



12 Pages

Complete, fold and seal
(see note 2 below)

SURNAME: Arman

FORENAME(S): Bailey

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	ARM22874486
2	Title of Examination Paper	Dynamics
3	Module Code	GOEE4002
4	Date and Time of Examination	13/05/25 9:30
5	Examination Venue	Tycoch main hall
6	Seat Number	C10
7	Number of Answer Books handed in	1

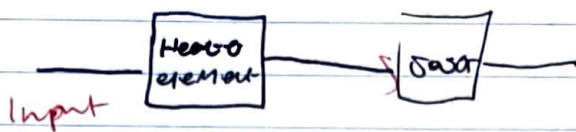
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RK



Q1 a)

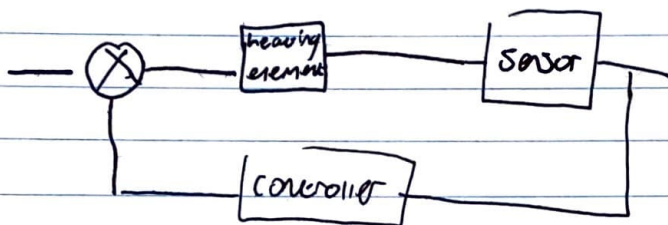
i)



ii) open loop systems The open-loop system will not respond as it has no feedback loop to do so.

1

b)

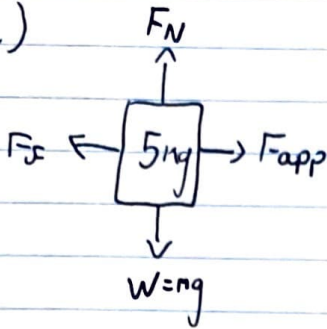


c)

i)

Q2)

a)



$$F_{\text{net}} = F_{\text{app}} - F_f$$

$$F_f = \mu mg$$

$$F_f = 0.3 \times 5 \text{ kg} \times 9.81 \text{ m/s}^2$$

$$F_f = 14.715 \text{ N}$$

$$F_{\text{net}} = 40 \text{ N} - 14.715 \text{ N}$$

Error carried
forward

$$F_{\text{net}} = 25.285 \text{ N}$$

$$F = ma \Rightarrow \frac{F}{m} = a = \frac{25.285 \text{ N}}{5 \text{ kg}}$$

$$a = 5.057 \text{ m/s}^2$$

b)

$$\text{i) } F_d = -6 \text{ V} \Rightarrow F_d = -0.5 \text{ N s/m} \times 2 \text{ m/s}$$

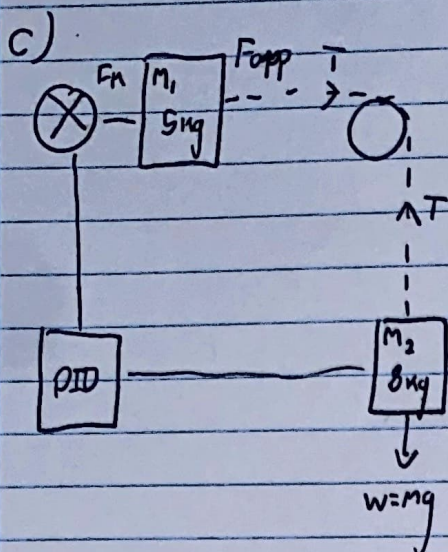
$$F_d = -1 \text{ N}$$

$$F_{\text{ss}} = |F_d| + F_f$$

$$F_{\text{ss}} = 1 \text{ N} + 14.715 \text{ N} = 15.715 \text{ N}$$

ii)

$$G(0) = \frac{1}{m(0)+b} \Rightarrow \frac{1}{0.5 \text{ N s/m}} = 2 \text{ m/N s}$$



Block 1

$$F_{app} - F_k - T = m_1 a$$

$$40\text{N} - 14.715\text{N} - T = 5\text{kg} \times 2\text{m/s}^2$$

$$25.285\text{N} - T = 10\text{N}$$

$$-T = -15.285\text{N}$$

Block 1

$$F_{app} - F_k - T = m_1 a$$

$$F_{app} - 14.715\text{N} - T = 10\text{N}$$

$$F_{app} - T = 24.715\text{N}$$

$$F_{app} = 87.195\text{N}$$

Block 2

$$W - T = m_2 a$$

$$78.48\text{N} - T = 16\text{N}$$

$$-T = -62.48\text{N}$$

$$T = 62.48\text{N}$$

.....

