



Complete, fold and seal
(see note 2 below)

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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.

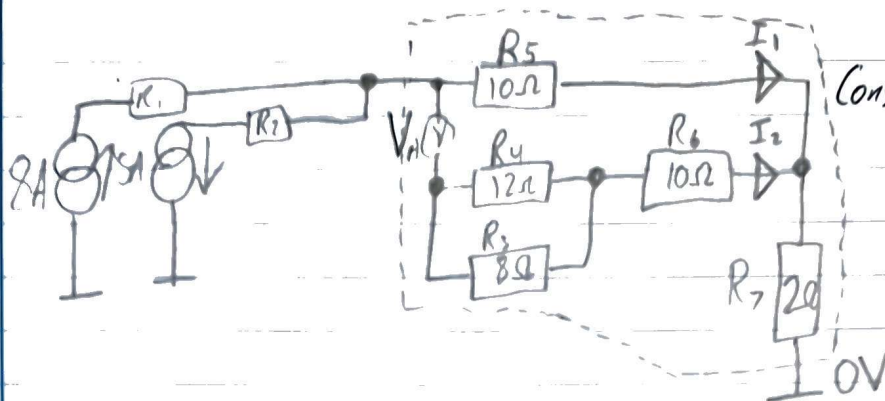
1	Student Number	PES15826963
2	Title of Examination Paper	Electronic Principles and Electrical
3	Module Code	GOEE4003
4	Date and Time of Examination	16/05/2022 9:25am
5	Examination Venue	Ward 2, Hill House
6	Seat Number	

7	Number of Answer Books handed in	1
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List the numbers of the questions you have attempted	Office Use
1	
2	
3	
4	
Q1	25
Q2	10
Q3	19
Q4	23
Total	77/100

77%
✓ KCF.

1)



Consider the following circuit:

Q2

25/25

i) To The total resistance in the LOAD (dashed-line area):

$$\frac{R_3 \times R_4}{R_3 + R_4} = \frac{8 \times 12}{8 + 12} = \frac{96}{20} = 4.8 \Omega = R_{34} \text{ (parallel)}$$

$$R_{34} + R_6 = 4.8 + 10 = 14.8 \Omega = R_{346} \text{ (series)}$$

$$\frac{R_{346} \times R_5}{R_{346} + R_5} = \frac{14.8 \times 10}{14.8 + 10} = \frac{148}{24.8} = \frac{1480}{248} = \frac{740}{124} = \frac{185}{31} = 5.96774193 \Omega = R_{3456} \text{ (parallel)}$$

$$R_{3456} + R_7 = \frac{185}{31} + 2 = \frac{185}{31} + \frac{62}{31} = \frac{247}{31} = 7.96774193 \Omega \text{ (series)} = R_{LOAD}$$

ii) Ignore R_1 & R_2 .

$$8A \uparrow - 5A \downarrow = 3A = I_{Total}$$

The voltage point is between resistor groups.

$$I_{Total} \cdot R_{LOAD} = V_A ; \frac{247}{31} \cdot 3A = \frac{741}{31} V = 23.9032258 \dots V = V_A$$

iii) $I^2 R = P$; $V^2 \div R = P$; etc.

$$(I_{Total})^2 \cdot R_{LOAD} = P_{LOAD} ; \left(\frac{247}{31}\right)^2 \cdot (3A)^2 = \frac{247}{31} \cdot 9 = \frac{2223}{31} W = 71.7096774 W = P_{LOAD}$$

$$iv) \frac{R_{346} \times R_5}{R_{346} + R_5} = \frac{10}{24.8} = \frac{25}{62} \text{ For } I_2$$

$$= 403.225806 \dots \times 10^{-3}$$

$$= \frac{25}{62} = 1.20967741 A \times 3A$$

$$= I_2$$

$$\text{For } I_1, \frac{R_{346} \times R_7}{R_{346} + R_7} = \frac{14.8}{24.8} = \frac{6}{31}$$

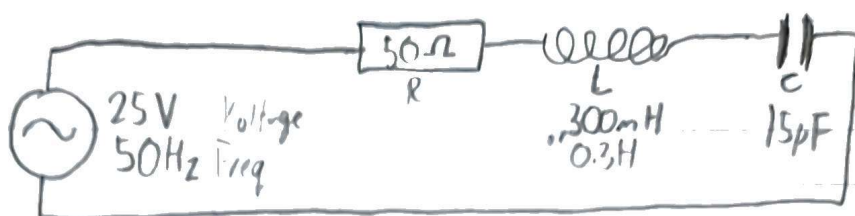
$$= 193.548387 \dots \times 10^{-3}$$

$$= 1.93548387 A$$

$$= I_1$$

This area will be re-written in the next pages.

