

**337831(37)**

**B. E. (Eighth Semester) Examination, 2020**

APR-MAY

**(New Scheme)**

**(Mechanical Engg. Branch)**

**ROBOTICS**

***Time Allowed : Three hours***

***Maximum Marks : 80***

***Minimum Pass Marks : 28***

***Note : Attempt all questions. Part (a) of each question is compulsory. Attempt any two parts from (b), (c) and (d). Give neat and clean diagrams wherever needed.***

**Unit-I**

1. (a) Laws of Robotics. 2
  
- (b) Briefly describe three basic configuration of arm in robotics manipulators. 7

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- (c) Write short note on Robot Anatomy. What are design and control issues in robotics? Explain in brief. 7
- (d) Define the following : 7
- (i) Load carrying capacity
  - (ii) Work volume
  - (iii) End-effector

### Unit-II

2. (a) Explain revolute joint and a prismatic joint. 2
- (b) Derive an fundamental rotation matrices about  $x$ ,  $y$  and  $z$  from rotational transformation matrix. 7
- (c) Frame {2} is rotated with respect to frame {1} about the  $x$ -axis by an angle of  $60^\circ$ . The position of the origin of frame {2} as seen from frame {1} is  ${}^1D_2 = [7.0, 5.0, 7.0]^T$ . Obtain the transformation matrix,  ${}^1T_2$  which describes frame {2} relative to frame {1}. Also find the description of point  $P$  in frame {1} if  ${}^2P = [2.0, 4.0, 6.0]^T$ . 7

- (d) How many degrees of freedom are normally provided in the arm of a manipulator? 7

**Unit-III**

3. (a) Define the degree of freedom. 2
- (b) Explain mapping between direct and inverse kinematics. 7
- (c) What are global and local scale factor? When these are useful? 7
- (d) Explain why homogenous coordinates are required in modeling of robotics manipulators. 7

**Unit-IV**

4. (a) What are the functions of sensor in Robotics? 2
- (b) What are the industrial applications of vision controlled robotics systems? 7
- (c) Explain various kinds of sensors used in robotics with suitable diagram. 7

- (d) Briefly discuss a robotic vision system with multiple cameras as for manipulator control. 7

### Unit-V

5. (a) What are the Non-Industrial applications? 2
- (b) Make chronological chart showing the major development in the field of robotics. 7
- (c) Write short notes on any **two** : 7
- (i) Justification of Robots
  - (ii) Inspection applications
- (d) Explain in details industrial applications of robot with suitable diagram. 7