

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	133872
2	Title of Examination Paper	ELECTRICAL + ELECTRONIC PRINCIPLES.
3	Module Code	SGEE 4000
4	Date and Time of Examination	29/4/24 9:30 AM.
5	Examination Venue	COLEG SIR GAR. G43
6	Seat Number	

7	Number of Answer Books handed in	1
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[illegible]

54%

Complete
section,
remove
strip, fold as
indicated
and SEAL

Please complete this section and SEAL before the examination starts.

Surname

(Black Capitals) Forename(s)

DAVID, LUKE.

2430

Q1. TRANSIENTS.

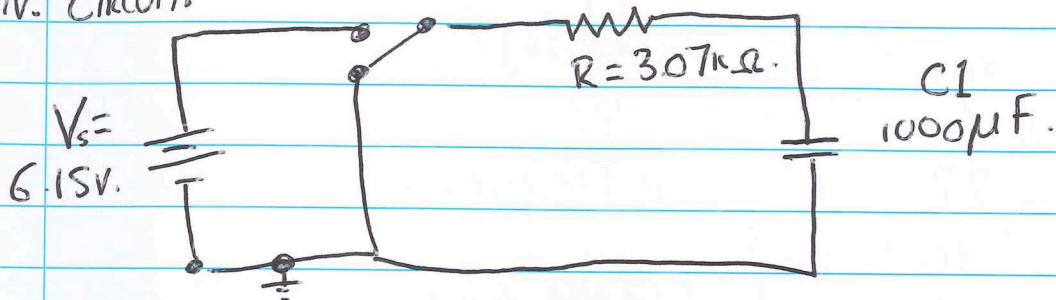
$$(1a) \quad R = \frac{R_1 \times R_2}{R_1 + R_2} = \frac{5000 \times 8000}{5000 + 8000}$$

$$= 3.07 \text{ k}\Omega.$$

$$V_s = \frac{R_2}{R_1 + R_2} \times V_1 = \frac{8000}{5000 + 8000} \times 10$$

$$= 6.15 \text{ V.}$$

EQUIV. CIRCUIT.



(b) TIME CONSTANT.

$$\tau = RC = (3.07 \times 10^3) \times (1000 \times 10^{-6})$$

$$\tau = 3.07 \text{ SECONDS.}$$

ii) FULLY CHARGED.

$$5\tau = 5 \times 3.07 = 15.35 \text{ SECONDS.}$$

(c) i) CHARGING TO 5V.

$$V_c = V_s (1 - e^{-t/\tau})$$

$$5 = 6.15 (1 - e^{-t/3.07})$$

$$t = -\tau \ln(1 - V_c/V_s)$$

$$t = -3.07 \ln(1 - 5/6.15)$$

$$t = 5.14 \text{ SECONDS.}$$

ii) DISCHARGING TO 5V.

$$V_c = V_s (e^{-t/\tau})$$

$$5 = 6.15 (e^{-t/3.07})$$

$$t = -\tau \ln(V_c/V_s)$$

$$t = -3.07 \ln(5/6.15)$$

$$t = 0.63 \text{ SECONDS.}$$

(9)

Pt. 2.

(d) i) Time Constant.
$$\tau = L/R = \frac{250 \times 10^{-3}}{400}$$
$$= 0.625 \text{ ms}$$

2

ii) STEADY STATE.
$$I_{\text{MAX}} = V/R = 9/400$$
$$= 22.5 \text{ mA.}$$

2

iii) To fall to 10 mA. (DISCHARGE).
$$i = I(e^{-t/\tau})$$
$$10 \times 10^{-3} = 22.5 \times 10^{-3} (e^{-t/0.625 \times 10^{-3}})$$
$$t = -\tau \ln(i/I)$$
$$t = -0.625 \times 10^{-3} \ln(10 \times 10^{-3} / 22.5 \times 10^{-3})$$
$$t = 0.5 \text{ ms.}$$

To DISCHARGE TO 20 mA.

$$i = I(e^{-t/\tau})$$
$$20 \times 10^{-3} = 22.5 \times 10^{-3} (e^{-t/0.625 \times 10^{-3}})$$
$$t = -\tau \ln(i/I)$$
$$t = -0.625 \times 10^{-3} \ln(20 \times 10^{-3} / 22.5 \times 10^{-3})$$
$$t = 73.6 \text{ } \mu\text{S}$$

12

16

Q2. COMPLEX NUMBERS

a) $Z_1 = 6 - j4$, $Z_2 = 3 + j5$, $Z_3 = 1.61 - j0.51$

TO CALCULATE $Z_T = \left[\frac{Z_1 Z_2}{Z_1 + Z_2} \right] + Z_3$

① $Z_1 + Z_2 = (6 - j4) + (3 + j5)$
 $= 9 + j$

② $Z_1 Z_2 = (6 - j4)(3 + j5)$
 $= 18 + j30 - j12 - j^2 20$
 $= 18 + j18 + 20$
 $= 38 + j18$

