



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: MATHEWS

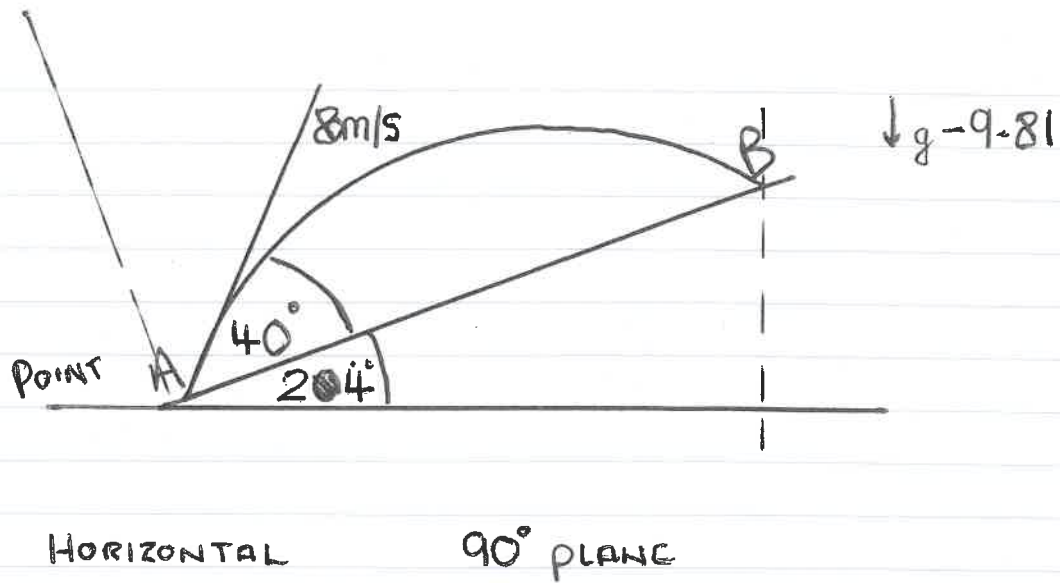
FORENAME(S): JASON ELLIS

1	Student Number	1603331 / 1 ~~MAT01043543~~
2	Title of Examination Paper	DYNAMICS & INSTRUMENTATION
3	Module Code	GOAC4005-006
4	Date and Time of Examination	16/5/2018 14:00
5	Examination Venue	G.C. SWANSEA
6	Seat Number	11
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
Q1	10
Q2	10
Q3	15
Q4	15
Q5	10
Q6	1
Total	61

87% ✓

Q 1



V	80 cos 64	
u	80 cos 64	80 sin 24
t	0	11.47
a	-	-9.81 cos
s		←

a) Use $S = ut + \frac{1}{2} at^2$

∴

- $S = (80 \sin 40)t + \frac{1}{2} -9.81 \cos 24 (t)^2 = 0$
- $S = t(80 \sin 40) + -4.905 \cos 24 (t)$
- $t = \frac{80 \sin 40}{4.905 \cos 24} = 11.47 \text{ (s)}$ ✓

6 ✓

b) Use $S = ut + \frac{1}{2} a t^2$

∴

- $S = 80 \cos 40 \times 11.47 + \frac{1}{2} -9.81 \sin 24 (t)^2$
- $80 \cos 40 \times 11.47 = 702 + -4.905 \sin 24 (t)^2$
- $702.9 - 262.46 = 440 \text{ m}$ ✓

↑
702.9

4 ✓

Q2 A $S = 17t^2 + 10t$

B $S = 9t^2 + 30$

a)

A $\frac{ds}{dt} = 34t + 10$

B $\frac{ds}{dt} = 18t$

$$34t + 10 = 18t (x2) = 36t$$

$$\begin{array}{r} 34t + 10 = 36t \\ \hline 10 = 2t \end{array}$$

$$10 = 2$$

$$\frac{10}{2} = 5t(s) \quad \checkmark$$

5.

