Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Sixth Semester B.Tech Degree (S,FE) Examination May 2022 (2015 Scheme)

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 following performance parameters of a robot. (6)

(i) Repeatability

(ii) Resolution

(iii) Accuracy

b) What is meant by work space of a robot? How robots are classified based on work space? (6)

c) A cartesian robot has a horizontal reach of 550 mm and a horizontal stroke of 350 mm. What is the maximum limit within which the object placed is not reachable? (3)

2 a) Provide the typical features of robotic sensors? Explain any five sensors used in robotics and mention areas of application of each? (10)

b) Compare the various drive systems used in robotics? (5)

3 a) Define a robot and with a neat diagram explain the anatomy of a robot? (7)

b) With a neat sketch explain the following hydraulic actuators. (8)

(i) Rotary actuator (ii) Linear actuator

PART B

Answer any two full questions, each carries 15 marks

4 a) A mobile body reference frame OABC is rotated 60^0 about OY – axis of the fixed base reference frame OXYZ. If $p_{xyz} = (4,7,3)^T$ and $q_{xyz}= (2,6,5)^T$ are the co-ordinates with respect to OXYZ plane, what are the corresponding co-ordinates of p and q with respect to OABC frame? (6)

b) Differentiate between forward and inverse kinematics? (4)

c) What is rotation matrix? Mention any three properties of rotation matrix? (5)

5 a) Describe any four image processing techniques used in robotics? (10)

b) What is homogeneous transformation matrix? Explain the matrix elements? (5)

6 a) What do you mean by link parameter table? How it can be obtained by using Denavit - Hartenberg method? (10)

b) What is kinematic decoupling? Give the advantage of using kinematic decoupling? (5)

PART C

Answer any two full questions, each carries 20 marks

7 a) What is meant by robot singularities? Why are they important? (5)

b) Explain Lagrangian mechanics? (5)

c) How can PID controller be useful in robot actuation and control? (10)

8 a) Derive the kinetic and potential energies for a planar 2-link manipulator with link lengths d_1, d_2, joint angles θ_1, θ_2 and masses m_1, m_2? (10)

b) Describe in detail how robots can be used for material handling and assembly? (10)

9 a) Give any five recent developments in robotics? (5)

b) Write down all the motion and speed control commands in VAL and explain the function performed by each of these commands? (5)

c) Explain the structure of robot programming language? (10)

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