

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST-3 EXAMINATION – DEC, 2021

B.Tech VII Semester (ECE)

COURSE CODE: 18B1WEC737

MAX. MARKS: 35

COURSE NAME: ROBOTIC SYSTEM AND CONTROL

COURSE CREDITS: 3

MAX. TIME: 2 Hours

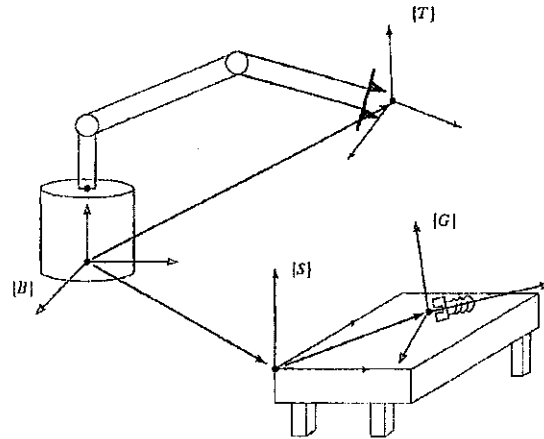
Note: All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means. Missing data, if any, can be appropriately assumed.

1. (a) What is an industrial robot? Explain how it is different from a humanoid robot? (2)
(b) What are the “three laws of Robotics”, postulated by Issac Asimov. Why these laws are important? (3)
2. (a) What is a Teleoperated Manipulator? Describe the advancement in robotics, classified into four generations in robotics. (2)
(b) With a sketch explain (i) Revolute (ii) Prismatic and (iii) Spherical joints used in a robotic manipulator. (3)
3. (a) What are the basic components of a robot? Briefly explain each of them. (2)
(b) Describe the advantages and disadvantages of DC motor, servo motor and stepper motor in the context of a robotic system. Give a situation where each of them can be used. (3)
4. (a) What are End-Effector? List two common types of End-Effectors used in robotics and briefly describe them. (2)
(b) Describe the (i) Cartesian (ii) Cylindrical and (iii) Spherical / Polar robots along with their applications. (3)
5. What is a rotation matrix? Explain how the orientation of a tool used by a robotic manipulator arm can be described by using a rotation matrix. What are the properties of rotation matrix? (5)

[P.T.O]

6. Figure below shows a robotic manipulator and a bolt lying on a table. Assume that we know the frame at the manipulator's fingertips, $\{T\}$ relative to the manipulator's base, $\{B\}$ and where the tabletop, $\{S\}$ is located in space relative to the manipulator's base, $\{B\}$ and the location the bolt, $\{G\}$ lying on the table, calculate the position and orientation (frame) of the bolt relative to the manipulator's hand. Give the steps used to find the frame of the bolt.

(5)



7. A frame $\{B\}$ is described as initially coincident with $\{A\}$. We then rotate $\{B\}$ about the vector ${}^A\hat{K} = [0.707 \ 0.707 \ 0.0]^T$ (passing through the origin) by an amount $\theta = 30^\circ$. Give the frame description of $\{B\}$. Given that for a general axis of rotation by equivalent angle-axis representation,

(5)

$$R_K(\theta) = \begin{bmatrix} k_x k_x v\theta + c\theta & k_x k_y v\theta - k_z s\theta & k_x k_z v\theta + k_y s\theta \\ k_x k_y v\theta + k_z s\theta & k_y k_y v\theta + c\theta & k_y k_z v\theta - k_x s\theta \\ k_x k_z v\theta - k_y s\theta & k_y k_z v\theta + k_x s\theta & k_z k_z v\theta + c\theta \end{bmatrix}$$
