Course Name : Diploma in Electrical Engineering

Course Code : EE

Semester : Sixth

Subject Title : Elements of Industrial Automation (Elective)

Subject Code : 17641

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	--	--	25@	125

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

A diploma engineer has to look after the day-to-day operations, control and maintenance of controllers used in various automated industrial systems to ensure trouble free working. He should be well conversant with the various technical aspects of commonly used control components and control actions in respect of their working and performance. With the above knowledge, he should also be able to implement innovative ideas of automation wherever necessary.

Programmable Logic Controllers (PLC) have revolutionized and replaced the conventional industrial automation systems. A single PLC can reliably handle number of complex control actions in real time with high precision.

Therefore, the electrical diploma engineer must have the basic knowledge of industrial control components, actions and must be well conversant with the use of PLC therein.

General Objectives:

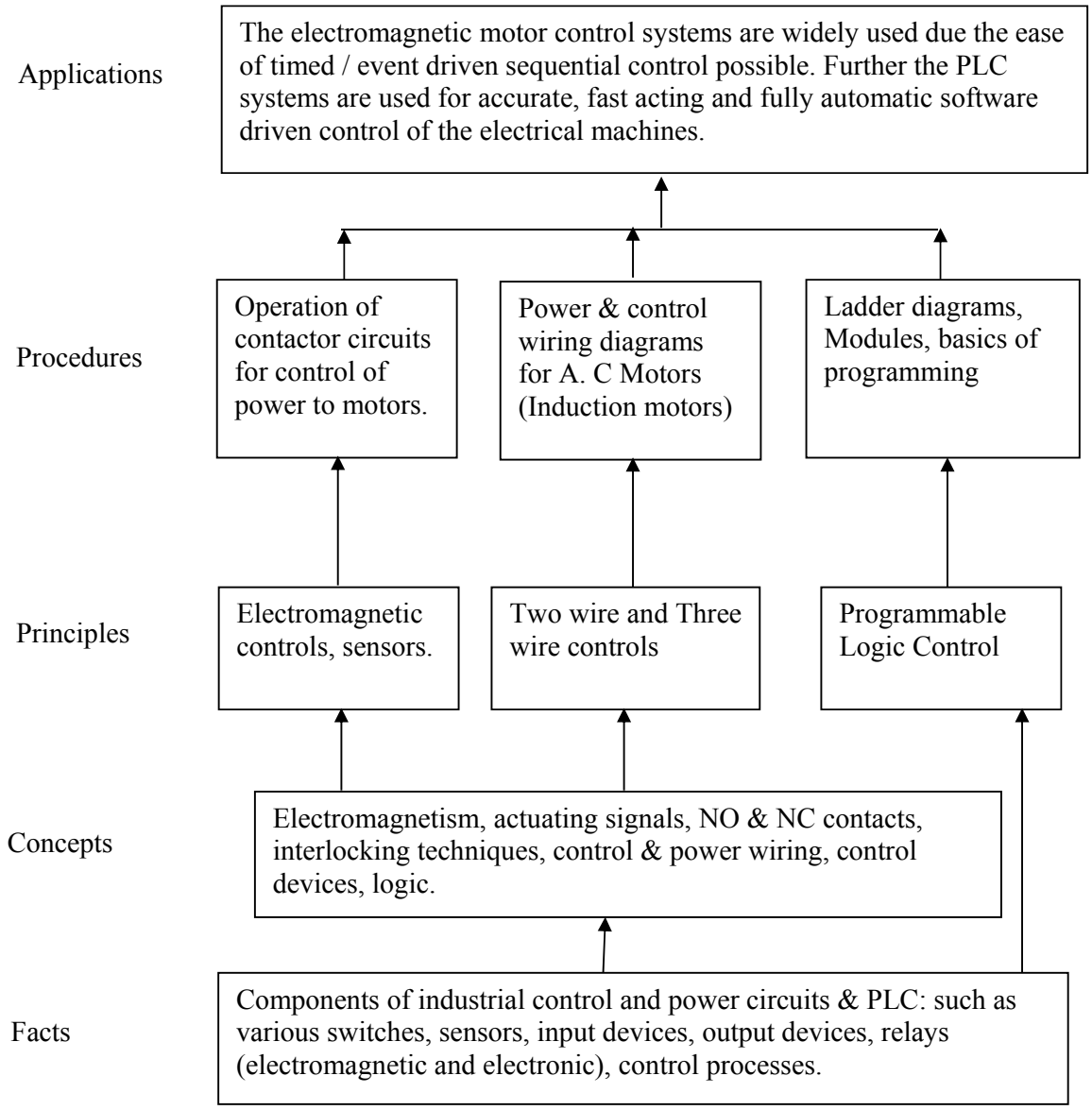
1) Understand the working of various industrial control components.