Please Turn Over for more questions



$$V_s = 25V$$

$$f = 50Hz$$

$$R = 50\Omega$$

$$L = 0.3H$$

$$C = 15\mu F$$

i) Inductive Reactance of L as X_L : " $2\pi fL$ " ✓

$$2 \cdot \pi \cdot 50Hz \cdot 0.3H = 30\pi = 94.2477796 \dots X_L \text{ units? } \underline{\underline{3}}$$

ii) Capacitive Reactance of C as X_C : " $\frac{1}{2\pi fC}$ " ✓, " $\mu = 10^{-6}$ " ✓

$$\frac{1}{2 \cdot \pi \cdot 50Hz \cdot 15\mu F} = \frac{1}{100\pi \cdot 15 \times 10^{-6}} = 212.206590 \dots X_C \text{ units? } \underline{\underline{3}}$$

$$= \frac{1}{1.5 \times 10^{-3} \cdot \pi}$$

$$1.5 \times 10^{-3} = 15 \times 10^{-4}$$

iii) $\Sigma X = Z$, Total Impedance, " $\sqrt{R^2 + (X_L - X_C)^2} = Z$ "

$$\sqrt{50\Omega^2 + \left(30\pi - \frac{1}{15 \times 10^{-4} \cdot \pi}\right)^2} = \sqrt{2500 + 13914.2811 \dots}$$

$$= 128.118231 \dots \Omega \text{ or } Z \quad \underline{\underline{3}}$$

While $X_C > X_L$, phase shift will lag.

iv) $\Sigma X = Z$, The entire current in the circuit, " $\frac{V}{Z}$ ", and because L & C are not resistances.

$$V/Z = I_{\text{Total}}$$

$$25V (V_{\text{Total}})$$

$$50\Omega + \dots \text{ basically } 128.118231 \dots \Omega = \frac{25V}{128.11 \dots \Omega} = 195.132260 \dots mA$$

v) Phase "Difference" between voltage & current. " $X_L - X_C$ " ✓

$$X_C - X_L = 117.958811$$

$$\frac{X_C - X_L}{X_R} = 67.228093 \dots$$

$$\cos^{-1}\left(\frac{V_s}{Z}\right) = \cos^{-1}\left(\frac{25}{128}\right) = -78.7475500 \dots$$

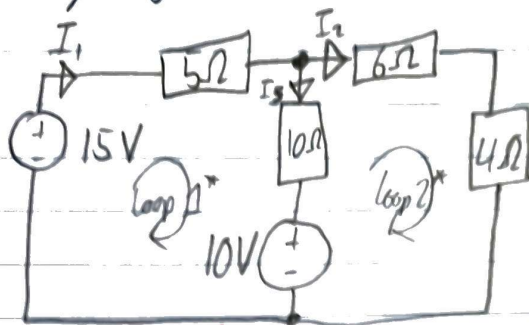
$$\text{Pol}(25, -128.118231)$$

$$-78.958811 \dots$$

$$\in \text{Is that it? The phase diff.}$$

$$? \text{ If that's P.D.P.}$$

3) a) Consider the following circuit:



* Loops are manually designated by examinee.

