SREENIVASA INSTITUTE of TECHNOLOGY and MANAGEMENT STUDIES
(AUTONOMOUS)

(AUTOMATION and ROBOTICS)

Code: 18MEC325

QUESTION BANK

III - B.TECH / II - SEMESTER REGULATION: R18

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SREENIVASA INSTITUTE OF TECHNOLOGY AND MANAGEMENT STUDIES

(Autonomous)

DEPARTMENT of MECHANICAL ENGINEERING

QUESTION BANK **AUTOMATION AND ROBOTICS (**18MEC325)

III B.Tech II Semester

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18MEC325 AUTOMATION AND ROBOTICS

Course Educational Objectives:

1. To study the various fundamental and advanced concepts of automation in industry
2. To understand the line balancing and flow lines in automated industry
3. To learn about basic concepts of drives, sensors used in robots
4. To study about the kinematics and dynamics analysis of robots
5. To gain knowledge in robot programming and application.

UNIT – 1: BASICS OF AUTOMATION

Basic elements of an automated system – Advanced automation function – Levels of automation – Hardware components for automation and process control – Overview of material handling – Material transport equipments – Analysis of material transport system – Introduction to automated storage and retrieval system

– Conventional storage methods and equipments – Analysis of storage system – Over view of automated identification technique – Bar code technology – Radio frequency techniques – AIDC technologies.

UNIT – 2: AUTOMATED FLOW LINES AND LINE BALANCING

Automated flow lines: Work part transport – Storage buffers – Control of the production line – Applications of flow line in machining system – System design consideration of flow lines. **Assembly line balancing:** Line balancing methods – Ways of improving line balance and flexible assembly lines –Automated assembly system and configuration – Parts delivery at work station and applications.

UNIT – 3: INDUSTRIAL ROBOTICS AND DRIVE SYSTEM

Introduction – Robot anatomy – Robot configuration and motions – Robot specifications – Pitch, yaw, roll, joint notations, speed of motion, pay load – Work volume. Robot Drive System: Pneumatic, hydraulic drives, mechanical and electrical drives – Servo motors and stepper motor. Grippers: Mechanical, pneumatic and hydraulic grippers, magnetic grippers and vacuum grippers – Two fingered and three fingeredgrippers – Internal and external grippers. Robot Sensors: Position and velocity sensor – Tactile sensor – Proximity and range sensor – Touch sensor – Force and torque sensor – Uses of sensors in robotics.

UNIT – 4: KINEMATICS AND DYNAMICS OF ROBOTS

Robot Kinematics: Manipulator kinematics – Position representation – Forward and reverse transformation – Adding orientation – Homogeneous transformations – D-H notation – Forward and inverse kinematics. **Robot Dynamics:** Differential transformation – Compensating for gravity – Robot arm dynamics. **Trajectory Planning:** Trajectory planning and avoidance of obstacles – Path planning – Skew motion – Joint integrated motion – Straight line motion.

UNIT – 5: ROBOT PROGRAMMING AND APPLICATION

Robot Programming: Lead through programming – Robot language structure – Motion commands of move, speed control, workplace, path, frames, end effecter operation, sensor operation and react statement – Program sequence and subroutine – Teach pendant programming – VAL II programming.

Robot Applications: Material transfer and machine loading / unloading – Processing applications in spray coating, spot and arc welding – Assembly and inspection automation – Selection of robots in industry applications.

Course Outcomes:

On successful completion of the course, Students will be able to		POs related to COs
CO1	Summarize the various fundamental and advanced concepts of automation in Industry	**PO1, PO2**
CO2	Understand the line balancing and flow lines of robotics in automated industry	**PO1, PO2**
CO3	Demonstrate the basic concepts of drives, sensors used in robots	**PO1, PO2**
CO4	Compare and analyze the kinematics and dynamics of robots	**PO1, PO2**
CO5	Explain about robot programming and applications	**PO1, PO2, PO3, PO4, PO5**

Text books:

1. Automation, Production Systems and Computer-Integrated Manufacturing, Mikell.P.Groover, 4/e, 2016, Pearson Education, New Delhi.
2. Industrial Robotics: Technology, Programming and Applications, Mikell P Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G Odrey and Ashish Dutta 2/e, 2012, Tata McGraw-Hill Education Pvt. Ltd.,

Reference books:

1. Introduction to Robotics: Analysis, Control, Applications, 3/e, 2020, Saeed B.Niku, Wiley India Pvt, Ltd., New Delhi.
2. Robotics Technology and Flexible Automation, S.R.Deb and Sankha Deb, 2/e, 2009, Tata McGraw-Hill Education Pvt. Ltd., Noida.
3. Robots and Robotics - Principles, Systems, and Industrial Applications, Mark R Miller & Rex Miller 2017, McGraw-Hill Education.
4. Introduction to Robotics: Mechanics and Control, John J. Craig, 3/e, 2005, Pearson Education, New Delhi.
5. Robotics: Fundamental Concepts and Analysis, Ashitava Ghosal, 1/e, 2006, Oxford University Press, New Delhi.
6. Robotics: Control, Sensing, Vision and Intelligence, K.S. Fu, R.C.Gonzales and C.S.G.Lee, 1/e, 2008, Tata McGraw-Hill Education Pvt. Ltd., Noida.

