SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)
Approved by AICTE, Affiliated to Anna University, Chennai, Accredited by NBA,
'A' Grade Accreditation by NAAC & ISO 9001:2015 Certified Institution
SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

V SEMESTER

PEI102 – ROBOTICS & AUTOMATION
Regulation - 2023
Academic Year 2025 - 2026 (ODD Sem)

Prepared by

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ENGINEERING

QUESTION BANK

SUBJECT: PEI 102 - ROBOTICS AND AUTOMATION

SEM/YEAR: V / III – EIE

	UNIT I - FUNDAMENTALS OF ROBOT			
	Robot – Definition – Robot Anatomy – Co-ordinate systems, Work Envelope, types and classification – specifications – Pitch, yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their functions – Need for Robots – Different Applications			
	PART – A			
Q.No.	**Questions**	**BT Level**	**Competence**	**Course Outcome**
1.	Define a robot.	BTL-1	Remember	CO 1
2.	List any two types of robots based on configuration.	BTL-1	Remember	CO 1
3.	What do you mean by robot anatomy?	BTL-2	Understand	CO 1
4.	Name any two parts of a robot and state their functions.	BTL-1	Remember	CO 1
5.	Define the term 'coordinate system' in robotics.	BTL-1	Remember	CO 1
6.	List any two coordinate systems used in robot programming.	BTL-1	Remember	CO 1
7.	What is a work envelope?	BTL-1	Remember	CO 1
8.	Explain the importance of a robot's work envelope.	BTL-2	Understand	CO 1
9.	Define degrees of freedom (DoF) in a robot.	BTL-1	Remember	CO 1
10.	What do you understand by the term 'payload' in robots?	BTL-2	Understand	CO 1
11.	State the meaning of pitch and roll in robotic movement.	BTL-1	Remember	CO 1
12.	What is yaw motion in robotics?	BTL-1	Remember	CO 1
13.	What is the use of joint notation in robot kinematics?	BTL-2	Understand	CO 1
14.	List two common joint notations used in robotic arms.	BTL-1	Remember	CO 1
15.	Define speed of motion with reference to robots.	BTL-1	Remember	CO 1
16.	Why is speed of motion important in industrial robots?	BTL-2	Understand	CO 1

17.	List two specifications used to describe a robot.	BTL-1	Remember	CO 1
18.	Define the term "end-effector."	BTL-1	Remember	CO 1
19.	Explain the function of an end-effector in a robot.	BTL-2	Understand	CO 1
20.	What is the need for robots in hazardous environments?	BTL2	Understand	CO 1
21.	Mention two applications where robots are preferred over humans.	BTL-1	Remember	CO 1
22.	Why are robots used in the automotive industry?	BTL-2	Understand	CO 1
23.	List two advantages of using robots in manufacturing.	BTL-1	Remember	CO 1
24.	Describe any two functions performed by robots in daily life or industry.	BTL-2	Understand	CO 1
	PART-B			
1.	Apply the concept of coordinate systems to explain how the position of a robot's end effector is determined. (16)	BTL-3	Apply	CO 1
2.	Use the definitions of pitch, yaw, and roll to describe the orientation changes of a robot arm during a pick-and-place task. (16)	BTL-3	Apply	CO 1
3.	Given the specifications of speed and payload, select a suitable type of robot for a specific industrial application. (16)	BTL-3	Apply	CO 1
4.	Demonstrate how to calculate the work envelope for a 3-joint robot manipulator. (16)	BTL-3	Apply	CO 1
5.	Apply joint notation conventions to write the movement commands for a 2R robot arm. (16)	BTL-3	Apply	CO 1
6.	Using the robot anatomy, explain how each part contributes to the robot's overall functionality in material handling. (16)	BTL-3	Apply	CO 1
7.	Given a scenario in assembly, apply the robot specifications to suggest improvements in speed and payload. (16)	BTL-3	Apply	CO 1
8.	Analyze the different types of robots and classify them based on their structure and applications. (16)	BTL-4	Analyze	CO 1
9.	Analyze the relationship between speed of motion and payload in robot design and explain how it affects performance. (16)	BTL-4	Analyze	CO 1
10.	Analyze how pitch, yaw, and roll angles affect the robot's ability to reach and orient objects in 3D space. (16)	BTL-4	Analyze	CO 1
11.	Discuss the importance of coordinate systems in programming and controlling robotic movements. (16)	BTL-4	Analyze	CO 1
12.	Analyze the need for robots in modern industries and explain how their applications have evolved over time. (16)	BTL-4	Analyze	CO 1
13.	Compare different robot parts in terms of their functions and discuss how failure in any part affects overall performance. (16)	BTL-4	Analyze	CO 1