Q3a

9/15

Loop 1: $-15 + 5I_1 + 10I_3 + 10 = 0$ Loop 2: $-10 + 10I_3 + 6I_2 + 4I_2 = 0$
 $5I_1 + 10I_3 + 10I_2 = 5V$ $3/5$
 $15I_1 + 10I_2 = 5V$ ①
 $15I_1 + 10I_2 = 5V$

$20I_1 - = 0$ $-15 + 10 = -5$
 $15I_1 + 10I_2 = 5$ ① $-15 + 5I_1 + 10I_3 + 10$ ② $-10 + 10I_3 + 6I_2 + 4I_2$
 $-10I_1 + 20I_2 = 10$ $5 = 15I_1 + 10I_2$ $10 = 10I_3 + 10I_2 + 6I_2 + 4I_2$
 $10 = 10I_1 + 20I_2$

$5 = 15I_1 + 10I_2$ ①

$10 = 10I_1 + 20I_2$ ②

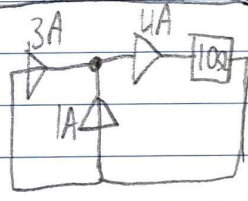
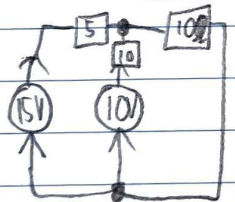
$10 = 30I_1 + 20I_2$ ①, ②

correct method

error carried forward

$20I_2 = 10$ $I_2 = 0.5$ $I_1 = 0$ but voltage should flow in both loops, right?

But if



Let's say that I_3 is "independent".

$15 + 5I_1 + 10I_3 + 10V$ ①

$5 = 5I_1 + 10I_3$ ①

$10 = 10I_3 + 10I_2$ ②

$10 = 20I_3 + 5I_1$ ①, ②

still would not help, let's convert I_3 into I_1, I_2

$10 = 10I_3 + 10I_2$ ②

$10 = 10I_1 + 10I_2$ ②

$10 = 10I_1 + 20I_2$ ②

$5 = 15I_1 + 10I_2$ ①

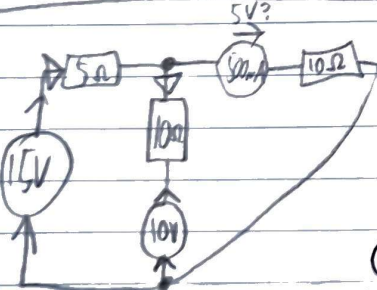
$5 = 5I_1 + 10I_2$ ①

$5 = 5I_1 + 10I_3$ ①

$15 = 5I_1 + 30I_2$ + Sep

$20 = + 40I_2$

$500mA = I_2$ Please Turn Over



Bad Findings:

$I_1 = 0mA$ should be 3A?

$I_2 = +500mA$

$I_3 = -500mA$

error carried forward

3/5

Q36



-

$$2.4\Omega + 3\Omega = R_{12} + R_3 = \underline{5.4\Omega} \quad R_{TH} \text{ is } \cancel{4.8\Omega} \text{ is } \cancel{6\Omega}$$

✓✓✓

- $$V_L^2 \uparrow \quad \uparrow \quad R_L$$

Q49



- 3/10

$$81.8 \mu A \times 10k = 911 = 818.18 mV = V_8$$

$$8.120 \times 10^{-3} \text{ V} = \frac{8.120}{100} = 7.487 \text{ V}$$

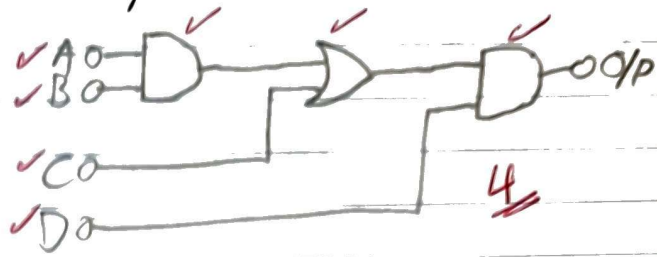
$$\frac{V_E}{R_E} = \frac{I_{E1}}{100000} = \frac{118.18 \mu A}{100000} \Rightarrow V_E = 118.18 \text{ mV}$$

$$x_{3.9\Omega} = 460.90 \mu\text{M} \quad I_0 \approx I_c$$

But because there is a capacitor, calculations will be more difficult if manually done.

