



INTERNAL ASSESSMENT APPROVAL FORM (INCLUDING COLLABORATIVE PROVISION)

This form is used to ensure that assessment specifications have been through an internal review process prior to external examination/approval and release to students. It should be completed for each assessment for a particular module. The assessment tasks, criteria and marking scheme should accompany this form.

PARTNER (and taught location if relevant):	Coleg Sir Gar				
EXTERNAL EXAMINER NAME:	Dr Arfan Ghani				
ASSESSMENT AUTHOR :	AINSLEY THOMAS				
MODULE TITLE:	ENGINEERING MATHEMATICS				
MODULE CODE:	PSDE 4003		MODULE LEVEL:	4	
COMPONENT NO. (e.g. 1 of 2):	2 OF 2		COMPONENT WEIGHTING (e.g. 50% of the module):	80	
ASSESSMENT PERIOD	☐ Semester 1	☒ Semester 2	☐ Semester 1 Re-sit	☐ Semester 2 Re-sit	Other, please state
TYPE OF ASSESSMENT:	☐ Coursework		☒ Examination		☐ Practical
LANGUAGE OF ASSESSMENT:	ENGLISH		TRANSLATION REQUIRED (Y/N):	N	
FOR EXAMINATIONS ONLY. SPECIFY BELOW ANY ADDITIONAL MATERIAL(S) TO BE USED IN THE EXAMINATION					
This box will expand as you type					

INTERNAL MODERATOR PLEASE TICK TO INDICATE THAT THE ASSESSMENT INCLUDES:		Please ✓ YES NO		Comments
1	Tasks that are specified clearly, accurately and comprehensibly, with appropriate use of language and neat presentation	✓		
2	Tasks which enable the module learning outcomes to be demonstrated (as per the module syllabus)	✓		
3	Tasks which conform to the assessment described in the module syllabus	✓		
4	Tasks which are written at the appropriate level of the Framework for Higher Education Qualifications (see http://www.qaa.ac.uk/docs/qaa/quality-code/qualifications-frameworks.pdf?sfvrsn=170af781_14).	✓		
5	Clear criteria for assessment and guidance about how marking/grading will be applied	✓		
6	Guidance about expected evidence for submission, e.g. essay or report, word count, bibliography and references			N/A
7	Reference to good academic conduct, for example referencing, plagiarism and Turnitin			N/A
8	Actions to complete			
This box will expand as you type				
SIGNATURE OF APPROVAL:		SIGNATURE		DATE

INTERNAL MODERATOR: I confirm that this version of the assessment specification is ready to be sent to the Partnership Team Leader	Nigel. H Davies	2/10/2018
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ONLY TO BE COMPLETED IF THE ASSESSMENT IS LINKED TO A COLLABORATIVE PARTNER

PARTNERSHIP TEAM LEADER PLEASE TICK TO INDICATE THAT THE ASSESSMENT INCLUDES:		Please ✓		Comments
		YES	NO	
1	Tasks that are specified clearly, accurately and comprehensibly, with appropriate use of language and neat presentation			
2	Tasks which enable the module learning outcomes to be demonstrated (as per the module syllabus)			
3	Tasks which conform to the assessment described in the module syllabus			
4	Tasks which are written at the appropriate level of the Framework for Higher Education Qualifications (see http://www.qaa.ac.uk/docs/qaa/quality-code/qualifications-frameworks.pdf?sfvrsn=170af781_14).			
5	Clear criteria for assessment and guidance about how marking/grading will be applied			
6	Guidance about expected evidence for submission, e.g. essay or report, word count, bibliography and references			
7	Reference to good academic conduct, for example referencing, plagiarism and Turnitin			
8	Actions to complete <i>This box will expand as you type</i>			
SIGNATURE OF APPROVAL:		SIGNATURE		DATE
PTL: I confirm that this version of the assessment specification is ready to be sent to the External Examiner				

UWTSD PROVISION: please submit the completed document to the appropriate Programme Director.

COLLABORATIVE PROVISION: please submit the completed document (or make available electronically) to the Partnership Team Leader. This must be in accord with specific arrangements for sharing electronic documents (e.g. via SharePoint or similar).

The assessment tasks, criteria and marking scheme should accompany this form

THIS DOCUMENT IS ALSO AVAILABLE IN WELSH

LOCATION: COLEG SIR GAR

LLEOLIAD: COLEG SIR GAR

LEVEL 4

LEFEL 4

**EXAMINATION PERIOD
MAY 2019**

**CYFNOD ARHOLIADAU
MAI 2019**

MODULE CODE: PSDE4003/SGEE4002
Engineering Mathematics

TIME: 2 HOURS

ANSWER ALL OF SECTION A

ANSWER THREE OUT OF FOUR IN SECTION B

Equipment or materials required – Calculators are permitted. Formulae sheets provided.

