



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.

Complete, fold and seal
(see note 2 below)

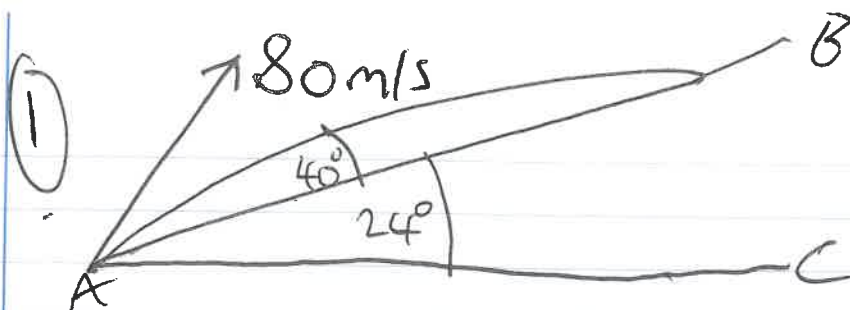
SURNAME: EVANS

FORENAME(S): Kieran,
Anthony

1	Student Number	1603323/1
2	Title of Examination Paper	Dynamics, control and Instrumentation
3	Module Code	GOAC 4005-006 ~~MAK011005~~
4	Date and Time of Examination	16 th May 2018
5	Examination Venue	Tycoch College Main Hall
6	Seat Number	6
7	Number of Answer Books handed in	1

List the numbers of the questions you have attempted	Office Use
Q ₁	10
Q ₂	7
Q ₃	2
Q ₄	14
Q ₅	8
Q ₆	3
Total	44

63% ✓



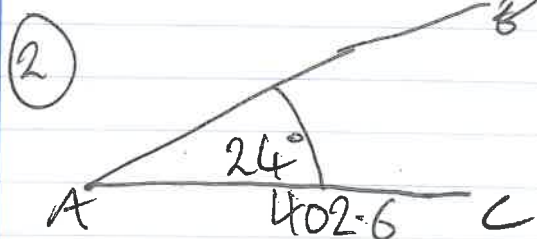
$T =$
 $S = u \cdot t + \frac{1}{2} \cdot a \cdot t^2$
 $S = 80 \sin(40) \cdot t + \frac{1}{2} \cdot -9.81 \cos(24) \cdot t^2$
 $x = t(80 \sin(40) \cdot t + \frac{1}{2} \cdot -9.81 \cos(24))$
 $t = 0$
 $t = \frac{80 \sin(40)}{4.905 \cos(24)}$
 $T = 11.48$ ✓

	Horizontal	on the plane	90° to plane
U	$80 \cos(64)$	$80 \cos(40)$	$80 \sin(40)$
V	$80 \cos(64)$	$-9.81 \cos(24)$	$-9.81 \cos(24)$
A			
T	11.48	11.48	11.48
S	① 402.6	② 440.7	0

⑥ ✓



$$11.48 \times 80 \cos(64) = 402.6 \text{ m}$$



$$402.6 \div \cos(24) = 440.7$$

cmets. ✓

$$BC = 440.7 - 402.6 = 38.1$$

④ ✓

2) A $S = 17t^2 + 10t$
 B $S = 9t^2 + 30$

a) A twice of B

(A) $17t^2 + 10t$
 $34t + 10$ $\frac{ds}{dt}$ (B) $9t^2 + 30$
 $18t$ $\frac{ds^2}{dt^2}$ 18

(A) $34t + 10$
 $34t + 10$
 $34t$
 t

(B) $(\times 2) 18$
 36
 $(-10) = 26$
 $(\div 34) = 26 \div 34 = 0.76 \quad t = \underline{0.76}$

b) $t=0$ and $t=4$

(A) $17t^2 + 10t$
 (0) $17 \cdot 0^2 + 10 \cdot 0 = 0$
 (4) $17 \cdot 4^2 + 10 \cdot 4 = 312$

