



Complete, fold and seal
(see note 2 below)

FORENAME(S): Josh Lewis

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	17835588
2	Title of Examination Paper	Dynamics Control and instrumentation
3	Module Code	GCEE4002
4	Date and Time of Examination	24/05/2023 10:02
5	Examination Venue	Gower college Swansea - Tychoch 68260
6	Seat Number	E4
7	Number of Answer Books handed in	1

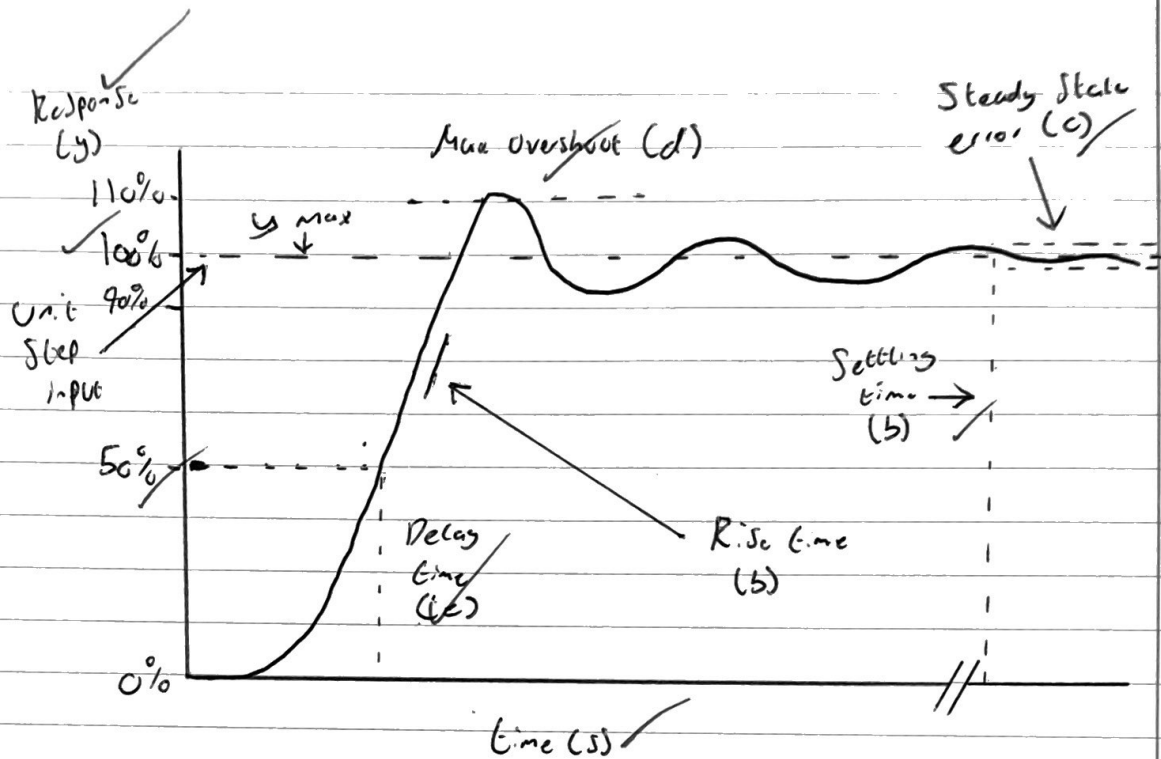
List the numbers of the questions you have attempted	Office Use
1	10
2	8
3	14.5
4	8.5
Total	(41/50)

(Gweler yr ochr arall am y fersiwn Cymraeg)

RK

69%

2.



4

- a) Rise time - The time it takes for the step input to reach 100%, and starts when the curve begins to rise.
- b) Settling time - When the step input has reached its max overshoot and has begun to settle down. From here the curve begins to fluctuate more around 100%.
- c) Here the line has now settled but will always give a slight reading very small reading greater or smaller than 100% (fluctuates around 100%).
- d) Maximum overshoot - This is a result of the step input rising at a fast rate which causes the response to exceed over the 100% and perhaps to 110% for example. This is also the max that the reading the response will give.
- e) Delay time - Time it takes for the response to reach 50%.

