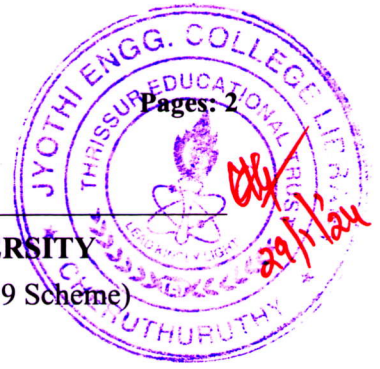


B

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

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

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**  
B.Tech Degree S6 (S, FE) Examination January 2024 (2019 Scheme)

**Course Code: AIT304**

**Course Name: ROBOTICS AND INTELLIGENT SYSTEM**

Max. Marks: 100

Duration: 3 Hours

**PART A**

*Answer all questions, each carries 3 marks.*

Marks

- |    |                                                                                          |     |
|----|------------------------------------------------------------------------------------------|-----|
| 1  | List and explain the features of four basic wheel types used for a robotic application.  | (3) |
| 2  | List and define the factors influencing the design of a robot.                           | (3) |
| 3  | Define the terms Dynamic range, Linearity, and Resolution for a Sensor.                  | (3) |
| 4  | Position sensors are not preferred to obtain the velocity and acceleration, Give reason. | (3) |
| 5  | Differentiate between holonomic and nonholonomic robots.                                 | (3) |
| 6  | Write the significance of differential drive, in mobile robotics?                        | (3) |
| 7  | Identify mobile robot localization problems.                                             | (3) |
| 8  | Describe the concept of mobile robot localization with suitable Block diagram.           | (3) |
| 9  | Explain the bug algorithm for obstacle avoidance in mobile robotics.                     | (3) |
| 10 | Compare any two traversal algorithms.                                                    | (3) |

**PART B**

*Answer one question from each module, each carries 14 marks.*

**Module I**

- |    |                                                                                 |     |
|----|---------------------------------------------------------------------------------|-----|
| 11 | a) Explain the anatomy of a robotic manipulator.                                | (6) |
|    | b) Describe the various joint configurations possible in a robotic manipulator. | (8) |

**OR**

- |    |                                                                                                                                              |     |
|----|----------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 12 | a) Explain the principle of operation of various grippers used in robotic systems.                                                           | (8) |
|    | b) Explain the general features of a legged robot and differentiate the terms static and dynamic stability in the context of a legged robot. | (6) |

**Module II**

- |    |                                                                                                                     |     |
|----|---------------------------------------------------------------------------------------------------------------------|-----|
| 13 | a) Explain the various sensor characteristics to be considered in the choice of the sensor for robotic application. | (6) |
|----|---------------------------------------------------------------------------------------------------------------------|-----|

- b) Explain the working principle of Hall effect sensor and any one application of the same. (8)

OR

- 14 a) Compare the performance characteristics of a hydraulic and pneumatic actuator. (6)  
b) Explain with a neat circuit diagram the working principle behind a permanent magnet stepper motor (8)

**Module III**

- 15 a) Explain the seven stages of robotic vision. (10)  
b) Differentiate and explain the working of a CCD and CMOS camera in a robotic vision system (4)

OR

- 16 a) List the different co-ordinate frames used in robotic systems and explain the need for mapping or transformation of co-ordinate systems for the same. (6)  
b) Frame {1} and {2} have coincident origins and differ only in orientation. Frame {2} is initially coincident with frame {1}. Certain rotations are carried out about the axis of the fixed frame {1}. First rotation about X axis by  $45^\circ$  then about Y axis by  $30^\circ$  and finally about X axis by  $60^\circ$ . Obtain the equivalent rotation matrix  ${}^1R_2$ . (8)

**Module IV**

- 17 a) Define the term odometry and explain the various error sources in odometric data. (4)  
b) Derive error model for odometric position estimation. (10)

OR

- 18 a) Give the mathematical definition of SLAM and elaborate the concept. (6)  
b) Compare and Contrast graph-based and particle SLAM (8)

**Module V**

- 19 a) Explain the potential field method-based path planning in robotic systems (6)  
b) Illustrate the working of Dijkstra's algorithm with a suitable example. (8)

OR

- 20 a) Explain the need for control decomposition in a robotic system. (6)  
b) With an example, elaborate the process of horizontal decomposition of a robotic control system. (8)

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