4) b) Illustrate the following Boolean equations as logic circuit designs:

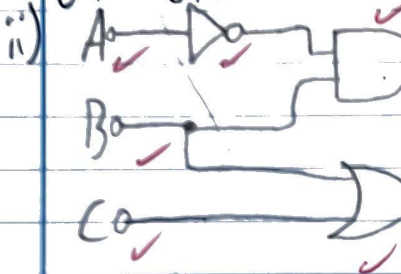
i) $Output = (A.B + C)D$



Q4b

8/8

ii) $Output = (\bar{A}.B) + (B+C)$



$\overline{X+Y} = \overline{X} . \overline{Y}$

X	Y	X.Y
0	0	0
0	1	0
1	0	0
1	1	1

AND

OR

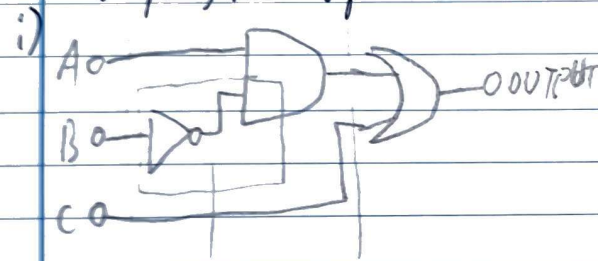
NAND

NOR

XOR & XNOR

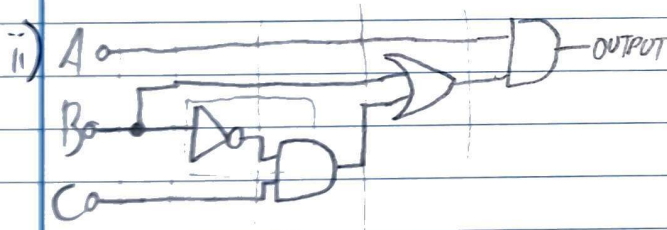
not included

c) Write the following illustrations of circuits as Boolean algebraic expressions:



$A.B + C = \text{OUTPUT}$

A	B	C	A.B	A.B + C
0	0	0	0	0
0	0	1	0	1
0	1	0	0	0
0	1	1	0	1
1	0	0	0	0
1	0	1	0	1
1	1	0	1	1
1	1	1	1	1



$(\bar{B}.C + B).A$

A	B	C	B.C	B.C + B	(B.C + B).A
0	0	0	0	0	0
0	0	1	0	0	0
0	1	0	0	1	0
0	1	1	1	1	0
1	0	0	0	0	0
1	0	1	0	0	0
1	1	0	0	1	1
1	1	1	1	1	1

$(B.C + B).A$

$(\bar{B}.C + B)$

$= B + C$

d) $Y = (\overline{A.B}) (\overline{A+C})$ Simplify using De Morgan's theorem.

$(\overline{A.B}) (\overline{A+C})$ ✓ $(\overline{X.Y}) = \overline{X} + \overline{Y}$

$(A.B) + (\bar{A} + \bar{C})$ ✓

$A.B + \bar{A} + \bar{C}$ ✓

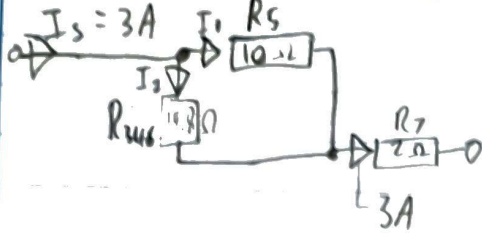
$Y = A.B + \bar{A} + \bar{C}$ ✓

A	B	C	A.B	A.B + \bar{A} + \bar{C}
0	0	0	0	1
0	0	1	0	1
0	1	0	0	1
0	1	1	0	1
1	0	0	0	1
1	0	1	0	1
1	1	0	1	1
1	1	1	1	1

Q4d

6/6

1) iv) Because $R_{346} = 14.8\Omega$, $R_5 = 10\Omega$, $I_{\text{total}} = 3A = 8A - 5A$, R_7 does not matter because that is a combining point?



$$\frac{3A}{\cancel{10\Omega}} \times \frac{10\Omega}{10\Omega + 14.8\Omega} = I_2 = \frac{75}{62} = \frac{10\Omega}{24.8\Omega} = 1.20967741... A$$

$$3A \times \frac{14.8}{10\Omega + 14.8\Omega} = I_1 = \frac{18}{62} = \frac{14.8\Omega}{24.8\Omega} = 0.5806451$$

$$= \frac{111}{62} = \frac{14.8}{24.8} = 1.79032258 A$$

