

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	1809801
2	Title of Examination Paper	Engineering maths
3	Module Code	SGEE 4002
4	Date and Time of Examination	13/5/2019 9:30
5	Examination Venue	C27
6	Seat Number	
7	Number of Answer Books handed in	

(Gweler yr ochr arall am y fersiwn Cymraeg)

[illegible]

Complete, fold and seal
(see note 2 below)

SURNAME: Williams

FORENAME(S): Kieran

Llyfr Atebion Arholiadau

12 Tudalen

Cyfarwyddiadau i Ymgeiswyr

1. Rhwch yr holl wybodaeth y gofynnir amdani yn y blychau isod.
2. Rhwch eich enw yn y lle a ddarparwyd ar y dde, plynwch ef a'i selio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

3. Rhaid i'r atebion fod mewn llawysgriflen ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgript annarllennadwy, neu drefnu lldd i gael ei theipio a chael yr ymgeisydd i dalu.
4. Ysgrifennwch eich atebion mewn inc.
5. Dechreuwch bob ateb ar dudalen newydd. Gwneuch unrhyw fras nodiadau yn y llyfr atebion a thynnwch llinell drwyddynt.
6. Ni ddylid rhwygo unrhyw ran o'r llyfr hwn; rhaid ei gyflwyno yn gyfan.
7. Os defnyddir mwy nag un llyfr, rhwymwch hwy gyda'i gilydd gan ddefnyddio'r tagiau sydd ar gael oddi wrth y gwyllwyr/gwylwyr.
8. Rhaid dychwelyd pob llyfr. Ni chaniateir mynd â llyfrau atebion, wedi eu defnyddio neu heb eu defnyddio, allan o'r lleoliad arholi o dan unrhyw amgylchriadu.

[illegible]

7	Nifer y Llyfrau Atebion a gyflwynwyd	
6	Rhif Sedd	
5	Lleoliad yr Arholiad	
4	Dyddiad ac Amser yr Arholiad	
3	Cod y Modwl	
2	Teitl y Papur Arholiad	
1	Rhif Myfyrwr	

(See the other side for English version)

Llenwch, plygwrch a seilwch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF:

$$\begin{aligned}
 \text{A 1)} \quad & 3(4y-3) - 5(2-3y) = 35 \\
 & 12y - 9 - 10 + 15y = 35 \\
 & 27y - 19 = 35 \\
 & 27y = 54 \\
 & y = \frac{54}{27} \quad y = 2
 \end{aligned}$$

5
5

$$2) \quad A = \begin{pmatrix} 3 & 2 \\ 1 & 3 \end{pmatrix} \quad B = \begin{pmatrix} -1 & 3 \\ 2 & 5 \end{pmatrix}$$

$$\begin{aligned}
 \text{(i)} \quad & 4B - 2A \\
 & = 4 \begin{pmatrix} -1 & 3 \\ 2 & 5 \end{pmatrix} - 2 \begin{pmatrix} 3 & 2 \\ 1 & 3 \end{pmatrix} \\
 & = \begin{pmatrix} -4 & 12 \\ 8 & 20 \end{pmatrix} - \begin{pmatrix} 6 & 4 \\ 2 & 6 \end{pmatrix} \\
 & = \begin{pmatrix} -10 & 8 \\ 6 & 14 \end{pmatrix}
 \end{aligned}$$

2

$$\begin{aligned}
 \text{(ii)} \quad & AB \\
 & = \begin{pmatrix} 3 & 2 \\ 1 & 3 \end{pmatrix} \begin{pmatrix} -1 & 3 \\ 2 & 5 \end{pmatrix} \\
 & = \begin{pmatrix} -3 & 6 \\ 2 & 15 \end{pmatrix}
 \end{aligned}$$

