



Complete, fold and seal
(see note 2 below)

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.**

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FORENAME(S): Buthaina

1	Student Number	1809248/1
2	Title of Examination Paper	~~fluid~~ Dynamics control and instrumentation
3	Module Code	M4X01405
4	Date and Time of Examination	15/05/2019
5	Examination Venue	Gower college
6	Seat Number	12
7	Number of Answer Books handed in	

List the numbers of the questions you have attempted	Office Use
Q1	4 ✓
Q2	2 ✓
Q3	15 ✓
Q4	12 ✓
Q5	6 ✓
Q6	5 ✓
Total	44 ✓ 63%

Question 2

A)

	Vertical	H	Plan $\perp$
S			
u	$80 \sin 64^\circ$ ✓	$80 \cos 64^\circ$ ✓	$80 \sin 40^\circ$ ✓
v		$80 \cos 64^\circ$ ✓	
A	-9.81		$-9.81 \cos 24^\circ$ ✓
T			10.49

 $\perp$

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

$$0 = 80 \sin 40^\circ t + \frac{1}{2} (-9.81) t^2$$

$$= T (80 \sin 40^\circ + \frac{1}{2} (-9.81) t) \underline{\cos 24^\circ}$$

$$= 80 \sin 40^\circ + (-4.91) t \underline{\cos 24^\circ}$$

$$= 80 \sin 40^\circ - 4.91 t \underline{\cos(24^\circ)}$$

$$\frac{4.91 t}{4.91} = \frac{80 \sin 40^\circ}{4.91 (\cos(24^\circ))}$$

$$T = 10.49 \text{ s}$$

$$\begin{aligned} \text{B)} \quad & 10.49 \times \cos 64^\circ \\ & = 4.6 \end{aligned}$$

Two

$$A \quad S = 24t^2 + 18t - 17$$

$$B \quad S = 14t^2 + 5t + 25$$

$$A) \quad \text{Velocity of A} = 48t + 18$$

$$48t + 18 = 3(14t^2 + 5t + 25)$$

$$48t + 18 = 42t^2 + 15t + 75$$

$$42t^2 - 48t + 15t + 75 - 18 = 0$$

$$42t^2 - 33t - 57 = 0$$

$$42t^2$$

$$(7t - 1)(6t + 5)$$

$$b) \quad T = 0$$

$$A) \quad S = 24(0)^2 + 18(0) - 17$$

$$= 25 \quad \times$$

$$B) \quad S = 14(0)^2 + 5(0) + 25$$

$$= 25 \quad \times$$

$$T = 4$$

$$A) \quad S = 24(4)^2 + 18(4) - 17$$

$$= 439 \quad \times$$

$$B) \quad S = 14(4)^2 + 5(4) + 25$$

$$269$$

$$\text{Distance of A} = 439 - 25$$

$$= 414$$

$$B = 269 - 44$$

$$= 225$$

c) The acceleration

$$A) \quad s = 24t^2 + 18t - 17$$

$$\frac{ds}{dt} = 48t + 18$$

$$\frac{d^2s}{dt^2} = 48 \text{ m s}^{-2}$$



$$B) \quad s = 14t^2 + 5t + 25$$

$$\frac{ds}{dt} = 28t + 5$$

$$\frac{d^2s}{dt^2} = 28$$

Three

A)

$$\frac{1}{6s^2 + (3+3)s + (8+8+8)}$$

$$= \frac{1}{6s^2 + 6s + 24}$$

$$= \frac{\frac{1}{m}}{(ms^2) + (c_1 + c_2 + c_v)s + (k_1 + k_2 + k_v) \frac{1}{m}}$$

$$TF = \frac{\frac{1}{6}}{s^2 + \frac{6}{6}s + \frac{24}{6}}$$

$$= \frac{\frac{1}{6}}{s^2 + s + 4}$$

b)

