



Nagar Yuwak Shikshan Sanstha's
Yeshwantrao Chavan College of Engineering
 (An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

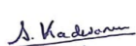
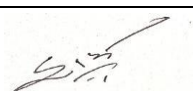
B.Tech SCHEME OF EXAMINATION 2023-24

(Department of Electronics Engineering)

B.Tech Honors in PLC and Industrial Automation

SoE No.
23EL-HIA-101

SN	Sem	Type	Sub. Code	Subject	T/P	Contact Hours				Credits	% Weightage			ESE Duration Hours
						L	T	P	Hrs		MSEs*	TA**	ESE	
1	V	PC	25ELH501	Fundamentals of PLC	T	3	0	0	3	3	30	20	50	3
2	V	PC	25ELH502	Lab: Fundamentals of PLC	P	0	0	2	2	1		60	40	
3	V	PC	25ELH503	Industrial Instrumentation and Controllers	T	3	0	0	3	3	30	20	50	3
4	VI	PC	25ELH601	Industrial Automation	T	3	0	0	3	3	30	20	50	3
5	VI	PC	25ELH602	Lab: Industrial Automation	T	3	0	0	3	3	30	20	50	3
6	VI	PC	25ELH603	SCADA and DCS	P	0	0	2	2	1		60	40	
7	VII	PC	25ELH701	Substation Automation	T	3	0	0	3	3	30	20	50	3
8	VII	PC	25ELH702	Lab: Substation Automation	P	0	0	2	2	1		60	40	
TOTAL						15	0	6	21	18				

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B. Tech SoE and Syllabus

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(Department of Electrical Engineering)

B.Tech Honors in PLC and Industrial Automation

V SEMESTER

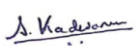
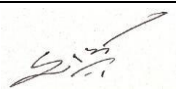
23ELH501: Fundamentals of PLC

Course Outcomes:

Upon successful completion of the course the students will be able to

1. Explain PLC architecture of industrial automation system.
2. Illustrate the process control, PLC architecture and interfacing
3. Develop PLC ladder logic for industrial applications
4. Demonstrate the function of SCADA with PLC systems.

Unit:1	Introduction	7 Hours
Introduction, history of PLC, Definition, advantages and Disadvantages importance of PLC, architecture and block diagram, types of PLC, CPU unit architecture, memory classification, Application of PLC, Size of PLC, Brands of PLC .		
Unit:2	PLC Hardware	6 Hours
Introduction, Classification of input and output Modules, Practical system and it mapping, Input Module, output Modules and Selection of I/O module		
Unit:3	PLC Instruction List	7 Hours
Bits and Word, I/O Addressing of PLC, Instruction Set of Ladder Program, Introduction to PLC Programming Languages, Symbol		
Unit:4	Ladder programming	6 Hours
Introduction, advantages and Disadvantages importance of Ladder , rules for ladder programming., simple ladder diagrams, ladder diagrams for logic gates, ladder diagrams using Timers, ladder diagrams using Counters, ladder diagrams for Arithmetic functions, ladder diagrams for Comparison Functions.		
Unit:5	PLC programming and It application	7 Hours
Ladder programming for Logical Function, Application Development -: Switch, Traffic light control ,Stepper Motor Control ,Timer, Reversing of Motor , Tank Level control , Contactor and Limit switch Control ,Sensor control		
Unit :6	SCADA & distributed control system:	6 Hours

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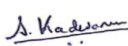
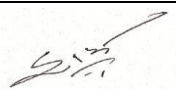
Introduction, block diagram, elements of SCADA, features of SCADA, MTU, RTU functions, applications of SCADA, communications in SCADA, introduction to DCS, architecture, input and output modules, specifications of DCS.

