

SURNAME: KANDIA

FORENAME(S): FRAN

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 read your answers in cursive script or have it typed and the expense of typing is 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	P136744
2	Title of Examination Paper	Instrumentation and Control 1
3	Module Code	M7X01643
4	Date and Time of Examination	18 May 2018
5	Examination Venue	Townhill Gym
6	Seat Number	G082
7	Number of Answer Books handed in	1

[illegible]

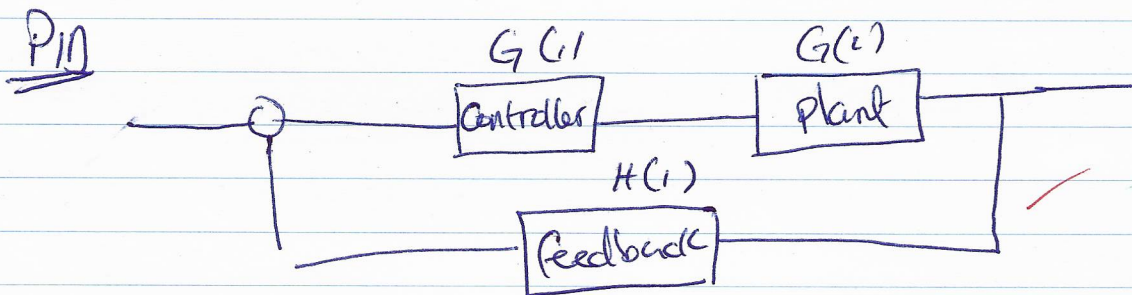
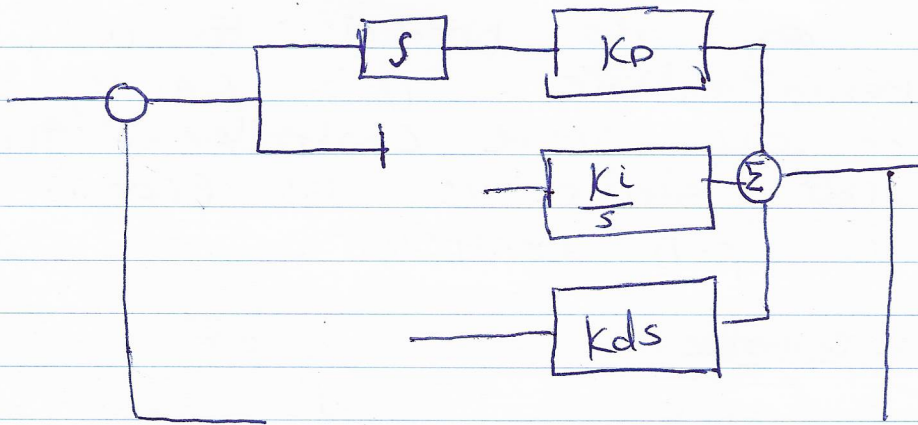
(Gweler yr ochr arall am y fersiwn Cymraeg)

43%

21.5/50

Gay

Q1 PID Controller is a Control System that maintain a desired variable within a specific range. It use a feedback to control the output within a specific range.



An example of a PID Controller would be a central heating system in a house where the temperature of the house is measured and controlled. The central heating uses hysteresis to keep the desired temperature of the room. Hysteresis is a set of setpoint placed to keep the temperature within a specific range.

$$T = \frac{G}{1+GH}$$

A two state Controller is also a Control System, however it doesn't use feedback mechanism. An example of a two state Controller is a light switch or even a toaster. Where in the toaster example the toaster itself never measures the colour of the bread to adjust its temperature. It's simply an on or off state controller. This particular state is less expensive than the PID Controller.

Two state Controller



3.

