

JEPPIAAR ENGINEERING COLLEGE

Jeppiaar Nagar, Rajiv Gandhi Salai – 600 119

DEPARTMENT OF MECHANICAL ENGINEERING

QUESTION BANK



VII SEMESTER

ME6010 – ROBOTICS

Regulation – 2013



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SUBJECT : ME6010– ROBOTICS
YEAR /SEM: IV /VII

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				
CO Mapping : C706.1				
Q.No	Questions	BT Level	Competence	PO
1	Define a Robot?	BTL-1	Remembering	PO2,PO3
2	Define automation?	BTL-1	Remembering	PO1,PO4,PO12
3	List out the types of automation?	BTL-1	Remembering	PO2,PO4
4	Mention the benefits of industrial automation systems?	BTL-5	Evaluating	PO2,PO3
5	What is meant by Robotics?	BTL-1	Remembering	PO1,PO2
6	What are the rules of Robotics? Write any two laws of robotics.	BTL-1	Remembering	PO1,PO2
7	Why are robots used?	BTL-1	Remembering	PO1,PO3
8	What is meant by Robot anatomy?	BTL-1	Remembering	PO1,PO2
9	List out the types of joint notation?	BTL-1	Remembering	PO1,PO2,PO3
10	Mention the classification of robots?	BTL-1	Remembering	PO1,PO3
11	What are the benefits of industrial robots?	BTL-2	Understanding	PO1,PO2,PO12
12	Name the important specifications of an industrial robot.	BTL-1	Remembering	PO2,PO3
13	What is meant by accuracy of robot?	BTL-1	Remembering	PO1,PO3
14	What is repeatability of robot?	BTL-1	Remembering	PO1,PO2
15	What is meant by resolution (precision)?	BTL-1	Remembering	PO1,PO2,PO12

16	List out the types of path control?	BTL-1	Remembering	PO1,PO2
17	List out the robot major components?	BTL-1	Remembering	PO1,PO3,PO4
18	What are the types of robot movements?	BTL-1	Remembering	PO1,PO2
19	What is meant by pitch, yaw and roll?	BTL-1	Remembering	PO1,PO12
20	What is work volume? What is meant by Work space?	BTL-1	Remembering	PO1,PO2
21	Define the term work envelop.	BTL-1	Remembering	PO1,PO2,PO12
22	What is meant by Quality of robot?	BTL-5	Evaluating	PO2,PO12
23	What are the three degrees of freedom associated with the arm and body motion?	BTL-1	Remembering	PO1
24	Define an Industrial Robot.	BTL-1	Remembering	PO1,PO12
25	Define payload capacity of Robot.	BTL-1	Remembering	PO1,PO12
26	Define base and tool Coordinate system?	BTL-2	Understanding	PO1,PO8,PO11
27	What are the four basic robot configurations available commercially?	BTL-2	Understanding	PO2
28	What is meant by palletizing and depalletizing?	BTL-4	Analyzing	PO2
29	What are the factors to be considered while selecting the robot?	BTL-1	Remembering	PO1
30	What are the disadvantages of robots?	BTL-1	Remembering	PO1,PO3
PART – B & C				
1	Explain any five work envelop of a robot with suitable diagram and mention its applications.	BTL-1	Remembering	PO1,PO2,PO4
2	Describe the important specifications of a robot and choose a suitable robot configuration for transferring 200 gram aluminium rod of 150 mm length. Give your justification.	BTL-5	Evaluating	PO1,PO2,PO3,PO11
3	(i) Sketch a robot wrist and indicate wrist pitch, wrist yaw and wrist roll. (or) Sketch and explain 3 DOF associated with wrist (ii) Explain about major parts of a robot with their functions.	BTL-5	Evaluating	PO1,PO2,PO3,PO12
4	(i) Discuss about the need for Robots (ii) Present a brief survey on how robots are applied in inspection work.	BTL-1	Remembering	PO1,PO2,PO4,PO11
5	Explain any four basic robot configurations with neat sketches and narrate individual merits, demerits and applications.	BTL-5	Evaluating	PO1,PO2,PO4,PO12
6	Write short notes on the following: (i) Types of robot controls (ii) Spatial resolution (iii) Repeatability.	BTL-6	Creating	PO1,PO3,PO11,PO12

UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS				
Pneumatic Drives - Hydraulic Drives - Mechanical Drives - Electrical Drives - D.C. Servo Motors, Stepper Motors, 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.				
PART – A				
CO Mapping : C706.2				
Q.No	Questions	BT Level	Competence	PO
1	What is an actuator?	BTL-1	Remembering	PO1,PO3
2	What are the factors which must be considered while choosing the drive system for robots?	BTL-1	Remembering	PO1,PO2
3	List the advantages and dis-advantages of hydraulic drive? (or) Which type of drive system is more suitable for heavy load robot application?	BTL-1	Remembering	PO1,PO2
4	List the advantages and disadvantages of pneumatic actuators?	BTL-1	Remembering	PO1,PO2,PO3
5	List the advantages and dis-advantages of Electrical actuator?	BTL-1	Remembering	PO1,PO2
6	Enumerate the difference bet. Open loop and closed loop control system?	BTL-1	Remembering	PO1
7	What are the elements of the closed loop control system ?	BTL-1	Remembering	PO1
8	What is a stepper motor? What are the different types of stepper motor?	BTL-1	Remembering	PO1
9	What are the advantages and disadvantages of Stepper motor?	BTL-1	Remembering	PO1,PO2
10	What are the characteristics of servomotor?	BTL-1	Remembering	PO1,PO2
11	Compare the AC and DC servomotors?	BTL-1	Remembering	PO1,PO2
12	Write about various types of motion convention?	BTL-1	Remembering	PO1
13	Write about the balls screw?	BTL-1	Remembering	PO1
14	Why servomotors are preferred with stepper motor in robot applications?	BTL-2	Understanding	PO1,PO2
15	What are the parts used in harmonic drive?	BTL-1	Remembering	PO1

16	Define End effector. Give some examples of Robot End Effector.	BTL-1	Remembering	PO1,PO2,PO6
17	What is meant by Gripper? What are the types of grippers?	BTL-3	Applying	PO1,PO2,PO3
18	List out the gripper design considerations?	BTL-3	Applying	PO1,PO2
19	What is the difference between internal grippers and external grippers?	BTL-1	Remembering	PO1,PO11,PO12
20	What are the types of Mechanical Grippers?	BTL-1	Remembering	PO1,PO2
21	List any two limitations of magnetic grippers.	BTL-3	Applying	PO1,PO2,PO4
22	What is a stripping device?	BTL-1	Remembering	PO1,PO2
23	List any four important factors to be considered in the selection and design of grippers?	BTL-1	Remembering	PO1,PO2
24	Give some examples of tool as robot End effector.	BTL-1	Remembering	PO1,PO3
25	Name some feedback devices used in robotics.	BTL-1	Remembering	PO1,PO11,PO12
26	What are the types of encoders?	BTL-4	Analyzing	PO1
27	List out the types of Drive systems used in Robots.	BTL-1	Remembering	PO2,PO11
28	Write the characteristics of actuating systems.	BTL-1	Remembering	PO1,PO11
29	List any two unique features of a stepper motor.	BTL-3	Applying	PO1
30	What is a RCC device? for what purpose is it used in a robots?	BTL-1	Remembering	PO1,PO2
PART – B & C				
1	Compare the servo motor with stepper motor choose suitable drive system for industrial robot along with your justification	BTL-3	Applying	PO1,PO2,PO4
2	Classify the end effector. Draw the different mechanism used in the gripper and give application	BTL-5	Evaluating	PO1,PO2,PO4 ,PO12
3	(i) Discuss various considerations for selection and design of a gripper. (ii) Explain working principle, salient features and applications of A.C. and D.C. Servo motor as robot drive system	BTL-5	Evaluating	PO1,PO2,PO4 ,PO12
4	State the features of 'Hydraulic and	BTL-5	Evaluating	PO1,PO2,PO3 ,PO11

	Pneumatic actuators' system with neat sketch.			
5	Explain the various drive system used with an industrial robot with their selection criteria and compare their features, merits and demerits.	BTL-4	Analyzing	PO1,PO2,PO3,PO4
6	(i) Explain vacuum grippers, with reference to the principle and applications. (ii) Explain the robot and end effector interface functions.	BTL-6	Creating	PO1,PO2,PO12,PO6

UNIT III SENSORS AND MACHINE VISION

Requirements of a sensor, Principles and Applications of the following types of sensors – Position sensors - Piezo Electric Sensor, LVDT, Resolvers, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors, binary Sensors., Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, 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 Servicing and Navigation.

