



12 Pages

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: Winter

FORENAME(S): Aled

1	Student Number	WIN21861113
2	Title of Examination Paper	Dynamics Control and instrumentation
3	Module Code	GOEE4002
4	Date and Time of Examination	13/5/25 09:30
5	Examination Venue	68860
6	Seat Number	B4

7	Number of Answer Books handed in	<u>1</u>
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[illegible]

41% EN
✓
OK

3)
a)

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

$$2 \pm \sqrt{-16}$$

$$2 \pm 4j$$

$$\begin{matrix} -1+2j \\ -1-2j \end{matrix}$$

$$\text{zeros} = -3 \text{ (z1)}$$

$$\text{poles} = -4 \text{ (p1)}$$

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

$$\begin{matrix} a & b & c \\ s^2 + 3s + 6 \end{matrix}$$

$$= -3 \pm \sqrt{3^2 - 4 \times 1 \times 6}$$

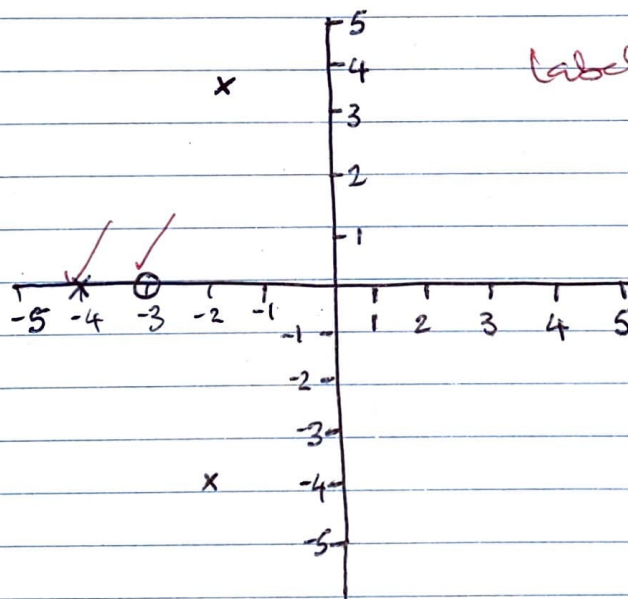
$$3^2 - 4 \times 1 \times 6 = -15$$

