

12 Pages

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.**

(see note 2 below)

SURNAME: MILLER

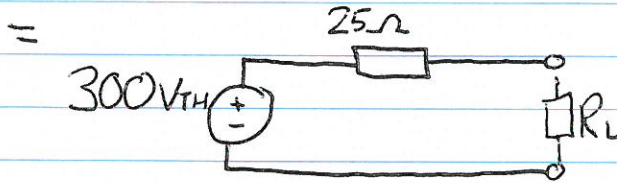
FORENAME(S): NATHAN

1	Student Number	MIL14820987
2	Title of Examination Paper	ELECTRICAL PRINCIPLES THEORY
3	Module Code	M2X0003
4	Date and Time of Examination	4/5/18 09:30
5	Examination Venue	68860
6	Seat Number	5
7	Number of Answer Books handed in	1 of 1

List the numbers of the questions you have attempted	Office Use
Q ₁	18
Q ₂	19
Q ₃	10
Q ₄	6
Office Use	53%

(1) i) $V_{TH} = \left(\frac{150\Omega}{150\Omega + 30\Omega} \right) \times 360V = 300V$ ✓

$R_{TH} = \frac{150\Omega \times 30\Omega}{180\Omega} = 25\Omega$ ✓

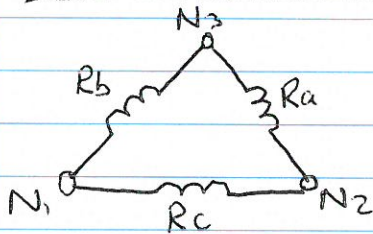


For Maximum Power Transfer $R_L = R_{TH} \therefore R_L = 25\Omega$ ✓

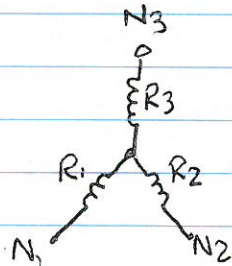
ii) $I = \frac{V}{R} = \frac{300}{50} = 6$ $P = I^2 R = 6^2 \times 50 = 1800W$

Check $\frac{V^2}{R} = \frac{300^2}{50} = \frac{90000}{50} = 1800W$ ✓

6.)



$R_a = 5 + 15j\Omega$
 $R_b = 15 - 5j\Omega$
 $R_c = 10 + 30j\Omega$
 $R_{TOTAL} = 35 + 40j\Omega$



$R_1 = \frac{R_b R_c}{R_{TOTAL}}$

$R_2 = \frac{R_a R_c}{R_{TOTAL}}$

$R_3 = \frac{R_a R_b}{R_{TOTAL}}$ ✓

Convert R_a, R_b, R_c, R_T to Polar =

$R_a = 5 + 15j \rightarrow 15.8 \angle 71.57^\circ$ ✓

$R_b = 15 - 5j \rightarrow 15.8 \angle -18.43^\circ$ ✓

$R_c = 10 + 30j \rightarrow 31.6 \angle 71.57^\circ$ ✓

$R_{TOTAL} = 35 + 40j \rightarrow 53.2 \angle 48.81^\circ$

$\therefore R_1 = \frac{(15.8 \angle -18.43^\circ)(31.6 \angle 71.57^\circ)}{53.2 \angle 48.81^\circ} = \frac{499.28 \angle 53.14^\circ}{53.2 \angle 48.81^\circ}$

$= 9.38 \angle 4.33^\circ$ back to Rectangular = $9.35 + 0.7j$

✓ Error carried forward

3. ✓

) cont.)

$$R_2 = \frac{(15.8 \angle 71.57^\circ)(31.6 \angle 71.57^\circ)}{53.2 \angle 48.81^\circ}$$

$$= \frac{499.28 \angle 143.14^\circ}{53.2 \angle 48.81^\circ} = 9.38 \angle 94.33^\circ$$

Back to rectangular =

$$-0.71 + 9.35j$$

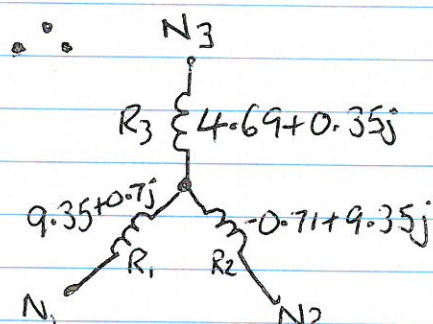
$$R_3 = \frac{(15.8 \angle 71.57^\circ)(15.8 \angle -18.43^\circ)}{53.2 \angle 48.81^\circ}$$

$$= \frac{249.64 \angle 53.14^\circ}{53.2 \angle 48.81^\circ}$$

$$= 4.7 \angle 4.33^\circ$$

Error corrected

$$\text{Back to rectangular} = 4.69 + 0.35j$$



(2)