PART – A

CO Mapping : C706.3

Q.No	Questions	BT Level	Competence	PO
1	Define vision and vision system?	BTL-1	Remembering	PO1,PO2
2	Classify the vision systems? What are the common imaging devices used for robot vision system?	BTL-1	Remembering	PO1,PO2
3	Define machine vision and its functions?	BTL-1	Remembering	PO1,PO2
4	Write the machine vision stages?	BTL-1	Remembering	PO1,PO2
5	Write the advantages of machine vision system?	BTL-1	Remembering	PO2,PO3
6	What is segmentation? What is thresholding?	BTL-1	Remembering	PO1,PO3
7	Define sensors and transducer.	BTL-3	Applying	PO1,PO2,PO12
8	What are the basic classifications of sensors?	BTL-3	Applying	PO1,PO12
9	Give an application example of a proximity sensor.	BTL-3	Applying	PO1,PO2
10	Brief on the working of inductive type proximity sensor.	BTL-3	Applying	PO1,PO2
11	Name some feedback devices used in robotics.	BTL-3	Applying	PO1,PO2,PO3
12	What is frame grabber? What is a tactile array sensor?	BTL-3	Applying	PO1,PO6
13	Classify the position sensors.	BTL-1	Remembering	PO1,PO2
14	What are the terms that define the performance of the transducers?	BTL-1	Remembering	PO1,PO2,PO3
15	What is LVDT and how does it work?	BTL-1	Remembering	PO1,PO2,PO3
16	Write about hall effect sensors?	BTL-1	Remembering	PO1,PO2,PO12
17	Write about pyroelectric sensor and piezoelectric sensors?	BTL-3	Applying	PO2,PO12
18	What are the types of light sensors?	BTL-3	Applying	PO2,PO3
19	What are photodiodes? What are the uses of	BTL-3	Applying	PO1,PO4

	Sniff sensors?			
20	What are the types and uses of Remote Center Compliance devices (RCC)?	BTL-3	Applying	PO1,PO2,PO4
21	What is an histogram of image?	BTL-3	Applying	PO2,PO4
22	What is meant by windowing and image restoration?	BTL-3	Applying	PO2,PO3,PO4
23	What is region growing, region splitting and edge detection?	BTL-1	Remembering	PO1,PO2
24	What is meant by feature extraction and pattern recognition?	BTL-1	Remembering	PO1,PO2
25	What is meant by quantization and morphology?	BTL-1	Remembering	PO1,PO2
26	Mention any two examples for contact and non-contact sensor.	BTL-2	Understanding	PO2
27	How does charge coupled device differ from charge induction device?	BTL-4	Evaluating	PO1
28	Give an example of touch sensor in the context of a robot.	BTL-2	Understanding	PO1,PO2,PO3
29	What is image analysis? What are the various techniques in image processing and analysis?	BTL-1	Remembering	PO1,PO2,PO3
30	What are areas of application of image processing in the field of robots? Name any two algorithms for image enhancement application.	BTL-1	Remembering	PO1,PO2,PO12
PART – B & C				
1	Explain the working principle of LVDT, Hall Effect sensor and compliance sensor along with respective circuit. Give the limitations of all three sensor mentioned.	BTL-6	Creating	PO1,PO2,PO1 2
2	Write any one algorithm for the edge detection and segmentation of an image. Explain how image segmentation helps to improve the quality of the images in a vision system. Describe the industrial applications of image processing in the field of mechanical engineering.	BTL-6	Creating	PO1,PO3,PO1 2
3	(i) What do you mean by robot vision? Explain. (ii) Explain and compare various lighting techniques used in machine vision.	BTL-6	Creating	PO1,PO3,PO1 2
4	With suitable sketch and citing appropriate application explain the following four sensors. (i) Optical proximity sensors (ii)	BTL-6	Creating	PO1,PO3,PO4

	Binary Touch sensors (iii) Slip sensors.			
5	(i) Describe the four types of photo electric sensors. (ii) Explain in detail the tactile and non-tactile sensors.	BTL-4	Analyzing	PO1,PO2,PO4
6	(i) Consider two frames $\{A\}$ & $\{B\}$. The frame $\{B\}$ is rotated with respect to frame $\{A\}$ by 30 degree. around z-axis and the origin of $\{B\}$ is shifted with respect to the origin of $\{A\}$ by $[5,10,5]$. the Z_a and Z_b axes are parallel point 'p' is described in $\{B\}$ by $(1,2,3)$. Describe the same point with respect to $\{A\}$ using the transform matrix . (ii) Write short note dynamics of a robot.	BLT-6	Creating	PO1,PO2,PO4

UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING				
Forward Kinematics, Inverse Kinematics and Difference; Forward Kinematics and Reverse Kinematics of manipulators with Two, Three Degrees of Freedom (in 2 Dimension), Four Degrees of freedom (in 3 Dimension) Jacobians, Velocity and Forces - Manipulator Dynamics, Trajectory Generator, Manipulator Mechanism Design - Derivations and problems. Lead through Programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End Effector commands and simple Programs.				
PART – A				
CO Mapping : C706.4				
Q.No	Questions	BT Level	Competence	PO
1	What are the methods of robot programming?	BTL-1	Remembering	PO1,PO2,PO12
2	What are the ways of accomplishing lead through programming?	BTL-1	Remembering	PO1,PO2,PO12
3	What is teach pendant?	BTL-3	Applying	PO1,PO2
4	What are the methods of teaching?	BTL-3	Applying	PO1,PO2
5	Write a short note on importance of kinematic study of the robot.	BTL-3	Applying	PO1,PO2
6	What is robot kinematics?	BTL-3	Applying	PO1,PO3
7	What is trajectory planning?	BTL-3	Applying	PO1,PO3,PO4
8	Define degrees of freedom.	BTL-1	Remembering	PO1,PO2
9	Explain joint mode of teaching robots.	BTL-5	Evaluating	PO2,PO3,PO4
10	Explain the reasons for defining points in a program.	BTL-1	Remembering	PO1,PO3,PO4
11	What is position representation?	BTL-1	Remembering	PO2,PO3
12	Define servo controlled robots.	BTL-1	Remembering	PO2,PO3,PO4
13	What is circular Interpolation?	BTL-1	Remembering	PO1,PO2
14	What are irregular smooth motions?	BTL-1	Remembering	PO1,PO2,PO4
15	What is manual lead through programming?	BTL-1	Remembering	PO1,PO2,PO3
16	What is powered lead through programming?	BTL-1	Remembering	PO1,PO2,PO4
17	Write down the limitations of Lead through methods	BTL-1	Remembering	PO1,PO2,PO3
18	Differentiate between Forward kinematics and reverse kinematics?	BTL-2	Understanding	PO1,PO2
19	Explain redundancy.	BTL-1	Remembering	PO1,PO2,PO3
20	Define servo control robots?	BTL-3	Applying	PO1,PO12
21	What are limitations of online and offline robot programming?	BTL-1	Remembering	PO1,PO3
22	List any two applications of straight line	BTL-1	Remembering	PO1,PO11

	interpolation in robotics.			
23	How can you define a manipulator?	BTL-1	Remembering	PO1,PO3
24	Write down the basic types of robot programming.	BTL-1	Remembering	PO1,PO2,PO3,PO12
25	List the Motion control commands used in VAL II programming and describe its functions.	BTL-1	Remembering	PO1,PO2,PO3,PO11,PO12
26	List the Speed control commands used in VAL II programming and describe its functions.	BTL-1	Remembering	PO1,PO2,PO4
27	List the Position control commands used in VAL II programming and describe its functions.	BTL-1	Remembering	PO1,PO2,PO3,PO4
28	List the End effector operation commands used in VAL II programming and describe its functions.	BTL-4	Analyzing	PO1,PO2,PO3,PO4
29	List the Sensor commands used in VAL II programming and describe its functions.	BTL-1	Remembering	PO1,PO2,PO4
30	What are the Robot Programming Languages used?	BTL-1	Remembering	PO1,PO2,PO4
PART – B & C				
1	(i) Explain the four statements of VAL robot programming language. List the commands used in VAL programming and describe its functions. (ii) Write a VAL program for pick-and-place operation on the conveyor system. it consists of two conveyors running parallel with centre distance of 600 mm at same level. An industrial robot is fixed centrally between the conveyors. The robot is used to transfer work pieces from conveyor 1 to 2 at a constant speed. Draw a schematic view of the system .assume all necessary dimension.	BLT-5	Evaluating	PO1,PO4,
2	Draw your environment diagram showing the industrial robot.	BTL-5	Evaluating	PO1,PO2,PO3
3	Illustrate the forward kinematics of a 3 DOF industrial robot with rational joints. Explain the functions of an inverse kinematics algorithm. Draw suitable diagram for your illustration. Mention the advantages of	BLT-5	Evaluating	PO1,PO3,PO4

	forward kinematics over inverse kinematics			
4	(i) Write about sensor and end effector commands. (ii) Differentiate the forward and reverse transformation with an example.	BLT-5	Evaluating	PO1,PO2,PO3,PO4
5	(i) Write an elaborate note on motion commands of robots. (or) Explain Wait, DELAY, SIGNAL commands with suitable examples. (ii) Explain manual lead through programming method in robot application.	BLT-5	Evaluating	PO1,PO3,PO4
6	(i) Explain Denavit-Hartenberg parameters with suitable examples.(ii) Discuss about Programming Languages used in computer controlled robots.	BLT-5	Evaluating	PO1,PO2,PO4,PO6