Total Lecture Hours **39 Hours**

S.N.	Name	Year	Publication	Author
1	Programmable Logic controllers and Industrial Automation	2017	Penram International Publishing India Pvt. Ltd	Madhuchhanda Mitra, Samarjit Sen Gupta

REFERENCE BOOKS:

S.N.	Name	Year	Publication	Author
1	Programmable Logic Controllers, Principles and Applications	2002	Prentice Hall of India Pvt. Ltd, 5th Edition	John W. Webb, Ronold A
2	Industrial Instrumentation and Control	2007	S.K. Singh	The McGraw Hill Companies
3	Introduction to PLC	Cengage India (2009)	ISBN: 9788131503027	Dunning. G.
4	Control of Machines	2008	New Age International Publication, ISBN 81-224-0363-8	S. K. Bhattacharya and Brijinder Singh
5	Programmable Logic Controllers	2015	Pearson Education, New Delhi, 2015	Hackworth. J.R.; Hackworth. F;

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V SEMESTER

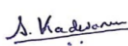
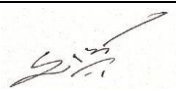
23ELH502:Lab:Fundamentals of PLC

Course Outcomes:

Upon successful completion of the course the students will be able to

1. To familiarize students with the hardware components, architectural layout, and software environment of Programmable Logic Controllers (PLCs).
2. To develop proficiency in programming basic automation logic using gates, starters, timers, and counters.
3. To understand the implementation of mathematical operations and data manipulation using PLC arithmetic instructions.
4. To apply advanced control strategies by configuring and tuning a PID controller within a PLC ecosystem.

S.N	LIST OF EXPERIMENTS
1	Study hardware and software used in PLC
2	Implementation Logic Gates
3	Implementation of DOL Starter
4	Implementation of On-Delay Timer
5	Implementation of Off-Delay Timer
6	Implementation of Up-Down Counter
7	Implementation of PLC Arithmetic Instructions
8	Implementation of PID Controller

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V SEMESTER

23ELH503: Industrial Instrumentation and Controllers

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. To understand the fundamental principles of industrial measurements including pressure, flow, level, temperature, and motion.
2. To analyze and select appropriate transducers and sensors for measuring force, torque, speed, and acceleration.
3. To learn the architecture and functioning of various industrial controllers (such as distributed, programmable, and stand-alone systems) and communication protocols.
4. To gain insight into final control elements, operator interfaces, and robotics used to improve modern process control systems.

Unit:1	Basic measurements	7 Hours
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Standard signals, instrument ranging and limitation, open system closed system.

Unit:2	Pressure,Flow and Temperature Measurements	6 Hours
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Pressure measurements – static, differential, and head pressure, vacuum measurements, aquastatic, and calibration.
Flow, and measurements – Orifice, venture, pitot tube, flow nozzle rotameter, positive displacement meter, turbine flow meter, electromagnetic flow meter, ultrasonic flow meter, open channel flow measurement, solid flow measurement. Sight glass, float gauge, displacer, torque tube, bubbler tube, diaphragm box, Differential Pressure methods, electrical methods- resistance type, capacitance type, ultrasonic level gauging.

Temperature measurements – bimetallic, filled-in, vapor pressure, and resistance thermometers, thermocouples, IC temperature sensors D-90, Pyrometers.

Unit:3	Speed ,Force and Torque Measurements	7 Hours
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Measurement of speed – Revolution counter, Drag cup tachometer, AC and DC tacho-generators, photo electric pickup.

Measurement of force – Load cell, pneumatic load cell, and hydraulic load cell.

Measurement of Torque – strain gauges and magneto elastic principle.

Measurement of acceleration – Elementary accelerometers, seismic accelerometers, practical accelerometers, calibration.

Unit:4	Controllers	6 Hours
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Distributed, programmable, stand-alone, hydraulic, batch-process, automatic blending, distributed numerical, process variables field instrumentation

Unit:5	Control Communication	7 Hours
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Motion sensors, real-time analytical measurements for input to process control, control communications.