14.	Analyze how work envelope limitations impact the selection of robots for specific tasks. (16)	**BTL-4**	Analyze	CO 1
15.	Evaluate the impact of payload and speed specifications on the efficiency of robots in different industrial applications. (16)	BTL-5	Evaluate	CO 1
16.	Critically evaluate the need for robots in hazardous environments like underwater or space applications. (16)	BTL-5	Evaluate	CO 1
17.	Design a robot system for a material handling application specifying its anatomy, coordinate system, work envelope, and key specifications. (16)	BTL-6	Create	CO 1

UNIT II - FUNDAMENTALS OF ROBOT

Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of All These Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic grippers, vacuum grippers, two fingered and three fingered grippers, internal grippers and external grippers, selection and design considerations of a gripper - gripper force calculation and analysis.

PART – A

Q.No.	Questions	BT Level	Competence	Course Outcome
1.	Define a pneumatic drive.	BTL-1	Remember	CO 2
2.	What is a hydraulic drive?	BTL-1	Remember	CO 2
3.	List any two mechanical drive elements used in robotics.	BTL-1	Remember	CO 2
4.	Define an electrical drive.	BTL-1	Remember	CO 2
5.	Mention two features of a D.C. servo motor.	BTL-1	Remember	CO 2
6.	State any two advantages of stepper motors.	BTL-1	Remember	CO 2
7.	What is an A.C. servo motor?	BTL-1	Remember	CO 2
8.	List two applications of pneumatic drive systems.	BTL-1	Remember	CO 2
9.	Compare any one difference between pneumatic and hydraulic drives.	BTL-2	Understand	CO 2
10.	What is the working principle of a stepper motor?	BTL-2	Understand	CO 2
11.	List two areas where A.C. servo motors are commonly used.	BTL-1	Remember	CO 2
12.	Why are D.C. servo motors suitable for precision control applications?	BTL-2	Understand	CO 2
13.	What is meant by an end effector in a robot?	BTL-1	Remember	CO 2
14.	Name any two types of grippers used in robotic systems.	BTL-1	Remember	CO 2
15.	Define a mechanical gripper.	BTL-1	Remember	CO 2
16.	State one function of a magnetic gripper and one function of a vacuum gripper.	BTL-2	Understand	CO 2
17.	What is the difference between a two-fingered and a three-fingered gripper?	BTL-2	Understand	CO 2
18.	Explain the function of internal grippers.	BTL-2	Understand	CO 2
19.	What are external grippers?	BTL-1	Remember	CO 2
20.	List any two design considerations while selecting a gripper.	BTL-1	Remember	CO 2
21.	What factors influence gripper force?	BTL-2	Understand	CO 2
22.	Mention two differences between mechanical and pneumatic grippers.	BTL-2	Understand	CO 2

