12. Write a program to interface ultrasonic sensors to detect obstacles and control a motorized robot.
13. Any one of the following mini projects or on similar concepts incorporating data acquisition from sensors/ input device, data analysis & control and display of result on any output device: Digital Thermometer, Light-Activated Lamp, Distance Measurement System, Traffic Light Simulation, Line-Following Robot. Automatic Plant Watering System, Solar Power Monitoring System, Energy Consumption Tracker, Water Quality Monitoring System, Automatic Irrigation System, Smart Street Lighting System, Air Quality Monitoring, CO2 Emission Tracker, Temperature and Humidity Logger, Smart Fish Tank Monitoring System, Biodiversity Protection System, Waste Segregation System, Smart Composting Bin, Smart Factory Prototype, Smart Health Monitoring System, Indoor Air Quality Monitor

Essential/recommended readings

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson education Asia, New Delhi (2007), 2nd Edition.
2. Michal Mc Roberts “Beginning Arduino” Second Edition, Technology in Action
3. Massimo Banzi, “Getting started with Arduino” 2nd Edition, Orelly 2011
4. Richard Blum, “Arduino Programming in 24 Hours”, Pearson Education, 1st
5. edition, 2015.
6. James M. Fiore, Embedded Controllers using C and Arduino, 2019
7. https://docs.arduino.cc/learn/

Suggestive readings

1. Raj Kamal: Microcontrollers, Architecture, Programming, System Design, 2nd Edition, Pearson.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.

DISCIPLINE SPECIFIC CORE COURSE – 20: Industrial Automation using PLC and SCADA (INDSC8A)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		

Industrial Automation using PLC and SCADA (INDSC8A)	**04**	**02**	**-**	**02**	**Course admission eligibility**	**Basic knowledge of programming**

Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce the importance of automation techniques in manufacturing and process industries.
- To impart the role of PLC in industry automation.
- To understand the significance and usage of SCADA in process automation industry.
- To expose to various control techniques employed in process automation.

Learning Outcomes

After successful completion of the course, students will be able to:

- Understand the need for automation in process industries and learn about PLC
- Learn the programming languages of PLC
- Design distributed Control Systems (DCS) and its applications
- Learn about SCADA, its usage in process automation industry and associated communication networks
- To apply PLC programming and implement it on PLC kits.

SYLLABUS OF DSC- 20

UNIT-I **(07 Hours)**

Single loop control, Centralized control, Distributed control systems, Open systems, SCADA systems, Types of data available, Data communication components and protocols.

UNIT-II **(08 Hours)**

Programmable Logic Controllers (PLC), Block diagram of PLC, input/output systems, CPU, memory Unit, Programmer Units, Peripheral devices, Controller programming tools, Programming of PLCs, Basic instruction sets, Design of alarm and interlocks, Networking of PLC, Overview of safety of PLC with case studies.

UNIT-III **(07 Hours)**

Automation in Process Industries

Introduction to computer based industrial automation- Direct Digital Control (DDC), Distributed Control System (DCS), PLC vs. DCS systems, Local control Units, dedicated

card controllers, Unit Operations controllers, DCS multiplexers, DCS system integration

UNIT-IV **(08 Hours)**

Supervisory Control and Data Acquisition (SCADA) Systems, Types of supervisory systems, Components of SCADA Systems, field data interface devices, communication network and other details, System Architecture: monolithic, distributed, networked, application of SCADA in the industry; security and weakness of SCADA Systems

Practical component: (Software/ Hardware) **(60 hours)**

1. Identify various components, modules, and front panel status indicators of a given PLC
2. Design the PLC ladder diagram to test the START-STOP logic using two inputs and one output
3. Design the PLC ladder diagrams for all fundamental logic gates
4. Design the PLC ladder program to Verify DeMorgan‟s Theorems
5. Design the PLC ladder diagrams for various arithmetic operations
6. Design the PLC ladder diagrams for various logical operations
7. Design a PLC ladder program for the blinking of LEDs
8. Design the PLC ladder diagram for implementing a digital timer
9. Design the PLC ladder diagram for implementing a digital counter
10. Design the PLC ladder diagram for sequential control of the DC motor.
11. Design the PLC ladder diagram for a temperature control system
12. Design the PLC ladder diagram for a flow control system
13. Design the PLC ladder diagram for a level control system
14. Interface personal computers in a network using different topologies
15. Identify the various level of distributed control system
16. Develop a SCADA mimic diagram and tag database for On-Off control of lamp
17. Develop a SCADA mimic diagram and tag database for Traffic light control system
18. Develop a SCADA mimic diagram and tag database for level control system
19. Develop a SCADA mimic diagram and tag database for water distribution system
20. Develop a SCADA mimic diagram and tag database for an elevator system
21. At least one industrial visit to study applications related to the subject and submission of the relevant report.

Essential/recommended readings

1. Frank D. Petruzella, "Programmable Logic Controllers", 5th Edition, McGraw-Hill, New York, 2016.
2. John W. Webb and Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003.
3. Bhatkar, Marshal, "Distributed Computer Control & Industrial Automation", 1st Ed., Dekker Publication, 1990.
4. Jai Prakash Gupta, Sanjay Gupta, "PC interface For Data Acquiring & Process Control", 2nd Ed., Instrument Society of America, 1994.

Suggestive readings

1. Krishna Kant, "Computer - Based Industrial Control", 2nd Edition, Prentice Hall, New Delhi, 2011.
2. Yoram Koren, "Robotics", McGraw Hill, 1992.
3. Lukas M.P, "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time

DISCIPLINE SPECIFIC ELECTIVE –: Modern Instrumental Methods of Analysis (INDSE7A)

Credit distribution, Eligibility and Pre-requisites of the Course

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Modern Instrumental Methods of Analysis (INDSE7A)	04	03	-	01	Course admission eligibility	Analytical Instruments

Learning Objectives

The Learning Objectives of this course are as follows:

- To familiarize with advanced spectroscopic techniques such as Mass spectrometry, NMR spectroscopy and X-Ray spectroscopy
- To understand the perspective of different advanced analytical methods.