0

$$\begin{aligned}
 \text{(iii)} \quad & A^{-1} \\
 & A = \begin{pmatrix} 3 & 2 \\ 1 & 3 \end{pmatrix}
 \end{aligned}$$

$$A^{-1} = \frac{1}{7} \begin{pmatrix} 3 & -2 \\ -1 & 3 \end{pmatrix}$$

$$\begin{aligned}
 |A| &= (3 \times 3) - (2 \times 1) \\
 &= 7
 \end{aligned}$$

$$= \begin{pmatrix} 3/7 & -2/7 \\ -1/7 & 3/7 \end{pmatrix}$$

5

7
12

$$3) Z_1 = 3 - j5 \quad Z_2 = 2 + j3$$

$$(i) Z_1 - Z_2 \\ = (3 - j5) - (2 + j3) \\ = 1 - j8$$

$$(ii) Z_1 Z_2 \\ = (3 - j5)(2 + j3) \\ = 6 - j15$$

$$(iii) \frac{Z_1}{Z_2}$$

$$= \frac{(3 - j5)(2 - j3)}{(2 + j3)(2 - j3)} = \frac{6 - j9 - j10 + j^2 15}{2^2 + 3^2}$$

$$= \frac{6 - j19 - 15}{13} = \frac{-9 - j19}{13}$$

$$= -0.69 - j1.46$$

$$4) y = 3x^5 - \frac{4}{x^2} + \sqrt{x}$$

$$y = 3x^5 - 4x^{-2} + x^{1/2}$$

$$\frac{dy}{dx} = 15x^4 + 8x^{-3} + \frac{1}{2}x^{-1/2}$$

$$5) \int_2^3 (4 + 5t + 3t^2) dt = \left[4t + \frac{5t^2}{2} + \frac{3t^3}{3} \right]_2^3$$

$$= \left[4(3) + \frac{5(3)^2}{2} + \frac{3(3)^3}{3} \right] - \left[4(2) + \frac{5(2)^2}{2} + \frac{3(2)^3}{3} \right]$$

$$= 61.5 - 26 \\ = 35.5$$

$$B 1) \frac{6}{(x+1)(x-2)}$$

$$a) \frac{6}{(x+1)(x-2)} = \frac{A}{x+1} + \frac{B}{x-2}$$

$$6 = A(x-2) + B(x+1)$$

$$\text{make } x-2=0 \quad x=2$$

$$6 = A(0) + B(2+1)$$

$$6 = B(3)$$

$$B = \frac{6}{3} \quad B = 2$$

$$\text{make } x+1=0 \quad x=-1$$

$$6 = A(-1-2) + B(0)$$

$$6 = A(-3)$$

$$A = \frac{6}{-3} \quad A = -2 \quad \frac{6}{(x+1)(x-2)} = \frac{-2}{x+1} + \frac{2}{x-2}$$

$$\int_3^5 \frac{6}{(x+1)(x-2)} dx = \int_3^5 \left(\frac{-2}{x+1} + \frac{2}{x-2} \right) dx = \left[-2\ln(x+1) + 2\ln(x-2) \right]_3^5$$

$$= \left[-2\ln(5+1) + 2\ln(5-2) \right] - \left[-2\ln(3+1) + 2\ln(3-2) \right]$$

$$= -1.386 - (-2.773)$$

$$= 1.387$$

$$b) \text{ Trapezium Rule } A = h \left[\frac{1}{2} (y_0 + y_n) + y_1 + y_2 + y_3 + \dots \right]$$

$$h = \frac{5-3}{4} = 0.5$$

x	3	3.5	4	4.5	5
y	1.5	0.8	0.9	0.44	0.3
	y_0	y_1	y_2	y_3	y_n

- ①

$$\int_3^5 \frac{6}{(x+1)(x-2)} dx \approx 0.5 \left[\frac{1}{2} (1.5+0.3) + 0.8 + 0.6 + 0.44 \right]$$