23.	Define gripper force in the context of robotic gripping systems.	BTL-1	Remember	CO 2
24.	Why is proper gripper selection important in robotic handling applications?	BTL-2	Understand	CO 2
PART-B				
1.	Apply the working principle of pneumatic drives to explain their use in a simple robot gripper mechanism. (16)	BTL-3	Apply	CO 2
2.	Demonstrate how to calculate the force exerted by a hydraulic gripper given the hydraulic pressure and piston area. (16)	BTL-3	Apply	CO 2
3.	Apply the differences between D.C. servo motors and stepper motors in selecting the drive system for a precise robotic arm. (16)	BTL-3	Apply	CO 2
4.	Use electrical drive characteristics to select a suitable drive for a high-speed robotic application. (16)	BTL-3	Apply	CO 2
5.	Apply the gripper force calculation to determine the required force for gripping a specific object without slippage. (16)	BTL-3	Apply	CO 2
6.	Analyze and compare the salient features of pneumatic, hydraulic, mechanical, and electrical drives used in robotics. (16)	BTL-4	Analyze	CO 2
7.	Analyze the pros and cons of magnetic and vacuum grippers for handling delicate objects. (16)	**BTL-4**	Analyze	CO 2
8.	Analyze how the choice between two-fingered and three-fingered grippers affects grasp stability and object manipulation. (16)	**BTL-4**	Analyze	CO 2
9.	Analyze the design considerations necessary when selecting a gripper for internal versus external gripping applications. (16)	**BTL-4**	Analyze	CO 2
10.	Compare the performance and application suitability of A.C. servo motors and stepper motors in robotic drives. (16)	**BTL-4**	Analyze	CO 2
11.	Evaluate the effectiveness of hydraulic drives versus electrical drives for heavy payload robot applications. (16)	BTL-5	Evaluate	CO 2
12.	Evaluate the role of mechanical drives compared to pneumatic drives in terms of precision and maintenance. (16)	BTL-5	Evaluate	CO 2
13.	Evaluate the impact of gripper design choices on robot performance in high-speed assembly lines. (16)	BTL-5	Evaluate	CO 2
14.	Critically evaluate the selection criteria of end effectors for different industrial applications, considering cost and reliability. (16)	BTL-5	Evaluate	CO 2
15.	Design a pneumatic gripper for handling fragile objects, including force calculation and control strategy. (16)	BTL-6	Create	CO 2
16.	Create a comparative analysis chart to select appropriate drives for a robotic arm in automotive assembly. (16)	**BTL-6**	Create	CO 2
17.	Develop a design proposal for a multi-fingered robotic gripper that can handle irregular-shaped objects securely. (16)	**BTL-6**	Create	CO 2

UNIT III - SENSORS IN ROBOTICS

Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

PART – A

Q.No.	Questions	BT Level	Competence	Course Outcome
1.	Define a force sensor in robotics.	BTL-1	Remember	CO3
2.	What is the difference between touch and tactile sensors?	BTL-2	Understand	CO3
3.	Mention two examples of proximity sensors used in robotics.	BTL-1	Remember	CO3
4.	What are non-contact sensors?	BTL-1	Remember	CO3
5.	Why is safety important in a robotic cell?	BTL-2	Understand	CO3
6.	List two safety considerations for robotic cell design.	BTL-1	Remember	CO3
7.	Define fail-safe hazard sensor systems.	BTL-1	Remember	CO3
8.	What is a compliance mechanism in robotics?	BTL-1	Understand	CO3
9.	Name two common types of cameras used in machine vision systems.	BTL-1	Remember	CO3
10.	What is the role of a frame grabber in machine vision?	BTL-2	Understand	CO3
11.	Explain what is meant by sensing and digitizing image data.	BTL-2	Understand	CO3
12.	What is signal conversion in machine vision systems?	BTL-1	Remember	CO3
13.	Why is image storage important in machine vision?	BTL-2	Understand	CO3
14.	Name two lighting techniques used in machine vision.	BTL-1	Remember	CO3
15.	Define image processing in the context of robotics.	BTL-1	Remember	CO3
16.	What is data reduction in image analysis?	BTL-2	Understand	CO3
17.	Explain image segmentation.	BTL-2	Understand	CO3
18.	What is feature extraction in machine vision?	BTL-1	Remember	CO3
19.	Define object recognition in image processing.	BTL-1	Remember	CO3
20.	Mention any two algorithms used in machine vision.	BTL-1	Remember	CO3
21.	List two applications of machine vision in robotics.	BTL-1	Remember	CO3
22.	How is machine vision used in inspection processes?	BTL-2	Understand	CO3