③ $\frac{Z_1 Z_2}{Z_1 + Z_2} = \frac{38 + j18}{9 + j} \times \frac{9 - j}{9 - j}$
 $= \frac{342 - j38 + j162 - j^2 18}{81 - j9 + j9 - j^2}$
 $= \frac{360 + j124}{82}$
 $= 4.39 + j1.51$

④ $\left[\frac{Z_1 Z_2}{Z_1 + Z_2} \right] + Z_3 = (4.39 + j1.51) + (1.61 - j0.51)$

$Z_T = 6 + j$

12

12

Pt. 2.

i) $\vec{Z} = R + jX_L$
 IMPEDANCE.

$$X_L = 2\pi fL = 2\pi \times 60 \times 0.6$$

$$= 226.19 \Omega.$$

$$Z = 75 + j226.19 \Omega$$

$$\text{OR } 238.3 \angle 71.65^\circ \Omega.$$

ii) CURRENT IN THE CIRCUIT.

$$I = V/Z = 120 \angle 0^\circ / 238.3 \angle 71.65^\circ$$

$$= 0.5 \angle -71.65^\circ \text{ A.}$$

iii) P.D. $\rightarrow$ RESISTOR.

$$V_R = IR = 0.5 \angle -71.65^\circ \times 75 \angle 0^\circ$$

$$= 37.5 \angle -71.65^\circ \text{ V.}$$

iv) P.D. $\rightarrow$ COIL.

$$V_L = IX_L = 0.5 \angle -71.65^\circ \times 226.19 \angle 90^\circ$$

$$= 113.09 \angle 18.35^\circ \text{ V.}$$

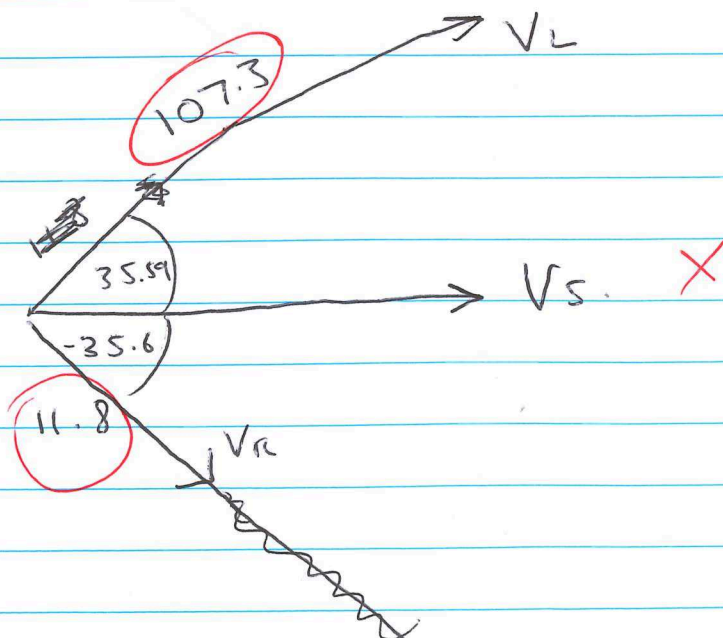
c) $V_R = 11.8 - j35.59$

$$V_L = 107.3 + j35.6$$

$$V_S = \cancel{119.1} + j0.01$$

APPROX $120 \angle 0^\circ$

d)



(11)

Q5. THEVENIN'S THEOREM.

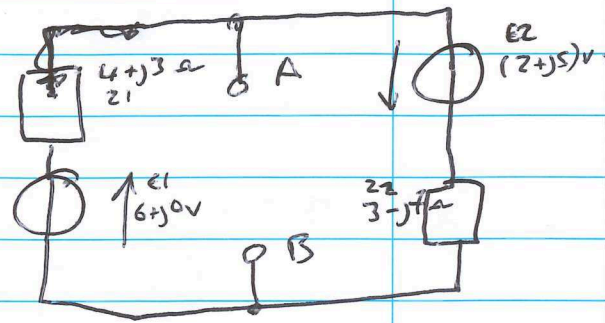
Remove Load.

$$a) I = \frac{E_1 + E_2}{Z_1 + Z_2} = \frac{(6+j0) + (2+j5)}{(4+j3) + (3-j7)}$$

$$= \frac{8+j5}{7-j4} = \frac{9.43 \angle 32^\circ}{8.06 \angle -29.74^\circ}$$

$$= 1.16 \angle 2.26^\circ \text{ A.} \quad \text{Add}$$

$$E_{AB} = E_1 - I_1(Z_1)$$



$$\begin{aligned} &= (6+j0) - (1.16 \angle 2.26^\circ) \times (4+j3) \\ &= (6+j0) - (1.16 \angle 2.26^\circ) \times (5 \angle 36.86^\circ) \\ &= (6+j0) - (5.8 \angle 39.12^\circ) \\ &= (6+j0) - (4.49 + j3.65) \\ &= 1.51 - j3.65 \text{ V. or. } 3.95 \angle -67.52^\circ \text{ V.} \end{aligned}$$

⑤ FIND IMPEDANCE, REMOVE SOURCE.

