ET4151: Robotics (Professional Elective)	
Teaching Scheme **Lectures: 03 Hrs/week** **Total credits: 03**	**Examination Scheme** **Test 1: 15 Marks** **Test 2: 15 Marks** **Teachers' Assessments: 10 Marks** **End Semester Exam: 60 Marks**

Prerequisites: Basic knowledge of Electronics

Course description: The course gives exposure to fundamentals of Robotics- Mechanical Systems, Microprocessors and Microcontrollers, Sensors and Actuators, Image Acquisition and Processing, Speech Processing. This course introduces Robot Operating System and Programming is C. This course discusses the applications of Robot in Industry and Home.

Course objectives: The course has the following objectives:

- To develop understanding Robotics components
- To know the classification of Robots
- To impart knowledge of Microprocessors and Microcontrollers
- To expose the students to Robot control and Robot Operating System

Course Outcomes: After completing the course, the students will able to:

CO1	Learn classification and mechanics and controls involved in Robot	**K1**
CO2	Understand data acquisition and processing	**K2**
CO3	Explore role of Sensors and Actuators in Robotics	**K3**
CO4	Study Machine Learning and AI	**K2**
CO5	Understand the role of Computer Vision in Robotics	**K2**
CO6	Understand various classes of Robots	**K1**

Detailed Syllabus:

Unit	Content
Unit-I	**Mechanical Systems in Robotics** Motion Control Classification, Open and Closed Loop Systems, Mechanical Components, Motors and Motor Drives- Servo Motors and Stepper Motors, Brushless DC Motors, Feedback Sensors- Linear and Rotary Encoders, Magnetic Encoders, Tachometers, Linear and Angular Displacement Transducers, Actuators- Solenoids. Power Transfer Mechanisms- Belts, Chains, Gears, Worm Gears, Rocker and Cam, Rack and Pinion, Walkers- Leg Actuators, Leg Geometry, Walking Techniques
Unit-II	**Data Acquisition and Processing** Sensors- Ultrasonic, Accelerometer, Temperature, Ambient Light, Ambient Temperature, Pressure, Strain Gauges, Smoke sensors, Signal Pre-conditioning, Instrumentation Amplifier, Analog to Digital Conversion, Microprocessors and Microcontrollers for Robotics- their choice, architecture, ATMEGA328p, STM32 Microcontroller, Multicore SOCs, Introduction to C and Robotic Operating System
Unit-III	**Robotic Vision System** Camera Specifications, Camera SOC, Image Formats, Multiresolution Images, Compression Formats, Image Processing System, introduction to segmentation and classification, introduction to Open CV system. Introduction to Speech acquisition and storage, Speech Synthesis.
Unit-IV	**Robotic Control Systems** Wheeled Robotic System, feedback control systems, study and application of PID controller to motion control, stability analysis Study of Robotic Arm

Unit-V	**Machine Learning** Introduction to AI and Machine Learning, Data Processing and Storage, Data Mining basics, interface to cloud, introduction to Machine to Machine Communication, Data Interpretation and inference engine

Text and Reference Books

1. Robot Mechanisms and Mechanical Devices – *Paul E. Sandin,* McGraw Hill, New York

2. Embedded C Programming and the Atmel AVR – *Richard H. Barnett, Sarah Cox, Larry O'Cull,* Thomson Delmar Learning, Canada

3. Mastering STM32, *Carmine Noviello*, Learn Pub

4. Robot Operating System (ROS), *Anis Koubaa*, Springer International Publishing

Mapping of course outcome with program outcomes:

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2		2							2				3		2
CO3						2			1		2		3		2
CO4			2		1	1			3				3		2
CO5		2											3		1
CO6	2												3		1

1-Low **2-Medium** **3-High**

Teachers' Assessment: Teachers Assessments of 10 marks is based on one of the/or combination of few of the following

1. Simulation

2. Presentation of case studies

3. Question and Answer/Numerical solution

4. Survey of actual channels used in practice

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 1	Test2	Teachers' Assessment/ Assignment (10)	End Semester Examination
K1	Remember	5	5	0	6
K2	Understand	10	10	05	42
K3	Apply	0	0	05	12
K4	Analyse	0	0	0	0
K5	Evaluate	0	0	0	0
K6	Create	0	0	0	0
Total Marks (100)		**15**	**15**	**10**	**60**

Assessment Table

Assessment Tool	K1 CO1	K2 CO2	K3 CO3	K2 CO4	K2 CO5	K1 CO6
Class Test 1 (15)	03	05	00	00	05	02
Class Test 2 (15)	02	04	00	02	04	03
Teacher's Assessment (10)	00	05	05	00	00	00
ESE Assessment	03	18	12	18	06	03

Approved in XXth Academic Council, Dated 26 August 201

Approved in XXth Academic Council, Dated 26 August 2019

ET4152- Lab Robotics	
Teaching Scheme **Practical: 2 Hrs/Week** **Total credits: 01**	**Examination Scheme** **Term Work: 25 Marks**

Laboratory Course Outcomes

As an outcome of completing the Laboratory course, students will able to:

CO1	Explore controllers, motors, actuators, encoders, sensors used in robots.
CO2	Understand internals of Robotic Operating System and programming
CO3	Participate in a group atmosphere for the defining, planning, and execution of an open-ended robotic system.

List of Experiments

Sr. No.	Details
1	Implement Stepper Motor and Servo Motor Interface to ATMEGA 328p
2	Implement interface of various sensors to ATMEGA 328p and STM32
3	Implement Interface to 3-axis accelerometer to ATMEGA 328p and plot response of the sensor to walking, running, and Turn
4	Implement Camera Interface to ATMEGA 328p and STM32/Raspberry Pi, acquire image and preform photometric corrections
5	Study of Robotic Operating System on Raspberry Pi, Installation and simple programming in C
6	Acquire various hand gestures on to computer using flex sensors and ATMEGA 328p and the nerve impulses and correlate the signals for Robotic Arm
7	Acquire sensor data using ATMEGA 328p and upload on cloud through 4G gateway
8	Control a stepper motor using command on HTML Page through cloud interface
9	Introduction to Open CV on Raspberry Pi- Basic Photometric and Geometric Processing

Mapping of Course outcome with Program Outcomes

PO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1				1	2	3						1			2
CO 2		3		1	1							2			2
CO 3				1							2	3			2

1-Low **2-Medium** **3-High**

Assessment Table

Assessment Tool	S1	S3	S4	S2
	C01	CO2	CO3	CO2
Term Work (25)	05	05	10	05

Approved in XXth Academic Council, Dated 26 August 201

Assessment Pattern

Assessment Pattern Level No.	Skill Level	Team Work
S1	Imitation	05
S2	Manipulation	05
S3	Precision	05
S4	Articulation	10
S5	Naturalization	00
Total		25

Approved in XXth Academic Council, Dated 26 August 2019

Approved in XXth Academic Council, Dated 26 August 2019