23.	What role does machine vision play in robotic navigation?	BTL-2	Understand	CO3
24.	Why is visual serving important in robotic applications?	BTL-2	Understand	CO3
PART – B				
1.	Apply the working principle of proximity sensors to explain how they are used for obstacle detection in a robotic arm. (16)	BTL-3	Apply	CO3
2.	Demonstrate how touch and tactile sensors can be integrated into a robot gripper to improve object handling. (16)	BTL-3	Apply	CO3
3.	Apply the concept of signal conversion in a machine vision system using a basic block diagram. (16)	BTL-3	Apply	CO3
4.	Use a compliance mechanism to explain how robots can perform insertion tasks without damaging components. (16)	BTL-3	Apply	CO3
5.	Explain how lighting techniques are applied in machine vision for accurate part inspection on a moving conveyor. (16)	BTL-3	Apply	CO3
6.	Analyze the differences between force, touch, and tactile sensors with respect to sensitivity and applications. (16)	BTL-4	Analyze	CO3
7.	Analyze the safety considerations in a robotic cell and discuss how fail-safe systems prevent accidents. (16)	BTL-4	Analyze	CO3
8.	Compare the role of segmentation and feature extraction in image processing for object recognition. (16)	BTL-4	Analyze	CO3
9.	Examine how signal digitization and image storage affect the performance of a machine vision system. (16)	BTL-4	Analyze	CO3
10.	Analyze how non-contact sensors differ from contact-based sensors in robotic navigation applications. (16)	BTL-4	Analyze	CO3
11.	Evaluate the effectiveness of force sensors versus tactile sensors in robotic assembly applications. (16)	BTL-5	Evaluate	CO3
12.	Evaluate the reliability of machine vision systems in inspection tasks in high-speed manufacturing lines. (16)	BTL-5	Evaluate	CO3
13.	Critically evaluate the integration of compliance mechanisms in robots used for medical or delicate electronics applications. (16)	BTL-5	Evaluate	CO3
14.	Assess the advantages and limitations of proximity and fail-safe hazard sensors in collaborative robotic environments. (16)	BTL-5	Evaluate	CO3
15.	Design a robotic inspection system using a camera, lighting, and segmentation algorithm to detect surface defects. (16)	BTL-6	Create	CO3
16.	Develop a machine vision solution for object identification and sorting in a warehouse environment using feature extraction techniques. (16)	BTL-6	Create	CO3
17.	Create a safety system architecture using sensors and fail-safe mechanisms for a multi-robot manufacturing cell. (16)	BTL-6	Create	CO3

	UNIT IV- KINEMATICS, DYNAMICS AND DESIGN OF ROBOTS			
	Robot kinematics - Geometric approach for 2R, 3R manipulators, homogenous transformation using D-H representation, kinematics of WMR, Lagrangian formulation for 2R robot dynamics; Mechanical design aspects of a 2R manipulator.			
	PART - A			
Q.N o.	**Questions**	**BT Level**	**Competence**	**Course Outcome**
1.	Define robot kinematics.	BTL-1	Remember	CO 4
2.	What is a 2R manipulator?	BTL-1	Remember	CO 4
3.	Mention two degrees of freedom in a 3R manipulator.	BTL-1	Remember	CO 4
4.	What is the geometric approach in robot kinematics?	BTL-2	Understand	CO 4
5.	Explain forward kinematics for a 2R manipulator.	BTL-2	Understand	CO 4
6.	What is the Denavit-Hartenberg (D-H) representation used for?	BTL-1	Remember	CO 4
7.	Define homogeneous transformation in robotics.	BTL-1	Remember	CO 4
8.	How does the D-H method simplify kinematic analysis?	BTL-2	Understand	CO 4
9.	What is a Wheeled Mobile Robot (WMR)?	BTL-1	Remember	CO 4
10.	Mention one application of WMR.	BTL-1	Remember	CO 4
11.	Explain the basic kinematics concept of a WMR.	BTL-2	Understand	CO 4
12.	What is Lagrangian formulation in robot dynamics?	BTL-1	Remember	CO 4
13.	State one advantage of using Lagrangian formulation for robot dynamics.	BTL-2	Understand	CO 4
14.	What does the Lagrangian represent in a 2R robot system?	BTL-1	Remember	CO 4
15.	Define the term 'joint variables' in the context of robot manipulators.	BTL-1	Remember	CO 4
16.	What are the mechanical design considerations for a 2R manipulator?	BTL-2	Understand	CO 4
17.	Name two common materials used for mechanical parts of a 2R manipulator.	BTL-1	Remember	CO 4
18.	Explain the importance of link length in the mechanical design of a 2R manipulator.	BTL-2	Understand	CO 4
19.	What is the role of the rotary joint in a 3R manipulator?	BTL-1	Remember	CO 4
20.	Describe the term 'forward kinematics'.	BTL-1	Remember	CO 4
21.	Differentiate between forward and inverse kinematics (one point).	BTL-2	Understand	CO 4
22.	What is the significance of transformation matrices in robot kinematics?	BTL-2	Understand	CO 4
23.	How are homogeneous transformation matrices used in the D-H method?	BTL-2	Understand	CO 4

