



Prifysgol Cymru
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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).
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Complete, fold and seal
(see note 2 below)

SURNAME: WOODHAM

FORENAME(S): RICHARD

1	Student Number	W0024874535
2	Title of Examination Paper	ELECTRICAL PRINCIPLES THEORY
3	Module Code	G0EE5001
4	Date and Time of Examination	15/05/2025 13:30
5	Examination Venue	TY LUCH (GCS) 068860
6	Seat Number	D3
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	
2	
3	
4	
Q1	23
Q2	27
Q3	10
Q4	9
Total	69/100

(Gweler yr ochr arall am y fersiwn Cymraeg)

69%
69/100

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

$$R = 6\Omega \checkmark \quad L = 2H \checkmark \quad \underline{\underline{3}} \quad C = 1000\mu F$$

$$C = 1F \quad \times$$

$$C \rightarrow \frac{1}{Cs} = \frac{1000}{s} \checkmark$$

Q1
23/30

Q1a

3/5

$$(1b) i) 3e^{3t} \cos(2t) + t^2 + 0.75 = f(t)$$

$$F(s) = 3 \cdot \frac{s+(-3)}{(s+(-3))^2 + 2^2} = \frac{3(s-3)}{(s-3)^2 + 4} \checkmark$$

T-6
T-8
T-1

Q1b

5/10

$$F(s) = \frac{3s-9}{(s-3)^2+4} + \frac{2!}{s^3} + \frac{0.75}{s} \quad \underline{\underline{2}}$$

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

$$F(s) = \frac{4}{(s-1)^2+4^2} + 5 \cdot \frac{1}{s+3} = \frac{4}{(s-1)^2+16} + \frac{5}{s+3} \quad \underline{\underline{2}}$$

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

$$F(s) = \frac{7}{s^2} \quad \underline{\underline{0}}$$

Question No.

(1b) iv) $t \cosh(2t) + e^{-2t} = f(t).$

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

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

v) $e^2 e^{-4t} t^3 - 3e^t \sin(e^2 t) = f(t).$

$$f(s) =$$

$$\textcircled{1} \text{ c) } L \frac{di}{dt} + Ri = v(t)$$

$$L = 0.5$$

$$R = 4$$

$$v(t) = 80e^{-10t}$$

Q1c

15/15

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

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

$$0.5 sI(s) - \cancel{0.5} i(0) + 4I(s) = \frac{80}{s+10}$$

$$I(s)(0.5s + 4) = \frac{80}{s+10}$$

$$I(s) = \frac{80}{(0.5s + 4)(s+10)} = \frac{160}{(s+8)(s+10)}$$

$$\frac{160}{(s+8)(s+10)} = \frac{A_1}{(s+8)} + \frac{A_2}{(s+10)} \quad 15$$

$$160 = A_1(s+10) + A_2(s+8)$$

$$s = -10$$

$$160 = A_2(-2) \quad \therefore A_2 = -\frac{160}{2} = -80$$

$$s = -8$$

$$160 = A_1(2) \quad \therefore A_1 = \frac{160}{2} = 80$$

$$\therefore \frac{160}{(s+8)(s+10)} = \frac{80}{s+8} - \frac{80}{s+10}$$

$$I(s) = \frac{80}{s+8} - \frac{80}{s+10} \quad A$$

$$1c) I(s) = \frac{80}{s+8} - \frac{80}{s+10} \quad \checkmark \quad \checkmark$$

$$I(t) = 80e^{-8t} - 80e^{-10t} \quad A$$

⑤

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

fundamental frequency $\stackrel{2}{=} 0.05$ (Hz) rad/sec

Q2

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

27/30

fundamental frequency $\stackrel{2}{=} 2 \times \pi \times 60 \text{ Hz} \times 0$

Q2a

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

2/5

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

Q2b

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

25/25

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

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

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

$a_0 = 1$

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

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

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

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

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

$$a_n = \frac{1}{\pi n} [\sin 0_n - \sin -\pi_n] = \frac{1}{\pi n} [0 - 0] \quad \checkmark$$

$$a_n = 0 \quad \checkmark$$

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

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

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

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

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

when $n = \text{even}$

$$b_n = -\frac{1}{\pi n} [\cos 0_n - \cos 2\pi_n] = -\frac{1}{\pi n} [1 - 1] = 0 \quad \checkmark$$

when $n = \text{odd}$.

$$b_n = -\frac{1}{\pi n} [\cos 0_n - \cos \pi_n] = -\frac{1}{\pi n} [1 - (-1)] = -\frac{2}{\pi n} \quad \checkmark$$



$$a_0 = 1$$

$$a_n = 0$$

$$b_n = \begin{cases} 0 & \text{when } n = \text{even} \\ -\frac{2}{\pi n} & \text{when } n = \text{odd} \end{cases}$$

$$f(x) = \frac{1}{2} + \sum_{n=1}^{\infty} \left[0 \cos nx + \left(-\frac{2}{\pi n} \right) \sin nx \right]$$

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



Question No.