2) Use principles of machine control to design simple schemes for control.

3) Understand the working of basic control actions (viz. ON-OFF, P+I+D).

4) Know skills to use PLC for implementing simple industrial control applications.

Learning Structure:



Topics and Contents	Hours	Marks
Topic 1:Industrial Control Components Specific Objectives: ➢ Use input devices such as push button, limit switches etc. in industrial machine control ➢ Use output devices such as relays, contactors, solenoid valves etc. as actuators in industrial control ➢ Differentiate 2 wire & 3 wire controls ➢ Define & Differentiate power and control wiring Contents: 1.1 Input devices (Basic working and schematic diagrams with functions) • Definition of control devices such as Push buttons, selector switches. • Solenoid valves, Limit switches and its types • Pressure, temperature, flow, float actuated switches • Reed switches, photoelectric, hall effect, inductive, capacitive proximity switches • Two wire and three wire control. 1.2 Output devices (Basic working and schematic diagrams with function) • Concepts of NO/NC contacts • Electromagnetic Relays, contactors and their ratings, solenoid valves • Solid state Relays • Latching Relays, Bimetallic Thermal Over-load Relay, Time Delay Relays (Timers), Electronic Overload Relay • Pneumatic cylinders • Concepts of Power and control wiring diagrams, main and auxiliary contacts • Interlocking of contactor circuits using push buttons, NC contacts and limit switches. 1.3 Schematic of symbols used in industrial control circuits	12	12
Topic 2: Industrial Machine Power and Control Circuits (contactor based) Specific Objectives: ➢ Prepare power and control circuit diagrams for starters of induction motors and describe briefly the working. ➢ Prepare power and control circuit diagrams for double winding motors and describe briefly the working. ➢ Prepare plugging and braking circuits (control and power) for 3 phase induction motors and describe briefly the working. ➢ Identify applications for servo motors. Contents: 2.1 DOL starters for 3 phase induction motors • Power and control circuit diagrams of forward- stop- reverse type. • Power and control circuit diagrams of forward and random reversing type. 2.2 Star delta starters & auto transformer starters for 3 phase induction motors • Power and control circuit diagrams of semi automatic type. • Power and control circuit diagrams of automatic type using timer • Power and control circuit diagrams for motors using autotransformer type starters 2.3 Starters for slip ring induction motors • Power and control circuit diagrams for Definite Time Limit Starter	14	24

