Tanat University | Department: Computer and control engineering | Faculty of Engineering

**Title:** Advanced computer networks | **Course code:** CCE628 | **Year:** Master students
**Final exam, Date:** 5/7/2016, **Total marks:** 60 | **Allowed time:** 3 hours | **Page: (1 /1)**

**Workout the following questions. Please Answer each question part in a septate page**

1. (12 marks: 5 and 7)

   (a) Consider framing in data link layer, what is byte-stuffing and bit-stuffing? Compare between them in contrasting their accompanied overhead.

   (b) The following character encoding is used in a data link protocol: A: 01000111 B: 11100011 FLAG: 01111110 ESC: 11100000 Show the bit sequence transmitted for the four-character frame A B ESC FLAG when each of the following framing methods is used:

   i. Byte count.
   ii. Flag bytes with byte stuffing.
   iii. Starting and ending flag bytes with bit stuffing.

2. (12 marks: 5 and 7)

   (a) What is Hamming distance? Explain Hamming error detection/correction code and mention its capability in detecting and correcting transmission errors.

   (b) Calculate a Hamming codeword that can correct 1-bit errors in the ASCII code for a line feed, LF, 0x0A. Use even parity.

3. (12 marks: 5 and 7)

   (a) Explain , in general, the operation of the sliding window protocol in stressing the role of the sender, the role of the receiver and the resources that must be available to each of them.

   (b) Suppose that an 11-Mbps 802.11b LAN is transmitting 64-byte frames back-to-back over a radio channel with a bit error rate of $10^{-7}$. How many frames per second will be damaged on average?

4. (12 marks: 5 and 7)

   (a) Explain the difference between 1-persistent, p-persistence, non-persistent and collision detection carrier sense multiple access protocols.

   (b) What is the length of a contention slot in CSMA/CD for (a) a 2-km twin-lead cable (signal propagation speed is 82% of the signal propagation speed in vacuum)?, and (b) a 40-km multi-mode fiber optic cable (signal propagation speed is 65% of the signal propagation speed in vacuum)?

5. (12 marks: 5 and 7)

   (a) What is the infrastructure and Ad hoc operation modes for wireless networks. Explain you answer.

   (b) Suppose that there are 10 RFID tags around an RFID reader. What is the best value of Q (the range of slots over which tags will respond)? How likely is it that one tag responds with no collision in a given slot?

**Best wishes…**

**The examination committee**

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| Course Title: Robotics | الانسان الآلي | Course Code: **CCE621** |
| Date: 9.6.2016 | Allowed time: 3 hours | No. of Pages: (2) |

# Answer all the following questions:

## Question No. 1

*(20 degrees)*

1. Compare hard automation with soft automation.
2. Briefly discuss various robot components.
3. What are the various types of reference frames attached to a robot? Explain with example.
4. What are the performance parameters? Define repeatability, resolution and accuracy.
5. Discuss the advantages and disadvantages of using robots in industry.
6. Draw any two Euler angle systems and show rotations and angles.
7. What are performance parameters? Define repeatability, resolution and accuracy.
8. Define the term: Robot kinematics.
9. Differentiate between robot forward kinematics and robot inverse kinematics.
10. Mention the two DH assumptions for frame assignment in forward kinematics. Explain how they reduce the parameters required to relate frame i to frame i − 1.
11. In your own words, explain briefly how machine learning can be used to estimate robot inverse kinematics. (Explain the steps of applying machine learning).

## Question No. 2

*(20 degrees)*

1. The co-ordinates of a point $P_{abc}$ in the mobile frame OABC is given by $[2,-2,-1]^T$. If the frame OABC is rotated $45^o$ with respect to OZ of the OXYZ frame , find the co-ordinates of $P_{xyz}$ with respect to the base frame.
2. A mobile body reference frame OABC is rotated $30^o$ about OZ-axis of the fixed base reference frame OXYZ. If $P_{xyz} = [1,-2,2]^T$ , $Q_{xyz} = [1,-3,2]^T$ are the co-ordinates with respect to OXYZ plane, what are the corresponding co-ordinates of P and Q with respect to OABC frame?
3. Write down the homogeneous transformation matrices for the co-ordinate frames situated at the points A, B, C, with respect to base co-ordinate frame 0. What is the position and orientation of B with respect to frame 'C' ? Refer to figure 1.

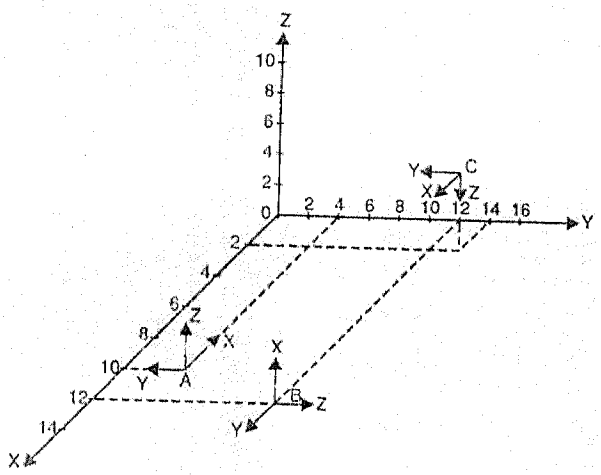


Figure 1 Problem 3. of Question No.2

## Question No. 3

*(22 degrees)*

1. Determine the homogeneous transformation matrix to represent a rotation of $30^o$ about OX-axis and a translation of 10 units along the OA-axis of the mobile frame.

2. Determine the homogeneous transformation matrix to represent the following sequence of operations:
   a. Rotation of 45° OC-axis.
   b. Translation of 2 units along OA-axis.
   c. Translation of -2 units along OY-axis
   d. Rotation of 90° about OX-axis
3. A robotic work cell has a camera with in the setup. The origin of the six joint robot fixed to a base can be seen by the camera. The homogeneous transformation matrix $H_1$ maps the camera with the cube centre. The origin of the base co-ordinate system as seen from the camera is represented by the homogeneous transformation matrix $H_2$.

$$H_1 = \begin{bmatrix} 0 & 1 & 0 & 2 \\ 1 & 0 & 0 & 1 \\ 0 & 0 & -1 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix} \qquad H_2 = \begin{bmatrix} 1 & 0 & 0 & -4 \\ 0 & -1 & 0 & 2 \\ 0 & 0 & -1 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

   a) What is the position and orientation of the cube with respect to the base co-ordinate system?
   b) After the system has been setup, someone rotates the camera 90 about the z-axis of the camera. What is the position and orientation of the camera with respect to robot's base co-ordinate system?
   c) The same person rotated by 90 the object about the y-axis of the object and translated 5 units of distance along the rotated y-axis. What is the position and orientation of the object with respect to the robot's base co-ordinate system?

## Question No. 4

*(23 marks)*

1. A six joint robotic manipulator equipped with a digital TV camera is capable of continuously monitoring the position and orientation of an object. The position and orientation of the object with respect to the camera is expressed by a matrix $[T_1]$, the origin of the robot's base co-ordinate with respect to the camera is given by $[T_2]$, and the position and orientation of the gripper with respect to the base co-ordinate frame is given by $[T_3]$. Where

$$T_1 = \begin{bmatrix} 0 & 1 & 0 & 3 \\ 1 & 0 & 0 & 2 \\ 0 & 0 & -1 & -1 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \quad T_2 = \begin{bmatrix} 1 & 0 & 0 & -2 \\ 0 & -1 & 0 & 2 \\ 0 & 0 & -1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \text{ and } T_3 = \begin{bmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 4 \\ 0 & 0 & 1 & 3 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

   Determine: i-the position and orientation of the object with respect to the base co-ordinate.
   ii- the position and orientation of the object with respect to gripper.
2. For the Cylindrical manipulator shown in figure 2, Find the homogeneous transformation matrix describing the forward kinematics of the whole manipulator, i.e. the position and orientation of the end effector with respect to the base. (Hint: Apply DH-convention).

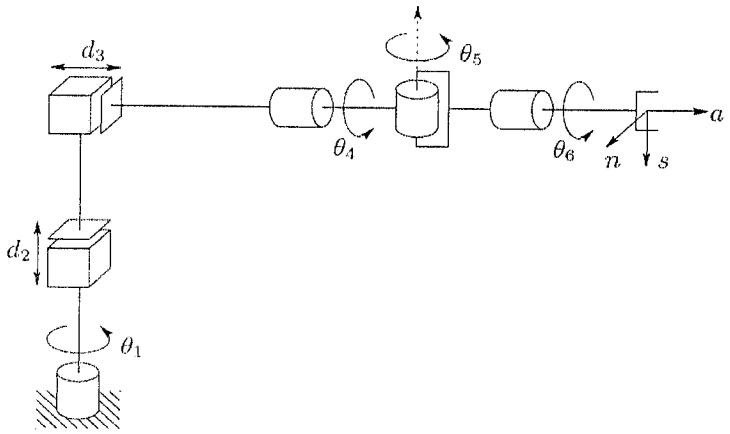


Figure 2 Problem 2 of Question No.4

*With my best wishes*

*Dr. Eng. Elsayed Sallam*