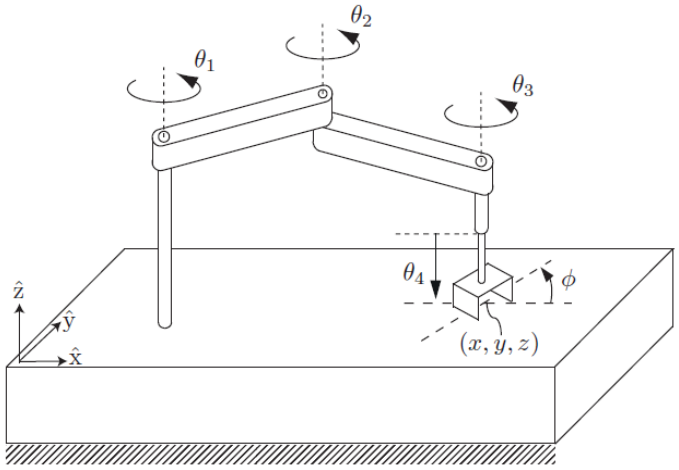
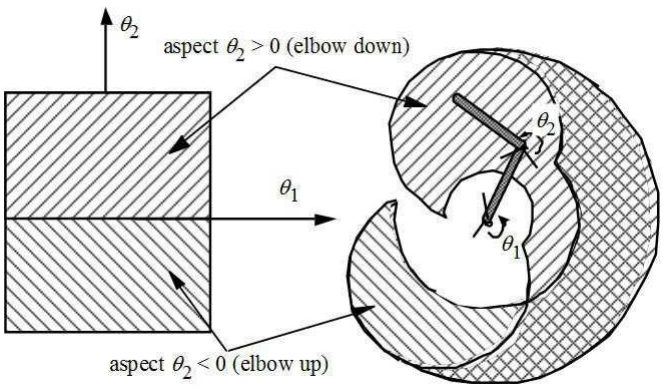
Question Format & QP Setter Information

Name of Examination	Final Assessment Test, Fall 2022-23 Semester, (JULY 2023)				
Slot: D2+TD2	Course Mode: Class-Base Learning		Class Number (s): VL2023240100319		
Course Code:	BECE312L	Course Title:	Robotics and Automation		
Emp. No.:	19670	Faculty Name:	Dr. Anand Singh	School: SENSE	
Contact No.:	8447168009	Email:	anand.singh@vit.ac.in		

Q. No.	Sub-division	Question Text	Marks	Unit / Module No.	Difficulty Level E/A/T	BL	CO
		Answer All the Questions	Total Marks: 10 X 10 = 100 Marks				
1.		Draw the pattern of the workspace for the following robotic structure and note down the merits and demerits of the obtained work volume. 	10	1	A	BL4	1
Sol.		**Example 2.9.** The SCARA robot of Figure 2.13 is an RRRP open chain that is widely used for tabletop pick-and-place tasks. The end-effector configuration is completely described by the four parameters (x, y, z, ϕ), where (x, y, z) denotes the Cartesian position of the end-effector center point and ϕ denotes the orientation of the end-effector in the x–y-plane. Its task space would typically be defined as $\mathbb{R}^3 \times S^1$, and its workspace would typically be defined as the reachable points in (x, y, z) Cartesian space, since all orientations $\phi \in S^1$ can be achieved at all reachable points.					
							
