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Total Number of Pages: 2

**B.Tech**  
**PEME5305**

**6<sup>th</sup> Semester Regular / Back Examination 2016-17**  
**ROBOTICS AND ROBOT APPLICATIONS**  
**BRANCH: EEE**  
**Time: 3 Hours**  
**Max Marks: 70**  
**Q.CODE: Z705**

**Answer Question No.1 which is compulsory and any five from the rest.**  
**The figures in the right hand margin indicate marks.**

- Q1 Answer the following questions: (2 x 10)**
- a) Define individual Robotic components and explain them briefly?
  - b) What is the minimum number of degrees of freedom by which one may place or rotate a rigid body in a three dimensional space ?
  - c) Define a Articulated or anthropomorphic robot using simple diagram ?
  - d) Define the terms Degeneracy and Dexterity?
  - e) Give Transformation matrix for rotation of angle 'θ' along 'X' and 'Y' of a robot .
  - f) Explain briefly why homogenous transformation matrix is used ?
  - g) What are the disadvantages of using Cartesian space trajectory planning?
  - h) What is an actuator ? explain and give examples of Robot actuators ?
  - i) With a practical example explain the importance of inverse kinematics ?
  - j) Define the term 'Jacobian'?
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- Q2 a) Characterize the following definition of a Robot (a) payload (b) reach (5)**  
(c)Precision (d) Repeatability
- b) Give different social and industrial applications of Robot? (5)**
- Q3 a) What is the final rotation matrix for rotation of 45<sup>0</sup> about OZ axis , (5)**  
followed by a 30<sup>0</sup> about OX axis , followed by a rotation of 60<sup>0</sup> about  
the OY axis?
- b) Suppose that we desire to place the origin of the hand frame of a (5)**  
cylindrical robot at [3,4,7]<sup>T</sup> . Calculate the joint variables of the robot?
- Q4 a) From simple two degree of Cartesian space robot configuration explain (5)**  
the concept of forward and inverse kinematics?
- b) Using a mathematical perspective explain the term 'Jacobian' and also (5)**  
give reasons why Jacobian is used in Robotics?

- Q5 a)** Give the D-H representation of a general purpose joint link combination and explain the matrix transformation used in a DH representation of a forward and inverse kinematics of robot? **(5)**
- b)** Briefly explain the (a) Lagrange Euler formulation (b) Newton Euler iterative algorithm **(5)**
- Q6 a)** In details explain the joint space and Cartesian space trajectory planning? **(5)**
- b)** It is desired to have the first of a six axis robot go from initial angle of 20 degree to a final angle of 70 degree in 3 seconds. Using a third order polynomial , calculate the joint angles at 1 ,2 and 3seconds **(5)**
- Q7 a)** Give the complete matrix framework for 'RPY' orientation and show individual transformations clearly **(5)**
- b)** Give working principle of some sensors used to measure position of a Robot hand ? **(5)**  
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- Q8 Write short answer on any TWO:** **(5 x 2)**
- a)** Hydraulic Actuator
- b)** LVDT
- c)** Parabolic Blending and Via points .