The LNMIIT, Jaipur
Department of Mechanical & Mechatronics Engineering
Introduction to Automation (INTROAUTO)

Subject Code: **INTROAUTO**	Course Title: **Introduction to Automation & Robotics**	Total Contact Hours: **40**	**L: 3**	**T: 0**	**P: 2**	**C: 4**
Pre-requisite: **Basic Electronics**		Year: **2**	Semester: **Odd**			
Type of Course**: Hons./Minor Program**						

***** L → Lectures, T → Tutorials, P → Practical C → Credit***

Learning Objective:

This is an undergraduate Hons./Minor Programme course offered to 3rd-semester Engineering students. The course will help the students in acquiring a mix of skills in mechanical, electronics and computing to be able to comprehend and design automation systems. Theoretical knowledge as well as hands-on practice on various sensors, actuators, digital electronics, signal conditioning devices and circuits which are used in automation systems, will be given. Study of methods for designing and analyzing automation systems and how to effectively interface them with controllers will also be done during this course. Practical knowledge on various sensors, actuators, digital electronics, signal conditioning devices and circuits which are used in mechatronic systems will be given so that students can do synergistic integration of mechanics, electronics, control theory, and computer science within product design and manufacturing, in order to improve and/or optimize its functionality. Programming using different software and hardware will be done to effectively interface them with controllers.

Course outcomes (COs):

On completion of this course, the students will have the ability to:		**Bloom's Level**
CO-1	Model and Analyze automation systems for an engineering application.	**3, 4**
CO-2	Identify and Explain sensors and actuators to monitor and control the behavior of a process or product.	**1, 2**
CO-3	Evaluate the performance of automation systems.	**2, 5**
CO-4	Design an automated system for an engineering application.	**6**
CO-5	Interface sensors and actuators with LabVIEW through MyRio.	**3, 4**
CO-6	Design and Simulate Mechatronic systems on Proteus and develop hardware.	**3, 6**
CO-7	Develop Microcontroller, Arduino and R-Pi programs and Apply them to control Hardware.	**3, 6**
CO-8	Simulate Electro-pneumatic and hydraulic logic circuits on Auto-Sim and apply them to Hardware setup.	**3, 4**

Course Topics:

S. No.	**Contents**	**Hours**
1	**Introduction to Automation:** History and Fundamentals of Automation, scope and significance of automation systems, security and ethics of automation, elements of automation systems, needs and benefits of automation in Industry. Examples: Pick and place robot, Bar code, Engine Management system, Washing machine etc.	**2**

2	**Sensors for Automation & Robotics:** Introduction to sensors, Static and dynamic characteristics, Types of sensors, Optical Sensors, Temperature Sensors, Magnetic and Electromagnetic Sensors, Mechanical Sensors, Pressure sensors	**10**
3	**Mechatronic system components, circuits and response:** Analysis of electric circuits and components, Amplitude Linearity, Bandwidth and Frequency Response, Phase linearity, Distortion of Signals, Response of a zero, first and second order system, system analogies.	**6**
4	**Closed-Loop controllers:** Continuous and discrete control, Two-step mode control, Electronic P, I, D, PI and PID controllers, control system performance, tuning, adaptive control.	**5**
5	**Digital Electronics:** Number systems, BCD codes and arithmetic, Gray codes, self-complimenting codes, Error detection and correction principles. Boolean functions using Karnaugh map, Design of combinational circuits, Design of arithmetic circuits. Design of Code converters, Encoders and decoders.	**6**
6	**Signal Conditioning:** Operational amplifiers, Protection circuits and devices, comparator, filters, Multiplexer, Pulse width Modulation, Counters, decoders, Data acquisition, Analog to digital conversion, digital to analog conversion.	**3**
7	**Actuators for Automation & Robotics:** Electrical Actuators : Solenoids, relays, diodes, thyristors, triacs, BJT, FET, DC motor, Servo motor, BLDC Motor, AC Motor, stepper motors. Mechanical, Hydraulic & Pneumatic devices –Power supplies, valves, cylinders, sequencing.	**10**

S. No.	Name of Lab Experiment	Hours
1	Designing 'PID' Controller on LabVIEW.	**2**
2	Interfacing Sensors and Actuators using LabVIEW and MyRio.	**2**
3	Design and simulation of LED blinking circuit. Hardware development of LED blinking circuit.	**2**
4	Design and simulation of timer and counter circuit. Hardware development of timer and counter circuit and testing.	**2**
5	Design and simulation of Motor control and LCD Display Circuit. Hardware development of Motor Control and LCD Display circuit.	**2**
6	Design and simulation of Amplifier, filter and motor driver circuit. Hardware development of amplifier, filter and motor driver circuit.	**2**
7	Interfacing Arduino with LabVIEW for Temperature control and ADC of sensor data.	**2**
8	Introduction to the Raspberry Pi and its initialization. Design an IoT based application with Raspberry Pi.	**2**

9	Designing Pneumatic Logic to control systems.	**2**
10	Designing Electro-Pneumatic logic to control systems.	**2**
11	Final Project	**4**

Textbook References:

Text Book:

1. William Bolton, *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*, 4th edition, Pearson Education, 2008.
2. Devdas Shetty & Richard Kolk, *Mechatronics System Design*, 3rd edition. PWS Publishing, 2009.
3. Groover, Mikell P., et al., *Industrial robotics: technology, programming, and applications*. McGraw-Hill, 2012.
4. David G Alciatore & Michael B Histand, *Introduction to Mechatronics and Measurement Systems*, 4th edition, Tata McGraw Hill, 2006.

Reference books:

1. Fraden, Jacob, and Lawrence G. Rubin, *AIP Handbook of Modern Sensors*, Physics Today 47.6 (1994): 74.
2. Khazan, Alexander D., *Transducers and their elements: design and application*, Prentice Hall, 1994.
3. Muller, Richard S., et al., *Device electronics for integrated circuits*, 1986, 54.
4. Sze, Simon M., Yiming Li, and Kwok K. Ng. *Physics of semiconductor devices*, John wiley & sons, 2021.
5. R. Siegwart, et.al, *Introduction to Autonomous Mobile Robots*, Prentice Hall of India, 3rd Edition, 2005.
6. John Craig, *Introduction to Robotics: Mechanics and Control*, Pearson/Prentice Hall Education, 3rd Edition, 2005.
7. Ruocco, S., *Robot sensors and transducers*, Springer Science & Business Media, 2013.

Video References:

1. http://video_demos.colostate.edu/mechatronics
2. http://mechatronics.me.wisc.edu

Additional Resources:

NPTEL, MIT Video Lectures, Web Resources etc.

Evaluation Method	
Item	**Weightage (%)**
Midterm	30
Final Examination	50

Teacher's assessment (Assignment/ Presentation/ Project/ Quiz)	20

CO and PO Correlation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	-	-	-	-	-	-	-	1	2	3	1
CO2	3	2	2	2	3	-	-	-	-	-	-	1	2	3	1
CO3	3	1	1	2	-	-	-	-	-	-	-	1	2	2	1
CO4	3	2	3	2	-	-	-	-	-	-	-	1	3	3	1
CO5	3	3	3	2	3	-	-	-	-	-	-	1	3	3	1
CO6	3	3	3	2	3	-	-	-	-	-	-	1	3	3	1
CO7	3	2	3	2	2	-	-	-	-	-	-	1	3	3	1

Prepared by: Dr Mohit Makkar
Last Update: 27/12/2021

Approved by: