

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.**

Complete, fold and seal
(see note 2 below)

SURNAME: BONAGURA

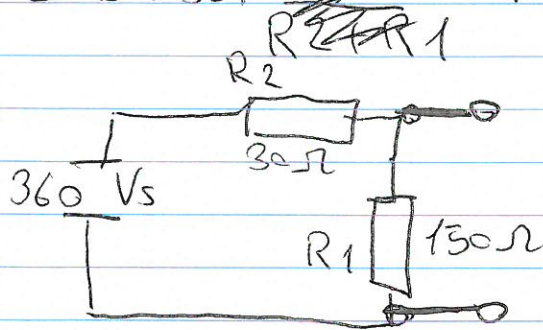
FORENAME(S): ETANUELE

1	Student Number	1603335A
2	Title of Examination Paper	ELECTRICAL PRINCIPLE THEORY
3	Module Code	112X0003
4	Date and Time of Examination	4/03/18
5	Examination Venue	68860
6	Seat Number	1
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
Q1	25
Q2	20
Q3	21
Q4	14
Office Use	80%

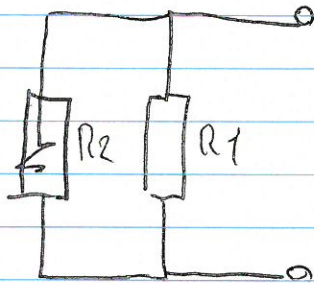
1)

a) ~~$V_{th} = 360 \cdot \frac{R_2}{R_1 + R_2}$~~ First remove the load

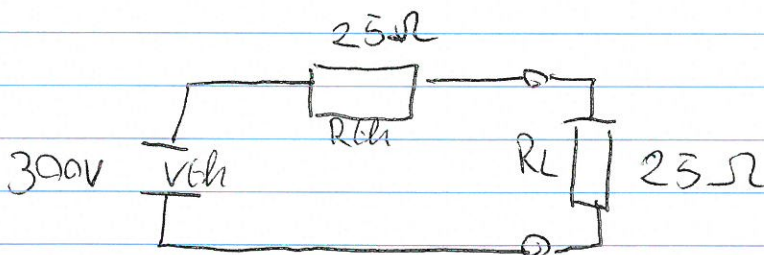


$$V_{th} = \frac{V_s \cdot R_1}{R_1 + R_2} = \frac{360 \cdot 150}{150 + 30} = 300V$$

Remove the source



$$R_{th} = \frac{R_1 \cdot R_2}{R_1 + R_2} = \frac{150 \cdot 30}{150 + 30} = 25\Omega$$



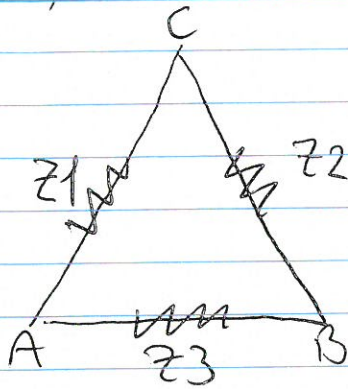
i The value of R_L has to be equal to R_{th}

$$ii \quad P_{max \text{ load}} = \frac{V_{th}^2}{4 R_{th}} = \frac{300^2}{4 \cdot 25} = 900W$$

(10)



b) DELTA

~~RAZ~~

$$Z_A = \frac{Z_1 \cdot Z_3}{Z_1 + Z_2 + Z_3}$$

$$Z_A = \frac{(5 + j15)(10 + j30)}{(30 + 40j)} =$$

$$Z_A = \frac{(13,81 \angle 71,56)(31,62 \angle 71,56)}{(50 \angle 53,13)} =$$

$$Z_A = \frac{499,91 \angle 143,12}{50 \angle 53,13} = 9,99 \angle 89,99 \Omega$$

$$(1,74 \times 10^{-3}) + j9,99 \Omega$$

A

$$Z_B = \frac{Z_2 \cdot Z_3}{Z_1 \cdot Z_2 \cdot Z_3} =$$

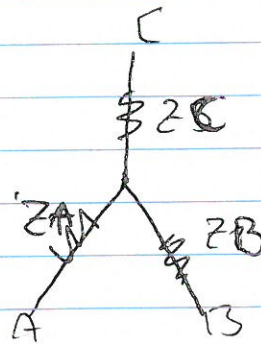
$$Z_B = \frac{(13,81 \angle -18,43)(31,62 \angle 71,56)}{50 \angle 53,13}$$