• Power and control circuit diagrams for Current Limit Acceleration Starter • Power and control circuit diagrams for Secondary Frequency Acceleration Starter 2.4 Plugging and dynamic braking of induction motors • Control and power circuits for simple plugging of motor • Dynamic Braking - D.C. injection braking power & control diagrams 2.5 Introduction to AC/DC Servo motors • Basics of construction of servo motors • Principle of working • Application areas in brief		
Topic 3. Introduction to Programmable Logic Controller Specific objectives ➢ Draw generalized block diagram of a PLC ➢ Draw simple block diagrams & state functions of different I/O modules. ➢ Know types and use of Memory in the PLC. Contents: 3.1 Introduction to PLC • Block diagram and working of Programmable Logic Controller • PLC advantages and disadvantages. • Proximity sensors /switches; inductive and capacitive types: description with simple block diagrams; areas of applications. • Opto-isolators, optical sensors. 3.2 PLC modules • digital I/O Modules and their ratings • analog I/O Modules and their ratings • timer/counter Modules • Memory: ROM: types (Mask ROM, PROM, EPROM, EEPROM) and RAM. • Functions of the above memory units. • PLC power supplies block diagram and function of each block.	12	24
Topic 4. Basic Components of PLC. Specific objectives ➢ Draw ladder diagrams for simple logic operations ➢ Use timers, counters in ladder diagrams ➢ Draw ladder diagrams for induction motor starters. Contents: 4.1 Ladder diagrams • Typical PLC inputs. • Typical PLC Outputs. • One contact, one coil circuit • Standard start-stop-seal circuit • Ladder diagrams for simple logic operations(NOT, AND, OR, EXOR) • On delay timer, off delay timer • Ladder diagrams for DOL, Star-delta (automatic) starters. • Up and down counter	14	24
Topic 5. Control Actions Specific objectives ➢ Describe in brief different control actions with their merits. Contents:	12	16

5.1 Process control actions (block diagrams with very brief functioning descriptions) • Proportional Controllers • Integral Controllers • Proportional-Integral Controllers • Derivative Controllers • Proportional-Integral-Derivative Controllers 5.2 Brief description of the PLC working with reference to above studied control actions		
Total	**64**	**100**

Practicals:
Skills to be developed:

Intellectual Skills:

1) Understand control circuit importance.
2) Appreciate the linkage of power and control circuits.
3) Understand the characteristics of the components for motor control and power circuits.
4) To develop the Ladder diagrams as per requirements of processes.
5) To understand & appreciate the importance of analog/digital I/O Modules.

Motor Skills:

1) Connect contactors in circuits.
2) Handle the coil, contacts, reset link and other parts.
3) Handle various parts of the induction motor starters.
4) Connect components of the DOL starter, star-delta starter with the motor circuit and operate them.
5) Develop the control and power circuits of motor operation.
6) Select components for power and control sections of motor.
7) To identify application of analog/digital I/O Modules in PLC.

List of Practicals:

Sr. No.	Laboratory/drawings work
1	Draw Symbols used in electromagnetic control circuit diagrams.
2	Construction & Operation of contactors.
3	Operation of different types of switches, relays used in motor control circuits (push-buttons, limit switches, relays with at least 2 NO and 01 NC contacts)
4	Operation of Direct-On-Line (DOL) starter (connections: power and control diagrams)
5	Operation of Direct-On-Line (DOL) starter with Reversing Control (connections: power and control diagrams)
6	Semi-automatic & Fully Automatic Star-Delta Starter. (connections: power and control diagrams)
7	Operations of motor control circuit of an electric oven (if available) else trace simple power & control circuits of available equipment in workshop or elsewhere in institute.

Sr. No.	Laboratory/drawings work
8	Components of PLC: draw symbolic representation of at least 20 components used to create ladder diagrams.
9	Create ladder diagrams for simple process - machine systems in presence of teacher in the laboratory (any three)

Learning Resources:

1. Books:

Sr. No.	Author	Title	Publisher
1	Eshwar U. S.	Handbook of Electric Motor Controls	Tata McGraw Hill
2	Bhattacharya & Singh	Control of Electrical Machines	New Age International Publishers
3	Webb & Reis	Programmable Logic Controllers-principles and applications	Prentice Hall India
4	Biswanath Paul	Industrial electronics and control (including Programmable Logic Controller) [3rd edition only, not earlier one]	Prentice Hall India
5	Bryan & Bryan	Programmable Controllers Theory and Implementation	An Industrial Text Company Publication
6	John R. Hackworth & Frederick Hackworth (Jr)	Programmable Logic Controllers	Pearson

2. CDs, PPTs, Models, Charts etc. :

Teachers must use educational software such as that available on the internet (eg.TRiLOGI, SIEMENS etc) for the PLC.

3. Websites:

1. www.brothersoft.com/download/plc-simulator,
2. www.edusoft.co.za/ladsim.htm