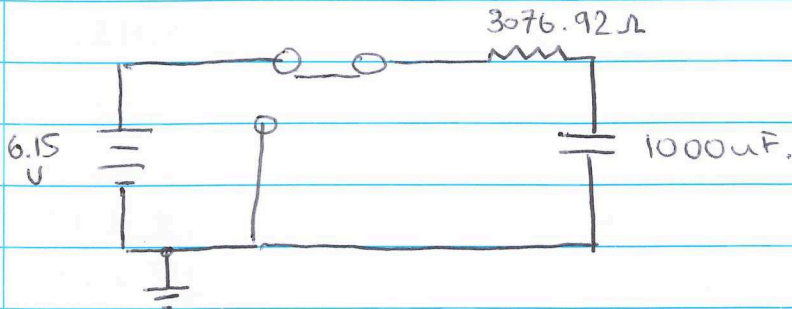
13

Q1

(a) Equivalent Voltage Equivalent Resistance.

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

$$\frac{5k\Omega \times 8k\Omega}{5k\Omega + 8k\Omega} = 3076.92\Omega$$



(b) $\tau = RC = 3076.92 \times 1000 \times 10^{-6} = 3.07s$

(ii) $5\tau = \text{Fully charged} \quad 5 \times 3.07 = 15.35s$

(c) $5V = 6.15V (1 - e^{-\frac{t}{3.07}})$
 $-3.07 \ln(1 - \frac{5}{6.15})$
 $= 5.15s$

(ii) $5V = 6.15V (e^{-\frac{t}{3.07}})$
 $-3.07 \ln(\frac{5}{6.15})$
 $= 0.64s$

(d) $\tau = L/R$

$\frac{0.25H}{400\Omega} = \frac{625\mu s}{0.625 \times 10^{-3}s} = 625\mu s$

(ii) $I_{max} = \frac{V}{R} = \frac{9}{400} = 0.0225A = 22.5mA$

(iii) 20mA .

$$20\text{mA} = 22.5\text{mA} \left(e^{-\frac{t}{0.625 \times 10^{-3}}} \right)$$

$$= 0.625 \times 10^{-3} \ln \left(\frac{20 \times 10^{-3}}{22.5 \times 10^{-3}} \right)$$

$$= 0.073 \times 10^{-3} \text{ s. } 73 \mu\text{s}$$

$$10\text{mA} = 22.5\text{mA} \left(e^{-\frac{t}{0.625 \times 10^{-3}}} \right)$$

$$= 0.625 \times 10^{-3} \ln \left(\frac{10 \times 10^{-3}}{22.5 \times 10^{-3}} \right)$$

$$= 0.506 \times 10^{-3} \text{ s. } 506 \mu\text{s}$$

12

Q2

(a) $Z_1 + Z_2$

$$(6 - j4) + (3 + j5) = 9 + j$$

$$7.211 \angle -33.69^\circ \quad 5.83 \angle 59.04^\circ$$

$$Z_1 \times Z_2$$

$$7.211 \angle -33.69^\circ \times 5.83 \angle 59.04^\circ = 42.04 \angle 25.35^\circ$$

$$37.99 + j17.99$$

$$\frac{Z_1 \times Z_2}{Z_1 + Z_2} = \frac{42.04 \angle 25.35^\circ}{9.05 \angle 6.34^\circ} = 4.65 \angle 19.01^\circ$$

$$+ Z_3$$

$$(4.39 + j1.51) + (1.61 - j0.51) = \underline{6 + j}$$

12

(b) $Z = R + jX_L$

$$X_L = 2\pi fL \quad 2\pi \times 60 \times 0.6 = 226.19 \Omega$$

$$Z = 75 + j226.19$$

2

$$(ii) \quad \frac{V}{I \angle Z} \quad \frac{120 \angle 0^\circ}{238.3 \angle 71.65^\circ} = 0.50 \angle -71.65^\circ \text{ A}$$