b) 0(s) A = $17(0)^2 + 10(0) = 0$

4(s) A = $17(4)^2 + 10(4) = 312 \quad \checkmark$

0(s) B = $9(0)^2 + 30 = 30$

4(s) B = $9(4)^2 + 30 = 174 \quad \checkmark$

• $174 - 30 = 144 \quad \checkmark$

2

2

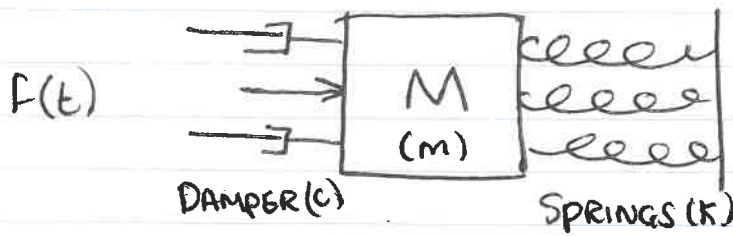
c) 34 (s) 102 Acceleration

34

✓

1

3



Applied $-2c - 3K = m\ddot{x}$ $f = m\ddot{x}$

$$f = m\ddot{x} + 2c\dot{x} + 3Kx$$

$$F(s) = ms^2X(s) + 2c sX(s) + 3KX(s)$$

$$F(s) = X(s) (ms^2 + 2cs + 3K)$$

$$\frac{X(s)}{F(s)} \text{ OUTPUT} = \frac{1}{ms^2 + 2cs + 3K}$$

GIVEN THAT $M=5$, $C=3$, $K=10$

$$\frac{1}{5s^2 + 6s + 30}$$

$$\frac{\frac{1}{5}}{s^2 + \frac{6s}{5} + \frac{30}{5}}$$

$$\omega_n^2 = \frac{30}{5}$$

$$\therefore \omega_n = \sqrt{\frac{30}{5}} = 2.44 \text{ RAD/SEC}$$

$$\frac{2.44}{2\pi} = \text{Hz}$$

c)

$$2 \zeta \omega_n = \frac{6}{5}$$

$$\therefore \zeta = \frac{6}{2 \times 5 \times 2.44} = 0.245 \quad \checkmark$$

d) THIS SYSTEM IS UNDER DAMPED. BELOW 1 ✓

3 ✓

1 ✓

$$G_s = \frac{(s+5)}{s^2+8s+7}$$

$$a \quad \frac{s+5}{(s+7)(s+1)}$$



POLES
ZEROS

$$\frac{-5}{(-7)(-1)}$$

• All poles are in the left hand side of plane. This system is **STABLE**

b) Make $s = 0$

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

$$c. \quad \frac{A}{s} + \frac{B}{(s+7)} + \frac{C}{(s+1)}$$

$$\frac{3(s+5)}{s(s+7)(s+1)} = \frac{A(s+7)(s+1) + Bs(s+1) + Cs(s+7)}{s(s+7)(s+1)}$$

Say $s = 0$

$$\frac{3(0+5)}{(7)(1)} = \frac{15}{7} \quad A = \frac{15}{7}$$

Say $s = -7$

$$\frac{3(-7+5)}{(-7)(-7+1)} = \frac{-6}{42} \quad B = \frac{-6}{42}$$

Say $s = -1$

$$\frac{3(-1+5)}{(-1)(-1+7)} = \frac{12}{-6} \quad C = \frac{12}{-6}$$

$$\begin{aligned}
 & \frac{15}{7} - \frac{6}{42(s+7)} - \frac{12}{6(s+1)} \\
 & \frac{15}{7} - \frac{6}{42} e^{-7t} - \frac{12}{6} e^{-t} \\
 & \frac{15}{7} - \frac{6}{42} e^{-14} - \frac{12}{6} e^{-2} = 1.87
 \end{aligned}$$