d)

$$0.01\text{V/m}$$

$$2\text{m/s} \times 5\text{s} = 10\text{m}$$

State the formula

$$0.01\text{V/m} \times 10\text{m} = 0.1\text{V}$$

Q3) a)

$$G(s) = \frac{(s+3)}{(s+4)(s^2+3s+6)}$$

$$\text{Zeros } (z_1) \Rightarrow (s+3) = 0$$

$$z_1 \Rightarrow s = -3 \checkmark$$

$$\text{poles } (p_1) \Rightarrow (s+4) = 0$$

$$p_1 \Rightarrow s = -4 \checkmark$$

$$p_2 \Rightarrow \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

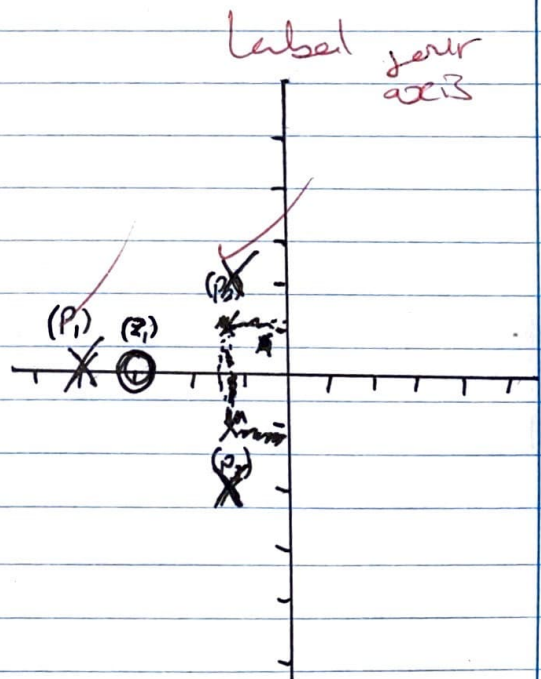
$$\Rightarrow \frac{-3 \pm \sqrt{3^2 - 4(1)(6)}}{2(1)}$$

$$\Rightarrow \frac{-3 \pm \sqrt{-15}}{2}$$

$$\Rightarrow \frac{-3 \pm 3.87}{2} \checkmark$$

$$p_3 = -1.5 + 1.93j \checkmark$$

$$p_4 = -1.5 - 1.93j \checkmark$$



b)

~~G(s)~~

$$G(-2+j) = \frac{(-2+j)+3}{((-2+j)+4)((-2+j)^2 + 3(-2+j) + 6)}$$

$$= \frac{1+j}{(2+j)(4-2j-2j+j^2) + -(6+3j)+6}$$

$$= \frac{1+j}{(2+j)(4-4j-1)}$$

$$= \frac{1+j}{6-2j+3j-j^2}$$

$$= \frac{1+j}{7+j}$$

$$= \frac{1+j}{7+j} \times \frac{7-j}{7-j} = \frac{7-j+7j-j^2}{49-7j+7j-j^2}$$

$$= \frac{8+6j}{50}$$

$$= 0.16 + 0.12j$$

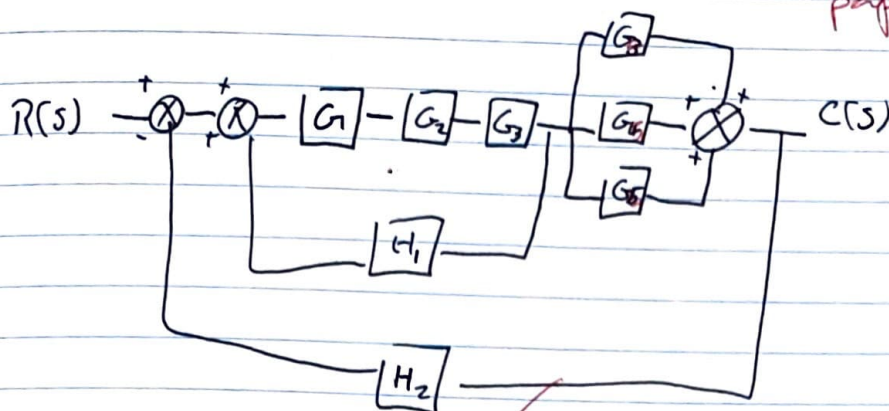
$$\text{Phase Angle} = \tan^{-1}\left(\frac{0.12}{0.16}\right) = 36.87^\circ$$

Q4)

