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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).
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: Ivey

FORENAME(S): James

1	Student Number	IVE 208 57781
2	Title of Examination Paper	Electrical Principles Theory
3	Module Code	GOEE 5001
4	Date and Time of Examination	15/05/25 PM
5	Examination Venue	Main Hall
6	Seat Number	B1 68860
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
1	
2	
3	
4	
Q1	4
Q2	19
Q3	0
Q4	10
Total	33/100

✓
✓
✓
✓

L2

33%

(Gweler yr ochr arall am y fersiwn Cymraeg)

3. a) $V_{TH} = \frac{-6j}{(4+8)-6j} = \frac{-6j}{12-6j}$

$V_{TH} = \frac{-6j}{(4+8)-6j} = 1j \angle 0.5V$

$V_{TH} = \text{Pol}(-0.5, 1j)$
 $= 1.12 \angle 116.5^\circ V$

$I_{TH} = \frac{-6j(4+8)}{(4+8)-6j} + 5j$

$I_{TH} = \frac{-72j}{12-6j} \times \frac{12+6j}{12+6j} = \frac{-864j - 432}{144 + 72j - 72j - 36j^2} = \frac{-432 - 864j}{180}$

$I_{TH} = \frac{-432 - 864j}{180} = -2.4 - 4.8j A$

$b) Z_L = \frac{V_{TH}}{I_{TH}} = \frac{1.12 \angle 116.5^\circ V}{-2.4 - 4.8j A} = 0.2 \angle 179.9^\circ \Omega$

$Z_L = 0.2 \Omega$

c) $P = I^2 \times Z_L$

$P = 2.4^2 \times 0.2$

$= 1.152 W$

a)

$I_{TH} = (-2.4 - 4.8j) \times 10V = -24 - 48j A$

~~1.152 W~~

4. a) $Z_A = 10 + 6j$ $Z_B = 8 + 4j$ $Z_C = 12 + 8j$

$$R1 = \frac{Z_A \times Z_B}{Z_A + Z_B + Z_C}$$

$$R2 = \frac{Z_A \times Z_C}{Z_A + Z_B + Z_C}$$

$$R3 = \frac{Z_B \times Z_C}{Z_A + Z_B + Z_C}$$

Q410/20

$$R1 = \frac{(10 + 6j)(8 + 4j)}{(10 + 6j) + (8 + 4j) + (12 + 8j)} = \frac{80 + 40j + 48j + 24j^2}{30 + 18j}$$

Wrong formula

$$R1 = \frac{56 + 88j}{30 + 18j} \times \frac{30 - 18j}{30 - 18j} = \frac{1680 - 1008j + 2640j - 1584j^2}{900 - 540j + 540j - 324j^2}$$

$$R1 = \frac{3264 + 1632j}{576 - 1224j} = 5.66 + 2.83j \Omega$$

$$R1 = \text{Pol}(5.66, 2.83)$$

$$= 6.33 \angle 26.6^\circ \Omega$$

Correct application of Delta to star, but question required

Star to Delta. Good use of complex notation.

Partial credit awarded.

$$R2 = \frac{(10 + 6j)(12 + 8j)}{(10 + 6j) + (8 + 4j) + (12 + 8j)} = \frac{120 + 80j + 72j + 48j^2}{30 + 18j}$$

$$R2 = \frac{72 + 152j}{30 + 18j} \times \frac{30 - 18j}{30 - 18j} = \frac{2160 - 1296j + 4560j - 2736j^2}{900 - 540j + 540j - 324j^2}$$

$$R2 = \frac{4896 + 3264j}{576 - 1224j} = 8.5 + 5.6j \Omega$$

$$R2 = \text{Pol}(8.5, 5.6)$$

$$= 10.18 \angle 33.3^\circ \Omega$$

$$R3 = \frac{(8 + 4j)(12 + 8j)}{(10 + 6j) + (8 + 4j) + (12 + 8j)} = \frac{96 + 64j + 48j + 32j^2}{30 + 18j}$$

$$R3 = \frac{64 + 112j}{30 + 18j} \times \frac{30 - 18j}{30 - 18j} = \frac{1920 - 1152j + 3360j - 2016j^2}{900 - 540j + 540j - 324j^2}$$

$$R3 = \frac{3936 + 2208j}{576 - 1224j} = 6.83 + 3.83j \Omega$$

$$R3 = \text{Pol}(6.83, 3.83) = 7.83 \angle 29.3^\circ \Omega$$

Q4a5/10

Question No.