$$= -3 \pm \sqrt{-15} \quad -3 \pm \sqrt{3.87j} = -3 \pm 3.87j$$

$$= -1 \pm \sqrt{-5}$$

$$p_2 = -2 \pm 3.87j$$

$$p_3 = -2 - 3.87j$$



label axes

3)
6 Evaluate the value of $G(s)$ at the point $s = -2+j$

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

$$-2+j+3 = 1+j \quad \checkmark$$

$$-2+j+4 = 2+j \quad \checkmark$$

$$((-2+j)^2 + 3(-2+j) + 6) \quad \checkmark$$

$$\begin{aligned} (-2+j)(-2+j) &= 4 - 2j - 2j - 1 \\ &= 3 - j \end{aligned}$$

$$j^2 = -1$$

$$3(-2+j) = -6+3j$$

$$-6+3j+6 = 3j \quad \checkmark$$

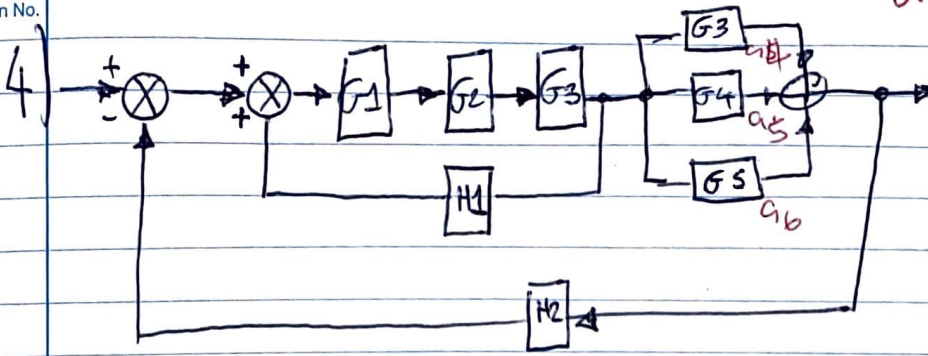
$$(s+4)(3-j+3j)$$

$$(2+j)(3-j+3j) \quad -6+3 = -3$$

$$-3+3 = 0$$

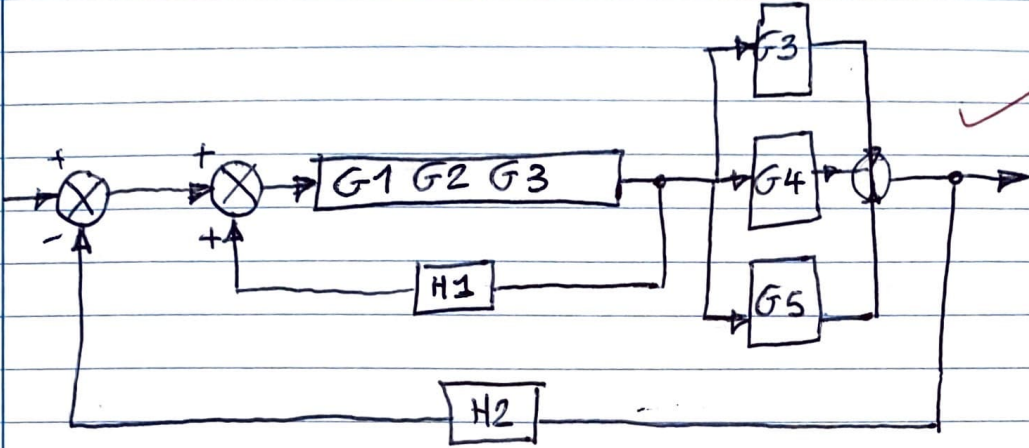
$$(2+j)(j+3j) = 2j+6j+2j+3j^2$$

$$f = \tan^{-1} \frac{y}{x}$$

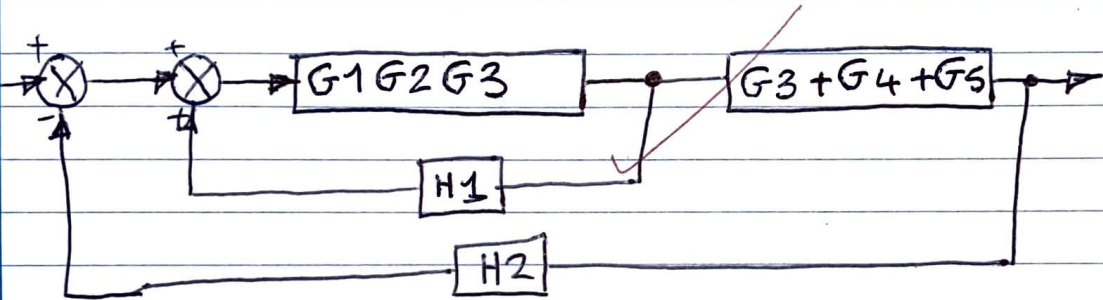


Typing error
in Exam
Script

$$\frac{R(s)}{C(s)}$$



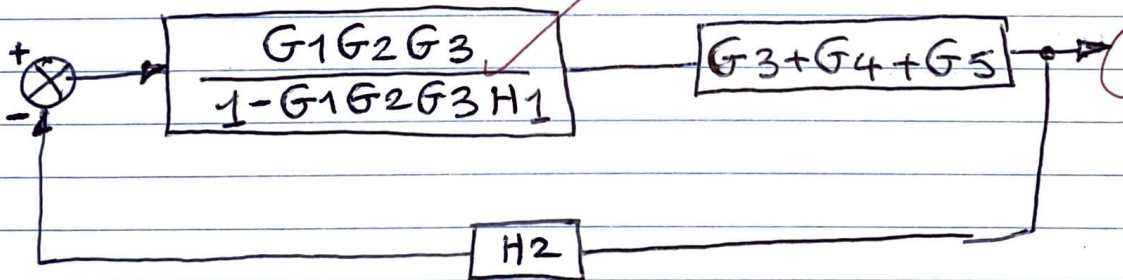
(3)



