University of Mumbai
Examination 2020

Program: Electronics Engineering
Curriculum Scheme: Rev2016
Examination: BE Semester VII
Course Code: ELXDLO7033 and Course Name: Robotics

Time: 2 hour Max. Marks: 80

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Q1.	**Choose the correct option for following questions. All the Questions are compulsory and carry equal marks**
1.	_____ is a measure of the ability of the robot to position the tool tip in the same place repeatedly.
Option A:	Precision
Option B:	Stroke
Option C:	Accuracy
Option D:	Repeatability
2.	Robot classification is generally not done based on
Option A:	Drive Technologies
Option B:	Work-Envelope Geometries
Option C:	Motion Control Methods
Option D:	Use of controller
3.	Which option is not a characteristic of Inverse kinematics
Option A:	easy to solve
Option B:	existence of multiple solution
Option C:	Singularities
Option D:	Possible non existence of a solution
4.	While finding the transformation matrix, transformations along x, y, z-axis is
Option A:	pre-multiplied
Option B:	post-multiplied
Option C:	Random
Option D:	doesnt matter
5.	A point p is attached to a frame F_{noa} and is subjected to the following transformations. Select the correct sequence of matrix multiplication. 1. Rotation of 90^o about the n-axis, 2. Followed by a rotation of 90^o about the o-axis, 3. Followed by a translation of [4, -3,7] along n-,o-,a axis.
Option A:	Trans(4,-3,7)Rot(n,90)Rot(o,90)
Option B:	Trans(4,-3,7)Rot(o,90)Rot(n,90)
Option C:	Rot(n,90)Rot(o,90)Trans(4,-3,7)
Option D:	Rot(o,90)Rot(a,90)Trans(4,-3,7)
6.	To place the origin of the hand frame of a cylindrical robot at $[3,4,6]^T$. Calculate

	the joint variables of the robot.
Option A:	r=5, l=6, $\alpha=53.1^{o}$
Option B:	r=6, l=5, $\alpha=23.1^{o}$
Option C:	r=5, l=6, $\alpha=33.1^{o}$
Option D:	r=6, l=5, $\alpha=43.1^{o}$
7.	Which parameter represents angle between two successive x-axis in DH representation?
Option A:	Theta
Option B:	Alpha
Option C:	D
Option D:	A
8.	_____ is a representation of the geometry and the interrelationship between different parts of the mechanism and where they are at any given time.
Option A:	Lagrangian
Option B:	Jacobian
Option C:	Euler
Option D:	Newton
9.	In $[D]=[J][D_\theta]$, $[D_\theta]$ represents
Option A:	differential motions of the hand along the x-, y-, and z-axes,
Option B:	differential rotations of the hand around the x-, y-, and z-axes
Option C:	differential motions of the hand along the n-, o-, and a-axes,
Option D:	the differential motions of the joints.
10.	To calculate the differential motions (or velocities) needed at the joints of the robot for a desired hand differential motion (or velocity), we need to calculate____
Option A:	Jacobian
Option B:	Inverse of Jacobian
Option C:	Langrangian
Option D:	Euler
11.	A lagrangian is defined as
Option A:	Kinetic energy of the system – potential energy of the system
Option B:	Potential energy of the system – kinetic energy of the system
Option C:	Kinetic energy of the system – momentum of the system
Option D:	momentum of the system – potential energy of the system
12.	Given a joint-space trajectory, the velocities and accelerations of each link are computed recursively, starting at the base and propagating to the tool. These are called the_____ equations
Option A:	Lagrangian
Option B:	Backward Newton Euler
Option C:	Inverse Jacobian
Option D:	Forward Newton Euler

13.	If a point D is reached at different times on path P, then trajectories _____
Option A:	Changes
Option B:	Remain same
Option C:	Cant say
Option D:	Need more data
14.	The motion between the two points is computationally expensive, in case of
Option A:	Trajectory
Option B:	Cartesian space description
Option C:	Joint space description
Option D:	Path
15.	If the unit of storage is one byte per pixel, then a single frame of a 2048 x 2048 pixel image uses ____ megabyte of memory.
Option A:	1
Option B:	2
Option C:	3
Option D:	4
16.	If the threshold is kept low for edge detection, then _____ is detected.
Option A:	No edge
Option B:	Correct edge
Option C:	Edge fragments
Option D:	False edge
17.	If the threshold is kept high for edge detection, then _____ is detected.
Option A:	no edge
Option B:	Correct edge
Option C:	Edge fragments
Option D:	False edge
18.	Analog image is converted to digital by performing
Option A:	Filtering
Option B:	Sampling and quantization
Option C:	Noise removal
Option D:	Edge detection
19.	In an image, boundary descriptors are called_____
Option A:	Line descriptors
Option B:	Area descriptors
Option C:	Volume descriptors
Option D:	Angle descriptors
20.	_____ will fill in small holes or narrow inlets in regions.
Option A:	Descriptions
Option B:	Segmentation
Option C:	Shrink operation
Option D:	Swell operation

Q2	**Solve any Four out of Six** **5 marks each**
A	Explain in detail Robot classification.
B	Explain path and trajectory
C	Short note on Template Matching
D	Explain Lagrangian Mechanics
E	Short note on Homogenous transformation matrix.
F	Short note on Gross Motion Planning

Q3	**Solve any Two Questions out of Three** **10 marks each**
A	Explain in detail Joint space trajectory planning.
B	Find the new location and orientation of frame B after a differential rotation of 0.1 radians about the y-axis followed by a differential translation of [0.1,0,0.2]. $B=\begin{bmatrix}0 & 0 & 1 & 10\\ 1 & 0 & 0 & 5\\ 0 & 1 & 0 & 3\\ 0 & 0 & 0 & 1\end{bmatrix}$
C	Develop DH representation of a four axis SCARA robot and obtain its arm matrix.