2.		Find the DoF for the below planner mechanism using Grublers formula.	10	1	A	BL3	1

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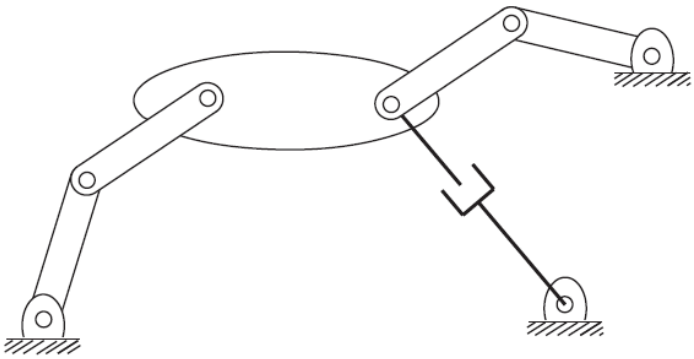
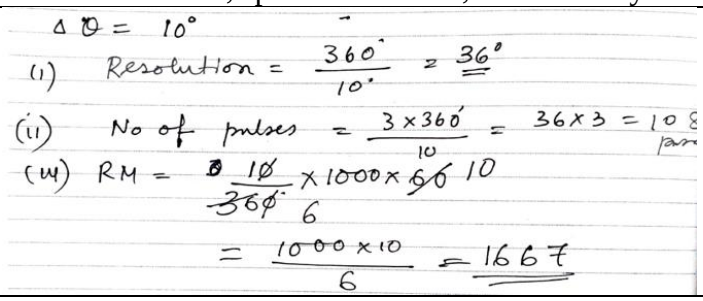
<tr><td></td><td></td><td>  </td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Sol.</td><td></td><td>Example 2.5 (A planar mechanism with overlapping joints). The planar mechanism illustrated in Figure 2.6 has three links that meet at a single point on the right of the large link. Recalling that a joint by definition connects exactly two links, the joint at this point of intersection should not be regarded as a single revolute joint. Rather, it is correctly interpreted as two revolute joints overlapping each other. Again, there is more than one way to derive the number of degrees of freedom of this mechanism using Grübler's formula: (i) The mechanism consists of eight links ($N = 8$), eight revolute joints, and one prismatic joint. Substituting into Grübler's formula yields
$$\text{dof} = 3(8 - 1 - 9) + 9(1) = 3.$$</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>3.</td><td></td><td>A stepping motor is to be used to actuate one joint of a robot arm in a light-duty pick-end application. The step angle of the motor is 10°. For each pulse received from the pulse train source, and the motor rotates through a distance of one step angle.
i. What is the resolution of the stepping motors?
ii. Relate this value to the definitions of control resolution, spatial resolution, and accuracy.</td><td>10</td><td>2</td><td>E</td><td>BL2</td><td>2</td></tr>
<tr><td>Sol.</td><td></td><td> 
</td><td></td><td></td><td></td><td></td></tr>
<tr><td>4.</td><td></td><td>What is thresholding? If the threshold value is 2.75 and 4.25, draw the patterns created after thresholding for the following Figure.
