

Menofiya University  
 Faculty of Engineering  
 Dept of Electrical Engineering .  
 Date: 3 /6/2014  
 Total Marks: 70  
 Subject/Code: Robotics / ELE 425 C



Final Term Exam  
 Academic Year: 2013-2014  
 4<sup>th</sup> Year  
 Allowed Time: 3 Hours

This exam measures ILO's no. (A2, A3, A8, B2, C13, D3)  
 Remarks: No. of pages: 2 No. of questions: 4  
 Allowed Tables and Charts: (None)

**Answer All The Following Questions:**

**The First Question (15- Marks)**

- Define: Dof, Manipulator, End-effector, link and joint
- Compare between the common translational robot arm designs.
- Explain the basic elements of a robotic system.

**The Second Question (15- Marks)**

- Deduce the planar rotation matrix  $R(\theta_1)$  corresponding to angle  $\theta_1$  from coordinate axes  $X_1Y_1$  to coordinate axes  $X_0Y_0$ .
- Find the Homogenous Matrix for a translation in XYZ plane to NOA plane shown in figure (1).

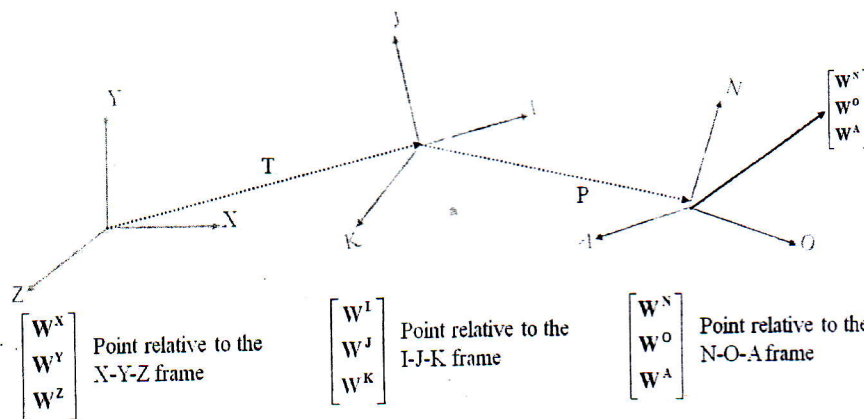


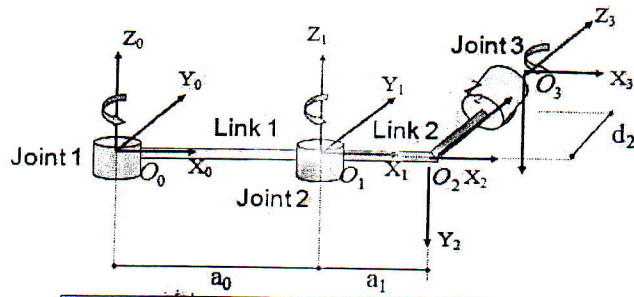
Figure (1)

**The Third Question (20- Marks)**

- What is the difference between Forward and Inverse Kinematics of a robot.
- Define: Joint angle, Joint distance, Link length, Link twist angle.
- Find the D-H matrix for a 3 Revolute Joints shown in figure (2), using link parameters in Table. 1

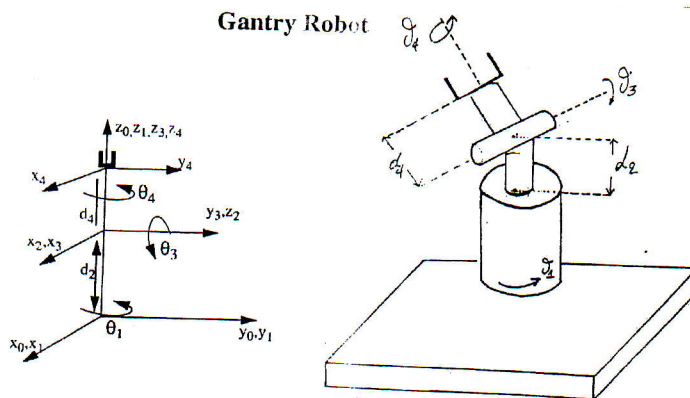
**The Fourth Question (20- Marks)**

- Deduce the resultant rotation matrix for YPR angles.
- Find the D-H matrix for a 4-DOF Gantry Robot Arm shown in figure (3), using link parameters in Table. 2



$i$	$\alpha_{(i-1)}$	$a_{(i-1)}$	$d_i$	$\theta_i$
0	0	0	0	$\theta_0$
1	0	$a_0$	0	$\theta_1$
2	-90	$a_1$	$d_2$	$\theta_2$

Figure (2) & Table. 1



joint	$\theta$	$d$	$a$	$\alpha$
1	$\theta_1$	0	0	0
2	0	$d_2$	0	-90
3	$\theta_3$	0	0	90
4	$\theta_4$	$d_4$	0	0

Figure (3) & Table. 2

With best wishes  
Dr. Hala. S. El Sayed