

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Sixth Semester B.Tech Degree Regular and Supplementary Examination July 2021

**Course Code: EC368****Course Name: ROBOTICS**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer any two full questions, each carries 15 marks*

Marks

- 1 a) Define the term degrees of freedom and explain six degrees of freedom associated with robot. (8)
- b) Describe the **TLL robot** configuration with neat sketch. (7)
- 2 a) Illustrate the working of strain gauge-based force sensor using Wheatstone bridge setup. (8)
- b) Compare hydraulic, electric, and pneumatic actuators. (7)
- 3 a) With the help of torque speed characteristic explain the working of servomotor. (7)
- b) Explain different types of joints with the help of neat sketches. (8)

**PART B***Answer any two full questions, each carries 15 marks*

- 4 a) Explain the functions of a machine vision system with the help of block diagram (10)
- b) Find the new location of point  $P(1, 2, 3)^T$  relative to the reference frame after a rotation of  $30^\circ$  about the  $z$ -axis followed by a rotation of  $60^\circ$  about the  $y$ -axis. (5)
- 5 a) A frame  $B$  is rotated  $90^\circ$  about the  $z$ -axis, then translated 3 and 5 units relative to the  $n$  and  $o$ -axes respectively, then rotated another  $90^\circ$  about the  $n$ -axis, and finally,  $90^\circ$  about the  $y$ -axis. Find the new location and orientation of the frame (8)

$$B = \begin{bmatrix} 0 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \\ 0 & 0 & -1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

- b) Explain the steps to be followed for the implementation of Denavit- Hartenberg representation. (7)
- 6 a) Explain the three phases involved in analog to digital signal conversion. (9)
- b) Derive the matrix representing RPY orientation. (6)

**PART C**

*Answer any two full questions, each carries 20 marks*

- 7 a) Derive the Jacobian operator for linear and angular velocity of end-effector. (10)  
b) Explain about Lagrangian mechanics. How will you derive dynamic model of robot? (5)  
c) What is PID control? What are the main advantages of PID control? (5)
- 8 a) Explain the robot language structure with a block diagram. (10)  
b) Distinguish textual and lead through programming. (5)  
c) Mention end-effector and motion commands in VAL programming language. (5)
- 9 a) Explain in detail about different control schemes of robots. (10)  
b) Explain the use of robots in industrial applications. (10)

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