$$\approx 1.35$$

2) $L_1: 4x + 2y - 6 = 0$
 $L_2: 3y - 6x = 3$

(i) $L_1: 4x + 2y - 6 = 0$
 $2y = -4x + 6$
 $y = -2x + 3$

gradient $m = -2$ intercept $c = 3$

ii) line perpendicular has a gradient m of $\frac{1}{2}$

$$m = \frac{1}{2} \quad x = 6 \quad y = 5$$

$$y = mx + c$$

$$5 = \frac{1}{2}(6) + c$$

$$5 = 3 + c$$

$$c = 2$$

$$\therefore y = \frac{1}{2}x + 2$$

b) $s = t^4 \sin 3t \quad t = 1.5$

let $u = t^4$ and $v = \sin 3t$

$$\frac{du}{dt} = 4t^3$$

$$\frac{dv}{dt} = 3 \cos 3t$$

$$\frac{ds}{dt} = \frac{d}{dt}(t^4 \sin 3t) = (t^4)(3 \cos 3t) + (\sin 3t)(4t^3)$$

$$= 3t^4 \cos 3t + 4t^3 \sin 3t$$

when $t = 1.5$

$$\frac{ds}{dt} = 3(1.5)^4 \cos(3 \times 1.5) + 4(1.5)^3 \sin(3 \times 1.5)$$

$$= 16.2$$

7
 $\frac{19}{20}$

3

4

5

c) $i = 2(3 - e^{-10t})$

$$i = 6 - 2e^{-10t}$$

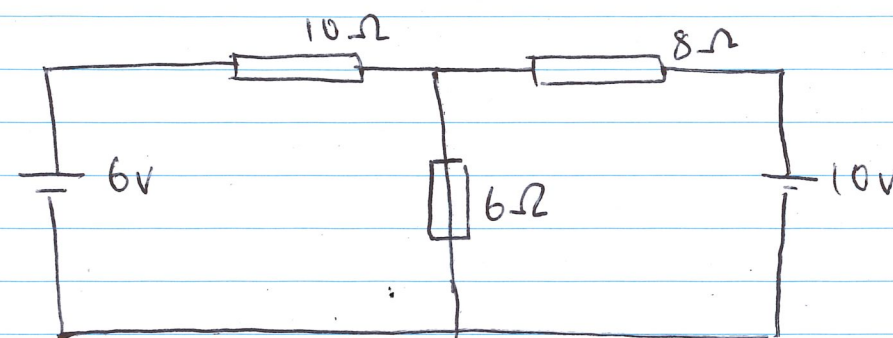
$$\frac{di}{dt} = 20e^{-10t}$$

when $t = 0$

$$\frac{di}{dt} = 20e^{-10 \times 0}$$

$$= 20$$

3)



$$\text{loop 1: } 10I_1 + 6(I_1 + I_2) = 6$$

$$\text{loop 2: } 8I_2 + 6(I_1 + I_2) = 10$$

$$16I_1 + 6I_2 = 6 \quad (1)$$

$$6I_1 + 14I_2 = 10 \quad (2)$$

Cramers rule:

$$I_1 = \frac{\begin{vmatrix} 6 & 6 \\ 10 & 14 \end{vmatrix}}{\begin{vmatrix} 16 & 6 \\ 6 & 14 \end{vmatrix}} = \frac{84 - 60}{224 - 36} = 0.13 \text{ A}$$

$$I_2 = \frac{\begin{vmatrix} 16 & 6 \\ 6 & 10 \end{vmatrix}}{\begin{vmatrix} 16 & 6 \\ 6 & 14 \end{vmatrix}} = \frac{160 - 36}{224 - 36} = 0.66 \text{ A}$$

6
 $\frac{18}{20}$

12

b)

$$16I_1 + 6I_2 = 6 \quad \textcircled{1} \quad \times 6$$

$$6I_1 + 14I_2 = 10 \quad \textcircled{2} \quad \times 16$$

$$96I_1 + 36I_2 = 36$$

$$- 96I_1 + 224I_2 = 160$$

$$-188I_2 = -124$$

$$I_2 = \frac{-124}{-188} I_2 = 0.68 \text{ A}$$

Sub I_2 into ①

$$16I_1 + 6(0.68) = 6$$

$$16I_1 + 4.08 = 6$$

$$16I_1 = 1.92$$

$$I_1 = \frac{1.92}{16} \quad I_1 = 0.12 \text{ A}$$

$$\frac{19}{20}$$