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Trinity Saint David

Examination Answer Books

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, fold over and seal down (using the label provided) 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.

Complete, fold and seal
(see note 2 below)

SURNAME:

KAZEMI

FORENAME(S):

ALEX

1	Student Number	Ka223873625
2	Title of Examination Paper	ELECTRICAL PRINCIPLES THEORY
3	Module Code	GOEE5001
4	Date and Time of Examination	15 MAY 2025 13:35
5	Examination Venue	GOWER COLLEGE SWANSEA
6	Seat Number	B2
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	
2	
3	
4	
Q1	11 ✓
Q2	28 ✓
Q3	3 ✓
Q4	6 ✓
Total	48/100 ✓

L2

48%

$$1 a) R = Z(s) = 2s + \frac{1000}{s} + 6$$

$$R = 6 \Omega \checkmark$$

$$L = 2H \checkmark$$

$$C = 1 \mu F \checkmark$$

Q1

14/30

Q1a

5/5

b)

$$i) L \{ 3e^{3t} \cos(4t) + t^2 + 0.75 \}$$

$$= \underline{\underline{\underline{\quad}}}$$

$$\frac{3 \cdot (s-3)}{(s-3)^2 + (4)^2} + \frac{2!}{s^3} + \frac{0.75}{s}$$

Q1b

5/10

$$ii) L \{ \sin(4t)e^t + 5e^{-3t} \}$$

$$= \frac{4}{(s-1)^2 + (4)^2} + \frac{5}{s+3}$$

$$iii) L \{ e^{2t} (3-t^2) + \frac{3\pi}{2} \}$$

$$= 3e^{2t} - e^{2t}t^2 + \left(\frac{3\pi}{2} \right)$$

$$iv) L \{ t \cosh(2t) + e^{-2t} \}$$

$$L \{ t \cosh(2t) + e^{-2t} \}$$

$$= \frac{s}{s^2 - (2a)^2} + \frac{1}{s+2}$$

$$iV) e^{-4t} (3 - 15t + e^{4t})$$

$$L = \mathcal{L} \{ e^{-4t} (3 - 15t + e^{4t}) \}$$

$$= \frac{3!}{(s+2)^4} - \frac{1}{s+2} = 0$$

$$c) \text{ O.S. } L \frac{di}{dt} + Ri = V(t)$$

$$0.5 \frac{di}{dt} + 4i = 80e^{-10t}$$

Q1C

L/15

2) a) i) $x(t) = 2 + 3 \cos(0.2t) + \cos(0.25t + \frac{\pi}{2}) + 4 \cos(0.3t - \pi)$

Fundamental Frequency is 0.05 Hz $\checkmark$ rad/sec

ii) $1 + 10 \cos(2\pi(60)t + \frac{\pi}{8}) + 2 \cos(2\pi(300)t + \frac{\pi}{4})$

Fundamental frequency = 60 Hz $\checkmark$

b) $f(x) \begin{cases} 1 & -\pi \leq x < 0 \\ 0 & 0 \leq x < \pi \end{cases}$

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos nx + b_n \sin nx$$

$$a_0 = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) dx$$

$$a_0 = \frac{1}{\pi} \int_{-\pi}^0 1 dx + \frac{1}{\pi} \int_0^{\pi} 0 dx$$

$$a_0 = \frac{1}{\pi} [x]_{-\pi}^0$$

$$a_0 = \frac{1}{\pi} (0 - (-\pi))$$

$$a_0 = \frac{1}{\pi} (\pi)$$

$$a_0 = 1$$

Q2

28/30

Q2a

4/5

Q2b

24/25

$$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \cos nx \, dx$$

$$a_n = \frac{1}{\pi} \int_{-\pi}^0 1 \cos nx \, dx + \frac{1}{\pi} \int_0^{\pi} 0 \cos nx \, dx$$

