JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -3 EXAMINATION- 2025

B.Tech-VIII Semester (OE)

COURSE CODE (CREDITS): 20B1WEC731 (3) MAX. MARKS: 35

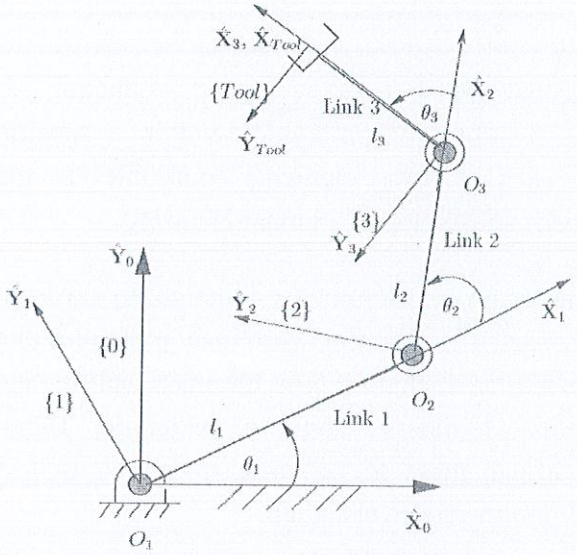
COURSE NAME: Automation and Robotics

COURSE INSTRUCTORS: EPN MAX. TIME: 2 Hours

Note: *(a) All questions are compulsory.*

(b) The candidate is allowed to make Suitable numeric assumptions wherever required for solving problems

Q.No	**Question**	**CO**	**Marks**
Q1	What were the major milestones in the industrial revolutions related to automation? Discuss the impact of automation on employment and productivity.	CO1	2
Q2	Identify the primary elements that impact the cost of production per unit and the total time required for production within a specific industry. Analyze how each of these elements contributes to the overall expenses and time frames involved in manufacturing.	CO1	3
Q3	How does a mass-spring type accelerometer function to measure acceleration? With a neat sketch explain the operational principles of a mass-spring type accelerometer, including how the mass, spring, and damping mechanisms interact to detect changes in acceleration. Detail how the displacement of the mass in response to acceleration is measured and converted into an electrical signal.	CO4	5
Q4	Explain the concept of position and orientation of a rigid body in robotics. Discuss the mathematical representation of position and orientation using transformation matrices. Provide examples of how the position and orientation of a robot end-effector are described and manipulated in different coordinate systems.	CO3	5
Q5	It is desired to rotate a position vector ${}^{A}P$ in frame $\{A\}$ about $\hat{Y}_A$ by 30 degrees and translate it 2 units in $\hat{X}$ and 3 units in $\hat{Y}$. Find the operator T which can perform the rotation and translation.	CO3	5

Q6	With neat sketch of a robotic link, describe the Denavit-Hartenberg (D-H) parameters and their significance in robot kinematics.	CO3	5
Q7	Figure below shows a three-link planar arm where all three joints are revolute. Find the Denavit Hartenberg (DH) parameters for the arm and tabulate the 4 parameters ($\alpha_{i-1}, a_{i-1}, d_i, \theta_i$, $where\ i = 1,2,3,4$). Find the transformation matrix of frame $\{3\}$ realative frame $\{1\}$, ${}^{3}_{1}T$. The general form of Link transformation is given as: $$ {}^{i-1}_{i}T = \begin{bmatrix} c\theta_i & -s\theta_i & 0 & a_{i-1} \\ s\theta_i c\alpha_{i-1} & c\theta_i c\alpha_{i-1} & -s\alpha_{i-1} & -s\alpha_{i-1}d_i \\ s\theta_i s\alpha_{i-1} & c\theta_i s\alpha_{i-1} & c\alpha_{i-1} & c\alpha_{i-1}d_i \\ 0 & 0 & 0 & 1 \end{bmatrix} $$ 	CO3	5
Q8	A single-link robot with a rotary joint is motionless at $\theta = 10$ degrees. It is desired to move the joint in a smooth manner to $\theta = 50$ degrees in 10 seconds. Find the coefficients of a cubic polynomial that accomplishes this motion and brings the manipulator to rest at the goal. Plot the position, velocity, and acceleration of the joint as a function of time.	CO5	5