

**Semester-II, Paper-4**  
**ROBOTICS AND AUTOMATION**

**Teaching scheme**

Lectures: 4 Hrs / Week

Practical: 2 Hrs/ week

**Examination scheme**

Theory: 100 Marks

Term work: 25 Marks

**Unit 1.**

(10 Hrs, 20 Marks)

Robots: History and evolution of robots, Laws of robotics, Basic configuration, degree of freedom, and work envelope, motion control methods.

**Unit 2.**

(10 Hrs, 20 Marks)

Drives for robots: Electrical, hydraulic and pneumatic.

Sensors: Proximity and range, tactile, force and torque.

End effectors, Position and velocity measurement.

Robot vision: Introduction to techniques, image acquisition and processing.

**Unit 3.**

(10 Hrs, 20 Marks)

Rotation matrix, Homogenous transformation matrix, Denavit- Hartenberg convention, Euler angles, RPY representation, Direct and inverse Kinematics for industrial robots for position and orientation Redundancy, Manipulator, Jacobian Joint, End effector, velocity-direct and inverse velocity analysis. Control: Individual joint computed torque.

**Unit 4.**

(10 Hrs, 20 Marks)

Robot dynamics: Lagrangian formulation, link Inertia tensor and manipulator Inertia tensor, Newton -Euler formulation for RR & RP Manipulators, Trajectory planning, interpolation, cubic polynomial linear segments with parabolic blending, static force and moment transformation, Solvability, Stiffness, Singularities

**Unit 5.**

(10 Hrs, 20 Marks)

Applications in industry -material handling, loading & unloading processing, welding & painting applications, assembly and inspection, Robot specification requirements.

Introduction to robot programming languages like AL and AML.

**References:**

1. Spong and Vidyasagar, 'Robot Dynamics and Control', John Wiley and Sons, 1990.
2. R.K. Mittal, I.J. Nagrath, 'Robotics and Control', Tata McGraw-Hill 2003.
3. Groover, 'Industrial Robotics', McGraw-Hill.
4. Asada and Slotine, 'Robot Analysis and Intelligence', Wiley Interscience, 1986.
5. Fu.K.S. Gon Zalez RoC., Lee CoS.G., 'Robotics, Control Sensing Vision and Intelligence', McGraw Hill, into Ed., 1987.

**List of Experiments:**

Term work shall consist of at least **eight** experiments based on above topics