UNIT V IMPLEMENTATION AND ROBOT ECONOMICS				
RGV, AGV; Implementation of Robots in Industries - Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.				
PART – A				
CO Mapping : C706.5				
Q.No	Questions	BT Level	Competence	PO
1	What are the different types of material handling operation?	BTL-1	Remembering	PO1,PO2,PO4
2	What are the three basic modes of operation in a robot language operating system?	BTL-2	Understanding	PO1,PO2,PO3
3	What is Gantry Robot?	BTL-1	Remembering	PO1,PO2
4	Write some applications of AGV?	BTL-3	Remembering	PO1,PO2,PO3
5	List out types of AGV vehicles?	BTL-3	Remembering	PO1,PO2
6	Distinguish between the AGV and Robot.	BTL-3	Remembering	PO1,PO2
7	Mention the limitations of implementing robots in industry.	BTL-3	Remembering	PO1,PO2,PO3
8	List out any two important factors in the selection of robot for an application.	BTL-3	Remembering	PO1,PO2,PO12
9	List out the few robot applications area in manufacturing.	BTL-1	Remembering	PO1,PO2
10	What are the functions of work cell controller?	BTL-1	Remembering	PO1,PO3
11	State some of the reasons made use of robots in welding operation.	BTL-1	Remembering	PO1,PO4
12	Differentiate palletizing and depalletizing.	BTL-5	Evaluating	PO1,PO12
13	What are the steps to be followed by the company in order to implement robot programs in its operations?	BTL-1	Remembering	PO1,PO2,PO3
14	What are the typical technical features required for material transfer?	BTL-5	Evaluating	PO1,PO2
15	What are the different methods of economic analysis?	BTL-1	Remembering	PO1,PO2,PO3
16	Write a note on ROI method?	BTL-1	Remembering	PO1,PO3
17	Define EUAC method?	BTL-1	Remembering	PO1,PO12
18	Define a dead man switch?	BTL-1	Remembering	PO1,PO12
19	What are the general characteristics that	BTL-1	Remembering	PO1,PO2,PO11

	make potential robot application technically practical and economically feasible?			
20	Define payback period?	BTL-1	Remembering	PO1,PO2
21	What is AGV?	BTL-3	Remembering	PO1,PO2,PO12
22	How does RGV differ from AGV?	BTL-1	Remembering	PO1,PO2,PO3
23	Define MTTR, MTBF?	BTL-1	Remembering	PO1,PO2,PO12
24	What is image resolution?	BTL-1	Remembering	PO1,PO2,PO4
25	Define Tracking?	BTL-1	Remembering	PO1,PO3,PO4
26	Function of robots in a Computer Integrated Manufacturing environment.	BTL-1	Remembering	PO1,PO2,PO3
27	What are the causes of human injury in a robotic environment?	BTL-1	Remembering	PO1,PO2,PO4, PO12
28	List few safety precautions necessary for robotic application.	BTL-1	Remembering	PO1,PO2,PO4, PO12
29	What are the three levels of safety sensor systems in robotics defined by National Bureau of Standards?	BTL-1	Remembering	PO1,PO2,PO4, PO12
30	What are the benefits of industrial robots?	BTL-4	Analyzing	PO1,PO2,PO3
PART – B & C				
1	Discuss the various steps to be taken for implementing robots in industry and safety issues. Write the advantages of using robots in industry.	BLT-5	Evaluating	PO1,PO2,PO3 ,PO12
2	Illustrate the pay back and rate of return method of economic analysis while implementing robots in industry suitable example problem.	BLT-5	Evaluating	PO1,PO2,PO3
3	(i) Briefly explain AGV & RGV types of robots in detail. (ii) Briefly explain the various steps involved for implementing the robot in industries.	BLT-5	Evaluating	PO1,PO2,PO12
4	Briefly explain the economic analysis of Robots in detail.	BLT-5	Evaluating	PO1,PO3,PO6
5	Briefly explain the Safety sensors and safety monitoring of Robots in detail.	BLT-5	Evaluating	PO1,PO2,PO4
6	List and explain direct and indirect costs involved in a robot application project. Justify whether you gain profit or loss.	BLT-5	Evaluating	PO1,PO2,PO4

