

COURSE TITLE : **INDUSTRIAL ELECTRONICS & PLC**
COURSE CODE : **5042**
COURSE CATEGORY : **A**
PERIODS PER WEEK : **4**
PERIODS PER SEMESTER : **52/5**
CREDITS : **4**

TIME SCHEDULE

MODULE	TOPIC	PERIODS
1	Power Semiconductor Devices & Thyristor Family	13
2	Converters	13
3	Motor Drives, Industrial Heating, Welding And UPS	13
4	PLC & Programming	13
TOTAL		52

Course General Outcome :

Module	GO	On completion of the study of this course the students will be able:
1	1	To Understand Various Types of Power Semiconductor Devices
	2	To Comprehend Thyristor Family
2	3	To Comprehend the Operation and Applications of Different Types Of Converters
3	4	To Understand various Motor Speed Control Methods Using Thyristors.
	5	To Understand The Principles and Applications of Industrial Heating, Dielectric Heating And Welding.
	6	To Understand the Principle Of UPS.
4	7	To Understand the Basics of PLC.
	8	To Understand PLC Programming.

On the completion of the study the student will be able:

MODULE I POWER SEMICONDUCTOR DEVICES AND THYRISTOR FAMILY.

1.1.0 To understand various types of power semiconductor devices.

- 1.1.1 To explain the characteristics, working principles of power MOSFETs.
- 1.1.2 To list the applications of power MOSFETs.
- 1.1.3 To explain the characteristics, working principles of power IGBTs.
- 1.1.4 To list the applications of IGBTs.

1.2.0 To comprehend thyristor family.

- 1.2.1 To explain the structure, characteristics and working principle of SCR.
- 1.2.2 To explain two transistor analogy of SCR.
- 1.2.3 To explain the turn on/triggering methods of SCR.
- 1.2.4 To explain the gate triggering methods using 'R' triggering, RC & UJT triggering.
- 1.2.5 To explain various commutation techniques of SCR.
- 1.2.6 To explain forced commutation circuits (class A to F).
- 1.2.7 To describe the structure, working principle and V-I characteristics of DIAC.
- 1.2.8 To describe the structure, working principle and V-I characteristics of TRIAC.

MODULE II CONVERTERS

2.1.0 To comprehend the operation and applications of different types of converters.

- 2.1.1 To Explain the Operation of Single Phase Half Wave, Full Wave Midpoint and Bridge Converters (Half and Fully Controlled) With R and RL Loads.
- 2.1.2 To Describe the Working of Thyristor AC Power Control Using SCR & Triac.
- 2.1.3 To Explain the Principle of Basic Inverter Circuit.
- 2.1.4 To Describe Series and Parallel Inverter Circuits With Waveforms.
- 2.1.5 To Explain Single Phase Dual Converters With Waveforms.
- 2.1.6 To Explain the Principles and Applications Of Low To High and High To Low Frequencies Cyclo Converters.
- 2.1.7 To explain the principles and applications of step up, step down and Jone's choppers.

MODULE III MOTOR DRIVES, INDUSTRIAL HEATING, WELDING AND UPS.

3.1.0 To understand various motor speed control methods using thyristors.

- 3.1.1 To compare AC and DC drives.
- 3.1.2 To explain the speed control of series & shunt DC drives.
- 3.1.3 To explain various methods of speed control of induction motors.
- 3.1.4 To describe stator voltage control, rotor on off control and variable voltage variable frequency control of induction motor.

3.2.0 To understand the principles and applications of industrial heating, dielectric heating and welding.

- 3.2.1 To explain Industrial Heating methods.
- 3.2.2 To explain the principle, merits and applications of Induction Heating.
- 3.2.3 To state the principle and applications of Dielectric Heating.
- 3.2.4 To explain the types of resistance welding schemes.
- 3.2.5 To explain timers used in resistance welding system.

3.3.0 To understand the principles of UPS.

- 3.3.1 To explain the principle of UPS.
- 3.3.2 To list the type of UPS.
- 3.3.3 To describe on-line UPS.
- 3.3.4 To describe off-line UPS.

MODULE IV PLC AND PROGRAMMING

4.1.0 To understand the basics of PLC.

- 4.1.1 To explain basic principles and architecture of PLC.
- 4.1.2 To list the advantages of PLC.
- 4.1.3 To list the applications of PLC.

4.2.0 To understand PLC programming.

- 4.2.1 To explain ladder logic and ladder diagram.
- 4.2.2 To explain different instruction sets used in ladder diagram.
- 4.2.3 To write ladder programs.
- 4.2.4 To explain real time applications of PLC.

CONTENT DETAILS

MODULE I Power semiconductor devices and thyristor family.

Power MOSFET - power IGBT- characteristics - working principles - applications - SCR – structure - characteristics - working principle - two transistor analogy - turn on/triggering methods - gate triggering methods - 'R' triggering - RC triggering - UJT triggering - commutation techniques - forced commutation circuits (class A to F) - DIAC - TRIAC- structure - working principle - VI characteristics.

MODULE II Converters

Single phase converters - half wave - full wave midpoint and bridge working principle – R, RL loads - thyristor 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 frequencies cyclo converters, step up, step down and Jone's choppers - principle – applications.

MODULE III Motor drives, industrial heating, welding and UPS

AC and DC drives- comparison, series and shunt DC drives - speed control - methods of speed control of induction motors - stator voltage control- rotor on off control - variable voltage variable frequency control, industrial heating methods - principle- merits - applications, dielectric heating - principle - applications, resistance welding schemes - types - timers, on-line and off-line UPS – operation.

MODULE IV PLC and programming

PLC - basic principles -architecture - advantages - different units, 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.

Text Books

1. Industrial Electronics and Control - S K Bhattacharya, S Chatterjee.
2. Programmable logic controllers - Frank D Petruzella.

Reference

1. Industrial Electronics and Control - Biswanath Paul - PHI
2. Thyristors principles and applications - Ramamoorthy
3. Power Electronic systems Theory and Design - Jai P Agrawal
4. Modern Power Electronics and AC Drives - Bimal K Bose
5. Power Electronics (Principles and Applications) - Joseph Vithayathil
6. Introduction to Programmable Logic Controllers - Gary Dunning - 3rd Edition - Delmar