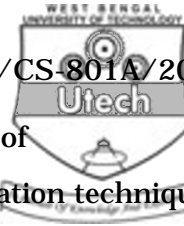




- 2



- ix) The diffuse lightning approach is a type of
- a) sensing
  - b) illumination technique
  - c) flow of control
  - d) none of these.
- x) RMFC is
- a) Robotic Motion Force Control
  - b) Random Motion Force Control
  - c) Resolved Motion Force Control
  - d) Relative Motion Force Control.
- xi) How many DOFs are possible in a rigid mechanical body in 3D space ?
- a) 3
  - b) 4
  - c) 5
  - d) 6.
- xii) The term 'Robot' was first introduced by
- a) Karel Capek
  - b) Alan MacWorth
  - c) Robert Fu
  - d) H.G. Wells.

**GROUP - B**

**( Short Answer Type Questions )**

Answer any *three* of the following.  $3 \times 5 = 15$

2. What is the advantage of Newton-Euler formulation over Lagrange-Euler formulation ?
3. Define degree of freedom ( DOF ). What are Roll, Pitch & Yaw ?
4. Explain internal state sensing and external state sensing.
5. Derive the translation matrix of imaging geometry.
6. Considering the robot arm control as a path trajectory tracking problem, classify the motion control.



**GROUP - C**

**( Long Answer Type Questions )**

Answer any *three* of the following.

3 × 15 = 45

7. a) Show and describe the architecture of a computer-based intelligent robotic manipulator.  
b) Describe an intelligent application of vision-controlled Robotic system. 8 + 7
8. a) Derive the basic form of Transformation matrix (  $R$  ) & thus explain orthogonal transformation.  
b) Explain Langrange-Euler formulation of Robot Arm Dynamics. 7 + 8
9. a) What is Trajectory Planning ? How does it function ?  
b) What is Rotation matrix used in Robot Arm Kinematics ? Note down the rotation matrices when
  - i) OUVW coordinate system is rotated an angle  $\alpha$  about the OX axis
  - ii) OUVW coordinate system is rotated an angle  $\phi$  about the OY axis
  - iii) OUVW coordinate system is rotated an angle  $\theta$  about the OZ axis. 7 + 8
10. a) Describe the basic algorithm for generating joint trajectory set points.  
How is it modified for Cartesian path control ?  
b) Classify Robotic Arms according to mechanical structures. 8 + 7
11. Write short notes on any *three* of the following : 3 × 5
  - a) Degree of freedom
  - b) Binary sensors
  - c) Expert system & knowledge engineering
  - d) Robot learning
  - e) Proximity sensing.

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