4

1.1 Pa.

 $F = ma$

$$a = \frac{F}{m}$$

Affecting

 F_j
force of friction

$$F - f_g = F_{net}$$

So N = 10N

$$a = \frac{F_{net}}{m} = \frac{60 \text{ N} - 10 \text{ N}}{20 \text{ kg}} = \frac{50 \text{ N}}{20 \text{ kg}} = 2.5 \text{ m/s}^2$$

1.2a

$$U = 25 \text{ m/s} \quad a = 10 \text{ m/s}^2 \quad W = 5 \text{ s} \quad V = ? \quad S = ?$$

$$V = U + at$$

$$V = 25 \text{ m/s} + (10 \text{ m/s}^2 \times 5 \text{ s})$$

$$V = 25 + 50$$

$$V = 75 \text{ m/s}$$

1.2b

$$U = 25 \text{ m/s} \quad a = 10 \text{ m/s}^2 \quad t = 5 \text{ s} \quad V = 75 \text{ m/s} \quad S = ?$$

$$S = \left(\frac{25 \text{ m/s} + 75 \text{ m/s}}{2} \right) 5 \text{ s}$$

$$= 250 \text{ m}$$

1.3

TF = Transfer function

 $\Delta = \text{determinant}$ $\Sigma = \text{The sum of}$ $n = \text{Number of forward paths}$ $P_i = i^{\text{th}} \text{ of forward path gain}$ $\Delta_i = \text{determinant of forward path gain}$

3a

Particle a = $\frac{du}{dt} = 6t + 10$ 1st derivative
Particle b = $\frac{dv}{dt} = 21t^2 + 8t$ 1st derivative
Particle c = $\frac{dw}{dt} = 30t^2 - 30$ 1st derivativeA = $\frac{dw}{dt} = 30t^2 - 30$ 2nd derivativeB = $\frac{dw}{dt} = 42t + 8$ 2nd derivativeC = $\frac{dw}{dt} = 60t$ 2nd derivative

$$R \quad V_B = 3V_A$$

$$21^2 + 8t = 3(6t + 10)$$

$$21^2 + 8t = 18t + 30$$

$$21^2 + 8t - 18t - 30 = 0$$

$$a = 21 \quad b = -10 \quad c = 430$$

$$= \frac{+21 \pm \sqrt{21^2 + 4(43)(-30)}}{2(21)}$$

$$= 11.93 \quad \text{or} \quad -11.93$$

$$t = 11.93 \text{ s}$$

3b.

Particle B = Particle C
Use second derivative

$$42t + 8 = 60t$$

$$8t = 18t - 8$$

$$t = \frac{18t - 8}{42} = 0.44 \text{ s}$$

3c. $t_4 - t_0 = t_4$

$$\text{Particle A: } 3(4)^2 + 10(4) - 8 = 80 \text{ m/s}$$

$$\text{Particle B: } 7(4)^3 + 4(4)^2 + 4 = 516 \text{ m/s}$$

$$\text{Particle C: } 10(4)^2 - 30(4) + 2 = 52 \text{ m/s}$$

3d.

$$\text{Particle B: } 7t^3 + 4t^2 + 4 = 10 \text{ m/s}$$

$$21t^2 + 8t + 10 = 0$$

$$\frac{-8 \pm \sqrt{8^2 + 4(21)(10)}}{2(21)}$$

$$= -5.455 \text{ (2 dp)} \quad \text{or } 5.555$$

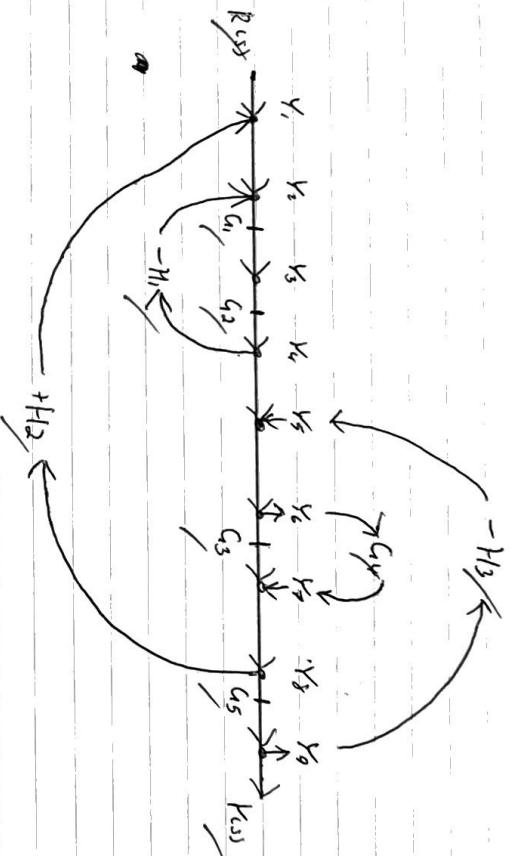
$$t = 5.555$$

2.5

4a.