$$Z_B = \frac{499,91 \angle 53,13}{50 \angle 53,13} = 9,99 \angle 0 \Omega$$

$$9,99 + j0 \Omega$$

$$Z_C = \frac{Z_1 \cdot Z_2}{Z_1 + Z_2 + Z_3}$$

STAR



$$Z_1 = 5 + j15 \Omega$$

$$Z_2 = 15 - j5 \Omega$$

$$Z_3 = 10 + j30 \Omega$$

$$Z_1 = 15,81 \angle 71,56$$

$$Z_2 = 15,81 \angle -18,43$$

$$Z_3 = 31,62 \angle 71,56$$

$$ZC = \frac{(15,81 \angle 71,56)(15,81 \angle -18,43)}{50 \angle 53,13}$$

$$ZC = \frac{249 \angle 53,13}{50 \angle 53,13} = 4,98 \angle 0 \text{ } \Omega$$

$$4,98 + j0 \text{ } \Omega$$

Q 2)

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

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

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

$$a_0 = \frac{1}{2\pi} \int_{-\pi}^0 0 dx + \frac{1}{2\pi} \int_0^{\pi} 1 dx$$

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

$$= \frac{1}{2\pi} [0 - (\pi)]$$

$$= \frac{1}{2\pi} \cdot -\pi$$

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

6

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

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

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

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

$$= \frac{1}{n\pi} [0]$$

$$a_n = 0$$

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

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

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

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

if n is odd if n is even

$$= -\frac{1}{n\pi} [1 + 1] \quad \left| \quad = -\frac{1}{\pi} [1 - 1] \right.$$

$$b_n = -\frac{2}{n\pi}$$

$$b_n = 0$$

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

$$f(x) = -\frac{1}{2} + \left[0 + \frac{2}{\pi} \sin x - \frac{2}{3\pi} \sin 3x - \dots \right]$$

$$\frac{2}{5\pi} \sin 5x - \dots]$$

Q 3) $i e^{4t} + 5 = \frac{1}{s-a} + \frac{1}{s}$

$$\frac{1}{s-4} + \frac{5}{s} \quad \checkmark$$

2

✓

11 $\cos(2t) + 7 \sin(2t) = \frac{s}{s^2+a^2} + \frac{7}{s^2+a^2}$

$$\frac{s}{s^2+2^2} + \frac{7 \cdot 2}{s^2+2^2} \quad \checkmark$$

2.

111) $(t^2 + 4t + 2)e^{3t} = \boxed{\frac{n!}{(s-a)^{n+1}}}$

$$t^2 e^{3t} + 4t e^{3t} + 2e^{3t}$$

✓

$$\frac{2!}{(s-3)^3} + 4 \cdot \frac{1!}{(s-3)^2} + 2 \cdot \frac{1}{s-3} \quad \checkmark$$

2

✓

IV) $6e^{5t} \cos(2t) - e^{7t}$

$$\frac{6 \cdot (s-5)}{(s-5)^2 - 2^2} - \frac{1}{s-7} \quad \checkmark$$

$$\frac{2}{(s-3)^3} + 4 \cdot \frac{1}{(s-3)^2} + 2 \cdot \frac{1}{(s-3)} \quad \checkmark$$

2

✓

V) $V(t) = 5e^{-2t} \sin(4t)$

$$V(s) = \frac{4}{(s+2)^2 + 4^2} = \frac{1}{(s+2) + 4} \quad \checkmark$$

b)

$$t = 0$$

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

$$\mathcal{L} \left[\frac{dx}{dt} \right] = sF(s) - x(0)$$

$$F(s) \quad 5s(x(0)) + 3x(s) = \frac{4}{s}$$

$$x(s) (5s + 3) = \frac{4}{s}$$

$$x(s) = \frac{4/s}{5s + 3} = \frac{4}{s} \cdot \frac{1}{5s + 3} \quad \checkmark$$

