



UNIVERSITY OF MINES AND TECHNOLOGY, TARKWA

SECOND SEMESTER EXAMINATIONS, MAY, 2018

COURSE NO: CE 474

COURSE NAME: INTRODUCTION TO ROBOTICS

CLASS: CE 2015

TIME: 3 hours

Name: _____ Index Number: _____

INTRUCTION: Answer ALL the questions on this paper. All questions carry equal Marks.

1.

a. Match the following

Robot part	Function
a. Manipulator arm	1. For holding a piece or tool
b. Controllers	2. Move the manipulator arm and end effector
c. Drives	3. Number of degrees of freedom of movement
d. Gripper	4. Delivers commands to the actuators

b. Discuss Isaac Asimov's **3 laws of robotics**.

c. Discuss the four properties that qualifies a device/machine as a robot.

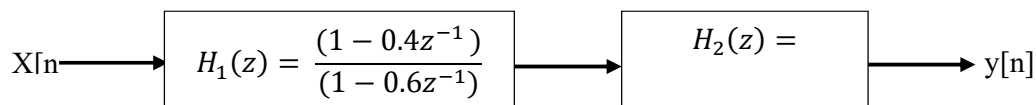
d. Give 3 examples each of the following robots classifications:

	Robot Classification	Examples
1	Arm Configuration	
2	Drive System	
3	Drive Gear System	
4	Level of Technology	
5	Field of Application	

e. **Discuss the most central reasons** for using robots (NB: concentrate on Tasks and Environments) **[20 marks]**

2.

a. Two systems $H_1(z)$ and $H_2(z)$ are connected in cascade as shown below. The overall output $y(n)$ is the same as the input $x(n)$ with a one unit delay. The transfer function of the second system $H_2(z)$ is



b. Consider the z-transform $X(z) = 5z^2 + 4z^{-1} + 3; 0 < |z| < \infty$. Find the inverse z-transform $x[n]$

- c. Find the z transform of the finite sequence 1, 0, 0.5, 3.
- d. Determine the z -transform and region of convergence of the following sequences:
- $x_1(n) = \delta(n) + 2\delta(n-1) + 5\delta(n-2) + 7\delta(n-3) + \delta(n-5)$
 - $x_2(n) = \delta(n+2) + 2\delta(n+1) + 5\delta(n) + 7\delta(n-1) + \delta(n-3)$
 - $x_3(n) = \delta(n-2) + 2\delta(n-3) + 5\delta(n-4) + 7\delta(n-5) + \delta(n-7)$

[20 marks]

3.

- With the aid of the **Basic Control Loop** diagram explain the steps in the process of controlling a system.
- Using the appropriate equations, briefly explain the following control responses as applied to controllers with one condition of application each.
 - Proportional (P) control
 - Proportional (P) plus Integral (I) control
 - Proportional (P) plus Integral (I) plus Derivative (D) Control
- If figure 1 is the SS-Model in canonical form I of a second-order discrete system, then derive the state-space model of the system governed by the difference equation:

$$y(n) - 2y(n-1) + 3y(n-2) = 2x(n) - 3x(n-1) + 4x(n-2)$$

NB: the terms used have their usual meanings.

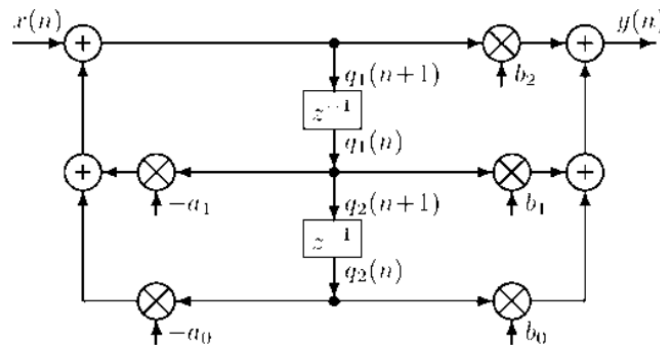


Figure 1 SS-Model in canonical form I of a 2nd order discrete system

[20 marks]

Examiner: E. Effah/Dr N. V. Nofong