$$a_n = \frac{1}{\pi} \left[\frac{\sin nx}{n} \right]_{-\pi}^0$$

$$a_n = \frac{1}{n\pi} [\sin nx]_{-\pi}^0$$

$$a_n = \frac{1}{n\pi} (\sin(0) - \sin(-n\pi))$$

$$a_n = \frac{1}{n\pi} (0 + 0)$$

$$a_n = \frac{1}{n\pi} (0)$$

$$a_n = 0$$

$$b_n = \frac{1}{\pi} \int_{-\pi}^{\pi} f(x) \sin nx \, dx$$

$$b_n = \frac{1}{\pi} \int_{-\pi}^0 1 \sin nx \, dx + \frac{1}{\pi} \int_0^{\pi} 0 \sin nx \, dx$$

$$b_n = \frac{1}{\pi} \left[-\frac{\cos nx}{n} \right]_{-\pi}^0$$

$$b_n = \frac{1}{n\pi} [-\cos nx]_{-\pi}^0$$

$$b_n = \frac{1}{n\pi} [-\cos nx]_{-\pi}^0$$

$$b_n = \frac{-1}{n\pi} (\cos(0) - \cos(n\pi))$$

~~$$b_n = \frac{1}{n\pi} (1 - (-1)^n) \text{ when even}$$~~

$$b_n = 0 \text{ when even}$$

$$b_n = \frac{-2}{n\pi} \text{ when odd}$$

7

$$a_0 = 1 \quad a_n = 0$$

$$b_n = 0 \text{ when even}$$

$$b_n = \frac{-2}{n\pi} \text{ when odd}$$

$$f(x) = \frac{1}{2} - \frac{2}{\pi} \left[\cancel{a_1 \cos x} + a_2 \cos 2x + a_3 \cos 3x + a_4 \cos 4x + a_5 \cos 5x \dots \right. \\ \left. + b_1 \sin x + b_2 \sin 2x + b_3 \sin 3x + b_4 \sin 4x + b_5 \sin 5x \dots \right]$$

$$f(x) = \frac{1}{2} - \frac{2}{\pi} \left(\overset{\sin(x)}{\frac{1}{3} \sin 3x} + \frac{1}{5} \sin 5x + \frac{1}{7} \sin 7x + \frac{1}{9} \sin 9x + \frac{1}{11} \sin 11x \right)$$

3

$$3) a) V_{TH} = \frac{8-j6}{4+8-j6} = \frac{8-j6}{12-j6} \times (10)$$

$$= \frac{8-j6}{12-j6} = 0.67 \angle -18.46^\circ \times 10$$

$$= 6.7 \angle 0^\circ V$$

$$\text{or } 6.7 \angle 0^\circ V$$

$$Z_{TH} = \frac{(4) \times (8-j6)}{4+8-j6} + j5$$

$$= \frac{(32-j24)}{12-j6} + j5$$

$$= 2.67 + j4 + j5$$

$$= 2.67 + j9$$

$$\text{or } 9.39 \angle 73.48^\circ \Omega$$

$$b) Z_L = 1$$

$$c)$$

Q3

3/20

Q3a

3/10

Q3b

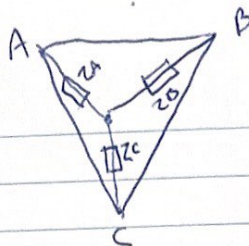
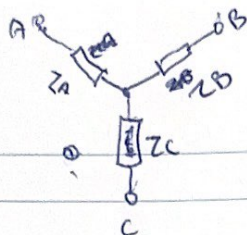
0/3

Q3c

0/7

Question No.

