Roll No.												

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 15-12-2025 **Time:** 1.00pm to 04.00pm

School: SOE	**Program:** B.Tech	
Course Code: MEC3060	**Course Name:** Robotics	
Semester: V	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5	CO6
Marks	10	14	12	12	26	26

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	Write the shape of workspace of cartesian robot and SCARA robot.	2 Marks	L2	CO2
2.	Define degree of mobility and degree of maneuverability.	2 Marks	L2	CO1
3.	Define Singularity concept with respect to kinematics of robots.	2 Marks	L2	CO3
4.	Explain velocity propagation from link to link briefly.	2 Marks	L2	CO4
5.	Define path and write the position vector of a manipulator.	2 Marks	L2	CO5
6.	List the three motion constraints involved in trajectory generation.	2 Marks	L2	CO5
7.	List any four trajectory profiles commonly used in robotics.	2 Marks	L2	CO5
8.	Define ROS.	2 Marks	L2	CO6
9.	What components are needed to build your own ROS environment.	2 Marks	L2	CO6
10.	Define manipulation in ROS.	2 Marks	L2	CO6

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	Write the classification of robots on various parameters.	**08 Marks**	**L3**	**CO1**
	b.	The inverse kinematics of robots plays an important role in design of algorithms for their orientation. The final position of the end effector is to be kept at (x, y) = (22 cm, 25 cm). If link 1 and link 2 are of 35 cm and 48 cm respectively. Find the angular orientations of link 1 and link 2.	**12 Marks**	**L3**	**CO2**
		Or			
12.	**a.**	Derive inverse kinematics of 2 dof serial robotics manipulator.	**12 Marks**	**L3**	**CO2**
	b.	What is workspace? Explain types of workspace and explain the parameters affecting the workspace.	**08 Marks**	**L3**	**CO1**

13.	**a.**	Explain the role of Jacobians in robotics. Also explain the kinematics structure of Jacobian for position and velocity mapping in robotics.	**10 Marks**	**L4**	**CO3**
	b.	The Jacobian or rotation matrix for a 2 dof robotic serial manipulator is given as follows: $$\begin{bmatrix} -0.250 & 0.433 & -0.866 \\ 0.433 & -0.750 & -0.500 \\ -0.866 & -0.500 & 0.000 \end{bmatrix}$$ Calculate the angular displacement along longitudinal axis, angular displacement along lateral axis and angular displacement along vertical axis.	**10 Marks**	**L3**	**CO4**
		Or			
14.	**a.**	Calculate roll, pitch and yaw angles for frame {B} with respect to reference frame {U} for angular motion along all three axes. The rotation matrix is given for 2 dof robotic serial manipulator as follows: $$\begin{bmatrix} -0.350 & 0.333 & -0.666 \\ 0.513 & -0.350 & -0.300 \\ -0.756 & -0.410 & 0.100 \end{bmatrix}$$	**10 Marks**	**L4**	**CO3**
	b.	A frame {C} is rotated about Z axis of the universal coordinate system by 35 degrees and translated along X, Y and Z by 3, 2.1, and 2.2 units, respectively. Let the position of a point Q in {C} is given by $[1.0\ 2.0\ 3.0]^T$. Calculate the final position with respect to universal coordinate system.	**10 Marks**	**L3**	**CO4**

15.	**a.**	The initial and final positions of rotary joint are 8 and 45 deg respectively. The link reaches final position in 5 seconds. It starts from rest and becomes motionless. Determine the suitable 3rd order polynomial trajectory function for the same. Draw the time history of position and velocity.	**15 Marks**	**L3**	**CO5**
	b.	Explain the requirements for trajectory generation in robotics.	**05 Marks**	**L3**	**CO5**
Or					
16.	**a.**	For robot with 1 rotary joint, the angular positions and angular velocities at the beginning of the trajectory path and end of the trajectory path are given as follows. At time t = 0, the angular position is $\theta = \theta_i$, angular velocity is $\dot{\theta} = \dot{\theta}_i$ and at time t = t_f, the angular position is $\theta = \theta_f$, the angular velocity is $\dot{\theta} = \dot{\theta}_f$. Find the suitable trajectory function of the form $\theta(t) = a_0 \times e^{a_1 \times t} + a_2 \times t^{a_3}$ which satisfies the above conditions.	**15 Marks**	**L3**	**CO5**
	b.	Explain collision free path trajectory generation in robotics and also write the requirements of the collision free path.	**05 Marks**	**L3**	**CO5**

17.	**a.**	Explain the manipulation used in ROS along with key functionalities of it. Also explain the advantages and applications of manipulation in ROS.	**10 Marks**	**L3**	**CO6**
	b.	Explain the autonomous navigation used in ROS along with major components of it. Also explain the advantages and applications of autonomous navigation in ROS.	**10 Marks**	**L3**	**CO6**
Or					
18.	**a.**	Explain blender design used in ROS and also explain the advantages of it.	**10 Marks**	**L3**	**CO6**
	b.	Explain Robot vision in ROS along with types and importance of it. Also explain the advantages of it.	**10 Marks**	**L3**	**CO6**