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Section A

Answer all questions:

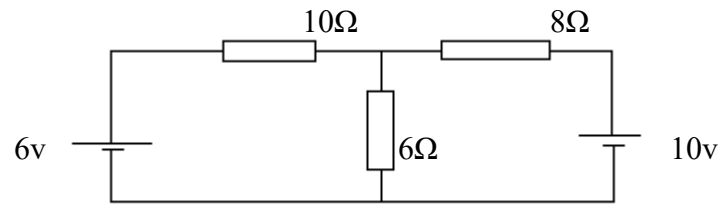
- 1 Solve the equation: $3(4y - 3) - 5(2 - 3y) = 35$ (5 marks)
- 2 If $A = \begin{pmatrix} 3 & 2 \\ 1 & 3 \end{pmatrix}$ and $B = \begin{pmatrix} -1 & 3 \\ 2 & 5 \end{pmatrix}$ find the following:
(i) $4B - 2A$ (ii) AB (iv) The inverse of matrix A (12 marks)
- 3 Consider two complex numbers $z_1 = 3 - j5$ and $z_2 = 2 + j3$. Find the following:
(i) $z_1 - z_2$ (ii) $z_1 z_2$ (iii) $\frac{z_1}{z_2}$ (10 marks)
- 4 Differentiate w.r.t. x : $y = 3x^5 - \frac{4}{x^2} + \sqrt{x}$ (5 marks)
- 5 Evaluate the integral: $\int_2^3 (4 + 5t + 3t^2) dt$ (8 marks)

Section B

Answer 3 questions from this section:

- 1 (a) Express $\frac{6}{(x+1)(x-2)}$ in partial fractions, and hence evaluate the integral $\int_3^5 \frac{6}{(x+1)(x-2)} dx$
(b) Estimate the integral $\int_3^5 \frac{6}{(x+1)(x-2)} dx$ using the trapezium rule with 4 strips (20 marks)
- 2 (a) Consider the straight lines
 $L_1: 4x + 2y - 6 = 0$ $L_2: 3y - 6x = 3$
(i) Find the gradient of the line L_1 and its intercept on the y axis.
(ii) Find the equation of the line perpendicular to L_1 and passing through the point $(6, 5)$.
(b) By differentiating $s = t^4 \sin 3t$, using the product rule, find the gradient where $t = 1.5$
(c) If $i = 2(3 - e^{-10t})$, find the initial rate of growth of current. (20 marks)

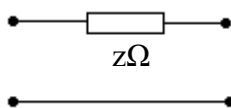
- 3 (a) By using Kirchoff's laws and mesh (loop) analysis, obtain two simultaneous equations for the current in each loop in the circuit below, and by using **either** inverse matrices **or** Cramer's Rule, find the current through each of the resistors.



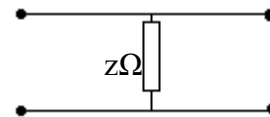
- (b) Confirm your answer by the elimination method.

(20 marks)

- 4 Given the following two port networks and their transfer matrices:

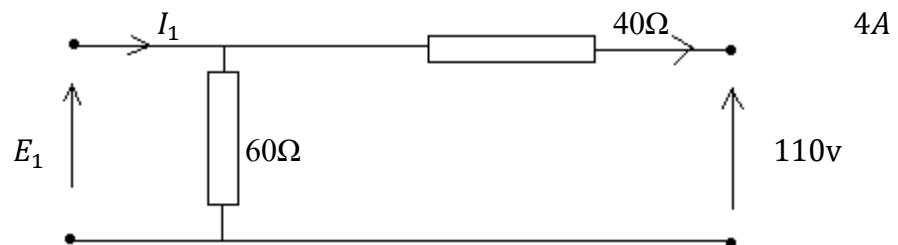


$$\begin{pmatrix} 1 & z \\ 0 & 1 \end{pmatrix}$$



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

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



(20 marks)

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

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

If $y = a^x$ then $x = \log_a y$. If $y = \log_a x$ then $x = a^y$.

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

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

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

5. Differentiation

(i) Standard derivatives

y	$\frac{dy}{dx}$
ax^n	nax^{n-1}
$a \sin(kx)$	$ka \cos(kx)$
$a \cos(kx)$	$-ka \sin(kx)$
ae^{kx}	kae^{kx}
$a \ln x$	$\frac{a}{x}$

(ii) product rule $\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$

(iii) quotient rule $\frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$

(iv) function of a function rule $\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$

6. $y = f(x)$ has a stationary point where $\frac{dy}{dx} = 0$.