Q5. $2s^5 + 3s^4 + 2s^3 + s^2 - s + 4$

s^5	2	2	-1	0
s^4	3	1	4	0
s^3	1.3	-3.6	0	0
s^2	9.3	4	0	
s^1	-4.15	0		
s^0	4	0		

- $-\left(\frac{(2 \times 1) - (3 \times 2)}{3}\right) = 1.3$
- $-\left(\frac{(2 \times 4) - (3 \times -1)}{3}\right) = -3.6$
- $-\left(\frac{(2 \times 0) - (3 \times 0)}{3}\right) = 0$
- $-\left(\frac{(3 \times -3.6) - (1.3 \times 1)}{1.3}\right) = 9.3$
- $-\left(\frac{(3 \times 0) - (1.3 \times 4)}{1.3}\right) = 4$
- $-\left(\frac{(1.3 \times 4) - (9.3 + -3.6)}{9.3}\right) = -4.15$
- $-\left(\frac{(9.3 \times 0) - (-4.15 \times 4)}{-4.15}\right) = 4$

THERE ARE 2 POLES IN THE RIGHT HAND SIDE OF THE PLANE. AS WE CAN SEE IN THE FIRST COLUMN IT HAS CHANGED FROM A POSITIVE TO A NEGATIVE THEN BACK TO A POSITIVE.



5
4
3
2
1
0

2

3

1.3

9.3

-4.15

4

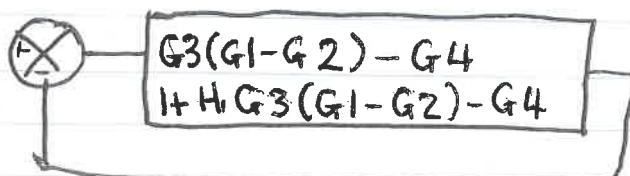
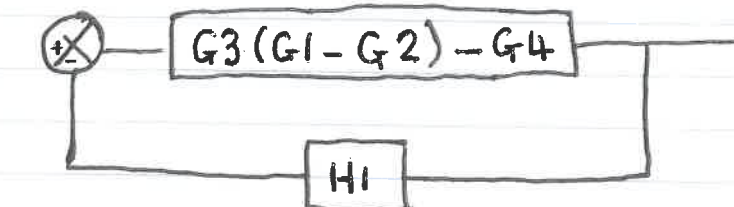
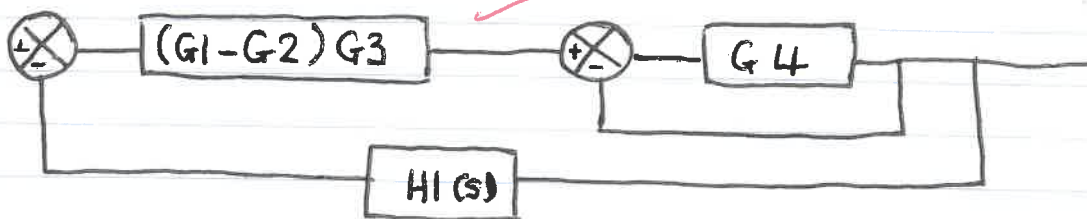
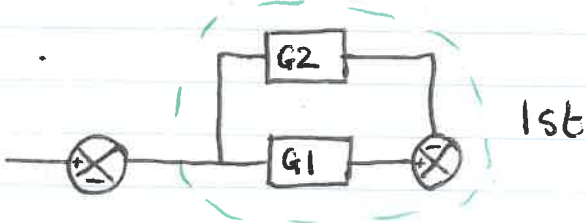
POSITIVE TO NEGATIVE

NEGATIVE TO POSITIVE.

10

STUDENT PEN.

Q6 a) Simplify



1

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

$$b) \frac{(\text{Amplifier} \times 100)(2 \text{ deg/V})}{1 + H_1 (0.4 \text{ mV/deg})} = 500$$

$$5 \text{ mV} \times 500 = 2500$$

$$100 \times 0.4 \times 5 = 200^\circ$$

✗
✗