(3)

$$\frac{G(s)}{1 - G(s)H(s)}$$

$$+ \otimes = (-) \quad + \otimes = (+)$$



(3)

$$\frac{G1G2G3}{1 - G1G2G3H1}$$

$$\frac{G1G2G3}{1 - G1G2G3H1}$$

$$\frac{G1G2G3}{1 + G1G2G3H2}$$

$$\frac{G1G2G3}{1 - G1G2G3H1}$$

$$\frac{G1G2G3}{1 + G1G2G3H2}$$

$$\frac{G1G2G3}{1 + G1G2G3H2}$$

4)
$$\frac{R(s)}{C(s)} = \frac{\frac{G_1 G_2 G_3}{1 - G_1 G_2 G_3 H_1}}{1 - \left[\frac{G_1 G_2 G_3}{1 + G_1 G_2 G_3 (G_1 + G_2 + G_3) H_2} \right]}$$

9

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

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

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

5) $R = 150 \Omega$ $L = 2H$ $C = 25 \mu F$

$$\frac{d^2 i}{dt^2} + \frac{R}{L} \frac{di}{dt} + \frac{1}{LC} i = \frac{V}{CL}$$

a) natural frequency of the circuit?

$$\frac{d^2 i}{dt^2} + \left(\frac{R}{L}\right) \frac{di}{dt} + \left(\frac{1}{LC}\right) i = \frac{V}{CL}$$

$$\frac{d^2 \theta_0}{dt^2} + 2\xi \omega_n \frac{d\theta_0}{dt} + \omega_n^2 \theta_0 = 64 \omega_n^2 \theta_0$$

$$\omega_n^2 = \frac{1}{LC} = \frac{1}{2 \times 25 \times 10^{-6}} = \frac{20000}{1}$$

$$\omega_n^2 = 20000$$

$$\omega_n = 141.42 \text{ rad/s}$$

(4)

6) Determine whether the circuit is overdamped, critically damped or underdamped?

$$2\xi \omega_n = \frac{R}{L} \quad \frac{150}{2} = 2 \times \xi \times 141.42$$

$$75 = 2 \times \xi \times 141.42$$

$$75 = \xi \times 282.84$$

$$\xi = \frac{75}{282.84}$$

$$\xi = 0.265 \text{ rad/s}$$

$$0.265 < 1$$

underdamped.

(3)

- 5)
c) what is the damped frequency of oscillation of the circuit?

$$\text{Damped frequency} = \omega_d = \omega_n \sqrt{1 - \xi^2}$$

$$\omega_d = 141.42 \sqrt{1 - 0.265^2} = 136.36 \text{ rad/s}$$

- d) calculate the time constant τ of the circuit

$$\tau = \frac{1}{\xi \omega_n}$$

$$\tau = \frac{1}{0.265 \times 141.42} = 0.0267 \text{ s}$$

or = 26.68 ms

- e) applied voltage 10V is constant
find steady state current? $V = I \times R$

$$V = I \times R \quad I = V \div R$$

$$I = 10 \div 150 = 0.067 \text{ A} \quad \text{or} = 0.067 \text{ A}$$

2) $m = 5 \text{ kg}$ $\mu = 0.3$ $F = 20 \text{ N}$

$$F_f = \mu \times m \times g$$

$$F_f = 0.3 \times 5 \times 9.81$$

$$F_f = 14.72 \text{ N}$$

$$F_{\text{net}} = ma = m \frac{d^2x}{dt^2}$$

$$20 - 14.72 = 5.28 \text{ N}$$

$$a = 5.28 \div 5 = 1.056 \text{ m/s}^2$$

$$\frac{1}{b} \quad \frac{1}{0.5}$$

2
6)
i)

$$2 \text{ m/s}$$

$$b = 0.5 \text{ Ns}$$

$$G(t) = \frac{1}{ms} + b$$

$$\frac{1}{b}$$

$$\frac{1}{0.5} = 2 \text{ N}$$

$$\text{final } F_d = -bv$$

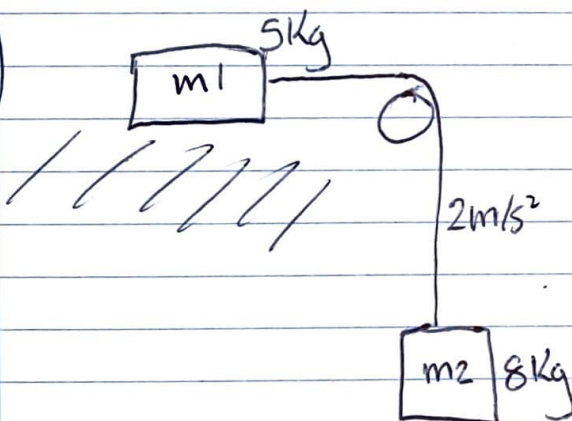
$$= -0.5 \text{ Ns/m} \times 2 \text{ m/s}$$

