Uka Tarsadia University

B. Tech.

CSE / CSE (CC) / CE (SE)

Semester VII

Program Elective - VI

ROBOTICS AND INTELLIGENT SYSTEMS

AI6014

EFFECTIVE FROM July-2024

Syllabus version: 1.00

Subject Code	Subject Title
AI6014	**Robotics and Intelligent Systems**

Teaching Scheme				Examination Scheme				
Hours		Credits		Theory Marks		Practical Marks		Total Marks
Theory	Practical	Theory	Practical	Internal	External	Internal	External	
4	0	4	0	40	60	0	0	100

Objectives of the course:

- To understand the Fundamentals and Applications of Robotics
- To develop Proficiency in Vision and Image Analysis for Robotics
- To master the control and implementation of robotic systems

Course outcomes:

Upon completion of the course, the student shall be able to,

CO1: Comprehensive Understanding of Robotics Fundamentals.
CO2: Proficiency in Vision and Image Analysis for Robotics.
CO3: Competence in Sensory Systems and Software/Hardware for Robotics.
CO4: Mastery in Robot Control.
CO5: Application Proficiency in Industrial, Medical, and Service Robotics.
CO6: Capability in Developing Intelligent Robots.

Sr. No.	Topics	Hours
	Unit – I	
1	**Introduction and Overview Of Robotics:** Definition and scope, Historical overview, Types of robots, Applications in computer science, Robot actuators, Sensors, End effectors, Homogeneous coordinates, Forward and inverse kinematics, Robot dynamics, Robot control systems, Motion planning and trajectory generation.	10
	Unit – II	
2	**Vision and Image Analysis:** Gestalt-based approach to robot vision, Matching – Check points within the framework of a knowledge-based visual inspection	10

	system, Stereoscopic vision for agv guidance, Hierarchical methods for robot vision.	
	Unit – III	
3	**Robotic Sensory Systems and Software/Hardware, System Simulation:** Geometric modeling aspects on vision and ultrasonic range sensing for robotic applications, Sensor planning for the error diagnosis of robot assembly tasks, Computer aided analysis of robot arm dynamics and adaptive control schemes, A programming environment for sensor-controlled robots, Symbolic simulation of sensory robot programs, Expert systems and multiple criteria decision support, Signal representation issues in neural-network modeling of perceptual properties, Robot control with procedural expert system, Rapid interference detection, Prolog language – cadd package interfacing procedures, Intelligent cooperation for robotics, The blackboard architecture in knowledge-based robotic systems, Implementation of specific robotic functions directly in hardware, The 3dp real-time motion-control computer.	10
	Unit – IV	
4	**Robot control:** A knowledge-based controller for a PWR -type nuclear power plant, Telepresence and intelligent control for a legged locomotion robot, Robust adaptive control of robotic manipulators, About qualitative robot control, Motion estimation from target tracking, Robust control of robotic manipulators, Automatic determination of quasi-time optimal joint trajectories and adaptive control for a robotic arm, A robust approach for the control of robotic manipulators, Analysis of cooperating robot manipulators on a mobile platform, On the theory of intelligent machines, Symbolic computation for robot design, Neural net system for adaptive robot control.	10
	Unit – V	
5	**Applications:** On-line scheduling and planning of robots and presses, Knowledge-based process planning, Scheduling and error recovery in robotized assembly, Complete garment assembly using robots, A model-based expert system for the diagnosis of faults in a robot system for cleaning castings, Genghis – An intelligent autonomous mobile robot, Benefits of expert robots – Intelligence vs. skill, Evaluation of applicative assembly design, Supported by expert systems.	10

Unit – VI		
6	**Developments of intelligent robots:** Vision and image analysis as applied to intelligent modules, Computer-aided process planning in robotic-based CIM systems, Current issues and future developments of intelligent robots, Industrial needs and applications, Integrating diverse knowledge – New ideas in knowledge processing, Intelligent control.	10

Text books:

1. Dr. C. Karthik, Mukesh Madanan ,Dr. Mintu Debnath and Mr. Dillip Narayan Sahu, "Robotics and Intelligent systems".
2. Dr. Dharmalingam G, Dr. Nalini Misra, Dr.Rajinder Kumar and Dr. Anurag Rawat, "Artificial Intelligence and Robotics"

Reference books:

1. Timothy Jordanides and Bruce Torby, "Expert Systems and Robotics".
2. George Zobrist, C Y Ho, "Intelligent Systems and Robotics", Kindle Edition.

Course objectives and Course outcomes mapping:

- To understand the fundamentals and applications of robotics: CO1, CO2.
- To develop proficiency in vision and image analysis for robotics: CO3, CO4.
- To master the control and implementation of robotic systems: CO5, CO6.

Course units and Course outcomes mapping:

Unit No.	Unit Name	Course Outcomes					
		CO1	CO2	CO3	CO4	CO5	CO6
1	Introduction And Overview Of Robotics	✓					
2	Vision and Image Analysis		✓				
3	Robotic Sensory Systems and Software/Hardware, and System Simulation			✓			
4	Robot Control				✓		
5	Applications					✓	
6	Developments of Intelligent robots						✓

Programme outcomes:

PO 1: Engineering knowledge: An ability to apply knowledge of mathematics, science, and engineering.

PO 2: Problem analysis: An ability to identify, formulates, and solves engineering problems.

PO 3: Design/development of solutions: An ability to design a system, component, or process to meet desired needs within realistic constraints.

PO 4: Conduct investigations of complex problems: An ability to use the techniques, skills, and modern engineering tools necessary for solving engineering problems.

PO 5: Modern tool usage: The broad education and understanding of new engineering techniques necessary to solve engineering problems.

PO 6: The engineer and society: Achieve professional success with an understanding and appreciation of ethical behavior, social responsibility, and diversity, both as individuals and in team environments.

PO 7: Environment and sustainability: Articulate a comprehensive world view that integrates diverse approaches to sustainability.

PO 8: Ethics: Identify and demonstrate knowledge of ethical values in non-classroom activities, such as service learning, internships, and field work.

PO 9: Individual and team work: An ability to function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give/receive clear instructions.

PO 11: Project management and finance: An ability to demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: recognition of the need for, and an ability to engage in life-long learning.

Programme outcomes and Course outcomes mapping:

Programme Outcomes	Course Outcomes					
	CO1	CO2	CO3	CO4	CO5	CO6
PO1	✓	✓	✓	✓	✓	✓
PO2			✓	✓	✓	
PO3		✓	✓	✓	✓	✓
PO4		✓	✓	✓	✓	✓

PO5		✓	✓	✓	✓	✓
PO6		✓	✓	✓	✓	✓
PO7					✓	
PO8					✓	
PO9					✓	
PO10					✓	
PO11					✓	
PO12					✓	