CO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO.1	3	2	-	-	-	-	-	-	-	-	-	-
CO.2	3	2	-	-	-	-	-	-	-	-	-	-
CO.3	3	2	-	-	-	-	-	-	-	-	-	-
CO.4	3	2	-	-	-	-	-	-	-	-	-	-
CO.5	3	2	2	2	2	-	-	-	-	-	-	-
CO*	**3**	**2**	**2**	**2**	**2**	-	-	-	-	-	-	-

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DEPARTMENT of MECHANICAL ENGINEERING

QUESTION BANK **AUTOMATION AND ROBOTICS (**18MEC325)

Q.NO	Questions			
	UNIT-I BASICS OF AUTOMATION			
	PART A(TWO MARKS QUESTIONS)	CO	BL	PO
1	What are the advanced automation function.	**CO1**	**1**	**PO1**
2	List various levels in automation.	**CO1**	**1**	**PO1**
3	Define automation?	**CO1**	**1**	**PO1**
4	What are the hardware components required for automation?	**CO1**	**1**	**PO1**
5	List the basic elements of an automated system.	**CO1**	**1**	**PO1**
6	Give examples of automation system.	**CO1**	**1**	**PO1**
7	What are the types of Automation.	**CO1**	**1**	**PO1**
8	Define open loop system?	**CO1**	**1,2**	**PO1**
9	List the material handling equipments.	**CO1**	**1**	**PO1**
10	List the various types of conveyors.	**CO1**	**1**	**PO1**
	PART B (TEN MARKS QUESTIONS)			
1	What are the various types of automation explain in detail.	**CO1**	**1**	**PO1**
2	Describe briefly advanced automation functions	**CO1**	**1,2**	**PO1**
3	a) Explain different Levels of automation b) Discuss briefly need of automation	**CO1**	**1.2**	**PO1**
4	Discuss various types of material handling equipment	**CO1**	**1,2**	**PO1**
5	Explain AS (Automated Storage) and RS (Retrieval System) components and terminology	**CO1**	**1,2**	**PO1**
6	Explain analysis of AS (Automated Storage) and RS (Retrieval System)	**CO1**	**1,4**	**PO1**
7	Explain briefly Analog-to-Digital Conversion and Digital Conversion -to-Analog	**CO1**	**2,3**	**PO1**
8	Define material handling system and explain Principles of Material Handling	**CO1**	**1,2**	**PO1**
9	Describe briefly Automated Guided Vehicles (AGVs)	**CO1**	**1,2**	**PO1**
10	Explain Bar code Technology.	**CO1**	**1,2**	**PO1**

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Q.NO	Questions			
	UNIT-2: AUTOMATED FLOW LINES AND LINE BALANCING			
	PART A(TWO MARKS QUESTIONS)	CO	BL	PO
1.	What is buffer storage?	**CO2**	**1**	**PO1**
2.	What is line balancing?	**CO2**	**1**	**PO1**
3.	What are the objectives of automated flow line?	**CO2**	**1**	**PO1**
4.	What are the reasons to include buffer storage in production line?	**CO2**	**1**	**PO1,PO2**
5.	What are the different types of flowlines?	**CO2**	**1**	**PO1**
6.	List out the rotary indexing mechanisms.	**CO2**	**1**	**PO1**
7	List out various methods of transporting workpieceS on flow lines	**CO2**	**1,2**	**PO1**
8.	What do you mean by synchronous and asynchronous work transport system?	**CO2**	**1,2**	**PO1**
9.	Define automated flow line and List out automated flow lines	**CO2**	**1**	**PO1**
10.	Write down advantages and Dis-advantages of buffer storage	**CO2**	**1**	**PO1**
	PART-B (TEN MARKS QUESTIONS)			
1.	What is an automated production line? Explain general configuration of automated production line. and its system configuration.	**CO2**	**1,2**	**PO1**
2.	Explain reasons for using storage buffers in automated flow lines?	**CO2**	**1,2**	**PO1**
3.	Explain work part transfer methods in detail.	**CO2**	**1,2**	**PO1**
4.	Explain largest candidate rule line balancing method with an example.	**CO2**	**1,3**	**PO1**
5.	Discuss kilbridge Wester method with an example	**CO2**	**1,3**	**PO1**
6.	Explain linear transfer mechanisms with neat sketch	**CO2**	**1,2**	**PO1**
7.	Given the following tasks, time and sequence develop a balanced line capable of operating with a 10 minutes cycle time, using Rank Positional Weight (RPW) methodand calculate the i)efficiency of that line (ii) balance delay .	**CO2**	**1,2,3**	**PO1,PO2**

Task element	A	B	C	D	E	F	G	H
Time (min)	3	5	7	5	3	3	5	6
Element Predecessor	-	A	B	-	C	B,D	D	G

<table>
<tr>
<td>8.</td>
<td>Toy assemblies should be done as per the information given in the table below and cycle time is 1minute balance the line using kill bridge and wester’s method.
Determine (i)efficiency of line (ii) balance delay
<table>
<tr><td>Task Element</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>Time (min)</td><td>0.5</td><td>0.3</td><td>0.8</td><td>0.2</td><td>0.1</td><td>0.6</td><td>0.4</td><td>0.5</td><td>0.3</td><td>0.6</td></tr>
<tr><td>predecessors</td><td>-</td><td>1</td><td>1</td><td>2</td><td>2</td><td>3</td><td>4,5</td><td>3,5</td><td>7,8</td><td>6,9</td></tr>
</table>
</td>
<td>CO2</td><td>1,2,3</td><td>PO1,PO2</td>
</tr>
<tr>
<td>9.</td>
<td>Given the following data describe line balancing problem, develop a solutionusing largest candidate rule method allowing a cycle time of 3 minutes.
Calculate i) efficiency of line (ii) balance delay (iii) smoothness index
<table>
<tr><td>Task Element</td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td><td>I</td></tr>
<tr><td>Time (min)</td><td>1</td><td>1</td><td>2</td><td>1</td><td>3</td><td>1</td><td>1</td><td>2</td><td>1</td></tr>
<tr><td>predecessors</td><td>-</td><td>A</td><td>B</td><td>B</td><td>G, D</td><td>A</td><td>F</td><td>G</td><td>F, H</td></tr>
</table>
</td>
<td>CO2</td><td>1,2,3</td><td>PO1,PO2</td>
</tr>
<tr>
<td>10</td>
<td>.A manual production flow line is arranged with six stations and a conveyor system is used to move parts along the line .The belt speed is 1.8m/min and the spacing of row work parts along the line is one every 1.5m .The total line length is 13.5m,hence each station length equals 2.25m.Determine the following
(1)Feed rate(2)Tolerance time(3)Theoritical cycle time.</td>
<td>CO2</td><td>1,2</td><td>PO1</td>
</tr>
</table>

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Q.No	Questions			
	UNIT-3: INDUSTRIAL ROBOTICS AND DRIVE SYSTEM			
	PART-A(TWO MARK QUESTIONS)	CO	BL	PO
1.	Mention any 4 components of a robot.	**CO3**	**1**	**PO1**
2.	What is Tactile sensor	**CO3**	**1**	**PO1**
3	List out any two common Robot configurations	**CO3**	**1**	**PO1**
4.	What is meant by work envelope?	**CO3**	**1**	**PO1**
5.	Define a drive system in robot.	**CO3**	**1**	**PO1**
6.	What are the various types of drives used in robot?	**CO3**	**1**	**PO1**
7.	State any two advantages and disadvantages of pneumatic drive?	**CO3**	**1**	**PO1**
8.	What are the various types of grippers used in robot?	**CO3**	**1**	**PO1**
9	What are the advantages of magnetic gripper?	**CO3**	**1**	**PO1**
10	Define Pitch,Yaw and roll.	**CO3**	**1**	**PO1**
	PART-B (TEN MARKS QUESTIONS)			
1.	Explain anatomy of robot with a neat sketch.	**CO3**	**1**	**PO1**
2.	Sketch and explain the four basic robot configurations classified according to the coordinate system.	**CO3**	**1,2**	**PO1**
3	Discuss about magnetic and vacuum grippers.	**CO3**	**1,2**	**PO1**
4	Write short notes on the following: (i) Types of robot controls (ii) Spatial resolution (iii) Repeatability.	**CO3**	**1**	**PO1**
5	Briefly explain the working principle of position sensors and tactile sensors with neat sketch.	**CO3**	**1,2**	**PO1**
6	Explain briefly working of pneumatic drive and state advantages and disadvantages of pneumatic drive.	**CO3**	**1**	**PO1**
7	With neat sketches, explain velocity sensors and touch sensors used in Robots.	**CO3**	**1**	**PO1**
8	Explain the different types of electrical servo motors used in robot actuation.	**CO3**	**1,2**	**PO1**
9	With a neat sketch explain the magnetic gripper and List its advantages and limitations..	**CO3**	**2**	**PO1**
10.	With suitable illustration explain working on external and internal grippers.	**CO3**	**1**	**PO1**
11.	Discuss in detail the selection and design considerations of grippers in robots.	**CO3**	**2**	**PO1**