24.	State two challenges in the mechanical design of robot manipulators.	BTL-1	Remember	CO 4

PART – B

1.	Apply the geometric approach to derive the forward kinematics of a 2R planar robot with given joint angles and link lengths. (16)	BTL-3	Apply	CO 4
2.	Using the D-H convention, apply transformation matrices to solve the forward kinematics of a 3R manipulator. (16)	BTL-3	Apply	CO 4
3.	Apply the kinematic model of a Wheeled Mobile Robot (WMR) to determine its position based on wheel velocities. (16)	BTL-3	Apply	CO 4
4.	Use Lagrangian formulation to derive the dynamic equations of motion for a 2R robotic manipulator. (16)	BTL-3	Apply	CO 4
5.	Apply mechanical design principles to suggest optimal dimensions for a 2R arm to achieve a specified reach and torque. (16)	BTL-3	Apply	CO 4
6.	Analyze the influence of link lengths and joint angles on the reachable workspace of a 2R robot. (16)	BTL-4	Analyze	**CO 4**
7.	Compare the kinematic behavior of 2R and 3R manipulators in terms of degrees of freedom and motion complexity. (16)	BTL-4	Analyze	CO 4
8.	Analyze the role of D-H parameters in simplifying the modeling of multi-joint robotic systems. (16)	BTL-4	Analyze	CO 4
9.	Analyze how wheel configuration impacts the mobility and controllability of a WMR. (16)	BTL-4	Analyze	CO 4
10.	Examine how inertia and joint torque affect the dynamic response of a 2R robot arm using the Lagrangian formulation. (16)	BTL-4	Analyze	CO 4
11.	Evaluate the suitability of using the geometric approach versus D-H representation for complex manipulators. (16)	BTL-5	Evaluate	CO 4
12.	It is desired to have the first joint of a 6-axis robot go from initial angle of 30° to a final angle of 75° in 5 seconds. Using a third-order polynomial, calculate the joint angle at 1, 2, 3, and 4 seconds. (16)	BTL-5	Evaluate	CO 4
13.	A robot is to be driven from an initial position through two via points before it reaches its final destination using a 4-3-4 trajectory. The positions, velocities, and time duration for the three segments for one of the joints are given below. Determine the trajectory equations and plot the position, velocity, and acceleration graphs for the joint. (16) $$\theta_1 = 30° \quad \dot{\theta}_1 = 0 \quad \ddot{\theta}_1 = 0 \quad \tau_{1i} = 0 \quad \tau_{1f} = 2\theta_2 = 50° \quad \tau_{2i} = 0 \quad \tau_{2f}$$ $$= 4 \quad \theta_3 = 90° \quad \tau_{3i} = 0 \quad \tau_{3f} = 2 \quad \theta_4 = 70° \quad \dot{\theta}_4$$ $$= 0 \quad \ddot{\theta}_4 = 0$$ (16)	BTL-5	Evaluate	CO 4
14.	A 2-DOF planar robot is to follow a straight line between the start (3,10) and the end (8,14) points of the motion segment. Find the joint variables for the robot if the path is divided into 10 sections. Each link is 9 inches long. (16)	BTL-5	Evaluate	CO 4

15.	Design a 2R robot arm that can operate within a specified workspace and carry a payload of 3 kg, specifying link lengths and joints. (16)	BTL-6	Create	CO 4
16.	Propose a conceptual mechanical design for a mobile robot that integrates both WMR navigation and 2R manipulation. (16)	BTL-6	Create	CO 4
17.	Create a kinematic simulation model for a 3R robotic arm and validate it with transformation matrices. (16)	BTL-6	Create	CO 4