Q2

$$\frac{G}{1+G11} \parallel \frac{b \pm \sqrt{4-b^2c}}{2a}$$

$$G(s) = \frac{K}{1+T_s s}, \quad H(s) = \frac{1}{\epsilon s}$$

$$K = 1.7, \quad T_s = 0.2, \quad \epsilon s = 0.5$$

~~$$G(s) = \frac{1.7}{1+0.2s}$$~~

$$G(s) = \frac{1.7}{1+0.2s}, \quad H = \frac{1}{0.5s}$$

①

$$T = \frac{1.7}{1+0.2s}$$

$$\frac{\left(\frac{1.7}{1+0.2s}\right) \left(\frac{1}{0.5s}\right) + 1}{1}$$

✓

$$T = \frac{\frac{1.7}{1+0.2s}}{1 + \frac{1.7}{0.2s + 0.1s}}$$

x

$$T = \frac{\frac{1.7}{1+0.2s}}{0.2s + 0.1s + 1.7}$$

✓

$$T = \frac{1.7}{1 + 0.2s}$$

$$\frac{0.2s + 0.1s + 1.7}{0.2s + 0.1s}$$

$$T = \frac{1.7}{1 + 0.2s}$$

$$\frac{0.3s + 1.7}{0.2s + 0.1s}$$

$$T = \frac{1.7(0.3s + 1.7)}{1 + 0.2s(0.2s + 0.1s)}$$

$$T = \frac{0.51s + 2.89}{0.2s + 0.1s + 0.04s^2 + 0.02s^2}$$

$$T = \frac{0.51s + 2.89}{0.3s + 0.06s^2}$$

Poles

$$0.06s^2 + 0.3$$

1.02

Zeros

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

$$\frac{0.51 \pm \sqrt{0.51^2}}{2}$$

$$\frac{2.89 \pm \sqrt{2.89^2}}{2(0.51)}$$

$$s = \frac{2.89 \pm 2.89}{1.02}$$

$$s = \frac{2.89 - 2.89}{1.02} = 0$$

$$s = \frac{2.89 + 2.89}{1.02}$$

$$s = 5.67$$

Q3

$$\frac{K}{s} \times \frac{1}{\sqrt{w^2+1}} \times \frac{1}{\sqrt{2w^2+1}}$$

$$\frac{R_1}{\sqrt{w^2+1}} \times \frac{R_2}{\sqrt{3.1w^2+1}} \times \frac{R_3}{\sqrt{4w^2+1}}$$

$$\theta_1 = \tan^{-1} w \quad \theta_2 = \tan^{-1} 3.1w \quad \theta_3 = \tan^{-1} 4w$$

$$\theta_T = -\theta_1 - \theta_2 - \theta_3$$

(2)

	R1	R2	R3	RT	Q1	Q2	Q3	QT
0.5	18.0	57.0	14.0					
1	17.0	49.0	14.5					
1.5	15.0	43.0	13.2					
2	14.0	42.0	12.0					
2.5	13.0	42.0	12.0					
3	12.0	41.0	11.0					
3.5	12.0	41.0	11.0					
4	12.0	41.0	11.0					

continued on separate sheet.

(8)

Plot

(1)

Q4

- 1) Sensitivity ✓ 7/ Environmental Casens ✓
- 2) Range ✓
- 3) Cost ✓
- 4) Linearity ✓
- 5) ph ?
- 6) Response time ✓

Sensitivity - How ~~the~~ quick the sensor would react x.

Range - ~~Specific~~ A specific range where the sensor can measure the variable ✓

Cost - How much money would the sensor be regarding to the budget of the project

Linearity - How linear is the sensor ✓

ph - this would be necessary to measure the ph of water x - ~~not asked for~~.

Response time - How quickly the sensor can respond to changes ✓

Environment - How the sensor would react to ~~the~~ surroundings, for example the ~~chlor~~ chlorine in the water or the gas it's been exposed to. ✓

(4)



Q5

$$K_p = 1, K_i = 1, K_d = 1$$

$$V_T = \left(K_p + \frac{K_i}{s} + K_d s \right) \left(\frac{1}{1+s} \right) \quad \checkmark$$