Travelled between $= 312 - 0$
 $= \underline{312}$

(B) $9t^2 + 30$
 (0) $9 \cdot 0^2 + 30 = 30$
 (4) $9 \cdot 4^2 + 30 = 174$

Travelled between
 $174 - 30$
 $= \underline{144}$

c) After 3 seconds for Particle (A)

(A) $17t^2 + 10t$

$\frac{dv}{dt} = 34t + 10$
 $= 34 \text{ m/s}^2$

$$(5) 2s^5 + 3s^4 + 2s^3 + s^2 - s + 4$$

	A	B	C	D
s^5	2	2	-1	0
s^4	3	1	4	0
s^3	1.33	~~1.66~~	0	0
s^2	9.26	-3.66	0	0
s^1	-4.23	4	0	0
s^0	~~1.23~~	4	0	0

$$-\begin{vmatrix} a & b \\ c & d \end{vmatrix} / c$$

$$-(ad-bc) \div c$$

$$s^3 A = -\frac{(2 \times 1 - 2 \times 3)}{1.33} = \frac{-4}{1.33} = -3.01$$

$$s^3 B = -\frac{\begin{vmatrix} 3 & 2 \\ 2 \times 4 - 1 \times 3 \end{vmatrix}}{1.33} = \frac{-3}{1.33} = -2.26$$

$$s^2 A = -\frac{\begin{vmatrix} 3 & 1 \\ 3 \times 0 - 1 \times 1.33 \end{vmatrix}}{1.33} = \frac{1.33}{1.33} = 1$$

$$s^2 B = -\frac{(3 \times 0 - 4 \times 1.33)}{1.33} = \frac{-5.32}{1.33} = -4$$

$$s^1 A = -\frac{(1.33 \times 4 - 3.66 \times 9.26)}{9.26} = \frac{-4.23}{9.26} = -0.457$$

$$s^1 B = 0$$

$$s^0 A = -\frac{(9.26 \times 0 - 4 \times -4.23)}{-4.23} = \frac{16.92}{-4.23} = -4$$

here we have an unstable pole zero diagram. We can tell this from column A. In column A we have 2 changes, from positive to negative and back to positive. There would be 1 pole in the right hand plane on the diagram.

(4)

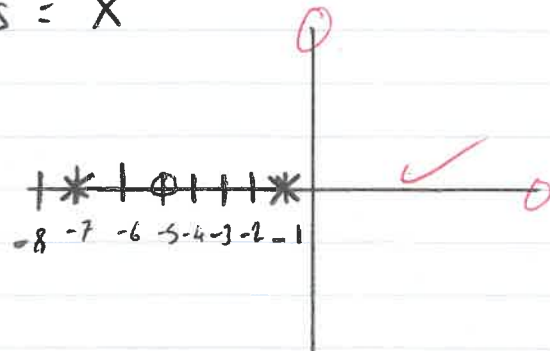
$$\frac{s+5}{s^2 + 8s + 7}$$

a) zeros + poles.

$$\frac{s+5}{(s+7)(s+1)} \quad \text{zeros} = 0 \quad \text{Poles} = X$$

$$\begin{aligned} 7 \times 1 &= 7 \\ 7 + 1 &= 8 \end{aligned}$$

Stable as all poles are situated on the left of the pole zero diagram/graph.



b) D.C.

$$\frac{s=0}{(0+7)(0+1)} = \frac{5}{(7)(1)} = \frac{5}{7}$$

c) magnitude input is (3)

$$\frac{1}{s} \frac{s+5}{(s+7)(s+1)} \rightarrow \frac{3}{s} \frac{s+5}{(s+7)(s+1)}$$

$$3(s+5) = A(s+7)(s+1) + B s(s+1) + C s(s+7)$$

$$\begin{aligned} \text{A) } s=0 \\ 3(0+5) &= (0+7)(0+1) \\ 3(5) &= (7)(1) \\ 15 &= 7 \end{aligned}$$

$$A = \frac{15}{7}$$

$$\begin{aligned} \text{B) } s=-7 \\ 3(-7+5) &= -7(-7+1) \\ 3(-2) &= -7(-6) \\ -6 &= 42 \end{aligned}$$