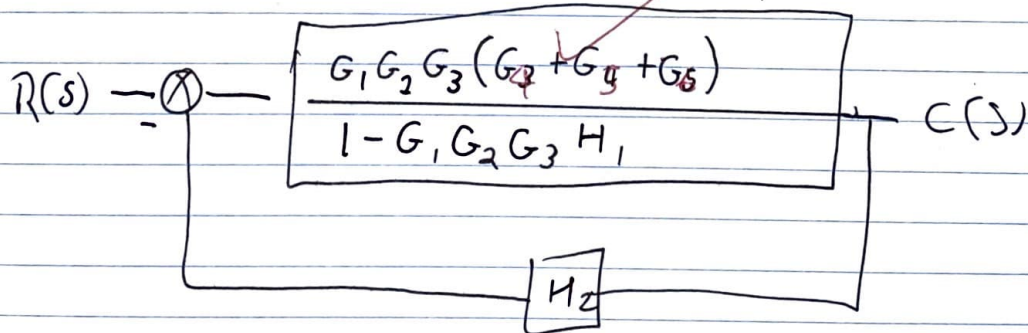
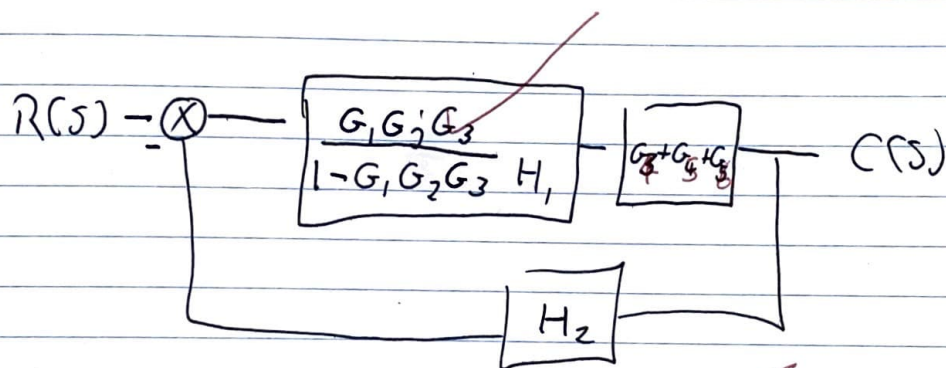
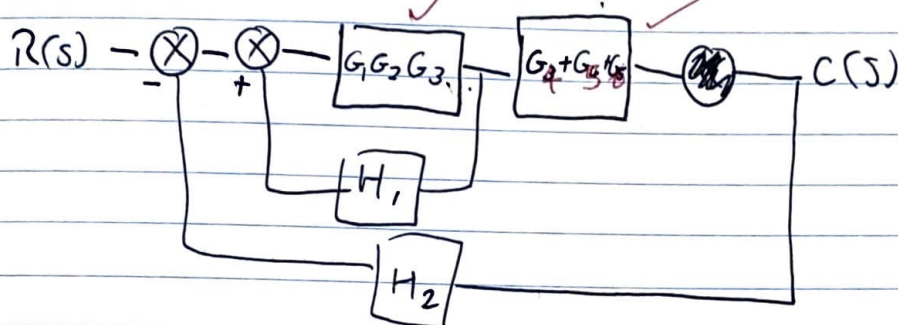
12

Q4)

Typing error in paper



12



$$R(s) = \frac{G_1 G_2 G_3 (G_4 + G_5 + G_6)}{1 - G_1 G_2 G_3 H_1} \quad \text{--- } G(s)$$

$$\frac{Y(s)}{R(s)} = \frac{1 + \left[\frac{G_1 G_2 G_3 (G_4 + G_5 + G_6)}{1 - G_1 G_2 G_3 H_1} \right] H_2}{1}$$

$$\frac{G_1 G_2 G_3 (G_4 + G_5 + G_6)}{1 - G_1 G_2 G_3 H_1}$$

$$\frac{1 - G_1 G_2 G_3 + \left[\frac{G_1 G_2 G_3 (G_4 + G_5 + G_6)}{1 - G_1 G_2 G_3 H_1} \right] H_2}{1 - G_1 G_2 G_3 H_1}$$

$$\frac{G_1 G_2 G_3 (G_4 + G_5 + G_6) (1 - G_1 G_2 G_3 H_1)}{(1 - G_1 G_2 G_3 H_1) (1 - G_1 G_2 G_3 + G_1 G_2 G_3 (G_4 + G_5 + G_6) H_2)}$$

$$\frac{Y(s)}{R(s)} = \frac{G_1 G_2 G_3 (G_4 + G_5 + G_6)}{1 - G_1 G_2 G_3 + G_1 G_2 G_3 (G_4 + G_5 + G_6) H_2}$$

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Question No.

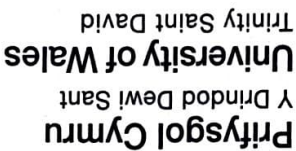
(25)

i) $\frac{d^2 \phi_0}{dt^2} + 2\xi \omega_n \frac{d\phi_0}{dt} + \omega_n^2 \phi_0 = b \omega_n \phi_0$

①

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1



12 Tudalen

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 seilio i lawr (gan ddefnyddio'r label a ddarparwyd) i guddio'ch enw.

CYFENW:

Llenwch, plygwrch a seliwrch
(gweler nodyn 2 isod)

3. Rhaid i'r atebion fod mewn llawysgrifennau ddalenadwy. Gall yr Arholiwr naill ai anwybyddu sgript annarllenadwy, neu drefnu iddi gael ei theipio a chael yr ymgeisydd i dalu.
4. Ysgrifennwch eich atebion mewn inc.
5. Dechreuwch bob ateb ar dudalen newydd. Gwnewch unrhyw fras nodiadau yn y llyfr atebion a thynnu llinell drwyddynt.
6. Ni ddylid rhwgo 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 gwyliwr/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 amgylchiadau.

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

Rhestrwch nifau'r cwestiynau a ymgeistwyd gennyh	
At Dibenion y Swyddfa	Cyfanswm

(See the other side for English version)