$$V_T = \left(1 + \frac{1}{s} + 1s \right) \left(\frac{1}{1+s} \right)$$

$$V_T = \frac{1 + \frac{1}{s} + 1s}{\cancel{s+s^2} \cdot \frac{1}{1+s}}$$

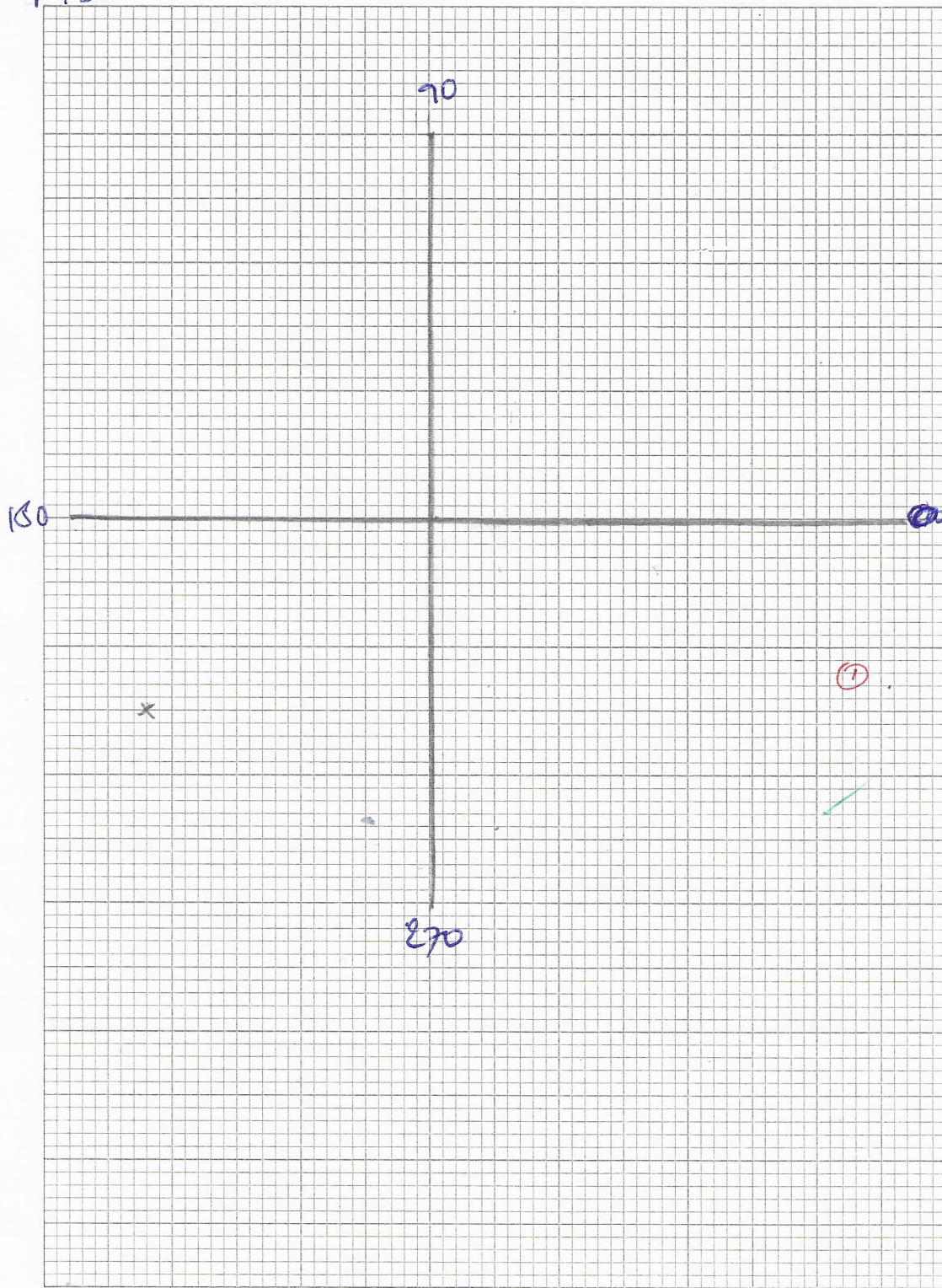
1 1/2

$$V_T = \frac{1 + \frac{1}{s} + 1s}{s + s^2}$$

$$V_T = \frac{1s + \cancel{s} + 1}{s + s^2}$$

Feran kanda (2)
P136744

Nyquist diagram



fern kanda P136744 @ Nyquist diagram

ω	R_1	R_2	R_3	R_T	Q_1	Q_2	Q_3	Q_T
0.5	0.67	1.58	0.71	0.75	26.57	57.17	63.43	-147.7
1	0.5	1.037	0.45	0.23	45.0	72.12	75.96	-193.08
1.5	0.4	0.74	0.32	0.09	56.31	77.86	80.54	-214.71
2	0.3	0.57	0.24	0.04	63.43	80.84	82.87	-227.14
2.5	0.29	0.47	0.20	0.02	68.20	82.65	84.29	-235.14
3	0.25	0.39	0.16	0.02	71.57	83.86	85.29	-241.34
3.5	0.22	0.34	0.14	0.01	74.05	84.73	85.91	-244.69
4	0.2	0.30	0.12	7.2×10^{-3}	75.96	85.39	86.42	-247.77