Started on	Monday, 25 April 2022, 3:03 PM
State	Finished
Completed on	Monday, 25 April 2022, 4:49 PM
Time taken	1 hour 45 mins
Marks	4.50/5.00
Grade	**9.00** out of 10.00 (**90**%)

Question **1**

Correct

Mark 1.00 out of 1.00

Coordinate frame 1 is rotated by 60 degrees around the x axis and displaced by

(2,1,2) with respect to coordinate frame 0.

Point P_1 = [0,2,4]. What is P_0

Select one:

a. [2, 1.32, 5.16]

b. [0, -2.46, 5.16]

c. [2,-1.46,5.73] ✔

d. [0, -2.46, 3.73]

The correct answer is: [2,-1.46,5.73]

Question **2**

Correct

Mark 1.00 out of 1.00

Coordinate frame 1 is rotated by 60 degrees around the x axis and displaced by (2,1,2) with respect to coordinate frame 0. (Same as q1)

Axis 2 is rotated by 90 degrees around the y axis and displaced by (0,1,0) with respect to axis 1.

What is T_2^0

Select one:

a. $T_2^0 = \begin{pmatrix} 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 \\ -1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

b. $T_2^0 = \begin{pmatrix} 0 & 0.866 & 0.5 & 2 \\ 0 & 0.5 & -0.866 & 2 \\ -1 & 0 & 0 & -2 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

c. $T_2^0 = \begin{pmatrix} 0 & 0 & 1 & 2 \\ 0.86 & 0.5 & 0 & 1.5 \\ -0.5 & 0.866 & 0 & 2.866 \\ 0 & 0 & 0 & 1 \end{pmatrix}$ ✔

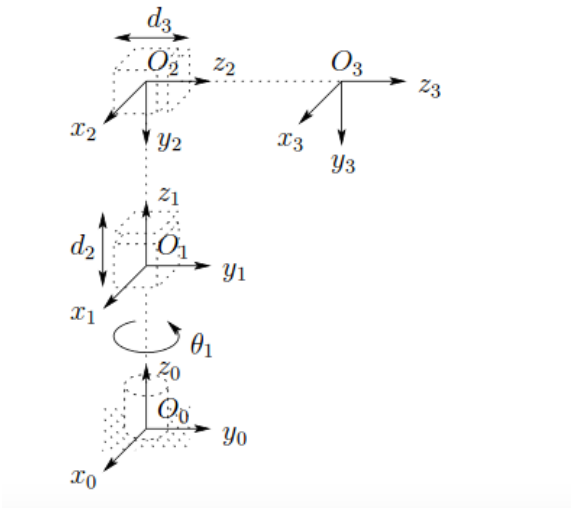
d. $T_2^0 = \begin{pmatrix} 0 & -1 & 0 \\ 0 & 0 & 1 \\ -1 & 0 & 0 \end{pmatrix}$

The correct answer is: $T_2^0 = \begin{pmatrix} 0 & 0 & 1 & 2 \\ 0.86 & 0.5 & 0 & 1.5 \\ -0.5 & 0.866 & 0 & 2.866 \\ 0 & 0 & 0 & 1 \end{pmatrix}$

Question **3**

Partially correct

Mark 0.50 out of 1.00



The following questions are about the DH parameters for the arm above. Tick all options that are correct.

Select one or more:

a. Parameters for i=2 are: ✔

Extract of DH parameter table

i	a_i	α_i	d_i	θ_i
2	0	-90	d_2	0

b. Parameters for i=2 are:

Extract of DH parameter table

i	a_i	α_i	d_i	θ_i
2	d_2	-90	0	θ_1

c. Parameters for i=3 are:

Extract of DH

parameter table

i	a_i	α_i	d_i	θ_i
3	0	-90	d_3	0

d. Parameters for i=1 are:

Extract of DH parameter table

i	a_i	α_i	d_i	θ_i
1	0	0	0	θ_1

The correct answers are: Parameters for i=1 are:

Extract of DH parameter table

i	a_i	α_i	d_i	θ_i
1	0	0	0	θ_1

,
Parameters for i=2 are:

Extract of DH parameter table

i	a_i	α_i	d_i	θ_i
2	0	-90	d_2	0

Question **4**

Correct

Mark 1.00 out of 1.00

You have an RPP arm with the following transformation matrices. Work out J_v

$$T_1^0 = \begin{pmatrix} \cos(\theta_1) & 0 & -\sin(\theta_1) & 0 \\ \sin(\theta_1) & 0 & \cos(\theta_1) & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$T_2^0 = \begin{pmatrix} \cos(\theta_1) & 0 & -\sin(\theta_1) & -d_1\sin(\theta_1) \\ \sin(\theta_1) & 0 & \cos(\theta_1) & d_1\cos(\theta_1) \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$T_3^0 = \begin{pmatrix} \cos(\theta_1) & \sin(\theta_1) & 0 & -d_1\sin(\theta_1) - d_2\sin(\theta_1) \\ \sin(\theta_1) & -\cos(\theta_1) & 0 & d_1\cos(\theta_1) + d_2\cos(\theta_1) \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

What is the linear velocity of the endpoint if joint 1 is rotated to $\pi/2$ radians and is rotating at 1 radian per second, joint 2 is extended to 2m and is extending at 1m/s, joint 3 is extended to 5m and is extending at 2m/s

Select one:

- a. [-2, -7, 1]
- b. [-2, 0, 1]
- c. [-3, 7, 0]
- d. [-3. -7, 0] ✔
- e. [-2, 0, -1]

The correct answer is: [-3. -7, 0]

Question **5**

Correct

Mark 1.00 out of 1.00

You have an RPP arm with the following transformation matrices. Work out J_ω

$$T_1^0 = \begin{pmatrix} \cos(\theta_1) & 0 & -\sin(\theta_1) & 0 \\ \sin(\theta_1) & 0 & \cos(\theta_1) & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$T_2^0 = \begin{pmatrix} \cos(\theta_1) & 0 & -\sin(\theta_1) & -d_1\sin(\theta_1) \\ \sin(\theta_1) & 0 & \cos(\theta_1) & d_1\cos(\theta_1) \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

$$T_3^0 = \begin{pmatrix} \cos(\theta_1) & \sin(\theta_1) & 0 & -d_1\sin(\theta_1) - d_2\sin(\theta_1) \\ \sin(\theta_1) & -\cos(\theta_1) & 0 & d_1\cos(\theta_1) + d_2\cos(\theta_1) \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

What is J_ω

Select one:

a. $J_\omega = \begin{pmatrix} -sin(\theta_1) & 0 & 0 \\ cos(\theta_1) & 0 & 0 \\ 0 & 1 & 1 \end{pmatrix}$

b. $J_\omega = \begin{pmatrix} 0 & -sin(\theta_1) & 0 \\ 0 & cos(\theta_1) & 0 \\ 1 & 0 & 0 \end{pmatrix}$

c. $J_\omega = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix}$ ✔

d. $J_\omega = \begin{pmatrix} -sin(\theta_1) & 0 & 0 \\ cos(\theta_1) & 0 & 0 \\ 0 & 0 & 0 \end{pmatrix}$

The correct answer is: $J_\omega = \begin{pmatrix} 0 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 0 & 0 \end{pmatrix}$

◄ Past Paper

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Quiz 2 - Control ►