$$B = \frac{-6}{42}$$

$$\begin{aligned} \text{C) } s=-1 \\ 3(-1+5) &= -1(-1+7) \\ 3(4) &= -1(6) \\ 12 &= -6 \end{aligned}$$

$$C = \frac{12}{-6}$$

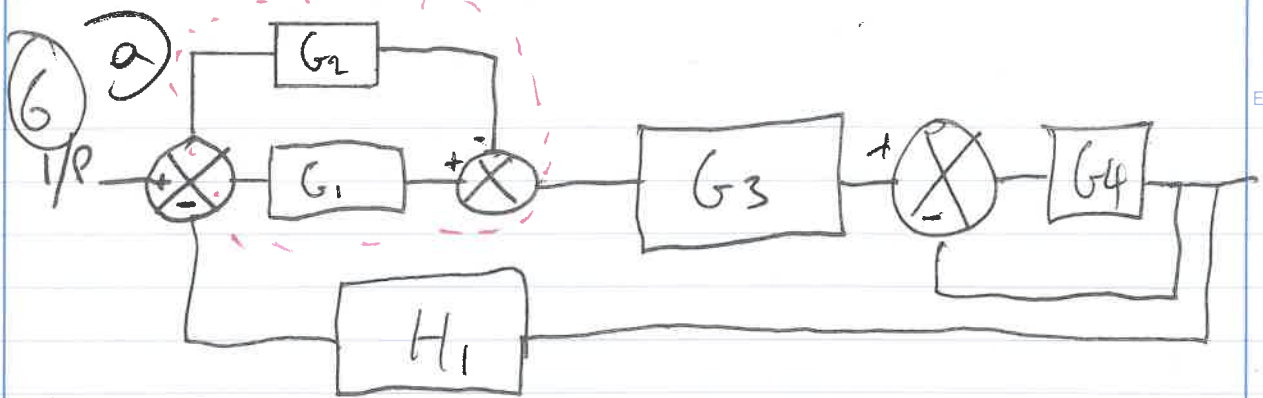
	A	B	C
$\mathcal{L}^{-1}$	$\frac{15}{7}$	$-\frac{6}{42}$	$-\frac{12}{6}$
	$\frac{15}{7}(s)$	$-\frac{6}{42}(s+7)$	$-\frac{12}{6}(s+1)$
		e^{-7t}	e^{-1t}
$\mathcal{L}$	~~$\frac{15}{7}$~~	$-\frac{6}{42}$	$-\frac{12}{6}$

$t=2$ seconds.

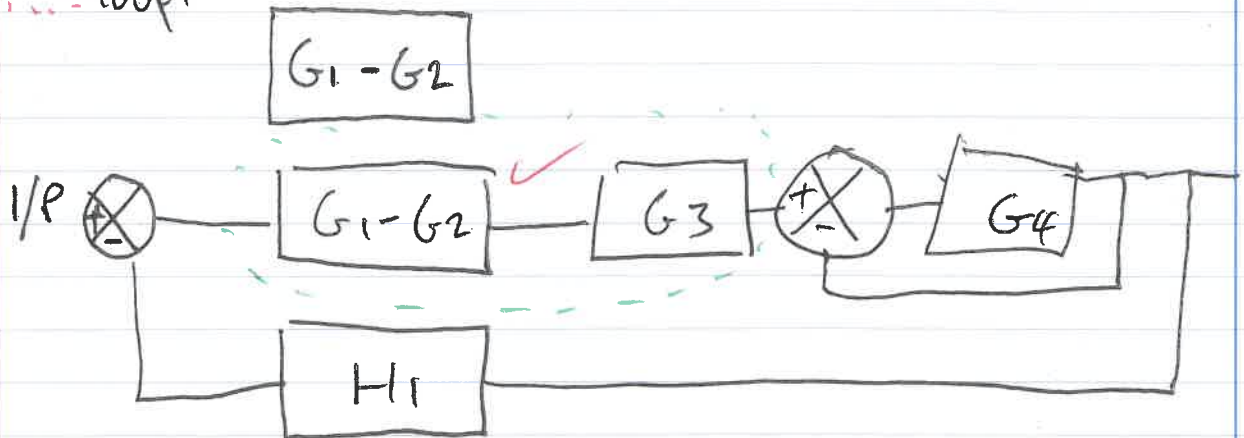
$\mathcal{L}$	$\frac{15}{7}$	$-\frac{6}{42}$	$-\frac{12}{6}$
		$e^{-(7 \times 2)}$	$e^{-(1 \times 2)}$
		e^{-14}	e^{-2}