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

$$14.72 + 2 = 16.72 \text{ N}$$

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

c)



$m_2 t$

d)

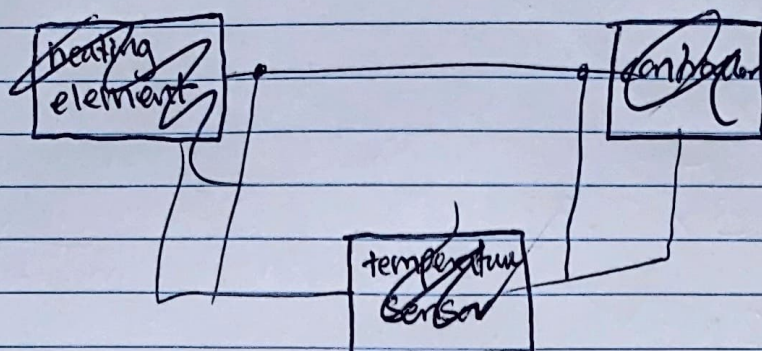
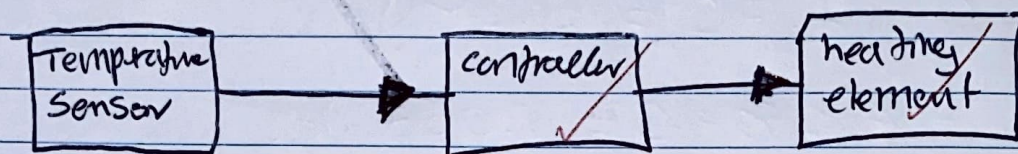
$$0.01 \text{ v/m}$$

$$2 \text{ m/s}$$

Seconds.

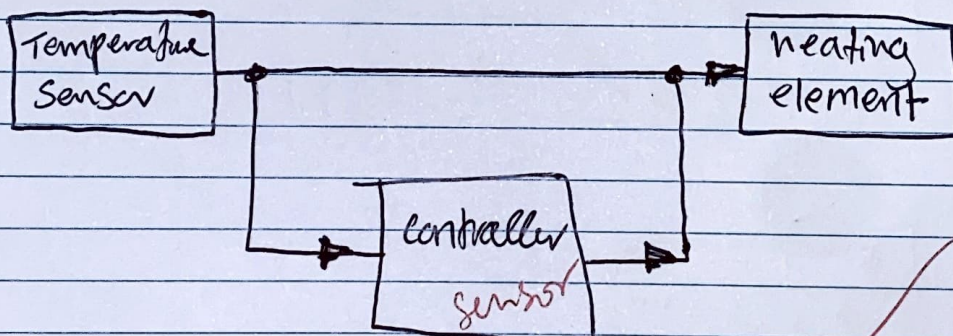
$$0.01 \text{ v} = 1 \text{ m}$$

$$5 \times 0.01 = 0.05 \text{ v/m}$$

1
a)1
a)

ii the temperature sensor will not acknowledge a change in temperature due to the heating element being turned on for a fixed point regardless of temperature

b)

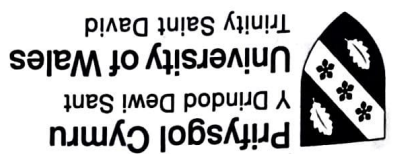


c)

$$G(s) = \frac{1}{s+2}$$

$$T(s) = \frac{Y(s)}{R(s)} = \frac{G(s)H(s)}{1+G(s)H(s)}$$

$$\frac{1}{30+2} = 0.03125$$



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

3. Rhaid i'r atebion fod mewn llawysgriften ddarlennadwy. Gall yr Arholwyr naill ai anwybyddu sgrïpt annarllennadwy, 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 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 amgylchiadau.

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

(See the other side for English version)

Rhestrwch ffiau'r cwestiynau a ymgeisiwyd gennyh	
At Ddibenion y Swyddfa	

Llenwch, plygwch a seliwch
(gweler nodyn 2 isod)

CYFENW:

ENW(AU) CYNTAF: