IV B.Tech I Semester

		L	**T**	**P**	**C**
23A30703c	**ROBOTICS** **(Professional Elective-V)**	**3**	**0**	**0**	**3**

Course Objectives:

- To introduce the fundamentals of robotics and its components.
- To understand the kinematics, dynamics, and control of robotic systems.
- To study various sensors, actuators, and robotic perception systems.
- To explore applications of AI in robotics, including motion planning and machine learning.
- To analyze real-world applications and ethical issues in robotics.

Course Outcomes:

Upon successful completion of this course, students will be able to:

- Understand the structure and functions of robotic systems.
- Analyze robotic movements through kinematics and dynamics.
- Design motion planning and control algorithms.
- Integrate AI and machine learning in robotic tasks.
- Apply robotics to real-world domains and evaluate ethical implications.

UNIT I: Introduction to Robotics

Definition, classification, and types of robots , Components of a robotic system , History and evolution of robotics , Sensors, actuators, controllers , Degrees of freedom and configurations , Power sources and drive systems , End effectors and robotic grippers , Introduction to ROS (Robot Operating System) –

UNIT II: Kinematics and Dynamics of Robots

Coordinate frames and transformations , Forward kinematics for robotic manipulators , Inverse kinematics and solutions , Jacobian matrix and velocity kinematics , Dynamics of manipulators using Lagrangian and Newton-Euler , Redundant robots and singularities , Trajectory planning: Linear, polynomial, and spline paths , Introduction to simulation tools (Gazebo, V-REP) –

UNIT III: Sensors, Perception and Localization

Types of sensors: IR, ultrasonic, LIDAR, vision , Sensor fusion and integration , Robotic vision: Cameras, image formation, and filtering , Object recognition and feature extraction , Mapping: Grid-based, topological, and semantic , SLAM (Simultaneous Localization and Mapping) , Localization algorithms: Kalman filter, particle filter , Obstacle detection and avoidance –

UNIT IV: Robotic Motion Planning and Control

Path planning algorithms: Dijkstra, A*, RRT , Motion control: PID, adaptive and robust control , Inverse dynamics and computed torque control , Trajectory tracking and motion stabilization , Motion planning for mobile and humanoid robots , Collision detection and avoidance techniques , Human-robot interaction and teleoperation , Case study: Designing motion plan for an autonomous robot –

UNIT V: AI and Applications in Robotics

Integration of AI in robotics , Machine learning for perception and control , Reinforcement learning for robotic agents , Deep learning in visual perception and grasping , Applications in industrial, medical, military, and service robots , Ethical considerations and safety standards , Autonomous navigation and decision-making , Capstone task: Proposing a robotic system for a societal problem –

Textbooks:

1. John J. Craig – Introduction to Robotics: Mechanics and Control
2. Saeed B. Niku – Introduction to Robotics: Analysis, Control, Applications
3. Mikell P. Groover – Industrial Robotics: Technology, Programming, and Applications

Reference Books:

1. Roland Siegwart, Illah Nourbakhsh, Davide Scaramuzza – Introduction to Autonomous Mobile Robots
2. Peter Corke – Robotics, Vision and Control
3. Richard D. Klafter – Robotic Engineering: An Integrated Approach

Online Courses:

- Coursera – Modern Robotics: Mechanics, Planning, and Control (Northwestern University)
  https://www.coursera.org/specializations/modernrobotics
- edX – Robotics MicroMasters (Columbia University)
  https://www.edx.org/micromasters/columbiax-robotics