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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Eighth Semester, B. E. - Mechanical Engineering

Semester End Examination; July - 2021

Industrial Robotics

Time: 3 hrs

Max. Marks: 100

Note: i) Answer any **FIVE** full questions. ii) Missing data, if any, may be suitably assumed.

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| 1 a. | Discuss the physical characteristics of the robot that determines work volume and illustrate the work volume of any two robot configuration with a neat sketch. | 9 |
| b. | Discuss and illustrate the concept of speed of response and stability in robotics. | 8 |
| c. | Discuss the factors that affect the load carrying capacity of a robot. | 3 |
| 2 a. | Discuss spatial resolution and accuracy with a neat sketch. | 8 |
| b. | Illustrate and explain spherical configuration robot with a sketch. Suggest suitable joints and its motion to build a spherical configuration robot. | 8 |
| c. | Define repeatability and illustrate how accuracy affects repeatability. | 4 |
| 3 a. | Illustrate and explain the working principle of potentiometer and list the applications of potentiometer. | 10 |
| b. | Illustrate and explain the working principle of a stepper motor. | 10 |
| 4 a. | Explain the working principle of a dc servo motor and discuss the affects of a back emf in a dc servo motor. | 10 |
| b. | Discuss the feedback mechanism associated with a velocity sensor and an incremental encoder. | 10 |
| 5 a. | Explain Direct kinematics and Inverse kinematics with a neat sketch. | 10 |
| b. | Develop a composite rotation matrix for rotation of angle α about OX axis followed by angle θ about OZ axis followed by angle ϕ about OY axis. | 10 |
| 6 a. | Derive Eulerian rotation matrix for system I and system II with a representation. | 10 |
| b. | Discuss Denavit-Hartenberg representation and discuss the parameters that describe any revolute or prismatic joint. | 10 |
| 7 a. | Discuss the types of programming methods and also explain the ways to accomplish lead through programming. | 10 |
| b. | Write the description for the below commands: | |
| i) | MOVE A1 | |
| ii) | APPRO A1, 50 | |
| iii) | MOVE ARM2 TO A1 | |
| iv) | DEFINE FRAME 1 = FRAME (A ₁ , A ₂ , A ₃) | |
| v) | MOVES ROUTE : FRAME 1 | 10 |
| vi) | CLOSE 3.0LB | |
| vii) | SIGNAL 105, 45 | |
| viii) | SIGNAL VOLT1 | |
| ix) | WAIT VOLT3 | |
| x) | REACT1 17, SAFETY | |

- 8 a. Explain the importance of below statements in framing a robot program for a certain applications.
- i) IF statement
 - ii) IF....THEN..... ELSE... END statement
 - iii) DO LOOPS
 - iv) Subroutine statements
- b. Discuss the basic elements and functions that should be incorporated in robot programming language.
- 9 a. Discuss the general considerations in robot material handling applications.
- b. Discuss the features of the welding robot.
- 10 a. Discuss the requirements of the robot for spray coating applications and list the benefits.
- b. Develop a robotic cell comprising of a 2 DOF robotic arm, incoming and outgoing conveyor. Illustrate this with neat sketch and explain the process involved in a simple pick and place operation.

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