Department of Technical Education

DIPLOMA COURSE IN ELECTRONICS AND COMMUNICATION ENGINEERING

INDUSTRIAL AUTOMATION

Subject Title : INDUSTRIAL AUTOMATION

Subject Code : EC
Hours Per Week : 04
Hours Per Semester : 64

TOPIC ANALYSIS

SL.No	Major Topics	Hours Allotted
	UNIT I	
1	Power Electronic Devices	11
2	Triggering and commutation circuits	05
3	Applications circuits of Thyristors and controlled rectifiers	04
	UNIT II	
4	Choppers , Inverters and Cycloconverters.	14
5	Speed control of AC/ DC Motors	06
	UNIT III	
6	Introduction to PLC	07
7	PLC Programming	13
	Tests and revision	04
	Total	**64**

On the completion of the course the students should be able to:

1. Understand the working of different types of Power electronic devices and circuits.

2. Know the applications of power Electronic circuits.

3. Comprehend the various types of power electronics circuits - Chopper, Inverters and Cycloconverters .

4. Know the Programming of PLC , Industrial applications .

5. Understand the importance of HMI and SCADA.

Details of Course Contents

1. Power Electronic Devices

Introduction to power Electronics - Applications , Overview of Classifications of Power Semiconductor Devices, Structure & characteristics of Power Diode, Power BJT, GTO, IGBT and MOSFET, Principle of working of SCR , DIAC , and TRIAC, Two transistor analogy of SCR.

2. Triggering and commutation circuits

Triggering of SCR, Commutation of SCR -Natural and forced Commutation – types of forced commutation -Comparison of Natural and Forced Commutation, Protection of SCR.

3. Applications circuits of Thyristors and controlled rectifiers.

Industrial Applications of Thyristor , Principle of operation of controlled rectifiers, Single Phase half wave and full wave controlled rectifiers.

4. Choppers , Inverters and Cycloconverters.

Introduction to Chopper - working principle - Control Schemes - Step-up chopper-Chopper classifications - Applications of choppers, Introduction to inverters - working principle of Half Bridge Inverter and Full Bridge Inverter, series invertor, Variable DC Link Inverter-Voltage Source and Current Source Inverters , PWM techniques used in inverters, Applications of Inverters, Introduction to Cycloconverters - Single phase to single phase midpoint cycloconverter - Applications of Cycloconverters - Dual Converter.

5. Speed control of AC/ DC Motors.

Introduction to electronic control of Motors - advantages, Speed control of DC shunt motor - Armature voltage control and Field control , speed control of induction Motor, Motor protection circuits.

6**. Introduction to PLC**

Introduction to PLC - relay logic panel -block diagram of Overall PLC system ,PLC Scanning considerations, Sensors and Actuators –Analog and digital types,

7. PLC Programming

Programming PLC -relation to Digital Logic Gates - relation to Boolean Algebra –simple examples , PLC Register Basics-General characteristics - Holding Registers, Input & Output Registers ,.Introduction to PLC Timer functions, Introduction to PLC Counter functions, Basic Number Comparison Functions, Skip Functions, Jump Functions , MOVE Functions and its significance ,Introduction to PID control of continues process with respect to PLC - PID Principle , module, Networking of PLCs-types, HMI / MMI and SCADA.

Specific Instructional Objectives :

1. Power Electronic Devices

1.1 Introduction to power Electronics ,Applications of power Electronics
1.2 Classifications of Power Semiconductor Devices.
1.3 Explain Structure & characteristics of power diode, Power BJT, GTO, IGBT and MOSFET.
1.4 Explain Working principle of SCR,DIAC,TRIAC.
1.5 Two transistor analogy of SCR.

2. Triggering and commutation of SCR

2.1 Mention the types of Triggering methods.
Explain Turn ON methods (Triggering) of SCR –
a) R- Triggering.
b) RC – Triggering.
c) Pulse triggering (Using UJT relaxation Oscillators)
2.2 Explain the Natural and forced Turn OFF Methods (Commutation) of SCR .
a) Resonant commutation.
b) Auxiliary commutation.
c) Complementary commutation.
2.3 Comparison of Natural and Forced Commutation
2.4 Discuss the protection of SCR - snubber circuit

3. Applications circuits of Thyristors and controlled rectifiers.

3.1 Applications of Thyristors – Explain Photo Electric Control of SCR - Light Dimmer circuit using DIAC and TRIAC - Burglar Alarm circuit
3.2 Introduction – Principle of operation of controlled rectifiers.
3.3 Explain circuit with waveforms of Single Phase half wave controlled rectifier with waveforms (only Resistive Load).
3.4 Explain Full wave mid point - Full bridge –Half bridge controlled rectifier. (only Resistive Load)
3.5 Know the importance of free wheeling diode.

(Refer Text 1 and Text 2)

4. Choppers , Inverters and Cycloconverters.

4.1 Explain the working principle of Chopper .
4.2 Discuss Chopper control Schemes - Constant frequency control and Variable Frequency control.
4.3 Explain Step-up chopper.
4.4 Discuss chopper classifications - First quadrant , Second quadrant ,Two quadrant and Four quadrant choppers.
4.5 List the Applications of choppers.
4.6 Introduction to Inverters.
4.7 Explain the working principle of Half Bridge Inverter.
4.8 Explain the working principle of Full Bridge Inverter
4.9 Explain the working principle of Series Inverter
4.10 Explain Variable DC Link Inverter (section 8.8 of Text 1)
4.11 Difference between Voltage Source and Current Source Inverters
4.12 Explain PWM techniques used in inverters.