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Q.NO	Questions			
	UNIT-4: KINEMATICS AND DYNAMICS OF ROBOTS			
	PART-A(TWO MARK QUESTIONS)	CO	BL	PO
1.	Define degrees of freedom of a robot.	**CO4**	**1**	**PO1**
2.	What is trajectory planning?	**CO4**	**1**	**PO1**
3.	Define transformation matrix?	**CO4**	**1**	**PO1**
4.	Define D-H notation	**CO4**	**2**	**PO1**
5.	Write any two differences between forward and inverse kinematics?	**CO4**	**1,2**	**PO1**
6.	What is robot arm Dynamics?	**CO4**	**1**	**PO1**
7.	Write about forward and inverse dynamics?	**CO4**	**1**	**PO1**
8.	What is link?	**CO4**	**1,2**	**PO1**
9.	Differentiate between joint and link.	**CO4**	**1,2**	**PO1**
10.	Define Manipulator kinematics.	**CO4**	**1**	**PO1**
	PART-B (TEN MARKS QUESTIONS)			
1.	Explain about forward kinematics transformation RR robot of 2 DOF with a neat sketch.	**CO4**	**1,2,3**	**PO1**
2	Differentiate between path planning and trajectory planning in detail.	**CO4**	**1,2**	**PO1**
3	Discuss about D-H representation in detail.	**CO4**	**1,2**	**PO1**
4	Explain the following terms in trajectory planning i) Path ii) trajectory iii) joint space projector planning iv) Cartesian space trajectory planning	**CO4**	**1**	**PO1**
5	Explain the trajectory planning for continous coordinate system.	**CO4**	**1,2**	**PO1**
6	Explain direct kinematics of a manipulated with a neat sketch.	**CO4**	**1,2**	**PO1**
7	Differentiate between joint space and world space of robot manipulator.	**CO4**	**1,2**	**PO1**
8	Explain about homogeneous transformation used in robot manipulator kinematics.	**CO4**	**1,2**	**PO1**
9	Obtain the homogeneous transformation matrix that represents a rotation of **α** degrees about the current X-axis followed by a translation of **b** units along the current X-axis, followed by a translation **d** unit along the current Z-axis followed by a rotation of **θ** degrees about the current Z-axis	**CO4**	**1,2,3**	**PO1,PO2**
10.	For the point $P_{XYZ} = (0,5,2)^T$ perform following operations i) rotate 30^o about Y-axis followed by translation of 4 units along Z-axis ii) Translate 6 units along Z-axis followed by rotation of 60^o along Y-axis	**CO4**	**1,2,3**	**PO1,PO2**

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Q.NO	Questions			
	UNIT-5: ROBOT PROGRAMMING AND APPLICATION			
	PART-A(TWO MARK QUESTIONS)	CO	BL	PO
1.	. List any two Robot languages.	**CO5**	**1**	**PO1**
2.	What is teach pendant.	**CO5**	**1**	**PO1**
3.	What is Manual Lead through Programing.	**CO5**	**1**	**PO1**
4.	What are the advantages of using robots in spray painting?	**CO5**	**1**	**PO1**
5.	Explain any two commands used in Robot programming.	**CO5**	**1**	**PO1**
6.	List out online robot programming methods.	**CO5**	**1**	**PO1**
7.	Write any four commands in VAL programming.	**CO5**	**1**	**PO1**
8.	List out various applications of robot in manufacturing industry.	**CO5**	**1**	**PO1**
9.	List out basic modes of operation in robot language structure.	**CO5**	**1,2**	**PO1**
10	Mention the safety precautions for robot operation.	**CO5**	**1**	**PO1**
	PART-B (TEN MARKS QUESTIONS)			
1.	Discuss briefly different applications of Industrial robot.	**CO5**	**1**	**PO1**
2	Explain the applications of robots in continuous arc welding & spray painting.	**CO5**	**1**	**PO1**
3	With schematic diagram, explain the robotic applications in weldingindustry.	**CO5**	**1**	**PO1**
4.	Explain lead through programming method in detail.	**CO5**	**1,2**	**PO1**
5.	What are the role of robots in loading and unloading?	**CO5**	**1**	**PO1**
6.	Explain teach pendant method of robot programming	**CO5**	**1**	**PO1**
7.	Explain the different types of Robot languages.	**CO5**	**1,2**	**PO1**
8.	Discuss the relative merits and demerits of different textual robot languages. Explain different program instructions.	**CO5**	**1,2**	**PO1**
9.	Explain the applications of industrial robots in manufacturing area.	**CO5**	**1**	**PO1**
10.	Explain VAL programming commands.	**CO5**	**1,2**	**PO1**

*****ALL THE BEST*****