$$\frac{\frac{1}{6}}{s^2 + 2\zeta s \omega_n + \omega_n^2}$$

we transfer it to

$$\omega_n^2 = 4$$

$$\omega_n = \sqrt{4} = 2$$

$$F = \frac{\omega_n}{2\pi}$$

$$= \frac{2}{2\pi}$$

$$= 0.31 \text{ Hz}$$

$$c) \quad 2\zeta s \omega_n = 1s$$

$$2\zeta s 2 = 1$$

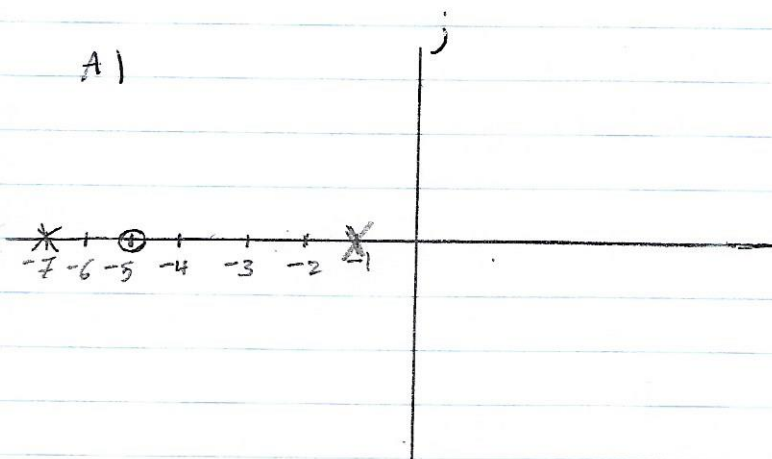
$$\zeta = \frac{1}{4}$$

$$\zeta = 0.25$$

d) because $\zeta < 1$ so the system is under damped

Four

A)



it is stable

b) The DC response

if $s = 0$

$$s^2 + 8s + 7$$

$$s + 5$$

$$0 + 5$$

$$\begin{aligned} (0)^2 + 8(0) + 7 \\ = 7 \end{aligned}$$

$$\frac{5}{7} = 0.71$$

$$c) \quad G(s) = \frac{s+5}{s^2+8s+7}$$

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

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

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

$$= \frac{A}{s} + \frac{B}{(s+7)} + \frac{C}{(s+1)}$$

$$= \frac{A(s+7)(s+1) + B[s](s+1) + C[s](s+7)}{s(s+7)(s+1)}$$

$$\text{if } s = 0$$

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

$$3s+15 = 7A + 0 + 0$$

$$7A = \frac{50}{7}$$

$$A = 7.14$$

$$\text{if } s = -7$$

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

$$-21+15 = 0 + 42B + 0$$

$$-21+15 = 42B$$

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

$$B = -0.14 \quad \checkmark$$

$$\text{if } s = -1$$

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

$$-3+15 = 0 + 0 + 6C$$

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

$$C = -2 \quad \checkmark$$

$$\frac{3(s+5)}{(s+7)(s+1)} = \frac{7.14(s+5)}{(s+7)(s+1)} - \frac{0.14(s+5)}{(s+7)(s+1)} - \frac{2(s+5)}{(s+7)(s+1)}$$

$$= \frac{7.14}{s+7} - 0.14 - \frac{2}{s+1}$$

$$= -14.57$$

Five

$$A) \quad 2s^5 + 3s^4 + 2s^3 + s^2 - s + 4$$

s^5	2	2	-1	0	✓	✓
s^4	3	1	4	0	✓	
s^3	1.3 ✓	-1.6	0			
s^2	4.85	4	0			
s^1	-2.67 ✓	0				
s^0						

(2) ✓

(1) ✓

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

$$= \frac{- [(2 \times 1) - (2 \times 3)]}{3}$$

$$= \frac{4}{3}$$

$$= 1.3$$

$$B = \frac{- \begin{vmatrix} 2 & -1 \\ 3 & 4 \end{vmatrix}}{3}$$

$$= \frac{- [8 + 3]}{3}$$

$$= \frac{-11}{3}$$

$$= -1.6$$

correct method.

(2) ✓

$$s^2 / A = \frac{- \begin{vmatrix} 3 & 1.3 \\ 1.3 & -1.6 \end{vmatrix}}{1.3}$$

$$= \frac{- [-5 - 1.3]}{1.3}$$

$$= \frac{6.3}{1.3}$$

$$= 4.85$$

$$B) = \frac{- \begin{vmatrix} 3 & 4 \\ 1.3 & 0 \end{vmatrix}}{1.3}$$

$$= \frac{- [0 - 5.2]}{1.3}$$

$$= \frac{5.2}{1.3}$$

$$= 4$$

$$s^1 / \begin{array}{r} A) = \frac{- \begin{vmatrix} 1.3 & -1.6 \\ 4.85 & 4 \end{vmatrix}}{4.85} \end{array}$$