If, at this point, $\frac{d^2y}{dx^2} < 0$ the point is a maximum.

If, at this point, $\frac{d^2y}{dx^2} > 0$ the point is a minimum.

7. Integration

(i) Standard integrals

$\int ax^n dx$	$\frac{ax^{n+1}}{n+1} + c$ (except when $n = -1$)
$\int \cos ax dx$	$\frac{1}{a} \sin ax + c$
$\int \sin ax dx$	$-\frac{1}{a} \cos ax + c$
$\int e^{ax} dx$	$\frac{1}{a} e^{ax} + c$
$\int \frac{1}{x} dx$ or $\int x^{-1} dx$	$\ln x + c$
$\int \frac{1}{ax+b} dx$	$\frac{1}{a} \ln(ax+b) + c$

(ii) Numerical integration:

Trapezium Rule: $h \left\{ \frac{1}{2} (y_0 + y_n) + y_1 + y_2 + y_3 + \dots \right\}$

Simpson's Rule: $\frac{1}{3} h \{ (y_0 + y_n) + 4(y_1 + y_3 + \dots) + 2(y_2 + y_4 + \dots) \}$

8. Statistics:

$$\bar{x} = \frac{\sum fx}{\sum f}$$

$$\sigma = \sqrt{\frac{\sum f(x-\bar{x})^2}{\sum f}}$$

Exam Solutions/Mark Scheme

	SECTION A			Qu total
1.	$\begin{aligned} 3(4y-3) - 5(2-3y) &= 35 \\ 12y - 9 - 10 + 15y &= 35 \\ 27y - 19 &= 35 \\ 27y &= 54 \\ y &= \frac{54}{27} = 2 \end{aligned}$	2	2	5
2.	(i) $4B - 2A = \begin{pmatrix} 12 & 8 \\ 4 & 12 \end{pmatrix} - \begin{pmatrix} -2 & 6 \\ 4 & 10 \end{pmatrix}$ $= \begin{pmatrix} 14 & 2 \\ 0 & 2 \end{pmatrix}$ (ii) $AB = \begin{pmatrix} 3 & 2 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} -1 & 3 \\ 2 & 5 \end{pmatrix} = \begin{pmatrix} 1 & 19 \\ 5 & 18 \end{pmatrix}$ (iii) $A^{-1} = \begin{pmatrix} 3 & 2 \\ 1 & 3 \end{pmatrix} = \frac{1}{9-2} \begin{pmatrix} 3 & -2 \\ -1 & 3 \end{pmatrix}$ $= \begin{pmatrix} 3/7 & -2/7 \\ -1/7 & 3/7 \end{pmatrix}$	2	5	12
3.	(i) $Z_1 \div Z_2 = (3-j5) - (2+j3)$ $= 1-j8$ (ii) $Z_1 Z_2 = (3-j5)(2+j3)$ $= 6+j9-j10-j^2 15$ $= 21-j$ (iii) $\frac{Z_1}{Z_2} = \frac{(3-j5)}{(2+j3)} = \frac{(3-j5)(2-j3)}{2^2+3^2}$ $= \frac{6-j9-j10+j^2 15}{13}$ $= \frac{-9-j19}{13}$ $= -0.692-j1.462$	2	3	10

Exam Solutions/Mark Scheme

				Qu total
SECTION A.				
4.	$y = 3x^5 - \frac{4}{x^2} + \sqrt{x}$ $y = 3x^5 - 4x^{-2} + x^{1/2}$ $\frac{dy}{dx} = 15x^4 + 8x^{-3} + \frac{1}{2}x^{-1/2}$	2	3	5
5.	$\int_2^3 (4 + 5t + 3t^2) dt$ $= \left[4t + \frac{5t^2}{2} + t^3 \right]_2^3$ $= \left[4(3) + \frac{5(3)^2}{2} + 3^3 \right] - \left[4(2) + \frac{5(2)^2}{2} + 2^3 \right]$ $= 61.5 - 26 = 35.5$	3	3	8
SECTION B.				
1 a)	$\frac{6}{(x+1)(x-2)} = \frac{A}{(x+1)} + \frac{B}{(x-2)}$ $6 = A(x-2) + B(x+1)$ put $x=2$ $6 = A(0) + B(3)$ $B = 2$ put $x=-1$ $6 = A(-3) + B(0)$ $A = -2$ $\therefore \frac{6}{(x+1)(x-2)} = \frac{2}{x-2} - \frac{2}{x+1}$ $\int_3^5 \left(\frac{2}{x-2} - \frac{2}{x+1} \right) dx = \left[2 \ln(x-2) - 2 \ln(x+1) \right]_3^5$ $= [2 \ln 3 - 2 \ln 6] - [2 \ln 1 - 2 \ln 4]$ $= -1.386 - (-2.773)$ $= 1.387$	6	6	