4B

$$V_{rms} = \sqrt{V_0^2 + \sum_{n=1}^{\infty} \frac{V_n^2}{2}}$$

Error:-

$$Current\ RMS = \sqrt{I_0^2 + \sum_{n=1}^{\infty} \left(\frac{I_n^2}{2}\right)}$$

$$V_{rms} = \sqrt{0 + \sum \frac{300^2}{2}} = 212.13\ V$$

$$I_{rms} = \sqrt{\frac{15^2}{2} + \frac{5^2}{2}} = 11.18\ A$$

$$ii) P_{av} = V_0 I_0 + \sum \frac{V_n I_n}{2} \cos(\phi_n - \phi_n)$$

$$P_{av} = 212 \times 11.18 \times \cos(30) = 1027\ VA$$

$$PS = \frac{P}{S}$$

$$P = 300 \times 15 = 4500\ W$$

$$PS = \frac{4500}{1027} = 4.38$$

E.C.F.

Examiner Only

Q24b

5/10

1 a) $R = 6\Omega$ ✓

$L = \frac{1000}{s}$

$C = 2s$

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

~~$\frac{1}{s-3} \times \frac{s}{s^2+2^2} + \frac{1}{s^3} + \frac{0.75}{s}$~~ ✓

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

~~$\frac{4}{s^2+4^2} \times \frac{1}{s} + \frac{1 \times 5}{s+3}$~~ ✓

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

~~$\frac{1}{s+2} \times \frac{3}{s} - \frac{2}{s^3} + \frac{3\pi}{2}$~~ ✓

iv) $t \cos h(2t) + e^{-2t}$

~~$\frac{t}{s} \times \frac{s}{s^2+2^2} + \frac{1}{s+2}$~~ ✓

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

0

Q1

4/30

Q1a

1/5

Q1b

3/10

Q1c

0/15

2) b)

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

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

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

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

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

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

$$a_0 = 1$$

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

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

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

$$a_n = \frac{1}{\pi} \left(\frac{\sin nx}{n} \right)_{-\pi}^0 + \frac{1}{\pi} \left(\frac{\sin nx}{n} \right)_0^{\pi}$$

$$a_n = \frac{1}{\pi n} (\sin nx)_{-\pi}^0 + \frac{1}{\pi n} (\sin nx)_0^{\pi}$$

$$a_n = \frac{1}{\pi n} (-\sin(-nx))_{-\pi}^0 + \frac{1}{\pi n} (\sin nx)_0^{\pi}$$

$$a_n = 0$$

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

$$b_n = \frac{1}{\pi} \int_{-\pi}^0 f(x) \sin nx dx + \frac{1}{\pi} \int_0^{\pi} f(x) \sin nx dx$$

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

Q219/30Q2a0/5Q2b19/25

$$2b) \quad b_n = \frac{1}{\pi} (-\cos nx) \Big|_{-\pi}^0 + \text{~~the same as above~~}$$

$$b_n = -\frac{1}{\pi n} (\cos nx) \Big|_{-\pi}^0 + \text{~~the same as above~~}$$

$$b_n = -\frac{1}{\pi n} (\cos nx) \Big|_{-\pi}^0 + \text{~~the same as above~~}$$

$$b_n = \frac{1}{\pi n} (2-)$$

when b_n is even = 0 ✓
 b_n is odd = 5

$$f(x) = \frac{1}{2} + \sum [0 (\cos nx) + 5 \sin nx]$$

$$f(x) = \frac{1}{2} (5 \sin nx) + \frac{1}{3} (5 \sin nx) + \frac{1}{5} (5 \sin nx) \dots$$

X =



Question No

Examiner Only

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

$x(t) = 0.6 \sin(0.2t) + (0.25 + \frac{\pi}{2}) \sin(0.25t + \frac{\pi}{2}) + (-1.2t - \pi) \sin(0.3t - \pi)$

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

$x(t) = (-20 \sin(600)t + 10 \frac{\pi}{8}) \sin(60t) + -4 \sin(2\pi(300)t + \frac{\pi}{4})$

X

Q2a0/5

Arholwr yn unig

Rhif y Cwestiwn

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

$$\frac{V}{I R}$$

$$I = \frac{V}{R} \text{ or } \frac{V}{Z}$$

$$I = \frac{80}{4.5} = 17.7A$$

0Q1c0/15