$\mathcal{L}$	$\frac{15}{7}$	$-\frac{6}{42}$	$-\frac{12}{6}$
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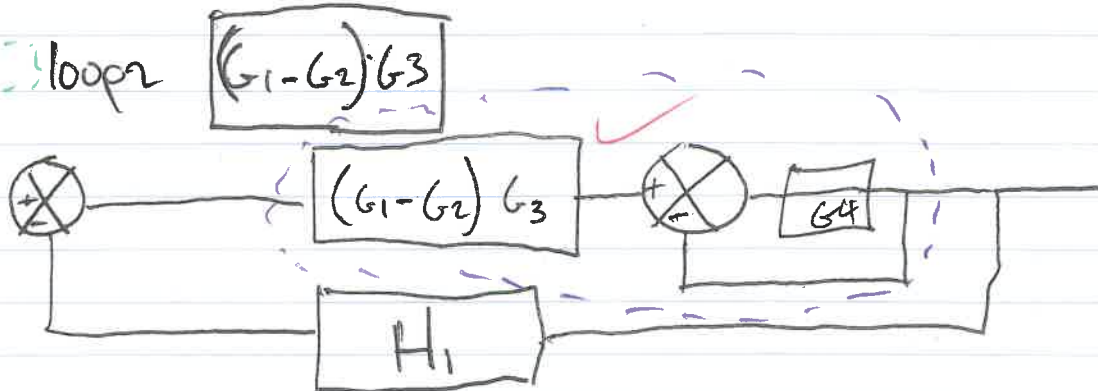
7 ✓



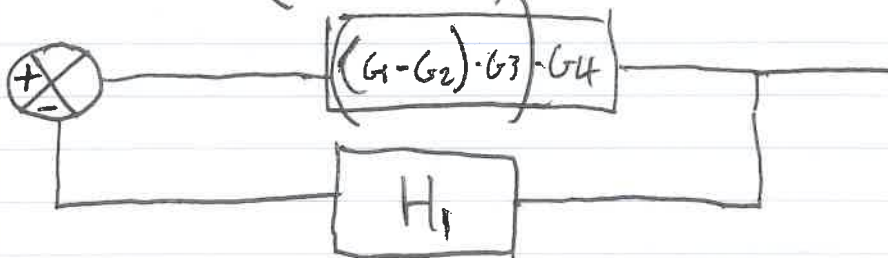
loop 1



loop 2



loop 3

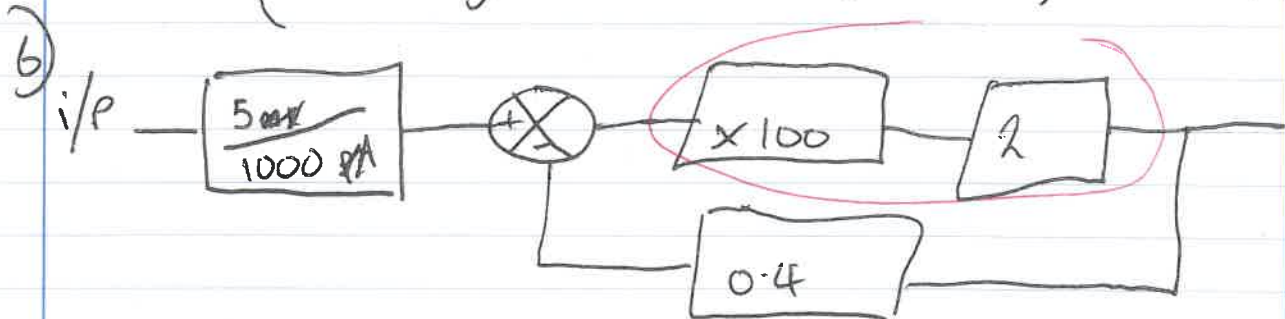


$$\frac{((G_1 - G_2) \cdot G_3) \cdot G_4}{1 + H_1 \cdot ((G_1 - G_2) \cdot G_3) \cdot G_4}$$