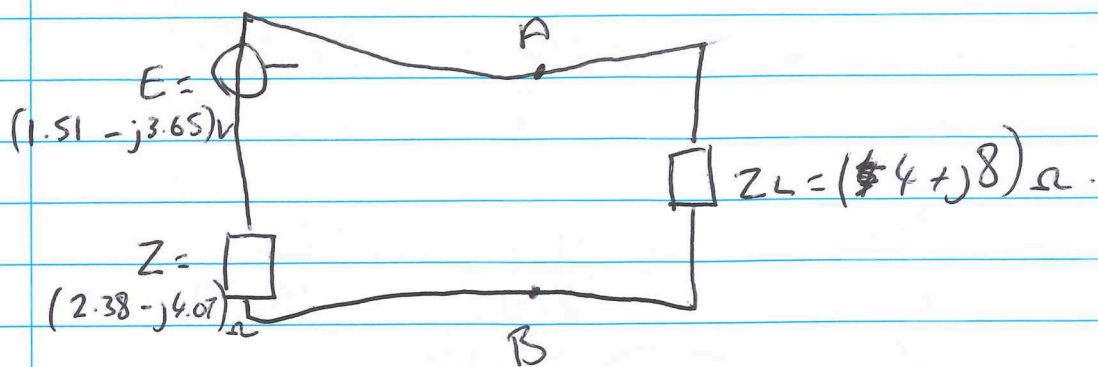
$$Z = \frac{Z_1 Z_2}{Z_1 + Z_2} = \frac{(4+j3)(3-j7)}{(4+j3) + (3-j7)}$$

$$= \frac{5 \angle 36.86^\circ \times 7.61 \angle -66.8^\circ}{7-j4}$$

$$= \frac{38.05 \angle -29.94^\circ}{8.06 \angle 29.74^\circ}$$

$$= 4.72 \angle -59.68^\circ \Omega. \quad \text{or. } 2.38 - j4.07 \Omega.$$

(C)



(a)

~~CURRENT~~

$$I_L = \frac{E}{Z + Z_L}$$

$$= \frac{1.51 - j3.65}{(2.38 - j4.07) + (4 + j8)}$$

~~$6.38 + j3.93$~~

$$= \frac{1.51 - j3.65}{6.38 + j3.93}$$

$$= 3.95 \angle -67.52^\circ / 7.49 \angle 31.63^\circ$$

$$= 0.52 \angle -99.15^\circ \text{ A}$$

OR.

$$-0.08 - j0.51 \text{ A.}$$

Q3. 3P + P.F.

i) SUPPLY CURRENT.

$$I = V/Z = 50 \angle 30^\circ / 8 + j12$$

$$= 50 \angle 30^\circ / 14.42 \angle 56.3^\circ$$

$$= 3.46 \angle -26.3^\circ \quad \text{Unit?}$$

2

ii) $S = VI = 50 \angle 30^\circ \times 3.46 \angle 26.3^\circ$

$$= 173 \angle 56.3^\circ \text{ VA}$$

$$P = VI \cos \theta$$

$$= 173 \cos 56.3^\circ$$

$$= 95.98 \text{ W}$$

$$Q = VI \sin \theta$$

$$= 173 \sin 56.3^\circ$$

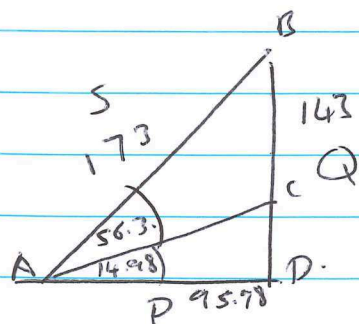
$$= 143.9 \text{ Var}$$

3

$$S = P + jQ$$

$$= 95.98 + j143.9 \text{ VA}$$

iii)



$$P.f = \cos \theta = \cos 56.3^\circ = 0.55$$

~~0.55~~ 0.55 (NOT GOOD ENOUGH)

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

CAPACITOR

$$CD = BD - BC$$

$$\tan^{-1} \frac{Q}{P} = 56.3^\circ$$

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