DIRECTORATE OF TECHNICAL EDUCATION

DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

III YEAR

M SCHEME

VI SEMESTER

2015 – 2016 onwards

POWER ELECTRONICS

CURRICULUM DEVELOPMENT CENTRE

DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

M - SCHEME

Course Name : Diploma in Electrical and Electronics Engineering

Subject Code : 33081

Semester : VI Semester

Subject Title : **POWER ELECTRONICS**

TEACHING AND SCHEME OF EXAMINATION:

No. of weeks per Semester: 15 Weeks

Subject	Instruction		Examination			
			Marks			Duration
	Hours/ Week	Hours/ Semester	Internal Assessment	Board Examination	Total	
POWER ELECTRONICS	5	75	25	75	100	3 hrs

TOPICS AND ALLOCATION OF HOURS

UNIT	TOPIC	TIME (Hours)
I	Overview Of Power Electronics	13
II	Line Commutated Power Control Circuits	13
III	Forced Commutated Power Control Circuits	13
IV	Applications Of Power Electronics	12
V	Motor Drive Applications	12
	Revision and Test	12
	Total	**75**

RATIONALE:

Developments in Electronics have their own impact in other fields of Engineering. Today all the controls and drives for the electrical machines are formed by electronic components and there are many electronic devices available to handle eclectic power in terms Kilo-Amps and Kilo-Volts. This subject gives a comprehensive knowledge base about the devices and circuits used in electrical power control.

OBJECTIVES:

On completion of these units, the student should be able to:

- Explain the scope and application of power electronics
- Explain the operating region and rating of SCR.
- Draw, explain and state the application for commutation circuits and trigger circuits of SCR.
- Familiarize the phase controlled rectifier and know the applications of the phase controlled rectifier.
- Draw and describe the working of half wave controlled rectifier circuit with R and RL load, single phase Semi Converter Bridge, Single phase full Converter Bridge for RL load, single phase and three phase full converter with RL load.
- Familiarizes the dual converter and twelve pulse converters.
- Study the complete protection of converter circuits.
- Understand the working choppers and inverters.
- Know the applications of choppers and inverters.
- Explain the various types of choppers with circuit diagram.
- Describe the various methods of inverters with circuit diagram.
- Failure of AC voltage controller & cyclo converter.
- Understand the application of power electronics devices as CB,UPS and VAR compensator
- Understand the control of DC Drives.
- Know the various methods of speed control of DC drives.
- Familiarize the control of AC drives.
- Know the torque - speed characteristics of three phase induction motor.
- Study the speed control of three phase induction motor using PWM and slip power recovery scheme.
- Understand the closed loop control of AC drive.
- Know the operation of single phase and three phase cyclo converter.
- Understand the micro controller based fault diagnosis in three phase thyristor converter circuits.
- Study the need of DSP based motor control.

DETAILED SYLLABUS

CONTENTS

UNIT	NAME OF THE TOPICS	HOURS
I	**OVERVIEW OF POWER ELECTRONICS** Power electronics-Definition (A-1.1)-Scope and Applications (B-1.3)-Power Electronic Switch Specifications (A-1.4.3)-Types of Power Electronic Circuits (A-1.5)-Design of Power Electronics Equipment (A-1.6)-Power module (A-1.9)-Intelligent module (A-1.10). Silicon Controlled Rectifier(D-2.4.1)-Forward Blocking Region(D-2.4.2)-Forward Conducting Region(D-2.4.3)-Reverse Blocking Region(D-2.4.4)-Effect of dv/dt and Snubber Circuits (D-2.4.7)-Effect of Rate of Rise in Current(di/dt)(D-2.4.8)-Thyristor Ratings(D-2.4.11) -Thyristor Gate Requirements(D-3.2)-Triggering Circuits for Thyristor(D-3.3)-Resistance Triggering Circuits(D-3.4.1)-RC Trigger Circuits(D-3.4.1)-UJT based Trigger Circuits-Driver and Buffer Circuits for Thyristor(D-3.4.7) Thyristor Commutation Techniques-Class A, Class B, Class C, Class D, Class E Types(C-5.1 to C-5.6)-Power Devices – MOSFET (A.8.3)-IGBT (A.8.5) – GTO (A.4.8.3)	13
II	**LINE COMMUTATED POWER CONTROL CIRCUITS** Line Commutated Converters(Controlled Rectifiers)-Principle of Phase Controlled Converter Operation(A-10.2)-Single Phase Full Converters(A-10.3)-Single Phase Dual Converters (A-10.3)-Three Phase Full Converters(A-10.6)-Three Phase Dual Converters(A-10.7)-12 Pulse converters(A-10.12) AC Voltage Controllers-Principle of Phase Control(A-11.3)-Single phase Bidirectional controllers with Resistive Load(A-11.4)-Single Phase Controller with Inductive Load(A-11.5)-Three Phase Full Wave Controllers(A-11.6)- Cyclo Converters-Single Phase Cyclo Converters(A-11.9.1)-Three Phase Cyclo Converters(A-11.9.2)	13