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<tr><td colspan="8">OR</td></tr>
<tr><td></td><td></td><td>Explain the working principle of the following proximity sensors
(i) Range sensor (ii) Inductive sensor</td><td>10</td><td>3</td><td>A</td><td>BL2</td><td>3</td></tr>
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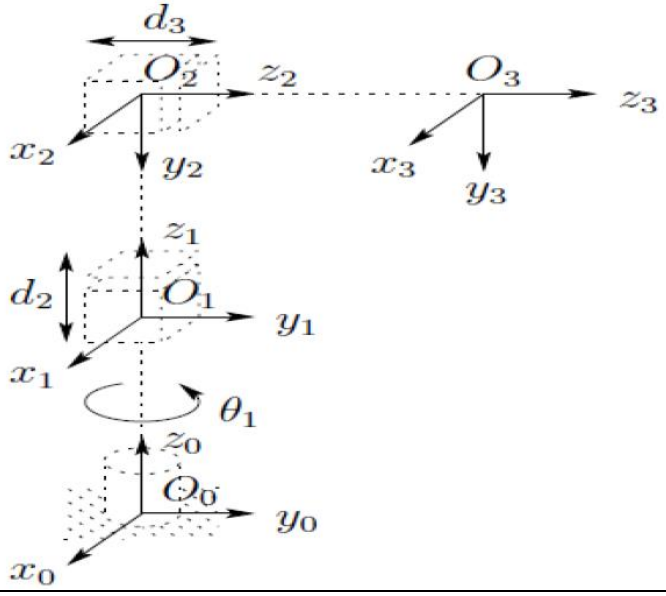
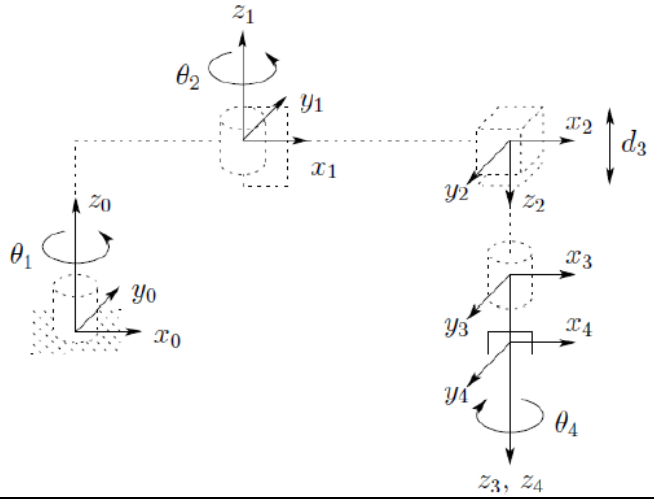
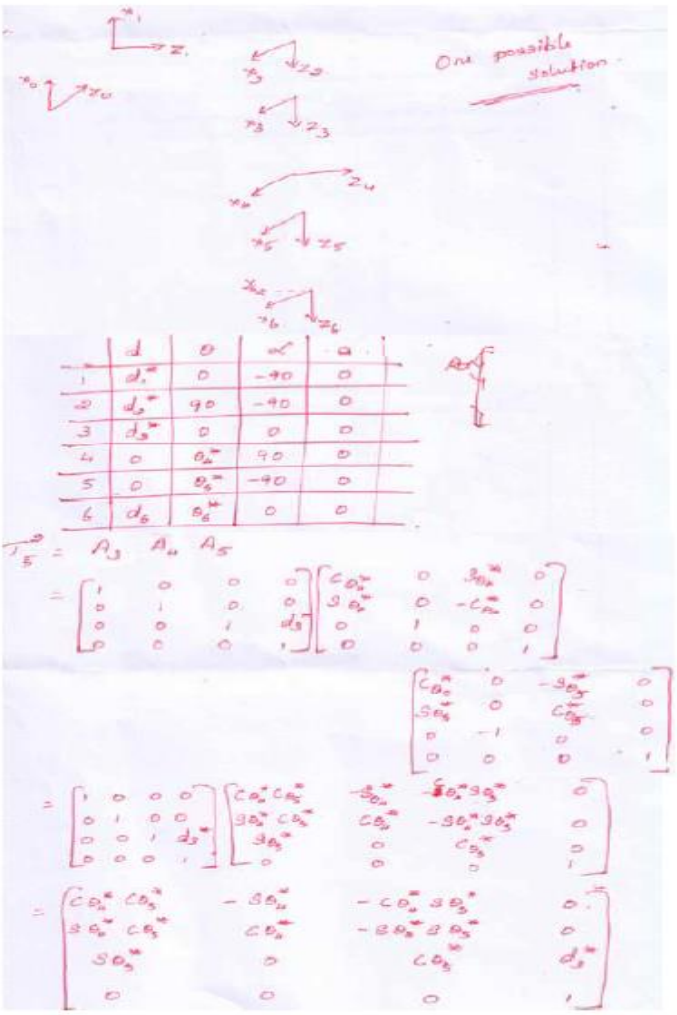
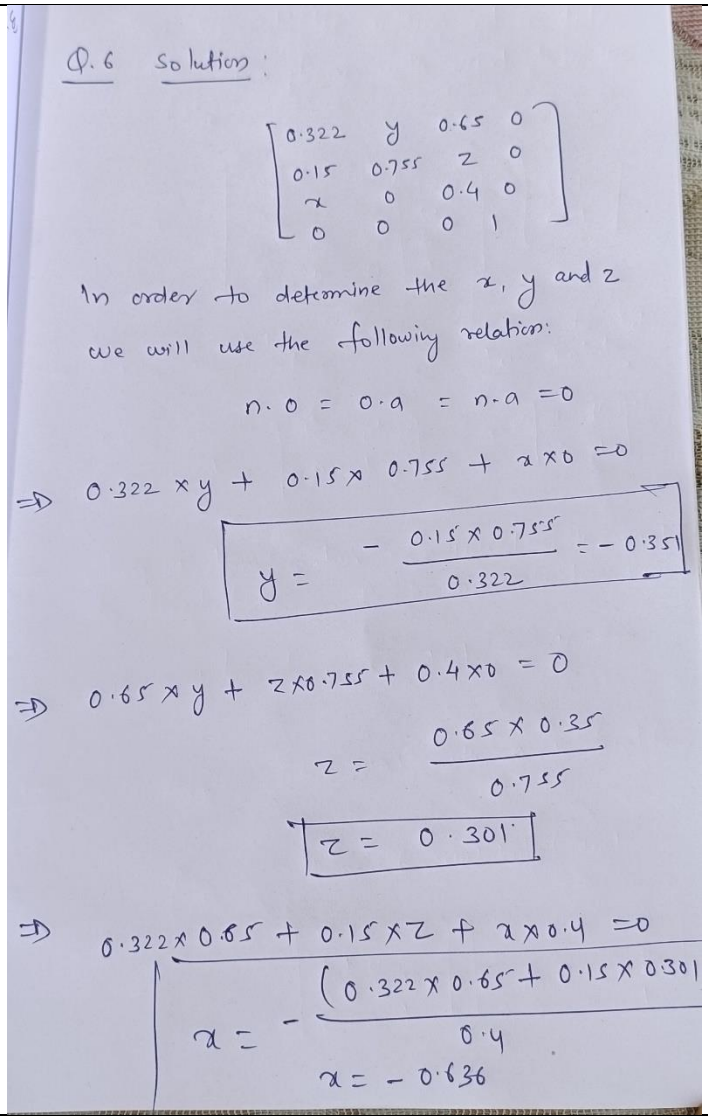
5.		Find the homogeneous transformation matrix for the manipulator shown below using the Denavit Hatenberg convention.  	10	4	T	BL4	4
OR							
		Find the homogeneous transformation matrix for the manipulator shown below using the Denavit Hatenberg convention.  	10	4	T	BL4	

Sol.							
6.		Find x,y,z from the matrix and verify about the rotation matrix $\begin{pmatrix} 0.322 & y & 0.65 & 0 \\ 0.15 & 0.755 & z & 0 \\ x & 0 & 0.4 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$	10	4	A	BL3	4

Sol.							
7.	(a) (b)	A parabolic blend is always needed at the beginning and at the end of a linear trajectory-Explain. How do you define the significance of the terms "Lift-off" and "Set-down" point in context to Linear Trajectory.	5 5	5	E	BL1	5
8.		Write an algorithm to program a robot to pick up two blocks (the blocks are of different sizes) from fixed positions on either side of a center position and to stack the blocks in the center position. The larger block will always be on the other side of the center position. The smaller block is to be placed on top of the larger block.	10	6	T	BL4	6
9.		Now a days robotics become integral part in health care sector. Explain the role of service robots during the pandemic.	10	7	E	BL1	7
10.		Briefly explain the applications of Robotics in Nuclear power plants and thermal plants.	10	7	E	BL1	7