Program: **Diploma in Electronics Engineering / Electronics and Communication Engineering**	
Course Code : **5042**	Course Title: **Industrial Automation**
Semester: **5 / 5**	Credits: **4**
Course Category: **Program Core/ Elective**	
Periods per week: **4 (L:3, T:1, P:0)**	Periods per semester: **60**

Course Objectives:

- Provide students a basic knowledge about the structure, concepts and application of power semiconductor devices.
- Enable them to develop PLC ladder programs for real time applications.

Course Prerequisites:

Topic	Course code	Course Title	Semester
Semiconductor Physics	2041	Basic Electronics	2
Amplifiers and Oscillators	3043	Electronic Circuits	3
Electrical Fundamentals	3041	Electric Circuits & Networks	3
Logic Circuits	3044	Digital Electronics	3

Course Outcomes:

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive Level
CO1	Illustrate the structure and operation of power semiconductor devices.	16	Understanding
CO2	Explain the working of Controlled Rectifiers, Inverters, Cyclo- Converters and Choppers.	16	Understanding
CO3	Illustrate the applications of power semiconductor devices in Industrial field.	13	Understanding

CO4	Develop PLC ladder program for an application.	13	Applying
	Series Test	2	

CO-PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2						
CO2	2						
CO3	2						
CO4	3						

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Illustrate the structure and operation of power semiconductor devices**		
M1.01	Illustrate the structure and operation of power semiconductor switching devices.	4	Understanding
M1.02	Illustrate two transistor analogy of SCR	4	Understanding
M1.03	Distinguish turn-on methods for SCR	4	Understanding
M1.04	Describe commutation techniques for SCR	4	Understanding
Contents: Power MOSFET , Power IGBT- structure - characteristics - working principles - applications - SCR - structure - characteristics - working principle – applications - two transistor analogy – DIAC , TRIAC- structure - working principle – characteristics – applications - turn on/triggering methods - gate triggering methods - 'R' triggering - RC triggering - UJT triggering - commutation techniques - forced commutation circuits (class A to F)			
CO2	**Explain the working of Controlled Rectifiers, Inverters, Cyclo Converters and Choppers**.		
M2.01	Illustrate the working of single phase-controlled rectifiers	4	Understanding
M2.02	Describe the operation of inverter circuits and single phase dual converter	4	Understanding

M2.03	Explain the working of cyclo converters	4	Understanding
M2.04	Describe the working of chopper circuits.	4	Understanding
	Series Test 1	1	

Contents:

Single phase converters - half wave - full wave midpoint and bridge - working principle with R, RL loads - AC power control using SCR and Triac - working principle - Basic inverter circuit - working principle - series and parallel inverter circuits - working principle – waveforms - single phase dual converters - working principle – waveforms - low to high and high to low frequency cyclo converters – applications - step up, step down and Jone's choppers – working principle - applications.

CO3	**Illustrate applications of power semiconductor devices in Industrial field**		
M3.01	Compare AC and DC drives	3	Understanding
M3.02	Explain various speed control techniques	3	Understanding
M3.03	Explain various industrial heating techniques	3	Understanding
M3.04	Illustrate the operation of ON- line and OFF-line UPS	4	Understanding

Contents:

AC and DC drives - comparison - series and shunt DC drives - methods of speed control of induction motors - stator voltage control - rotor ON-OFF control - variable voltage variable frequency control - Industrial heating methods - Induction heating - principle - merits – applications - Dielectric heating - principle - applications - Resistance welding schemes - types - ON-line and OFF-line UPS - operation.

CO4	**Develop PLC ladder program for an application.**		
M4.01	Explain the architecture of PLC	3	Understanding
M4.02	List advantages and application of PLC	2	Understanding
M4.03	Demonstrate ladder diagram instruction sets of PLC.	4	Understanding
M4.04	Develop ladder program for various applications	4	Applying
	Series Test	1	

Contents:

PLC - basic principle - architecture - advantages - applications - ladder logic - ladder diagram instruction sets - Bit instructions - timer/counter instructions - compare instructions - move instructions - math instructions - program control instructions - ladder programs - Real time applications of PLC.

Suggested Experiments:

1. PLC Logic Functions
2. Staircase Lamp
3. Conveyor Control
4. Counting Moving objects on a Conveyor
5. Fluid Level Control
6. Traffic Control Signal System

Text / Reference:

T/R	Book Title/ Author
T1	Industrial Electronics and Control - S K Bhattacharya, S Chatterjee
T2	Programmable logic controllers - Frank D Petruzella.
R1	Industrial Electronics and Control - Biswanath Paul - PHI
R2	Thyristors principles and applications - Ramamoorthy
R3	Modern Power Electronics and AC Drives - Bimal K Bose
R4	Power Electronics - P S Bimbhra
R5	Introduction to Programmable Logic Controllers - Gary Dunning - 3rd Edition - Delmar

Online resources:

Sl No	Website Link
1	https://nptel.ac.in/courses/108/102/108102145/
2	electronics -tutorials.ws
3	technologystudent.com
4	https://ndl.iitkgp.ac.in
5	https://www.electrical4u.com/electrical-engineering-articles/power-electronics/