2

$$(iii) \quad \frac{V}{I \angle R} \quad \frac{120 \angle 0^\circ}{75 \angle 0^\circ} = 1.6 \angle 0^\circ \text{ V}$$

2

$$(iv) \quad \frac{V}{I \angle X_L} \quad 0.50 \angle -71.65^\circ \times 226.19 \angle 90^\circ = 113.06 \angle 18.35^\circ \text{ V}$$

2

(c) $V = V_L + V_R$

$$(11.81 - j35.59) + (107.31 + j35.59) = 119.12 + j0$$

3

23

Q3.

$$\frac{V}{I_2}$$

$$\frac{50 \angle 30^\circ}{14.42 \angle 56.31^\circ}$$

$$= 3.47 \angle -23.31^\circ \text{ A}$$

inaccurate

2

(ii)

$$S = VI$$

$$P = VI \cos \phi$$

$$Q = VI \sin \phi$$

~~$$800 \times 14.42 \angle 56.31^\circ = 11528 \angle 56.31^\circ \text{ VA}$$~~

~~$$3 \times 11528 \cos 56.31^\circ = 19662 \text{ W}$$~~

$$50 \angle 30^\circ \times 3.47 \angle -23.31^\circ = 173.5 \angle 53.13^\circ$$

$$S = 173.5 \angle 53.13^\circ \text{ VA}$$

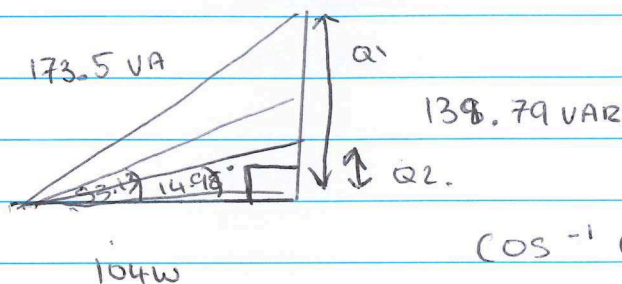
$$P = 173.5 \times \cos (53.13^\circ) = 104 \text{ W}$$

$$Q = 173.5 \times \sin (53.13^\circ) = 138.79 \text{ VAR}$$

numerical
error
method
OK

2

(iii)



$$\cos^{-1}(0.966) = 14.98^\circ$$

$$\tan(14.98^\circ) \times 104 = 27.83 \text{ VAR}$$

$$138.79 - 27.83 = 110.96 \text{ VA}$$

method
OK

8

(iv)

$$C = \frac{QC}{2\pi f V_{rms}^2}$$

$$2\pi f V_{rms}^2$$

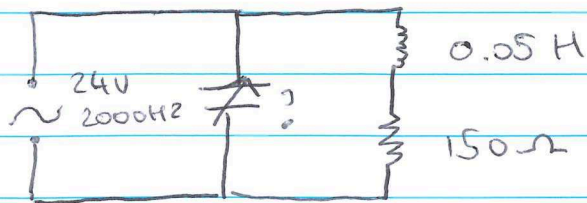
$$\frac{110.96}{2\pi \times 2000 \times 50^2}$$

$$= 3.53 \mu\text{F}$$

3

(15)

Q4.



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

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

$$= 5.99 \text{ nF.}$$

X

method ok

$$(b) \frac{L}{CR} = \frac{0.05}{5.99 \times 10^{-9} \times 150} = 55648.3 \Omega.$$

1/2

$$(c) \frac{V}{R_0} = \frac{24}{55648.3} = 431.28 \mu\text{A.}$$

1/2

$$(d) 2\pi f_r L/R.$$

$$\frac{2\pi \times 2000 \times 0.05}{150} = 4.18$$

1

$$(e) Q = f_r (f_2 - f_1) = \frac{2000}{4.18} = 478.4 \text{ Hz.}$$

2

$$(f) \text{Chirp } x$$

(4)