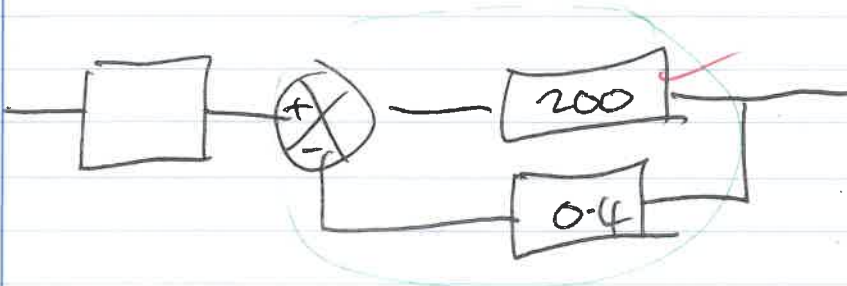
6

2 ✓

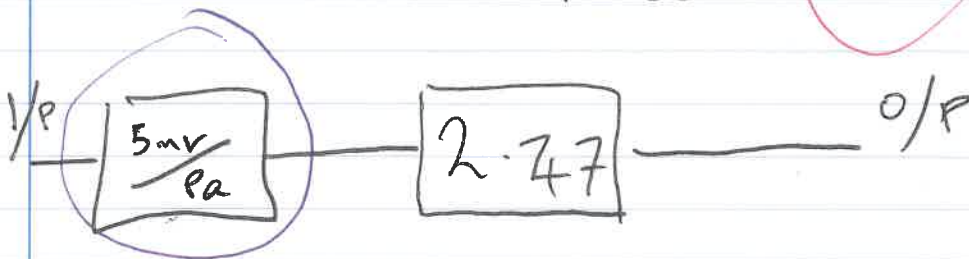
$$\frac{\left(\frac{(G_1 - G_2) \cdot G_3}{1 + H_1} \right) \cdot G_4}{1 + H_1 \left(\frac{(G_1 - G_2) \cdot G_3}{1 + H_1} \right) \cdot G_4 + 1 + H_1 \left(\frac{(G_1 - G_2) \cdot G_3}{1 + H_1} \right) \cdot G_4}$$



loop 1 = $100 \times 2 = 200$



loop 2 $\frac{200}{1 + 0.4 \times 200} = 2.47$



loop 3 $5 \text{ mV} \div 1000 \text{ Pa} = \frac{1}{200}$

$\frac{1}{200} \times 2.47 = 0.01235^\circ$

✓
①

3

F=ma

$$3Kx - 2c\dot{x} - M\ddot{x}$$

(fip)

$$M\ddot{x} + 2c\dot{x} + 3Kx$$

$$\mathcal{L} = M\cancel{s^2\ddot{x}} + 2c\cancel{s\dot{x}} + 3K\cancel{x}$$

$$\mathcal{L} = Ms^2 + 2cs + 3K$$

$$\frac{XF}{TF} = \frac{1}{s^2 + 2s + 3}$$

$$\frac{1}{s^2 + 2s + 3}$$

$$\frac{1}{(s-1)(s+3)}$$

$$\frac{\omega_n}{s^2 + s\omega_n + \omega_n^2}$$

$$B) m=4, c=3 \text{ and } k=10$$

$$Ms^2 + 2cs + 3k$$

$$4s^2 + (2 \cdot 3)s + 3 \cdot 10$$

$$4s^2 + 6s + 30$$

H₂