Fourier:

$$\cos nx = \frac{\sin nx}{n}$$

$$\sin nx = -\frac{\cos nx}{n}$$

$$a_0 = \frac{1}{2\pi} \int_{-\pi}^{\pi} f(x) dx$$

Split Limits =

$$a_0 = \frac{1}{2\pi} \int_{-\pi}^0 f(x) dx$$

$$+ \frac{1}{2\pi} \int_0^{\pi} f(x) dx$$

$$= \frac{1}{2\pi} [x]_0^{\pi} = \frac{1}{2\pi} [\pi x + 0] = \frac{1}{2\pi} [\pi x]$$

$$a_0 = \frac{1}{2}$$

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

$$= \frac{1}{\pi} \left[\frac{\sin nx}{n} \right]_0^{\pi} = \frac{1}{n\pi} [(\sin n\pi) + \sin(0)]$$

$$= \frac{1}{n\pi} (\sin n\pi) = \frac{1}{n\pi} (0.05480) = 0.0174$$

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

$$= \frac{1}{\pi} \left[-\frac{\cos nx}{n} \right]_{-\pi}^0 + \frac{1}{\pi} \left[-\frac{\cos nx}{n} \right]_0^{\pi}$$

$$= \frac{1}{n\pi} [(-\cos n(0)) - (-\cos n(-\pi))] = \frac{1}{n\pi} [-1 + 1] \therefore b_n = 0 \text{ even}$$

$$f(x) = \frac{1}{2} +$$

8

✓

7

✓

4

✓

$$(3) \text{ a) i.) } e^{4t} + 5 \rightarrow \frac{1}{s-4} + \frac{5}{s} \quad \checkmark$$

2 ✓

$$\text{ii) } \cos(2t) + 7\sin(2t)$$

$$\begin{aligned} \cos(2t) + 7\sin(2t) &\rightarrow \frac{s}{s^2+2^2} + \frac{2(2)s}{(s^2+2^2)^2} \\ &= \frac{s}{s^2+4} + \frac{4s}{(s^2+4)^2} \end{aligned}$$

1 ✓

$$\text{iii) } (t^2+4t+2)e^{3t} \rightarrow e^{3t}t^2 + e^{3t}4t + e^{3t}2$$

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

1 ✓

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

$$\text{iv) } 6e^{5t}\cos(2t) - e^{7t} \rightarrow \frac{6(s-7)}{(s-7)^2-2^2} - \frac{1}{s-7}$$

1 ✓

$$= \frac{s-7}{(s-7)^2-4} - \frac{1}{s-7}$$

$$\text{v) } v(t) = 5e^{-2t}\sin(4t) \rightarrow v(s) = \frac{5}{s+2}$$

$$v(s) = \frac{5 \times 4}{(s+2)^2+16}$$

2 ✓

(3) b.)

$$5 \frac{dx}{dt} + 3x = 4$$

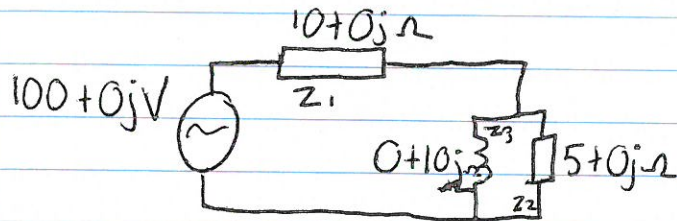
$$\frac{dx}{dt} = s V(s) \text{ when initial conditions} = 0$$

$$= 5sV(s) + 3s = \frac{4}{s} \quad \checkmark \quad = s(5Vs + 3) = \frac{4}{s}$$

$$\text{Partial Fractions} = \underline{A} + \underline{B}$$

3 ✓

(4)



$$= \frac{(0 + 10j)(5 + 0j)}{5 + 10j} = \frac{0 + 0j + 50j + 0j^2}{5 + 10j}$$

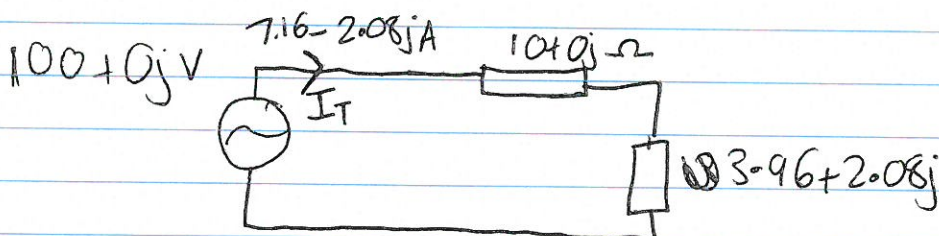
CORRECT METHOD

$$= \frac{50j - 1}{5 + 10j} \times \frac{5 - 10j}{5 - 10j} = \frac{250j - 500j^2 - 5 + 10j}{25 + 10j - 10j - 100j^2} = \frac{495 + 260j}{125}$$

$$= 3.96 + 2.08j \text{ For } Z_3 + Z_2 = Z_p$$

$$\text{Total } Z = Z_1 + Z_p = 13.96 + 2.08j$$

$$\frac{V}{Z} = I_{\text{TOTAL}} = \frac{100 + 0j \text{ V}}{13.96 + 2.08j} = 7.16 - 2.08j \text{ A}$$



$$= \frac{3.96 + 2.08j}{3.96 + 2.08j} \times \frac{3.96 + 2.08j}{(3.96 + 2.08j)(10 + 0j)} \times 100 + 0j \text{ V}$$

$$= \frac{3.96 + 2.08j}{39.6 + 2.08j} \times 100 + 0j \text{ V} = 10 + 0j \text{ V}$$