Unit :6	Control Improvement	6 Hours
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Operator interface, valves, servos, motors, and robots, process control improvement.

Total Lecture Hours	39 Hours
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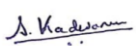
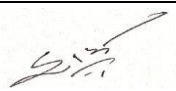
B.Tech Honors in PLC and Industrial Automation

V SEMESTER

23ELH503: Industrial Instrumentation and Controllers

Text Books					
S. N.	Author	Title	Edition	Year	Publisher
1.	S. K. Singh	Industrial Instrumentation	Third	2009	Tata McGraw Hill
2.	Gregory K. McMillan, Douglas M. Considine	Process / Industrial Instruments and Controls Handbook	Fifth	1999	Tata McGraw Hill
3.	D. Patranabis	Principles of Industrial Instrumentation	Second	2009	Tata McGraw Hill

Reference Books					
Sr.	Author	Title	Edition	Year	Publisher
1.	Ernest O. Doebelin, Dhanish. N. Manik,	Measurement Systems Application & Design	Fifth	2004	Tata McGraw Hill
2.	R. K. Jain	“Mechanical & Industrial Measurements	Eleventh	2004	Khanna Publishers

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B.Tech Honors in PLC and Industrial Automation

V SEMESTER

23ELH601: Industrial Automation

Course Outcomes:

Upon successful completion of the course the students will be able to:

1. Explain the fundamentals of industrial automation, automation hierarchy, and the functions of PLC, HMI, SCADA, DCS, and electric drives.
2. Analyze the architecture, hardware components, I/O modules, memory organization, and operating principles of PLC-based automation systems
3. Develop PLC programs using relay, timer, counter, logical, and data-handling instructions for industrial applications such as motor control, traffic lights, tank-level control, and conveyor systems.
4. Evaluate the performance and suitability of electric drives, special machines, and SCADA systems for different industrial automation and process-control applications.

Unit:1	Industrial Automation	7 Hours
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Introduction- Need and benefit of Industrial Automation, Automation Hierarchy, basic components of automation system, description of each component, types of automation system-fixed, programmable, and flexible, various systems for industrial automation- PLC, HMI, SCADA, DCS, Drives.

Unit 2	PLC Fundamentals	6 Hours
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Building blocks of PLC- CPU, memory organization, input-output modules (discrete and analog), special I/O modules, power supply, fixed and modular PLC, redundancy in PLC module.

Unit:3	PLC Programming and Applications	7 Hours
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PLC Programming and Applications - PLC programming instructions, Types of relays, relay instructions, timer instructions, on delay, off delay, retentive, counter instructions, up, down, high speed, logical instructions, data handling instructions, fundamental block diagram (FBD) of PLC, sequential functional chart (SFC), PLC based applications— motor sequence control, traffic light control, tank level control, conveyor system, stepper motor control etc.,

Unit:4	Electric Drives	6 Hours
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Types, functions, Characteristics, Four Quadrant Operation, V/f control, direct torque, Control, working principle of drives, specifications, types and applications of drives.

Unit:5	Special Machines	7 Hours
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Types of AC / DC motors, working principle, application, speed control.

Unit :6	Supervisory Control and Data Acquisition System (SCADA)	6 Hours
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Introduction, Architecture, Benefits, Interfacing with PLC, Process Control, Applications.

Total Hours	39
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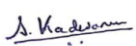
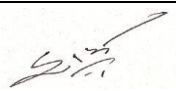
V SEMESTER
23ELH601: Industrial Automation

TEXT BOOKS

S.N.	Name	Year	Publication	Author
1	Programmable Logic Controllers: Principles and Applications	2002	Prentice Hall	John W. Webb, Ronald A. Reis
2	Industrial Automation & Robotics: A Complete Guide to PLC Programming, Sensors, Drives & Smart Manufacturing	2020		Saravanakumar Thangaraj
3	Fundamentals of Electrical Drives	2002	Narosa Publishing House	Gopal K. Dubey
4	Electric Machinery and Transformers	2001	Oxford University Press	Bhag S. Guru, Hüseyin R. Hızıroğlu

