Started on	Monday, 16 May 2022, 3:04 PM
State	Finished
Completed on	Monday, 16 May 2022, 5:04 PM
Time taken	1 hour 59 mins
Grade	**7.25** out of 10.00 (**73**%)

Question **1**

Partially correct

Mark 1.25 out of 2.00

Select the most appropriate type of control for each of the following scenarios.

A humanoid robot that needs to learn how to walk.	PID control	✗
A robot arm trying to reach for an object on a cluttered table with fragile glasses all over it.	Optimal control	✓
An autonomous military ship, that wants to avoid an enemy.	Game theory	✓
The controls for a nuclear power plant, where even a slight error could cause a meltdown.	Optimal control	✓
A smart trailer trying to make sure it doesn't bump into the truck that is pulling it.	PID control	✓
A mobile robot that needs to find its way out of a maze.	Reinforcement learning	✓
A drone that needs to patrol the skies above a farm, looking for crop damage.	Reinforcement learning	✗
A robot learning how to sweep the floor.	PID control	✗

Your answer is partially correct.

You have correctly selected 5.

The correct answer is: A humanoid robot that needs to learn how to walk. → Reinforcement learning, A robot arm trying to reach for an object on a cluttered table with fragile glasses all over it. → Optimal control, An autonomous military ship, that wants to avoid an enemy. → Game theory, The controls for a nuclear power plant, where even a slight error could cause a meltdown. → Optimal control, A smart trailer trying to make sure it doesn't bump into the truck that is pulling it. → PID control, A mobile robot that needs to find its way out of a maze. → Reinforcement learning, A drone that needs to patrol the skies above a farm, looking for crop damage. → PID control, A robot learning how to sweep the floor. → Reinforcement learning

Question **2**

Correct

Mark 2.00 out of 2.00

Consider the linear dynamical system below.

$$\begin{aligned}\dot{\mathbf{x}} &= \begin{bmatrix} 0 & 0 & 2 \\ -1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix} \mathbf{x} + \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} u, \\ \mathbf{y} &= \begin{bmatrix} 0 & -1 & 0 \end{bmatrix} \mathbf{x}\end{aligned}$$

Which of the following statements are true:

Select one:

- a. It is controllable but NOT observable.
- b. It is NOT controllable but observable.
- c. It is NEITHER controllable NOR observable.
- d. It is controllable and observable. ✔

Your answer is correct.

The correct answer is: It is controllable and observable.

Question **3**

Correct

Mark 2.00 out of 2.00

An autonomous car is travelling in a convoy behind a second vehicle, and needs to keep a fixed distance of 5 metres behind the leading vehicle. Every second, it calculates the Euclidean distance from its current position to the leading vehicle. It then uses PID control to stabilise around the 5m point.

The distances calculated over the first 4 seconds are:

Time (s)	0	1	2	3
Distance (m)	8	6	5	7

Select the answer with the correct proportional control (e), derivative control (d), and integral control (h) at t=4.

Select one:

- a. e = 7. d = -2. h = -6
- b. e = 7. d = -1. h = 13
- c. e = 5. d = -2. h = 6
- d. e = -2. d = -2. h = -6 ✔
- e. e = 2. d = 2. h = 7.5
- f. e = -2. d = 2. h = 7.5
- g. e = 2. d = 2. h = -6
- h. e = 7. d = 2. h = 7.5

Your answer is correct.

The correct answer is: e = -2. d = -2. h = -6

Question **4**

Correct

Mark 2.00 out of 2.00

Consider the second-order control system

$$\dot{x}_1 = 2x_2, \qquad x_1(0) = 0$$
$$\dot{x}_2 = 4u, \qquad x_2(0) = 0$$

where u is the control variable, and the cost function is given by

$$J(u) = A(x_1(2) - 3)^2 + B(x_2(2))^2 + C\int_0^2 \frac{1}{2}[u(t)]^2 dt$$

By introducing an appropriate Hamiltonian, find the control and state trajectory that minimises the cost function, for A = 4, B = 1, C = 1.

If x_1 = ct^3 + dt^2 +et + f, choose the appropriate values for the coefficients.

Select one:

- a. c = -3, d = -2, e = 0, f = 0
- b. c = -0.07, d = -0.14, e = 0, f = 0
- c. c = 0.18, d = -0.32, e = 0, f = 0
- d. c = -0.23, d = 0.2, e = 0, f = 0
- e. c = 0.33, d = 0.5, e = 0, f = 0
- f. c = 10.67, d = -16, e = 0, f = 0
- g. c = -0.78, d = 2.32, e = 0, f = 0 ✔
- h. c = -2.35, d = -4.63, e = 0, f = 0

Your answer is correct.

The correct answer is: c = -0.78, d = 2.32, e = 0, f = 0

Question **5**

Incorrect

Mark 0.00 out of 2.00

Consider the following zero-sum matrix game, where the given payoffs are to the column player, who is the maximising player.

$$\begin{pmatrix} 5 & 0 & 3 \\ 2 & 1 & 1 \\ 3 & 2 & 4 \end{pmatrix}$$

Which option represents a Nash equilibrium policy for the column player, where each number is the probability of picking that column?

Select one:

- a. [0.5, 0.5, 0]
- b. [0, 0, 1]
- c. [0, 0.5, 0.5]
- d. [1, 0, 0]
- e. [0, 0.75, 0.25]
- f. [0.25, 0, 0.75] ✖
- g. [0, 1, 0]
- h. [0.75, 0.25, 0]
- i. [0.5, 0, 0.5]

Your answer is incorrect.

The correct answer is: [1, 0, 0]

◄ Quiz 1 - Kinematics

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Quiz 3 - Planning, State Estimation, SLAM ►