Exam Solutions/Mark Scheme

SECTION B					Qu total												
1 b)	$h = \frac{5-3}{4} = 0.5$ <table><tr><td>x</td><td>3</td><td>3.5</td><td>4</td><td>4.5</td><td>5</td></tr><tr><td>y</td><td>1.5</td><td>0.8889</td><td>0.6</td><td>0.4364</td><td>0.3333</td></tr></table> $\therefore \int \approx 0.5 \left\{ \frac{1}{2}(1.5 + 0.3333) + 0.8889 + 0.6 + 0.4364 \right\}$ $= 0.5 \times 2.84195 = 1.421$	x	3	3.5	4	4.5	5	y	1.5	0.8889	0.6	0.4364	0.3333				
x	3	3.5	4	4.5	5												
y	1.5	0.8889	0.6	0.4364	0.3333												
2 a) i)	$y = -2x + 3$ $m = -2 \quad c = 3$	8			20												
ii)	perp to L_1 , $m = \frac{1}{2}$ at $(6, 5)$ $y = mx + c$ $5 = \frac{1}{2}(6) + c$ $c = 2$ $\therefore$ line is $y = \frac{1}{2}x + 2$	3															
b)	$s = t^4 \sin 3t$ Let $u = t^4$ and $v = \sin 3t$ $\frac{du}{dt} = 4t^3 \quad \frac{dv}{dt} = 3 \cos 3t$ $\frac{ds}{dt} = 3t^4 \cos 3t + 4t^3 \sin 3t$ $= -3 \cdot 2 - 13 \cdot 2$ $= -16 \cdot 4$	4	7														
(c)	$i = 2(3 - e^{-10t})$ $i = 6 - 2e^{-10t}$ $\frac{di}{dt} = 20e^{-10t}$ when $t = 0$ $\frac{di}{dt} = 20.$	2															
		2															
		2															
		2	6		20												

Exam Solutions/Mark Scheme

				Qu total
	SECTION B.			
3(a)	$6I_1 + 6(I_1 + I_2) = 6$ $8I_2 + 6(I_2 + I_1) = 10$ $\therefore 16I_1 + 6I_2 = 6$ $6I_1 + 14I_2 = 10$ $I_1 = \frac{\begin{vmatrix} 6 & 6 \\ 10 & 14 \end{vmatrix}}{\begin{vmatrix} 16 & 6 \\ 6 & 14 \end{vmatrix}} = \frac{84 - 60}{224 - 36} = \frac{24}{188} = 0.128$ $I_2 = \frac{\begin{vmatrix} 16 & 6 \\ 6 & 10 \end{vmatrix}}{188} = \frac{160 - 36}{188} = \frac{124}{188} = 0.660$	4 4 4	12	
(b)	$96I_1 + 36I_2 = 36$ $96I_1 + 224I_2 = 160$ $\underline{188I_2 = 124}$ $I_2 = \frac{124}{188} = 0.660$	2 3		
	Sub into ② $6I_1 + 14(0.660) = 10$ $6I_1 = 10.24 - 9.24 = 1.0$ $I_1 = \frac{1.0}{6} = 0.167$	3	8	20

Exam Solutions/Mark Scheme

			Qu total
4.	SECTION B. $\begin{bmatrix} 1 & 0 \\ 1/60 & 1 \end{bmatrix} \begin{bmatrix} 1 & 40 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 & 40 \\ 1/60 & 14/6 \end{bmatrix}$ $\det T = (1 \times 14/6) - (40 \times 1/60) = 1$ $\begin{bmatrix} E_1 \\ I_1 \end{bmatrix} \cdot T \begin{bmatrix} E_2 \\ I_2 \end{bmatrix} = \begin{bmatrix} 1 & 40 \\ 1/60 & 14/6 \end{bmatrix} \begin{bmatrix} 110 \\ 4 \end{bmatrix} = \begin{bmatrix} 270 \\ 8.5 \end{bmatrix}$ $E_1 = 270 \text{ V} \quad I_1 = 8.5 \text{ A.}$	2,4 A 8 2	20