III	**FORCED COMMUTATED POWER CONTROL CIRCUITS** DC-DC Switch-Mode Converters(Choppers)-Control of DC-DC Converters(B-7.2)-Step-Down(BUCK) Converter(B-7.3)-Continuous-Conduction Mode(B-7.3.1) - Step-Up(BOOST) Converters(B-7.4)-Continuous Conduction Mode (B-7.4.1) –BUCK-BOOST Converters (B-7.5) – Continuous Conduction Mode (B-7.5.1) - Cuk DC-DC Converters(B-7.6) DC-AC Switch-Mode Inverters-Pulse Width Modulated Inverters-Introduction(A-6.1)-Principle of Operation(A-6.2)-Single Phase Bridge Inverters(A-6.4)-Three Phase Inverters(A-6.5)-180^0 Conduction Mode(A-6.5.1)-120^0 Conduction Mode(A-6.5.2)-Voltage Control of Single Phase Inverters(A-6.6)-Single Pulse Width Modulation(A-6.6.1)-Multiple Pulse Width Modulation(A-6.6.2)-Sinusoidal Pulse Width Modulation(A-6.6.3)-Voltage Control of Three Phase Inverters(A-6.8)-Sinusoidal PWM(A.6.8.1).	13
IV	**APPLICATIONS OF POWER ELECTRONICS** Switch Mode Power Supplies-Full Bridge Converter type(C-11.1.4)-Uninterrupted Power Supply-ON line(No Break) and OFF line(Short-Break) types(C-11.2)-Static AC Circuit Breaker(C-11.5.1)-AC Solid State Relays(C-11.6.2). High Frequency FlourescentLighting (B -16.2.2)-Induction Heating(B16.3.1)-Electric Welding(B -16.3.2)-High Voltage DC Transmission(B -17.2)-Wind and Small Hydro Interconnection(B -17.4.2)-Static VAR Compensators(B -17.3)-Thyristor Controlled Inductors (B -17.3.1)-Thyristor Switched Capacitors(B -17.3.2).	12

V	**MOTOR DRIVE APPLICATIONS** DC Drives-DC Motor with a Separately Excited Field Winding(B -13.4)-Line Frequency Converters (B-13.7.2)-Effect of Discontinuous Armature Current(B -13.7.3)–Control of Adjustable Speed Drives(B -13.7.4)-Switch-Mode DC-DC Converters(B -13.7.1) Induction Motor Drives-Introduction(B -14.1)-Basic Principle of Induction Motor Operation (B -14.2)-Induction Motor Characteristics at rated(line) frequency and rated voltage(B -14.3)-Speed Control by Varying Stator frequency and voltage(B -14.4)-Torque-Speed Characteristics(B -14.4.1)-Start-Up Considerations(B -14.4.2)-Voltage Boost required at low frequencies(B -14.4.3)-Induction Motor Capability below and above the rated speed(B -14.4.4)-Variable frequency Converter Classifications(B -14.6)-Variable frequency PWM-VSI Drives (B -14.7)-Line frequency Variable-Voltage Drives(B -14.11)-Reduced Voltage Starting("Soft Start") of Induction Motors(B -14.12)-Speed Control by Static Slip-Power Recovery(B -14.13).	12

TEXT BOOKS:

S. No.	Book Name	Author	Publication	Edition
1	Power Electronics	MD Singh, KB Dhanchandaniata	McGraw Hill Publishing Company New Delhi	seventeenth reprint 2005

REFERENCE BOOKS:

S. No.	Book Name	Author	Publication	Edition
1.	"Power Electronics" - A	Mohammed H.Rashid	New Age Publication.	Third Edition,2004
2.	"Power Electronics" - B	Mohan, Undeland, Robbins.	Wiley India Edition.	Media Enhanced Third Edition
3.	"Power Electronics" - C	Dr.P.S.Bimbhra	Khanna Publishers.	Fourth Edition, 2011.
4.	"Power Electronics" - D	M.S.Jamil Asghar	PHI Learning Private Limited	Eastern Economy Edition, 2010