REFERENCE BOOKS:

S.N.	Name	Year	Publication	Author
1	SCADA: Supervisory Control and Data Acquisition	2009	International Society of Automation (ISA)	Stuart A. Boyer

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VI Semester

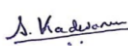
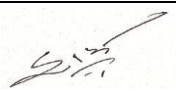
23ELH602: Industrial Automation Lab

Course Outcomes:

Upon successful completion of the course the students will be able to

1. Design and implement basic digital logic gates and combinational circuits using CMOS technology.
2. Develop and test assembly language programs to perform arithmetic, logical operations on ARM-based microcontrollers.
3. Interface and control basic peripherals like LEDs and LCDs using LPC2148 microcontroller.
4. Integrate hardware and software knowledge to simulate and debug digital and embedded systems.

Sr. No.	Experiments based on
1	Identify various parts and front panel status indicators of the given PLC.
2	Use PLC to test the START STOP logic for two input and one output.
3	Develop / Execute a ladder program for the given application using - timer, counter, comparison,
4	logical, arithmetic instruction.
5	Measure temperature of the given liquid using RTD or Thermocouple and PLC.
6	Develop a ladder program to ON / OFF LED lamp.
7	Develop a ladder program for sequential control application of lamp or DC motor.
8	Develop a ladder program for traffic light control system.
9	Develop a ladder program for automated car parking system.
10	Develop a ladder program for rotating stepper motor in forward and reverse direction at constant speed.

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B.Tech Honors in PLC and Industrial Automation

VI Semester

23ELH603: SCADA and DCS

Course Outcomes:

Upon successful completion of the course the students will be able to

1. Calculate operational parameters, scan intervals, and real-time process loop configurations for master-slave communication topologies.
2. Develop Human Machine Interface (HMI) screens and project environments utilizing memory tags, displays, sliders, and animation configurations.
3. Differentiate between modern process automation architectures, including supervisory systems (SCADA), distributed control infrastructures (DCS), and stand-alone components (PLC).
4. Appraise system reliability parameters, alarm configurations, data logging strategies, and security protocols across modern industrial networks.

Unit:1 Introduction

7 Hours

Definition of Supervisory Control and Data Acquisition (SCADA), application of SCADA, advantages and disadvantages, Major elements of SCADA, comparison of SCADA, DCS, PLC and smart instrumentation

Unit:2 SCADA

6 Hours

Block Diagram of SCADA system, Components of SCADA, Function of SCADA, SCADA applied to DA, Advantages DA through SCADA, Project creation using memory tags, numeric display, string display, various sliders and animations

Unit:3 Alarming and Data Logging

7 Hours

System concepts, human machine interface, Alarm configuration, alarm setup, alarm start-up and display, data logging, security issues

Unit:4 Real Time System

6 Hours

Definition, real time control for continuous process, communication access and master-slave concept, determination of scan intervals.

Unit:5 Digital Control System (DCS)

7 Hours

DCS architecture, database organization, reliability parameters

Unit :6 Human Machine Interface (HMI)

6 Hours

Automation system, instrumentation sub-system, control sub-system, human interface sub-system, advanced human interface sub-system.

Total Hours 39

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VI Semester

23ELH603: SCADA and DCS

Text books

1. Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, 4th Edition, International Society of Automation (ISA), USA.
2. Gordon Clarke and Deon Reynders, Practical Modern SCADA Protocols: DNP3, 60870-5 and Related Systems, Newnes / Elsevier.
3. Michael Wiebe, A Guide to Utility Automation: AMR, SCADA, and IT Systems for Electric Power, PennWell Books.