$$= \frac{- \begin{vmatrix} 5.2 + 7.76 \end{vmatrix}}{4.85}$$

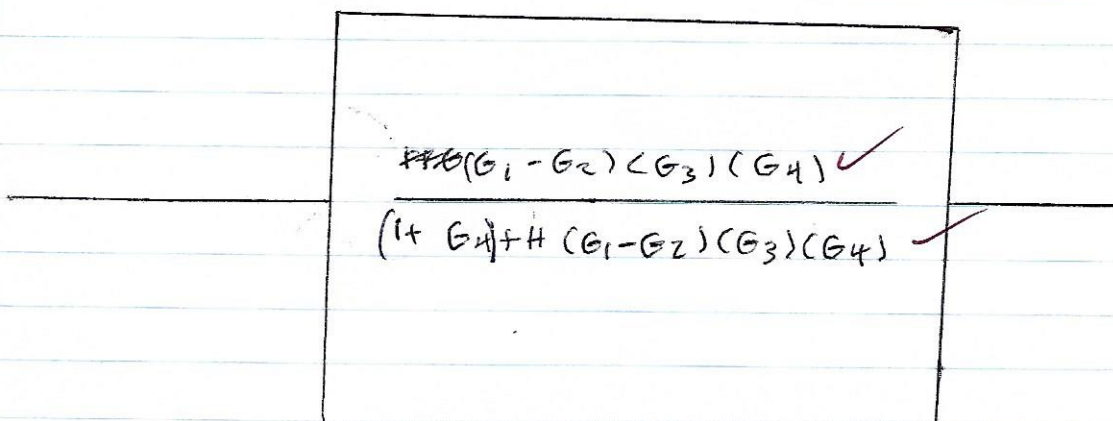
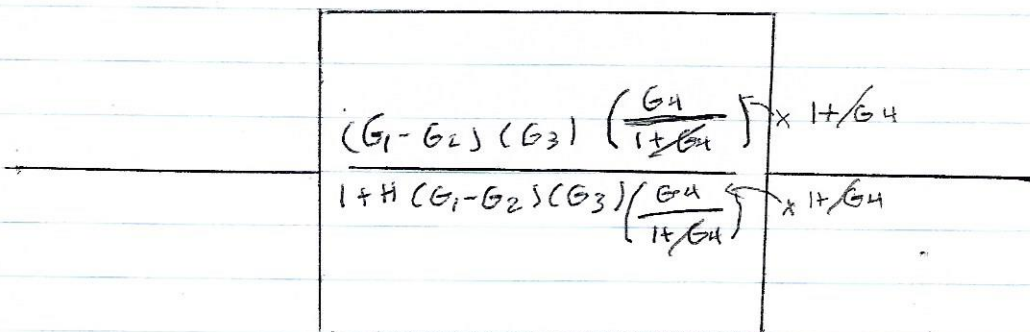
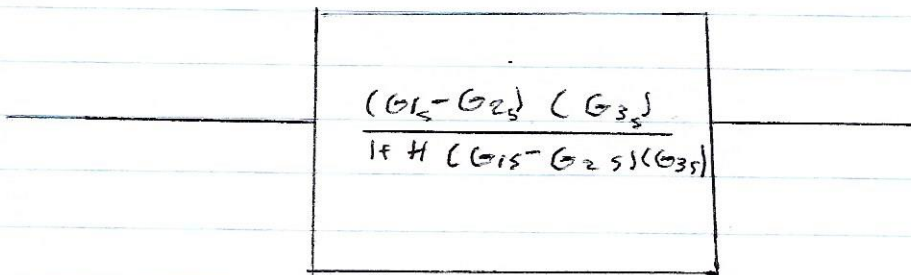
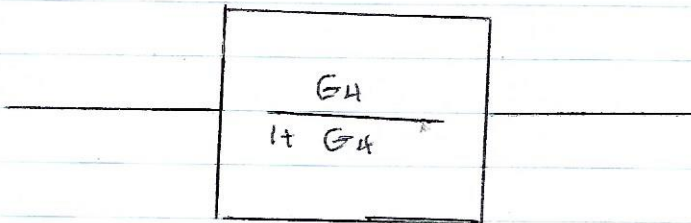
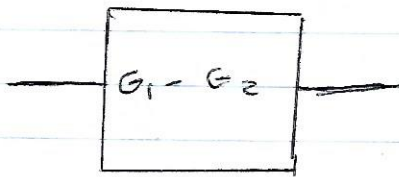
$$= \frac{-12.96}{4.85}$$

$$= -2.67$$

it is an stable



A) six



5 ✓

b)

$$\frac{100 \times 2}{0.4 \times 100 \times 2 + 1}$$

$$= 185.185 \times 1000$$

✗

$$185.19 \text{ K}$$