FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: **BACHELOR OF TECHNOLOGY (Electronics and Communication)**

Semester: **V**

Course Code: **202060506**

Course Title: **Industrial Electronics and Automation**

Course Group: **Professional Elective Course**

Course Objectives: This course provides vital knowledge of the various aspects of industrial automation. Further this enables students to understand the basic concepts of power electronics components and converters used in Industry for automation. Also, this course gives an insight of PLC, and DCS for industrial automation.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Theory		J/V/P*		Total
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 Industrial Automation:** Introduction to Industrial Automation, Role of automation in industries, types of manufacturing industries, type of automation system, Benefits of automation. Automation pyramid, automation tools like PAC, PLC, SCADA, DCS, Hybrid DCS with reference to automation pyramid.	08
2	**Power Electronics Devices and Converters:** Ideal characteristics of Semiconductor switches, Power semiconducting devices: Construction, operation and characteristics of SCR, LASCR, DIAC, TRIAC, IGBT, GTO, UJT, MCT. Comparison of widely used power switches (BJT, MOSFET and IGBT), 4-20 mA current loop, controlled rectifiers – single phase half-wave and Full-wave rectifiers with resistive and inductive loads; Step-Up and Step-down choppers; Single-phase voltage source Half and Full bridge Inverters; Single phase to single phase Cycloconverters, BLDC Drives.	10

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3	**Industrial Standard Protocols:** Definition of protocol, Introduction to Open System Interconnection (OSI) model, Communication standard (RS232, RS485), Modbus (ASCII/RTU), Introduction to third party interface, concept of OPC (Object linking and embedding for Process Control), HART Protocol: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation. Foundation Fieldbus H1: Introduction, frame structure, programming, implementation	**07**
4	examples, benefits, advantages and limitations. Comparison of HART, Foundation Fieldbus, Device net, Profibus, Controlnet, Industrial Ethernet.	**07**
5	**Programmable Logic Controller:** Programmable Controllers, Programmable logic controllers (PLCs), PLC Programming, Ladder Diagram, PLC Communication and Networking, PLC Selection, PLC Installation, Advantages and applications of PLCs for Industrial Automation.	**07**
6	**Distributed Control System:** Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.	**06**
		45

List of Practicals / Tutorials:

1	To study and plot characteristics of SCR/IGBT/MOSFET.
2	Study of UJT as a relaxation oscillator and trigger circuit for turning on SCR.
3	AC Phase firing controls using DIAC and TRIAC.
4	To study and observe the waveform of single-phase half and full wave-controlled rectifiers using resistive and reactive load.
5	To study step up and step-down choppers with various duty cycles.
6	To study full bridge inverters using resistive load.
7	To study various industrial protocols.
8	Logic implementation for any one industrial application.
9	Tune PID controller for heat exchanger using DCS.
10	Industrial visit report

Reference Books:

1	M.D. Singh, K. B. Khanchandani, **Power Electronics**, 2nd Edition, McGraw Hill Education
2	Muhammad H. Rashid, **Power Electronics: Devices Circuits and Applications**, 4th Edition, Pearson Education
3	S. K. Singh, **Industrial Instrumentation and Control**, 3rd Edition, McGraw Hill Education
4	C. D. Johnson, **Process Control Instrumentation Technology**, 8th Edition, Pearson Education India
5	Garry Dunning, **Introduction to Programmable Logic Controllers**, 3rd Edition, Cengage Learning India
6	W Bolton, **Programmable Logic Controllers**, 4th Edition, Elsevier.

Supplementary learning Material:	
1	NPTEL and Coursera Video Lectures

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2	MATLAB, PLC Software, LabView

Pedagogy:

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

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

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

Distribution of Theory Marks in %						**R**: Remembering; **U**: Understanding; **A**: Applying; **N**: Analyzing; **E**: Evaluating; **C**: Creating
R	**U**	**A**	**N**	**E**	**C**	
15	20	20	15	20	10	

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	Understand Industrial Automation, its types, automation pyramid and industrial standard protocols.	**30**
CO-2	Understand, design and development of various power electronics converters like rectifiers, choppers, inverters and cycloconverters.	**30**
CO-3	Learn the concept of Programmable Logic Controllers.	**20**
CO-4	Know the concept of a distributed control system.	**20**

Curriculum Revision:	
Version:	2.0
Drafted on (Month-Year):	June -2022
Last Reviewed on (Month-Year):	-
Next Review on (Month-Year):	June-2025

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