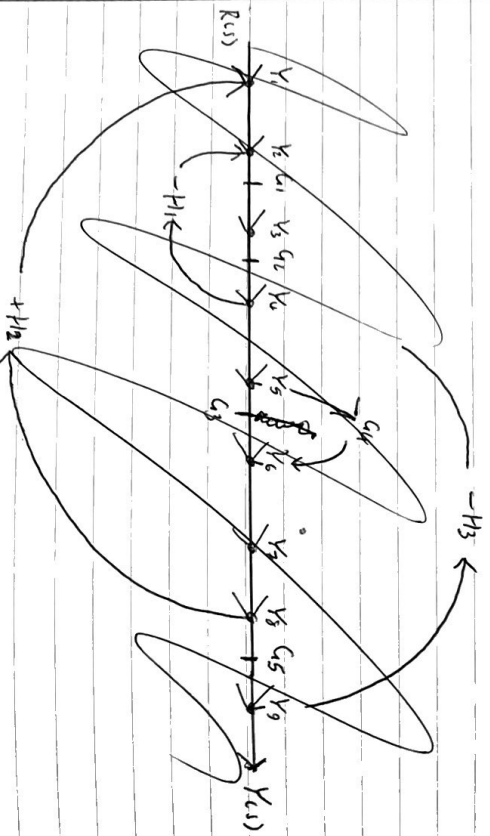
0 = Nodes

→ = direction



5

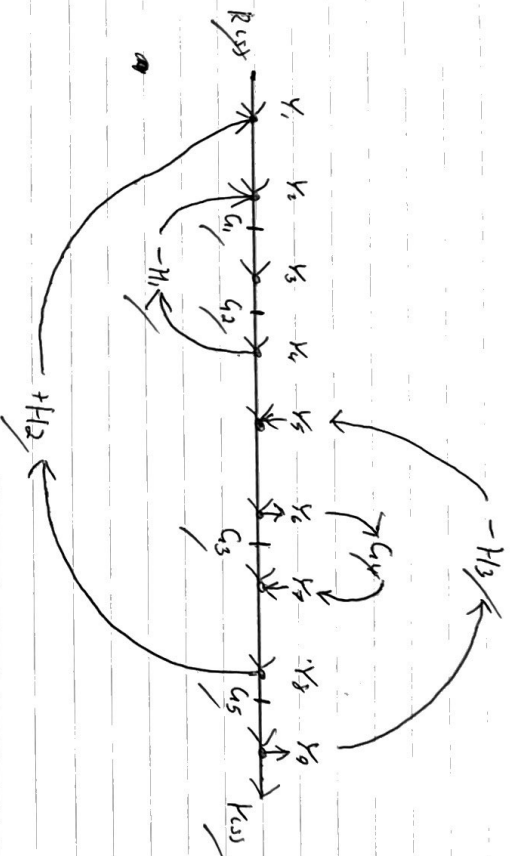
4b.



4a.

0 = Nodes

→ = direction



4b.

$$\text{Forward pass (N)} = 1. G_1, G_2, G_3, G_5$$

$$2. G_1, G_2, G_4, G_5$$

$$\text{No of loops (L)} = G_1, G_2, -H_1 = -G_1, G_2, H_1$$

$$2. G_1, G_2, G_1, G_2, G_3, H_2$$

$$3. G_1, G_2, G_3, G_4, G_5, G_6$$

$$4. G_3, G_5, -H_3 = -G_3, G_5, H_3$$

Now tracing loop pairs: L1. Y2, Y3, Y4, Y5

L2. Y1, Y6, Y3, Y4, Y5, Y6, Y3, Y2, Y1

L3. Y6, Y2

L4. Y5, Y6, Y4, Y8, Y9, Y5

1 and 2 are loadings

2nd pair: L1, L3

1 and 3 are not loadings

2nd pair: L1, L4

1 and 4 are not loadings

All are possible combinations are loading $\Delta = 2$ pairs

$$T(s) = \frac{1}{\Delta} \left(\sum_i p_i \Delta_i \right)$$

$\Delta = -1$ because forward cycle will be broken in error to calculate.

$$\Delta = \frac{1}{1 + H \Delta \left((-G_1 G_2 H_1 + G_3 G_4) + (G_1 G_2 H_1 + G_3 G_4 H_2) - (G_1 G_2 G_3 G_4) - (G_1 G_2 G_3 G_4) \right)}$$

1.5