4) a)

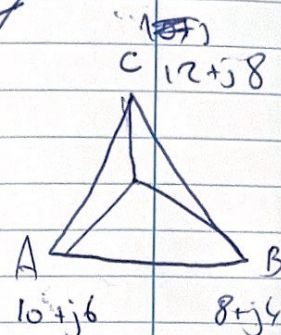
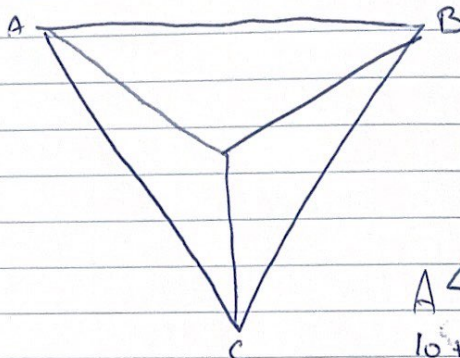
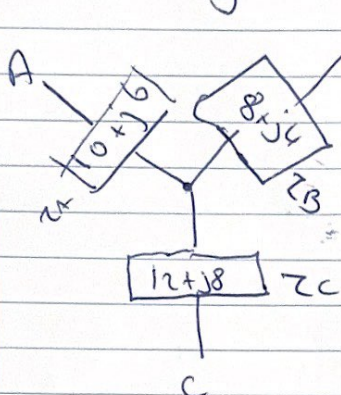


Examiner Only

Q4

6/20

$$Z_A = 10 + j6 \Omega \quad Z_B = 8 + j4 \Omega \quad Z_C = 12 + j8 \Omega$$



~~$Z_{eq} = Z_1 Z_2 Z_3$~~

$$Z_a = \frac{(Z_1 Z_2) + (Z_2 Z_3) + (Z_3 Z_1)}{Z_1}$$

$$Z_a = \frac{(10+j6) \times (8+j4) + (8+j4) \times (12+j8) + (12+j8) \times (10+j6)}{8+j4}$$

$= ?$

Q4a

1/10

Question No.

Examiner Only

$$Z_c = \frac{(Z_1 Z_2) + (Z_2 Z_3) + (Z_3 Z_1)}{Z_3}$$

~~$$Z_c = (10 + j6) + (8 + j4) +$$~~

$$Z_c = \frac{(10 + j6) \times (8 + j4) + (8 + j4) \times (12 + j8) + (12 + j8) \times (10 + j6)}{12 + j8}$$

= ??

$$Z_b = \frac{(Z_1 Z_2) + (Z_2 Z_3) + (Z_3 Z_1)}{Z_2}$$

$$Z_b = \frac{(10+j6) \times (8+j4) + (8+j4) \times (12+j8) + (12+j8) \times (10+j6)}{8+j4}$$

$= 2.1$

$$\begin{aligned}
 \text{b) Voltage rms} &= \sqrt{V_0^2 + \sum_{n=1}^{\infty} \left(\frac{V_n^2}{2} \right)} \\
 &= \sqrt{0 + \frac{(300)^2}{2} + \dots} \\
 &= 212.13 \text{ V}
 \end{aligned}$$

Q4b5/10

$$\begin{aligned}
 \text{Current rms} &= \sqrt{I_0^2 + \sum_{n=1}^{\infty} \left(\frac{I_n^2}{2} \right)} \\
 &= 0 + \frac{(15)^2}{2} \\
 &= 0 + \frac{(20)^2}{2} \\
 &= 14.14 \text{ A}
 \end{aligned}$$

$$P_{\text{avg}} = P_{\text{avg}}$$

$$\begin{aligned}
 \text{ii) } P_{\text{av}} &= V_0 I_0 + \sum_{n=1}^{\infty} \frac{V_n I_n}{2} \cos(\phi_n - \phi_n) \\
 &= (300) 0 + \frac{(300)(15)}{2} \cos(-30^\circ) \\
 &= 0 + 2250 \times \cos(-30^\circ) \\
 &= 1948.56 \text{ W}
 \end{aligned}$$

$$\begin{aligned}
 P_{\text{avg}} &= 1 \times V = 2 \cdot 14.14 \times 212.13 \text{ S.C.F} \\
 &= 2999.52 \text{ W}
 \end{aligned}$$

$$\begin{aligned}
 P_{\text{avg}} &= \frac{2999.52}{1948.56} = 1.54 \\
 &= 1948.56
 \end{aligned}$$