

B.E.-Instrumentation Engineering Sem VIII  
**IN8043 - Elective-II : Robotic System and Control**

P. Pages : 2

Time : Three Hours



**GUG/S/18/7107**

Max. Marks : 80

- Notes :
1. Same Answer book must be used for each section.
  2. All questions carry marks as indicated..
  3. Due credit will be given to neatness and adequate dimensions.
  4. Assume suitable data wherever necessary.

1. a) State the laws of robotics. 4  
b) Compare revolute joint with prismatic joint. 4  
c) Verify that a positive rotation of  $\theta$  about the  $Y_0$  – axis is the same as a negative rotation of  $\theta$  about the  $Y_1$  – axis, if frame – 0 is related to frame – 1 by a rotation of  $\pi$  about the  $Z_0$  – axis. 8

**OR**

2. a) Define robot. Discuss the types of robots based on their application in automation industry. 8  
b) Obtain the rotation matrix,  $R_{Y,\theta}$  for a rotation of  $\theta$  about the Y – axis in 3 – dimensional space. 8
3. a) Draw and justify the Denavit – Hartenberg (DH) frames for the SCARA manipulator. 8  
b) Show that the dynamic model of the regular pendulum system shown in below figure 1 is 8

$$\ddot{\theta} = \frac{-g}{\ell} \sin \theta$$

where,  $\ell$  is the length of pendulum,  $m$  is the mass of the tip of the pendulum,  $\theta$  is the angle between pendulum and vertical Y – axis and  $g$  is the gravity term.

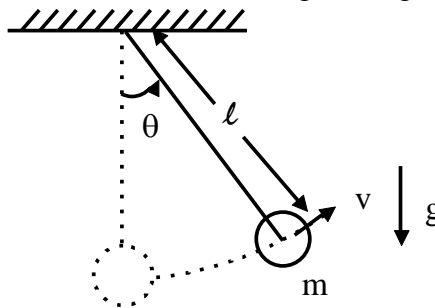


Figure 1 : Regular Pendulum system.

**OR**

4. a) Derive the forward Kinematic equation for articulated manipulator using DH – convention. 8  
b) Describe the general expressions for Kinematic and potential energy for 'n' link robotic manipulator. 8
5. a) Carryout the details of the computed torque control for trajectory tracking of robotic manipulator. 8

