



colegsirgâr

EXAMINATION INTERNAL VERIFICATION FORM (2017-2018)

MODULE :	PSDE4003 Engineering Mathematics			LEVEL:	4
PROGRAMME :	HNC Electrical and Electronic Engineering			TERM OF EXAM: (SPRING OR SUMMER)	n/a
LEARNING OUTCOME(S) BEING ASSESSED:	MILO1, MILO 2 (partially covered)	EXAM PAPER:	Main Class Test 1	EXAMINATION AUTHOR :	A. Thomas

VERSION:	DATE SUBMITTED FOR VERIFICATION:	INTERNAL VERIFIER COMMENTS (Approval or detail of amendments required):	DATE:
1.	27/10/2017	Clear instructions are given to the candidates. The set questions are at an appropriate level commensurate with a HNC, as outlined by the university exam board.	15/11/2017
2.			

INTERNAL VERIFIER PLEASE TICK TO INDICATE THAT THE EXAMINATION:

✓	Conforms to the assessment pattern described in the module syllabus
✓	Tests the module learning outcome(s) appropriately

SIGNATURES OF FINAL APPROVAL:

SIGNATURE	DATE
INTERNAL VERIFIER: I confirm that this version of the exam paper is ready to be sent to the external examiner	15/11/2017
EXAM AUTHOR: I confirm that internal verifier and external examiner approval have been received and that this version of the exam paper is ready for printing.	

HNC Electrical and Electronic Engineering

PSDE4003 Engineering Mathematics

Level 4, Year 1

Class Test 1 (2017-18)

This is a closed book test, worth **40%** of the module mark and addresses Module Intended Learning Outcomes 1 & 2.

Date of test =

Time allowed = 1.5 hours

Answer all questions

Marks

1. Transpose the formula

$$n = \frac{IR}{E - Ir}$$

To make I the subject.

[8]

2. Consider two complex numbers $z_1 = 2 + j5$ and $z_2 = 3 - j2$.

(a) Convert to polar form and hence find the following:

(i) $z_1 z_2$ (ii) $\frac{z_1}{z_2}$

(b) Convert the answers to part (a) into Cartesian form

[18]

3. Solve the following equations:

(i) $5(3x + 4) - 4(2x - 6) = 65$

(iii) $10^{(3x-4)} = 1822$

[12]

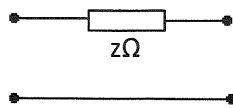
4. If $A = \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix}$, $B = \begin{pmatrix} 2 & -3 \\ 2 & 4 \end{pmatrix}$ and $C = \begin{pmatrix} 2 & 3 & 3 \\ 4 & 3 & 1 \end{pmatrix}$ find the following:

(i) $2A$ (ii) $3A - 2B$ (iii) AC

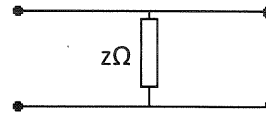
(iv) BA (v) Show that $AB \neq BA$

[18]

5. Given the following two port networks and their transfer matrices:

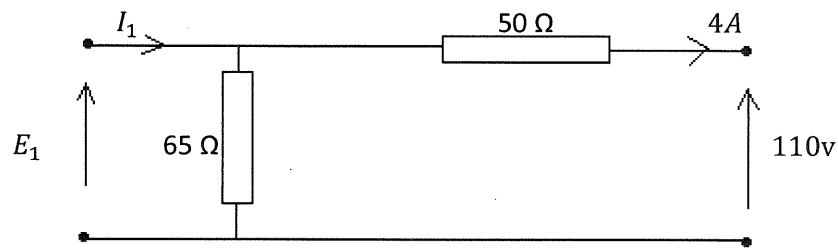


$$\begin{pmatrix} 1 & z \\ 0 & 1 \end{pmatrix}$$



$$\begin{pmatrix} 1 & 0 \\ \frac{1}{z} & 1 \end{pmatrix}$$

find the transfer matrix for the following circuit and show that its determinant is equal to zero. Hence or otherwise, find the input voltage E_1 , and current I_1 .

