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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.
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1	Student Number	HEN19852873
2	Title of Examination Paper	Dynamics, Control and Instrumentation
3	Module Code	GOEE4002
4	Date and Time of Examination	24/5/23 10:02 - 12:02
5	Examination Venue	Tycoch
6	Seat Number	C6
7	Number of Answer Books handed in	1

[illegible]

(Gweler yr ochr arall am y fersiwn Cymraeg)

Q1)

Force of friction = 10 N

1) ~~A 50~~ Force = 50 N Mass = 20 kg

$$F = \cancel{MA} \quad F = ma \quad F = 50 - 10 = 40 \text{ N}$$

$$a = \frac{F}{M} = \frac{\cancel{50}}{\cancel{20}} = \frac{40}{20}$$

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

2

2) A body travelling at an initial velocity of 25 m/s is acted upon by a linear acceleration of 10 m/s²

a. Velocity after 5 seconds:

$$u = 25 \text{ m/s} \quad a = 10 \text{ m/s}^2 \quad t = \cancel{5} 5 \text{ s}$$

$$v = u + at$$

$$v = 25 + (10 \times 5) = 75 \text{ m/s}$$

b. Total distance travelled

$$s = \left(\frac{u+v}{2} \right) t$$

$$s = \left(\frac{25+75}{2} \right) \times 5$$

$$\underline{s = 250 \text{ m}}$$

3

3

$$\tau f(s) = \frac{1}{\Delta} \left(\sum_i P_i \Delta_i \right)$$

Give the of each variable

$$\frac{1}{\Delta} = \tau \text{ the determinant}$$

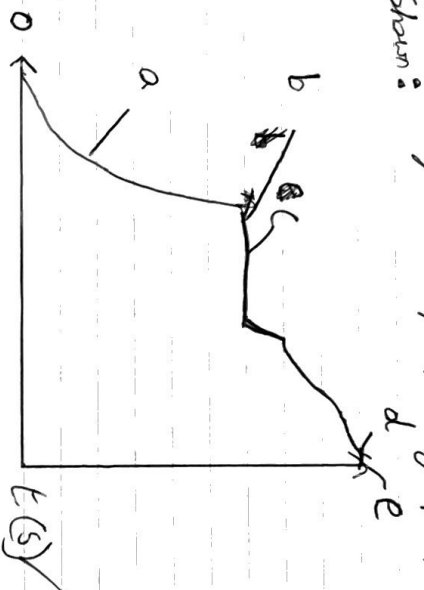
$$\left(\sum_i P_i \Delta_i \right) \quad \begin{array}{l} \text{Number of } \Delta \text{ sums} \\ \text{Determinant of} \\ \text{Matrix of non-binding} \\ \text{loops } (\Delta_i) \end{array}$$

Sum of P_i with amount of forward paths (P_i)

Number of loops

Q2

Draw a system time/response graph for the Step input shown.



a: Rise time is when the graph is moving upwards in a short amount of time, on the graph, the rise time is at the beginning of the sequence. Rise time usually causes the time to rise at a fast rate.

b: Settling time is when the rise time has slowed down almost to a steady state, however the difference is the time doesn't stop, it just slows down at a settling pace.

c: Steady state error is when the time is at a constant steady state that causes an error in time and the speed of the rise in time, a steady state error for too long can cause a delay time.

d: Maximum overshoot can occur when the rise eventually goes past the maximum rise before it is supposed to, this is what can lead up to a delay time once step before it occurs.

e: Delay time is when the sequence is complete however smaller in the sequence has caused the rise in time to be delayed causing the whole sequence to take longer than scheduled.

Q3

Particle A

$$S_a = 3t^2 + 10t - 8$$

Particle B

$$S_b = 7t^3 + 4t^2 + 4$$

Particle C

$$S_c = 10t^3 - 30t + 2$$

Where S = displacement in ~~m~~, t = time in seconds

Determine :

a) $a: 3t^2 + 10t - 8$
 $\frac{dS}{dt} = 6t + 10$ ✓

b: $7t^3 + 4t^2 + 4$
 $\frac{dS}{dt} = 21t^2 + 8t$ ✓
 $\frac{d^2S}{dt^2} = 42t + 8$

When $t = 1$

$$a = 3(1)^2 + 10(1) - 8 = 5.00$$

$$b = 7(1)^3 + 4(1)^2 + 4 = 15.00$$

$$5 \times 3 = 15.00$$

Therefore, when $t = 1$, Particle B is 3 times greater than Particle A

b)

The time when acceleration is equal between particle B and C

c)

When $t = 0$, ~~$t = 4.5$~~

$$S_a = 3(0)^2 + 10(0) - 8,$$

$$S_a = -8 \text{ m}$$

$$S_b = 7(0)^3 + 4(0)^2 + 4,$$

$$S_b = 4 \text{ m}$$

$$S_c = 10(0)^3 - 30(0) + 2,$$

$$S_c = 2 \text{ m}$$

When $t = 4$

$$S_a = 3(4)^2 + 10(4) - 8$$

$$S_a = 80 \text{ m}$$

$$S_b = 7(4)^3 + 4(4)^2 + 4$$

$$S_b = 180 \text{ m}$$

$$S_c = 10(4)^3 - 30(4) + 2$$

$$S_c = 522 \text{ m}$$

to be S?!