4.13 Mention the Applications of Inverters.
4.14 Explain the Basic Principle of operation of Cycloconverters .
4.15 Discuss the working of Single phase to single phase midpoint cycloconverter.
4.16 Mention the Applications of Cycloconverters.
4.17 Explain the circuit of Dual converter.

Note : Circuits of Chopper , Inverter and Cycloconerters may consists of SCR / Power BJT and for Resistive Load only.

5. Speed control of AC/ DC Motors.

5.1 List the advantages of electronic control of Motors.
5.2 Explain the block diagram representation of Armature voltage control method for speed control of DC shunt motor.
5.3 Explain the block diagram representation of Field control of DC shunt motor.
5.4 Explain Speed control of DC motors using Dual converters.
5.5 Explain the block diagram representation of speed control of Induction motor.
5.6 Discuss over voltage and over current protection of motors

(Refer Text 1 AND Text 2)

6**. Introduction to PLC**

6.1 Differentiate between relay logic panel & PLC based control panel
6.2 Explain the block diagram of Overall PLC system.
6.3 Discuss Process Scanning of PLC.
6.4 Mention the types of Sensors and Actuators – Input ON/OFF switching device-Input Analog devices, Output ON/OFF switching device-O/P Analog devices,

7. PLC Programming

7.1 Programming relation to Digital Logic Gates ,
7.2 Programming relation to Boolean Algebra –simple examples
7.3 PLC Register Basics-General characteristics of Registers, Holding Registers, Input & Output Registers
7.4 Introduction to PLC Timer- Describe Retentive and Delay timer functions.
7.5 Introduction to PLC Counter-Up/down Counter with examples
7.5 Basic Number Comparison Functions, Skip Functions
7.6 Jump Functions-Jump with non return and Jump with return
7.7 MOVE Functions and its significance
7.8 Introduction to PID control of continues process with respect to PLC-PID Principle, Block diagram of PID module
7.9 Introduction to Networking of PLCs-Levels of Industrial control and types of Networking.
7.10 Introduction to HMI / MMI and SCADA.

(Refer Text 3)

TEXT BOOKS

1. Power Electronics – DrJ.S Chitode –TECHNICAL PUBLICATIONS., Pune.
2. Industrial electronics and Contol - S.K.Bhattacharya, S.Chatterjee - TTTI Chandigarh
3. Programmable Logic Controllers - John W .Webb and Ronald A Reis (Principle and applications) (Fifth Edition)

REFERENCE BOOKS :

1. Power Electronics by Mohammed Rasheed - PHI
2. Industrial Electronics & Control by Biswanath Paul – PHI
3. Industrial Electronics - Bimbra, 2nd Edition, Khanna Publications
4. PLC Programming by Dunning Harry.
5. PLC Mannuals
6. Power Electronics – Essentials and Applications by L Umanad , Wiley India Publications
7. INDUSTRIAL AUTOMATION- K Shashidhar, Sapna Publications

DEPARTMENT OF TECHNICAL EDUCATION
DIPLOMA COURSE IN ELECTRONICS & COMMUNICATION ENGINEERING
FIFTH SEMESTER

Industrial Automation

Model Question paper

Note: Section 1 is compulsory, answer two questions each from the remaining three sections

Section 1

1. a) **Fill in the blanks with appropriate word / words** 1 x 5 = 5

i) SCR is a _____ directional device.
ii) A snubbar circuit is a _____cicuit.
iii) A single phase full wave half controlled bridge uses _____ no. of SCRs
iv) The HMI stands for _____
v) A cycloconverter is a circuits which converts _____ to _____

b) Write a note on HMI and SCADA. 5

Section II

2 a) Explain the Characteristics of power diode. 4
b) Explain the two transistor analogy of SCR. 6
c) Explain snubber circuit used for protection of thyristor 5

3 a) Explain how UJT relaxation oscillator is used trigger an SCR. 7
b) Define Commutation ? Explain Complementary commutation. 5
c) Differentiate between Natural and forced commutation. 2

4 a) Explain single phase full wave bridge controlled rectifier with waveforms. 8
b) Explain the lamp dimmer circuit. 5
c) What is the importance of free- wheeling diode. 2

Section III

5 a) Explain the basic principle of chopper operation 7
b) Explain the operation of two quadrant DC chopper 4

c) Explain the operation of a step-up DC chopper 4

6 a) Explain Variable DC Link Inverter. 6
b) Compare voltage source inverter with current source inverter 4
c) Explain the circuit of Dual converter 5

7 a) Explain the operation of single phase cycloconverter with waveforms. 7
b) Mention the application of the cycloconverrters 4
c) Explain the block diagram of Field control of DC shunt motor. 4

Section IV

8 a) Mention the advantages of PLCs over relay logic panel. 5
b) Explain the block diagram of PLC. 6
c) Explain Process scanning PLC. 4

9 a) Mention any 4 analog and digital sensors which can be connected to PLC. 4
b) Write the ladder diagram of Basic logic gates AND , OR and XOR. 6
c) Describe Retentive and Delay timer functions. 5

10. a) Explain the block diagram of PID controller. 5
b) Explain the block diagram of PID Module. 5
c) Write a note on PLCs networking. 5

********** End **********