Examiner Only

$$(3) a) V_{TH} = \frac{8-j6}{4+8-j6} \times 10 = \frac{80-j60}{12-j6} V$$

Q2310/20

$$\therefore \frac{(8-j6)(80-j60)}{(12-j6)(12+j6)} = \frac{960+j480-j360-j^2 360}{144-j72+j72-j^2 36}$$

Q23a9/10

$$j^2 = -1 \quad \therefore \begin{array}{c} \text{E.C.F} \\ 8 \end{array} \quad \begin{array}{c} 4 \\ \text{E.C.F} \end{array} \quad \begin{array}{c} \text{E.C.F} \\ 8 \end{array} \quad \begin{array}{c} \text{E.C.F} \\ 8 \end{array}$$

$$\frac{960 + j120 + 360}{144 + 36} = \frac{1320 + j120}{180} = 7.3 + j0.6 V$$

or

Correct method

Error carried forward

$$7.3 + j0.6 V = 7.36 \angle 5.19^\circ V = V_{TH}$$

$$Z_{TH} = \frac{(8-j6)(4)}{(8-j6)+4} + j5 = \frac{32-j24}{12-j6} + j5$$

$$\frac{(32-j24)(12+j6)}{(12-j6)(12+j6)} = \frac{384+j192-j288+144}{144+36} = \frac{528-j96}{180}$$

$$\frac{528-j96}{180} = 2.93 - 0.53j$$

5

$$\therefore Z_{TH} = 2.93 - 0.53j + j5 = 2.93 + j4.46 \Omega$$

$$\text{or } 5.34 \angle 56.71^\circ \Omega$$

Question No.

Examiner Only

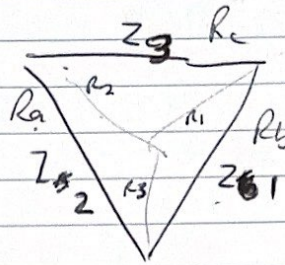
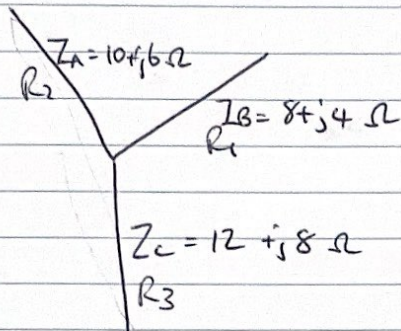
Q3c $I = \frac{V_{TH}}{Z_{TH} + Z_L} = \frac{7.3 + j0.6}{2.93 + j4.46 + Z_L} = 1$

Q3b0/3Q3c1/7

Arholwr yn unig

Rhif y Cwestiwn

(4)

Q49/20

$$R_2 = Z_A = 10 + j6 \Omega \quad R_1 = Z_B = 8 + j4 \Omega$$

$$R_3 = Z_C = 12 + j8 \Omega$$

$$R_{c21} = \frac{Z_A Z_C + Z_C Z_B + Z_B Z_A}{Z_A}$$

$$R_3 = Z_2 =$$

$$R_a = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_1}$$

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

$$R_a = \frac{80 + j48 + j40 + j^2 24 + 120 + j80 + 72j + j^2 48 + 96 + j48 + j64 + j^2 32}{8 + j4}$$

$$R_a = \frac{192 + j352}{8 + j4}$$

$$\frac{(192 + j352)(8 - j4)}{(8 + j4)(8 - j4)} = \frac{1536 - 768j + j^2 1408 - j^2 1408}{64 + 16}$$

Q4a9/10

$$\frac{1536 + 1408 + j2048}{80} = 36.8 + j25.6$$

or

$$44.83 \angle 34.82^\circ \Omega$$

$$R_b = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_2}$$

$$R_b = \frac{\cancel{2944} + j\cancel{2048}}{\cancel{10} + j6} \frac{192 + j352}{10 + j6}$$

$$\frac{\cancel{2944} + (192 + j352)(10 - j6)}{(10 + j6)(10 - j6)}$$

$$= \frac{1920 - j152 + j3520 - j^2 210}{100 + 36}$$

$$= \frac{1920 + \cancel{210} + j2368}{136} = \frac{15.66 + j17.41}{1}$$

or

$$23.41 \angle 48.03^\circ \Omega$$

$$R_c = \frac{R_1 R_2 + R_2 R_3 + R_3 R_1}{R_3} = \frac{192 + j352}{12 + j8}$$

E.C.F

$$\frac{(192 + j352)(12 - j8)}{(12 + j8)(12 - j8)} = \frac{2304 - j1536 + j4224 - j^2 2816}{144 + 64}$$

$$= \frac{5120 + j2688}{208} = 24.6 + j12.92$$