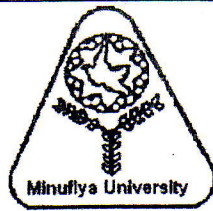


Menoufiya University  
 Faculty of Engineering  
 Shebin El- Kom  
 Second Semester(June) Examination  
 Academic Year: 2013-2014  
 Date: 12/6/2014



Dept.: Production Engineering  
 Year : Doctor of Philosophy in  
 Engineering  
 Subject: Mechatronics  
 Code : PRE 703  
 Time Allowed: 3 hours  
 Total Marks : 100 Marks

Allowed Tables and Charts: None  
 Examiner: Dr/ Mohamed Hesham Belal.

**Answer All The Following Questions:**

**Question No.(1):**

[ 25 Mark]

- (a)-[8]- Explain the term: Mechatronics and List the most application of Mechatronics and its products.
- (b)- [7]- Describe the following : Robot and Robotic – Direct and inverse kinematics of manipulators.
- (c)- [10]-Define the mathematical model and transfer function, Then for the mechanical System shown in Fig.(1), Obtain the transfer functions:  $X_1(s)/U(s)$  and  $X_2(s)/U(s)$  .

**Question No.(2):**

[ 25 Mark]

- (a)- [6]-Describe the major parts of robots, and classify the main groups of robot systems?
- (b)- [6]- List the common actuators found in a Mechatronics system showing for each actuators: type, actuation and work type.
- (c)- [13]- For the 3-DOF (RPP) manipulator arm shown in Fig.(2):
  - 1- Assign frames and tabulate the joint-link parameter,
  - 2- Determine the transformation matrices relating successive links,
  - 3- Obtain the orientation and position of the end-effector relative to the base,
  - 4- Check the correctness of the results and describe it at the home position.

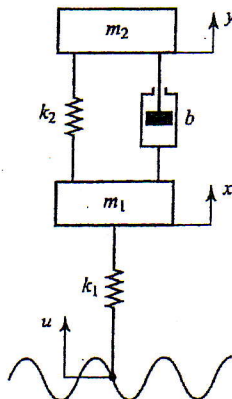


Fig.(1)

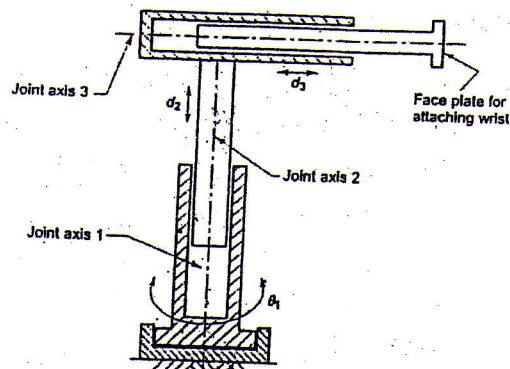


Fig.(2)

**Question No.(3):**

[ 25 Mark]

- (a)- [7]- Describe a diagram for Mechatronic system as a closed loop control system and mention the function for each component.
- (b)- [8]- Show with the aid of a net sketch an example of a simple mechatronic system involving mechanical elements used to maintain a constant rotation of shaft , then explain how the control system is operated?

(c)- [10]- Use the block diagram reduction technique to obtain the overall transfer Function  $C(s)/R(s)$  of the control system shown in the Fig.(3).

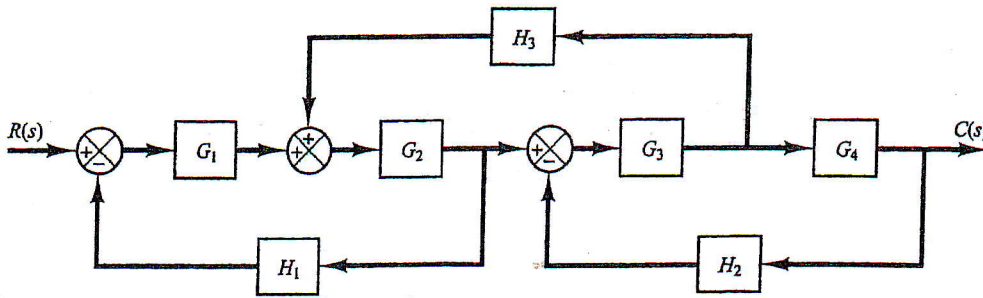


Fig.(3)

**Question No.(4):**

[ 25 Mark]

- (a)- [8]- In industrial applications, compare between pneumatic systems and hydraulic systems, showing the conditions for using him in robots.
- (b)- [7]- Draw the circuits for (P, I and D) electronic amplifiers and derive the transfer function for each?
- (c)- [10]- For the position control system shown in Fig.(4), two potentiometers of constant  $K_0$  are used for finding out the error signal between the input angular position  $r$  and the output angular position  $c$ . An electronic differential amplifier of constant  $K_1$  is used for the error signal amplification. The amplified signal is fed to a dc electric motor of resistance  $R_a$ , inductance  $L_a$  and back emf constant  $K_3$ . The torque developed by the motor is proportional to the armature current, where  $K_2$  is a proportionality constant. The torque has been transmitted to a mechanical vibrational set of inertia of the load and gear train referred to the motor shaft ( $J_0$ ) and viscous friction coefficient of the load and gear train referred to the motor shaft ( $b_0$ ). The gear ratio of the gear train is such that the output shaft rotates  $n$  times for each revolution of the motor shaft.

- 1- Describe the system by a set of differential equations,
- 2- Draw the block diagram representing the given system.

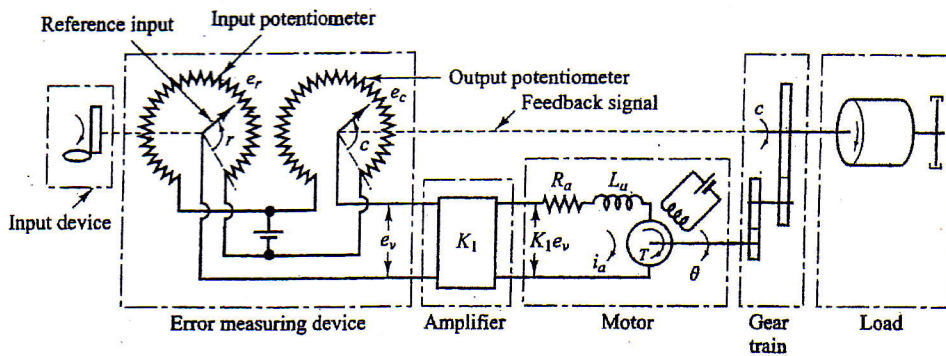


Fig.(4)

*With my best wishes*

This exam measure the following ILOs												
Question No.	Q1-a	Q2-a	Q3-a	Q4-a	Q1-b	Q2-b	Q3-b	Q4-b	Q1-c	Q2-c	Q3-c	Q4-c
	a-1	a-3	a-4	a-3	b-2	b-6	b-2	b-6	c-1	c-4	c-1	c-4
Skills	Knowledge & Understand				Intellectual				Professional			