	UNIT V- PROGRAMMING AND APPLICATIONS OF ROBOT			
Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.
PART – A
Q.No.	**Questions**	**BT Level**	**Competence**	**Course Outcome**
1.	What is teach pendant programming?	BTL-1	Remember	CO 5
2.	Define lead through programming.	BTL-1	Remember	CO 5
3.	Name two common robot programming languages.	BTL-1	Remember	CO 5
4.	What does VAL stand for in robot programming?	BTL-1	Remember	CO 5
5.	Mention one advantage of using VAL programming.	BTL-2	Understand	CO 5
6.	What is a motion command in robot programming?	BTL-1	Remember	CO 5
7.	Give an example of a sensor command in robot programming.	BTL-1	Remember	CO 5
8.	What are end effector commands used for?	BTL-1	Remember	CO 5
9.	How does teach pendant programming differ from lead through programming?	BTL-2	Understand	CO 5
10.	List one basic motion command used in robot programming.	BTL-1	Remember	CO 5
11.	Explain the purpose of sensor commands in robot programs.	BTL-2	Understand	CO 5
12.	What is a simple example of an end effector command?	BTL-1	Remember	CO 5
13.	Write a simple motion command example in VAL programming.	BTL-1	Remember	CO 5
14.	Describe the role of robots in inspection tasks.	BTL-2	Understand	CO 5
15.	How are robots used in assembly processes?	BTL-2	Understand	CO 5
16.	Mention one application of robots in material handling.	BTL-1	Remember	CO 5
17.	Why are robots used in underwater operations?	BTL-2	Understand	CO 5
18.	State one space-related application of robots.	BTL-1	Remember	CO 5
19.	What medical applications benefit from robotic systems?	BTL-1	Remember	CO 5
20.	Explain one advantage of using robots in medical surgery.	BTL-2	Understand	CO 5
21.	What is the function of the teach pendant in robot programming?	BTL-1	Remember	CO 5
22.	How does lead through programming help in robot training?	BTL-2	Understand	CO 5
23.	Name one type of sensor typically used in robot sensor commands.	BTL-1	Remember	CO 5
24.	Why is programming important for robot operation?	BTL-2	Understand	CO 5

	PART – B			
1.	Write a VAL program to move a robot arm through three positions using motion commands. (16)	BTL-3	Apply	CO 5
2.	Demonstrate how to program sensor commands in VAL to detect an object and stop the robot. (16)	BTL-3	Apply	CO 5
3.	Develop a simple robot program using teach pendant programming for pick and place operations. (16)	BTL-3	Apply	CO 5
4.	Illustrate lead through programming by describing how you would train a robot for an assembly task. (16)	BTL-3	Apply	CO 5
5.	Write a VAL program to control an end effector to grip and release an object in a packaging process. (16)	BTL-3	Apply	CO 5
6.	Design a robot program that uses sensor commands to inspect parts for defects on a conveyor belt. (16)	BTL-3	Apply	CO 5
7.	Create a simple robot program incorporating motion and end effector commands for material handling. (16)	BTL-3	Apply	CO 5
8.	Analyze the advantages and disadvantages of teach pendant programming compared to lead through programming. (16)	BTL-4	Analyze	CO 5
9.	Examine how motion commands affect robot accuracy and trajectory in industrial applications. (16)	BTL-4	Analyze	CO 5
10.	Analyze the importance of sensor commands in enhancing robot flexibility and safety in medical applications. (16)	BTL-4	Analyze	CO 5
11.	Discuss how programming of robots differs in underwater versus space applications, focusing on challenges and solutions. (16)	BTL-4	Analyze	CO 5
12.	Analyze the role of end effector commands in increasing the efficiency of robotic assembly lines. (16)	BTL-4	Analyze	CO 5
13.	Compare the programming complexities between inspection robots and material handling robots. (16)	BTL-4	Analyze	CO 5
14.	Analyze how VAL programming language facilitates integration of multiple command types in complex robotic tasks. (16)	BTL-4	Analyze	CO 5
15.	Evaluate the role of robot programming in improving productivity and safety in manufacturing industries. (16)	BTL-5	Evaluate	CO 5
16.	Assess the impact of advanced programming languages like VAL on the evolution of robotics in medical and space applications. (16)	BTL-5	Evaluate	CO 5
17.	Critically evaluate the limitations of teach pendant and lead through programming in modern robotics and suggest improvements. (16)	BTL-5	Evaluate	CO 5