$$\frac{A}{s} + \frac{B}{5s + 3} = \frac{4}{s}$$

$$A(5s + 3) + Bs = 4$$

$$\text{if } s = 0 \quad 4 = 3A \Rightarrow A = 1,3 \quad \checkmark$$

$$\text{if } s = -\frac{3}{5} \quad 4 = -\frac{3}{5}B \Rightarrow B = -6,6 \quad \checkmark$$

$$\frac{1,3}{s} - \frac{6,6/5}{5s + 3} \quad \checkmark$$

$$1,3 e^{-1,3t}$$

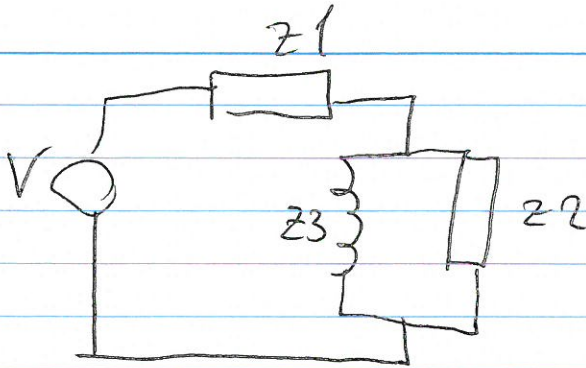
$$\mathcal{L}^{-1} = 1,3 (1,3 e^{-1,3t})$$

$$\text{if } t = 0 \quad 5s$$

$$\cancel{F(s) = 1,3 (1,3 e^{-1,3t})}$$

$$F(s) = 1,3 (1,3 e^{-6,6})$$

4)



~~$$I_{Z1} = \frac{V_s}{Z_1} = \frac{100 + j0}{Z_1}$$~~

$$Z_3 || Z_2 = \frac{(0 + j10)(5 + j0)}{(0 + j10) + (5 + j0)}$$

$$Z_3 || Z_2 = \frac{(0 + j10)(5 + j0)}{5 + j10}$$

$$Z_3 || Z_2 = \frac{(10 \angle 90^\circ)(5 \angle 0^\circ)}{11,18 \angle 63,43^\circ} = \frac{50 \angle 90^\circ}{11,18 \angle 63,43^\circ}$$

$$= 4,47 \angle -26,57^\circ = 3,99 - j1,99 \Omega$$

$$Z_T = Z_1 + (Z_2 || Z_3)$$

$$Z_T = (10 + j0) + (3,99 - j1,99) = 13,99 - j1,99 \Omega$$

$$I_t = \frac{V_s}{Z_T} = \frac{100 + j0}{13,99 - j1,99} = \frac{100 \angle 0^\circ}{14,47 \angle -26,57^\circ}$$

$$I_T = 22,37 \angle -26,57^\circ \text{ A}$$

ERROR CARRIED
FORWARD.

$$I_{Z1} = I_t \cdot \frac{(Z_2 || Z_3)}{(Z_2 || Z_3) + Z_1}$$

$$I_{Z1} = \frac{(22,37 \angle -26,57^\circ)(4,47 \angle -26,57^\circ)}{15 + j10}$$

$$I_{Z1} = \frac{29,99 \angle 0^\circ}{18,02 \angle 33,69^\circ} = 5,54 \angle -33,69^\circ \text{ A}$$

$$I_2 = I_1 \cdot \frac{Z_3}{Z_3 + Z_2} \quad \checkmark$$

$$I_2 = \frac{(22,37 \angle -26,57)(10 \angle 90)}{(5 + j10)} \quad \textcircled{1} \checkmark$$

$$I_2 = \frac{223,7 \angle -116,57}{11,18 \angle 63,43}$$

$$I_2 = 20,02 \angle -180 \text{ A} \quad -20,08 + j0 \text{ A}$$

$$I_3 = I_1 \cdot \frac{Z_2}{Z_2 + Z_3} \quad \checkmark \quad \text{error carried over} \quad \checkmark \quad \textcircled{1} \checkmark$$

$$= \frac{(22,37 \angle -26,57)(5 \angle 0)}{11,18 \angle 63,43}$$

$$= \frac{111,85 \angle -26,57}{11,18 \angle 63,43}$$

$$I_3 = 10,004 \angle -90 \text{ A} \quad -0 - j10,004$$