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Question Paper Code	13099
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B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

Seventh Semester

Electronics and Instrumentation Engineering

(Common to Instrumentation and Control Engineering)

20EIPC701 - ROBOTICS AND AUTOMATION

Regulations - 2020

Duration: 3 Hours

Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

	<i>Marks</i>	<i>K- Level</i>	<i>CO</i>
1. The main objective of industrial robot is to (a) Minimize the labour requirement (b) Increase productivity (c) Enhance the life of production machines (d) All the above	1	K1	CO1
2. How many degrees of freedom does a human shoulder have? (a) 1 (b) 2 (c) 3 (d) 4	1	K1	CO1
3. Generally, which type of robots have higher accuracy? (a) Non-rigid (b) Rigid (c) Smaller (d) Larger	1	K1	CO1
4. Recall of the following laws is Asimov's first and most important law of robotics (a) Robot actions must never result in damage to the robot (b) Robot must never take action harmful to human (c) Robot must follow the direction given by human (d) Robot must make business a greater profit	1	K1	CO1
5. Drives are also known as (a) Actuators (b) Controller (c) Sensor (d) manipulator	1	K1	CO2
6. The number of moveable joints in the base, the arm, and the end effectors of the robot determines _____ (a) degrees of freedom (b) payload capacity (c) operational limits (d) flexibility	1	K1	CO2
7. Identify from the following short range sensor (a) ultrasonic sensor (b) GPS (c) Radar (d) Camera systems	1	K1	CO2
8. ----- Drive is used for lighter class of robot. (a) Hydraulic (b) Pneumatic (c) Electric (d) All the above	1	K1	CO2
9. Internal state sensors of the end effectors measures the following. (a) Position (b) Position and Velocity (c) Velocity and Acceleration (d) Position, velocity and Acceleration	1	K1	CO3
10. The purpose of control input provides to robot joint actuators, In order to accomplish a task with (a) robot control system (b) end effectors (c) motor control (d) mechanical system	1	K1	CO3
11. The movement of manipulator's joints and links represent typically (a) Cartesian coordinates (b) Joint coordinates (Denavit-Hartenberg parameters) (c) Inverse kinematics (d) Euler angles	1	K1	CO3
12. A manipulator is also known as a (a) Track drive (b) Robot arm (c) Ultrasonic Sensor (d) Camera	1	K1	CO3

13. In robotics, Inverse kinematics is used for 1 K1 CO4
 (a) Finding orientation of tool with respective base
 (b) Mapping from the tool configuration space R^6 back to joint space R^n
 (c) Finding tool configuration space R^n
 (d) Mapping from joint space R^n to the tool configuration space R^6
14. The number of movable joints in the base, arm and end effector determines: 1 K1 CO4
 (a) Flexibility (b) Payload (c) Operational limit (d) Degrees of freedom
15. What is meant by forward dynamics? 1 K1 CO4
 (a) Calculation of torques equation
 (b) Calculation of motion equation if joint torques or end-effector forces are given
 (c) Calculation of motion equation
 (d) Calculation of joint torques or end-effector forces if motion variables are given
16. Industrial robot is generally designed to carry out which coordinate system: 1 K1 CO4
 (a) Polar (b) Cartesian (c) Cylindrical (d) Spherical
17. Which models gives relation between the position and orientation of the end-effector and spatial positions of joint-links? 1 K1 CO5
 (a) Kinematic model (b) Differential model (c) Integral model (d) Static model
18. If the orientation changes without the change of position then the transformation is 1 K1 CO5
 (a) Pure translation (b) Pure rotation (c) Combined transformation (d) None
19. Following is the robotic like device. 1 K1 CO5
 (a) Telecheries (b) Exo-skeleton (c) Locomotive device (d) All the above
20. Number of linear coordinate in a cylindrical coordinate robot. 1 K1 CO5
 (a) 2 (b) 3 (c) 1 (d) 0

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21. Classify the motion control of Robot arm. 2 K2 CO1
22. What is meant by Workspace? 2 K1 CO1
23. Recall about Gripper. 2 K1 CO2
24. Point out the uses of sensors in robotics. 2 K1 CO2
25. Mention the limitations of magnetic grippers. 2 K1 CO3
26. Name the electrical drives used in manipulators? 2 K1 CO3
27. Write about transformation in robotics. 2 K1 CO4
28. Mention the steps to derive kinematic model. 2 K1 CO4
29. What is Palletizing? 2 K1 CO5
30. State about robot arm dynamics. 2 K1 CO5

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31. a) Explain the main Robot anatomy with neat sketch. 10 K2 CO1
- OR**
- b) Discuss in detail about any two robot configurations classified according to the coordinate system. 10 K2 CO1
32. a) What are the different types of sensors? Classify them. Sketch and explain about proximity sensor. 10 K2 CO2
- OR**
- b) Describe the various types of drive system for robots and its limitations. 10 K2 CO2
33. a) Discuss the functions of gripper with the help of a sketch. Explain the working of magnet grippers used for robots. 10 K2 CO3

OR

- b) Discuss the functions of manipulators. Sketch and explain a pneumatic manipulator control circuits used for robots. 10 K2 CO3

34. a) Rotate the vector $v = 5i + 3j + 8k$ by an angle of 90° about the x-axis. The rotation transformation is given by 10 K3 CO4

$$H = \begin{vmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos 90 & -\sin 90 & 0 \\ 0 & \sin 90 & \cos 90 & 0 \\ 0 & 0 & 0 & 1 \end{vmatrix}$$

OR

- b) Frame {2} is rotated with respect to frame {1} about x-axis by an angle of 60° . The position of the origin of frame {2} as seen from frame {1} is ${}^1D_2 = [7 \ 5 \ 7]^T$. The transformation matrix 1T_2 is 10 K3 CO4

$$\begin{vmatrix} 1 & 0 & 0 \\ 0 & 0.5 & -0.866 \\ 0 & 0.866 & 0.5 \end{vmatrix}$$

using this matrix, determine the description of frame {1} relative to frame {2}.

35. a) Discuss in detail about the workplace design consideration for safety of Robots. 10 K2 CO5

OR

- b) Enumerate the non-manufacturing areas where robots are expected to be used. 10 K2 CO5

36. a) i) Briefly, explain about robot-programming language. 5 K2 CO4
ii) Explain in detail about RGV types of robots. 5 K2 CO5

OR

- b) i) With an example describe about inverse kinematics of Robot. 5 K2 CO4
ii) Write short notes on Robot cell layouts with neat diagram. 5 K2 CO5