FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: Bachelor of Technology (Artificial Intelligence (AI) and Data Science)

Semester: VI

Course Code: 202046718

Course Title: Robotics & Autonomous Systems

Course Group: Professional Elective Course - II

Course Objectives: To impart widespread acquaintance of robotic system along with different configurations, their kinematics, interfacing with various sensors, robot vision system and real field applications of them.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Theory J/V/P*
Lecture	Tutorial	Practical		Internal	External	Internal	External	
3	0	2	4	50/18	50/17	25/9	25/9	150 / 53

* **J**: Jury; **V**: Viva; **P**: Practical

Detailed Syllabus:

Sr.	Contents	Hours
1	**Introduction to Robotics:** History, Robot anatomy, classification of robots, Work envelop, Specifications of Robots (accuracy, precision, repeatability, resolution, etc.), Applications, Safety Laws, Types of robot programming	06
2	**Robot drive systems, End effectors and Automation:** Types of drives: Hydraulic drives, Pneumatic and Electric drives. DC servo motors, stepper motors and AC servo motors – Salient features and applications. Comparison of all drives End effectors. Types of grippers – Mechanical Grippers, Magnetic, vacuum, pneumatic and hydraulic gripper, Selection, and design consideration of grippers, Design of Mechanical Grippers.	08
3	**Robot sensor and Machine vision:** Need for sensors, types of sensors used in robotics, Classification and applications of sensors, Characteristics of sensing devices, selections of sensors, force and tactile sensor, slip sensor, proximity sensors, Robot vision setup (RVS), block diagram, components, working of RVS, Human vision vs. Robot vision, Applications of RVS, Robot Kinematics: Direct Kinematics,	08
4	**Interfacing with Microcontroller:** Introduction to AVR, Sensor (temperature and humidity, PIR, etc.) interfacing with controller, Optocoupler interfacing with controller, Actuator (stepper motor, DC motor) interfacing with controller	06

5	**Basics of IOT:** Introduction to IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks, Machine-to-Machine Communications, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino, Introduction to Python programming, Introduction to Raspberry Pi, Implementation of IoT with Raspberry Pi	**06**
6	**Robot Applications:** Industrial, Material Handling, Processing, Assembly: Peg in hole, Compliance, Inspection, Surgical, Space and Military applications; Futuristic robotics, Principles for robot application and application planning.	**06**

List of Practical:

1	Introduction of Robotic system, various configurations and DOF calculations
2	Basic robot Joints and its simulation using Robo Analyzer Software.
3	Pin, Slider joint using High end CAD software
4	MATLAB for Robotics application
5	Direct kinematics for open/closed loop configurations analytically/simulation/coding.
6	Inverse kinematics for open/closed loop configurations analytically/simulation/coding.
7	Coding/simulation of direct kinematics for open/closed loop configurations along with workspace generation using MATLAB.
8	Formulation of DH parameters of robot configuration and its simulation using Robo Analyzer Software
9	Introduction to microcontroller hardware
10	Interfacing with Microcontroller

Reference Books:

1	Industrial Robotics, Technology, Programming and Applications, Mikell P Groover, Tata McGraw Hill
2	Introduction to Robotics: Analysis, Control, Applications, Saeed Niku, John Wiley & Sons
3	Robotics and control, R K Mittal, I J Nagrath, Tata McGraw Hill
4	The AVR Microcontroller and Embedded Systems, Using Assembly and C, Muhammad Ali Mazidi, Sarmad Naimi and Sepehr Naimi, Pearson Education
5	A Robot Engineering Textbook , Mohsen Shahinpoor, Harper and Row, Publisher, New York
6	Introduction to robotics, John J Craig, Pearson/Prentice Hall
7	AI and IoT-Based Intelligent Automation in Robotics, Author (Ashutosh Kumar Dubey, Abhishek Kumar, S. Rakesh Kumar) Wiley-Scrivener; 1st edition

Supplementary learning Material:

1	NPTEL
2	Coursera

Pedagogy:

- Direct classroom teaching

- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation
- Industrial/ Field visits
- Course Projects

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks						**R**: Remembering; **U**: Understanding; **A**: Application, **N**: Analyze; **E**: Evaluate; **C**: Create
R	**U**	**A**	**N**	**E**	**C**	
20%	30%	25%	10%	10%	5%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	% weightage
CO-1	To understand and learn basic terminologies, anatomy and various types of hardware used in Robotic system.	**25**
CO-2	To understand the use of DH Parameters for forward and Inverse Kinematics	**15**
CO-3	To know about the interfacing of hardware devices with controller.	**20**
CO-4	To Understand use of IoT in Robotics.	**20**
CO-5	To understand Real-time applications of robot systems in different fields.	**20**

Curriculum Revision:

Version:	2.0
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June -2026