2

3.5

2

3.5

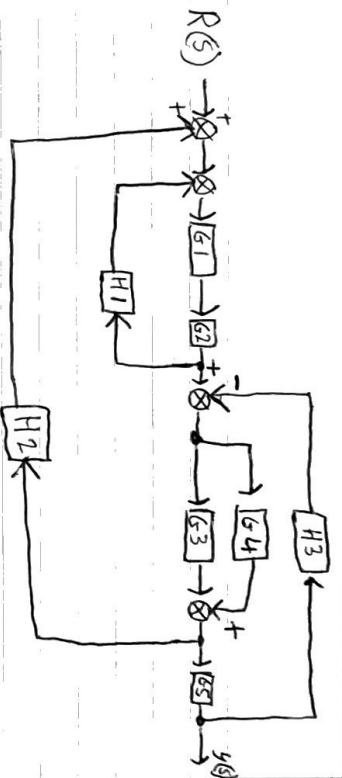
- d) The time required for ~~particle~~ B particle B to reach a velocity of 10 m/s

v is m/s

$$= \frac{v}{5}$$

$$\text{When } t=1 \quad v = \frac{m}{s} = \frac{15}{1} = 15 \text{ m/s}$$

Q4

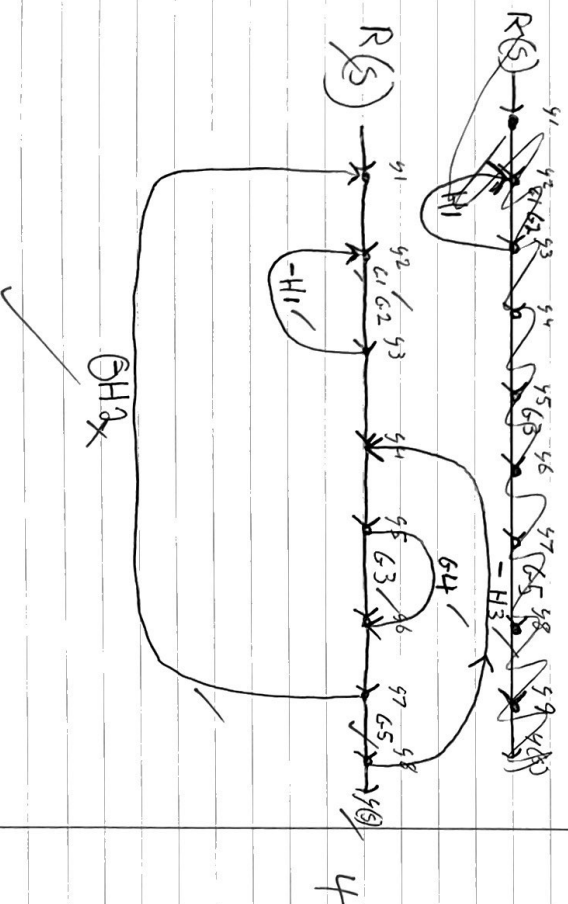


R(s)



a)

Signal flow graph:



Forward paths:

$$P_{11} = (G_1 G_2 G_3 G_5) \quad /$$

$$P_{12} = (G_1 G_2 G_4 G_5) \quad /$$

Loops:

$$L_1 = (G_1 G_2 - H_1) \quad /$$

$$L_2 = (G_1 G_2 G_3 - H_2) \quad /$$

$$L_3 = (G_1 G_2 G_4 - H_2) \quad /$$

$$L_4 = (G_1 G_2 G_3 - H_3) \quad /$$

$$L_5 = (G_1 G_2 G_4 - H_3) \quad /$$

Non-loading loops:

No pairs of non-loading loops

$$\frac{Y(s)}{R(s)} = \frac{1}{\Delta} \left(\sum_i P_i \Delta_i \right)$$

Rule of thumb: If there are no pairs of NFL, $\Delta_i = 1$

$$P_i = (G_1 G_2 G_3 G_5) (G_1 G_2 G_4 G_5)$$

$$P_{11} = (G_1 G_2 G_3 G_5) (G_1 G_2 G_4 G_5) \quad /$$

$$\frac{Y(s)}{R(s)} = \frac{1}{\Delta} = \frac{1}{(G_1 G_2 G_3 G_5 - G_1 G_2 G_4 G_5) - (G_1 G_2 H_1) + (G_1 G_2 G_3 H_2) + (G_1 G_2 G_4 H_2) + (G_1 G_2 G_3 G_5 H_3 - G_1 G_2 G_4 G_5 H_3)}$$

4

4