Reference Books

- 1 Samsonov & A. S. Morris, Measurement and Instrumentation: Theory and Application, Academic Press.
- 2 Bela G. Liptak, Instrument Engineers' Handbook – Process Control and Optimization, CRC Press.
- 3 K. Krishnaswamy, Raghunathan & Sivasubramanian, Instrumentation and Control Systems, New Age International Publishers.
- 4 William Bolton, Programmable Logic Controllers and Industrial Automation, Elsevier

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VII Semester

23ELH701: Sub-Station Automation

Course Outcomes:

1. Calculate operational parameters, scan intervals, and real-time process loop configurations for master-slave communication topologies.
2. Develop Human Machine Interface (HMI) screens and project environments utilizing memory tags, displays, sliders, and animation configurations.
3. Differentiate between modern process automation architectures, including supervisory systems (SCADA), distributed control infrastructures (DCS), and stand-alone components (PLC).
4. Appraise system reliability parameters, alarm configurations, data logging strategies, and security protocols across modern industrial networks.

Unit:1	Introduction	7 Hours
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Emerging communication technologies, Intelligent Electronic Devices (IEDs), network media, functions of Substation Automation Systems (SASs), impact of the IEC 61850 standard on SAS project.

Unit:2	Substation Automation Systems	6 Hours
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Switchyard level, equipment and interfaces, bay level, station level, system engineering, and communication with the remote-control center.

Unit:3	System Functionalities	7 Hours
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Functions of control system, monitoring, protection, measuring, metering, report generation, device parameterization.

Unit:4	System Input and Outputs	6 Hours
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Signals associated with primary equipment, and auxiliary power system

Unit:5	System Attributes and Various Tests	7 Hours
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-Redundancy, quality attributes, cyber security considerations, SAS performance, type tests, acceptance tests, compliance with IEC 61850 standard, factory acceptance tests.

Unit :6	Commissioning, Training, Planning and Development	6 Hours
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Planned commissioning tests, re-commissioning, project related training, corporate training, planning and development of SAS projects, quality management, future technological trends.

Total Hours	39
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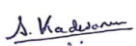
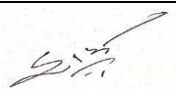
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Text Books					
S. N.	Author	Title	Edition	Year	Publisher
1.	S. G. Patki, A. k. Dinkar, and Sanjiv Singh	Substation Automation System Manual	1 st	2020	CBIP, india
2.	Er. R. S. Dahiya	Sub-station Engineering Design, concepts and computer applications	2 nd	2024	S. K. Kataria & Sons

Reference Books					
Sr.	Author	Title	Edition	Year	Publisher
1.	Evelio Padilla	Substation Automation System: Design and Implementation	1 st	2024	John Wiley & Sons Inc

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VII Semester

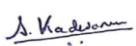
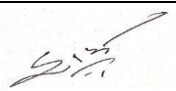
23ELH702: Lab: Substation Automation

Course Outcomes:

Upon successful completion of the course the students will be able to

1. Apply fundamental electrical engineering principles to conduct practical experiments and analyse results.
2. Demonstrate proficiency in using modern tools, instruments, and simulation software for experimental validation.
3. Interpret experimental data to evaluate system performance, efficiency, and compliance with standards
4. Work effectively in teams to plan, execute, and document practical experiments with professional ethics and safety compliance.

Sr. No.	Experiments based on
1	Circuit Breaker Status Indication from field input
2	To Control Group Operated Switches (GOS) from workstation
3	To Monitor Feeder parameter from workstation
4	Fault scenario simulation in a feeder
5	Fault scenario simulation in a Transformer /Bus
6	To Study Load Transfer from one Feeder to other during Transformer Maintenance
7	To Control of Bus Voltages Through Onload Tap Changes
8	To Develop 11KV/433 volts substation automation scheme using PLC for normal load operation

		Jun-23	1.00	Applicable for AY 2023-24 Onwards
Chairperson	Dean (Acad. Matters)	Date of Release	Version	