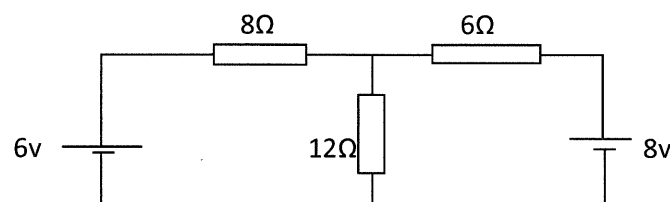


[16]

6. (i) Find the equation of the straight line joining the two points $(1, -1)$ and $(3, 7)$.
(ii) Find the equation of the line parallel to the line in part (i) passing through the point $(2, 11)$.
(iii) Find the coordinates of the intersection between the line in part (i) and the line $y - 1 = 2x$

[16]

7. By applying Kirchhoff's laws to the following circuit



The following simultaneous equations can be found:

$$6 = 20I_1 + 12I_2$$

$$8 = 12I_1 + 18I_2$$

Find the current through each resistor by using **Cramer's rule**

[12]

Formulae

1. The solution of the quadratic equation $ax^2 + bx + c = 0$ is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

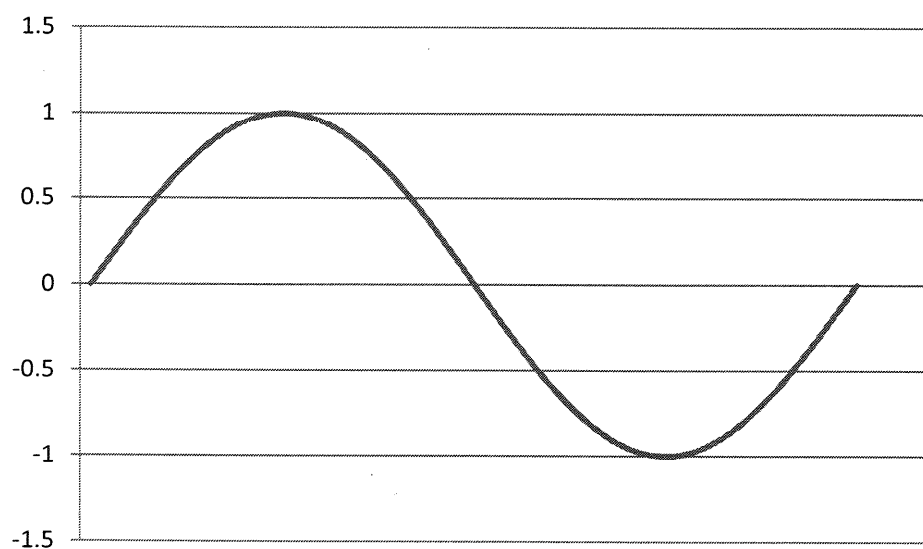
2. Logarithms

$$\log(x^y) = y \log x$$

$$\text{If } y = a^x \text{ then } x = \log_a y. \quad \text{If } y = \log_a x \text{ then } x = a^y.$$

3. If $y = e^x$ then $x = \ln y$. If $y = \ln x$ then $x = e^y$.

4. The graph of $y = \sin x$



5. The equation of a straight line is $y = mx + c$.

If a line has gradient m then any perpendicular line has gradient $-\frac{1}{m}$.

Test 1 Solutions/Mark Scheme

				Qu total
1	$n = \frac{IR}{E - Ir} \quad \text{or } I$ $n(E - Ir) = IR$ $nE - nIr = IR$ $nE = IR + nIr$ $nE = I(R + nr)$ $I = \frac{nE}{R + nr}$	2 1 2 2 1		8
2a	$Z_1 = 2 + j5 \quad r = \sqrt{2^2 + 5^2} = 5.385$  $\theta = \tan^{-1}\left(\frac{5}{2}\right) = 68.2^\circ$ $\therefore Z_1 = 5.385 \angle 68.2^\circ$ $Z_2 = 3 - j2 \quad r = \sqrt{3^2 + 2^2} = 3.606$  $\theta = \tan^{-1}\left(\frac{2}{3}\right) = 33.69^\circ$ $\therefore Z_2 = 3.606 \angle -33.7^\circ$	3 3		
(i)	$Z_1 Z_2 = 5.385 \angle 68.2^\circ \times 3.606 \angle -33.7^\circ$ $= 19.418 \angle 34.5^\circ$	3		
(ii)	$\frac{Z_1}{Z_2} = \frac{5.385 \angle 68.2^\circ}{3.606 \angle -33.7^\circ} = 1.493 \angle 101.9^\circ$	3		
b.	$x = r \cos \theta = 19.418 \cos 34.5^\circ$ $= 16$ $y = r \sin \theta = 19.418 \sin 34.5^\circ$ $= 11$ $\therefore Z_1 Z_2 = 16 + j11$ $x = 1.493 \cos 78.1^\circ = 0.308$ $y = 1.493 \sin 78.1^\circ = 1.461$	3		


 $\therefore \frac{Z_1}{Z_2} = -0.308 + j1.461$

3

18

Test 1 Solutions/Mark Scheme

				Qu total
3.	(i) $5(3x+4) - 4(2x-6) = 65$ $15x + 20 - 8x + 24 = 65$ $7x + 44 = 65$ $7x = 65 - 44$ $x = \frac{21}{7} = 3$	2		
	(ii) $10^{(3x-4)} = 1822$ $3x - 4 = \log 1822$ $3x = \log 1822 + 4$ $x = \frac{\log 1822 + 4}{3}$ $x = 2.42$	2	6	
4.)	$2A = \begin{pmatrix} 10 & 2 \\ 6 & 4 \end{pmatrix}$		2	
(i)	$3A - 2B = \begin{pmatrix} 15 & 3 \\ 9 & 6 \end{pmatrix} - \begin{pmatrix} 4 & -6 \\ 4 & 8 \end{pmatrix}$ $= \begin{pmatrix} 11 & 9 \\ 5 & -2 \end{pmatrix}$	2		
(ii)	$AC = \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} \begin{pmatrix} 2 & 3 & 3 \\ 4 & 3 & 1 \end{pmatrix} = \begin{pmatrix} 14 & 18 & 16 \\ 14 & 15 & 11 \end{pmatrix}$		4	
(iv)	$BA = \begin{pmatrix} 2 & -3 \\ 2 & 4 \end{pmatrix} \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} = \begin{pmatrix} 1 & -4 \\ 22 & 10 \end{pmatrix}$		4	
(v)	$AB = \begin{pmatrix} 5 & 1 \\ 3 & 2 \end{pmatrix} \begin{pmatrix} 2 & -3 \\ 2 & 4 \end{pmatrix} = \begin{pmatrix} 12 & -11 \\ 10 & -1 \end{pmatrix}$ $\therefore AB \neq BA$		4	

Test 1 Solutions/Mark Scheme

				Qu total
5	$\begin{bmatrix} 1 & 0 \\ 1/65 & 1 \end{bmatrix} \begin{bmatrix} 1 & 50 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 50 \\ 1/65 & 23/13 \end{bmatrix}$ $\det T = (1 \times 23/13) - (50 \times 1/65) = 1$ $\begin{bmatrix} E_1 \\ I_1 \end{bmatrix} = T \begin{bmatrix} E_2 \\ I_2 \end{bmatrix} = \begin{bmatrix} 1 & 50 \\ 1/65 & 23/13 \end{bmatrix} \begin{bmatrix} 110 \\ 4 \end{bmatrix} = \begin{bmatrix} 210 \\ 8.8 \end{bmatrix}$ $E_1 = \underline{210\text{ V}} \quad I_1 = 8.8\text{ A}$	4		
		2		
		2, 4		
		4		16
(6i)	$y = mx + c$ $-1 = m(1) + c$ $7 = m(3) + c$ $-8 = -2m$ $m = 4$ $7 = 4(3) + c$ $7 - 12 = c$ $c = -5$ $\therefore y = 4x - 5$	2		
		2		
		1	5	
(ii)	$M = 4, \quad y = mx + c \quad (2, 11)$ $11 = 4(2) + c$ $c = 3$ $\therefore y = 4x + 3$	2		
		2		
		1	5	
(iii)	$y = 4x - 5$ $y = 2x + 1$ $0 = 2x - 6$ $6 = 2x$ $x = 3$ $y = 2(3) + 1$ $y = 7$ $\therefore (3, 7)$	3		
		2		
		1	6	16

Test 1 Solutions/Mark Scheme

				Qu total
7	$6 = 20I_1 + 12I_2$ $8 = 12I_1 + 18I_2$ $I_1 = \frac{\begin{vmatrix} 6 & 12 \\ 8 & 18 \end{vmatrix}}{\begin{vmatrix} 20 & 12 \\ 12 & 18 \end{vmatrix}} = \frac{108 - 96}{360 - 144}$ $= \frac{12}{216} = 0.056$ $I_2 = \frac{\begin{vmatrix} 20 & 6 \\ 12 & 8 \end{vmatrix}}{216} = \frac{160 - 72}{216}$ $= \frac{88}{216} = 0.407$	3	3	3
				12