Program : **Diploma in Electrical and Electronics Engineering**	
Course Code : **4031**	Course Title: **Power Electronics Devices and Circuits**
Semester : **4**	Credits: **4**
Course Category: **Program Core**	
Periods per week: **4 (L:3 T:1 P:0)**	Periods per semester: **60**

Course Objectives:

- To introduce students to the basic theory of power semiconductor devices and passive components, their practical applications in power electronics
- To familiarize students to the principle of operation of different power electronic converters and their applications
- To provide strong foundation for further study of power electronics

Course Prerequisites:

Topic/Description	Course code	Course Title	Semester
Basics of electronics		Fundamentals of Electrical & Electronics Engineering	2
Electronic circuits		Analog & Digital Electronic Circuit	3

Course Outcomes

On completion of the course, the students will be able to:-

COn	Description	Duration (Hours)	Cognitive level
CO1	Select appropriate power semiconductor device for a particular application	16	Understanding
CO2	Summarize the principle and operation of controlled rectifiers	14	Understanding
CO3	Summarize the principle and operation of DC and AC Converters	12	Understanding
CO4	Summarize various inverters and electric drives	16	Understanding
	Series Test	2	

CO-PO Mapping

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

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

Course Outline:

On completion of the course, the students will be able to:-

Module Outcome	Description	Duration (Hours)	Cognitive Level
CO1	**Select appropriate Power semiconductor device for a particular application.**		
M1.01	Summarize the operation of power electronic devices	8	Understanding
M1.02	Explain the operation of SCR	3	Understanding
M1.03	Classify and explain turn onand turn off methods of SCR.	4	Understanding
M1.04	Summarize the idea of datasheets of SCR	1	Understanding

Contents:

Power Electronic Devices- List various devices -Symbols (MOSFET, IGBT,GTO, LASCR,SCS,UJT, DIAC, TRIAC and SCR) -MOSFET - list different types -structure and working of N-channel enhancement type-IGBT--structure-working principle - applications-UJT- schematic diagram and working-DIAC & TRIAC-schematic diagram-working- V/I characteristics.

Silicon Controlled Rectifier (SCR)-structure-V-I characteristics- definitions- holding current- latching current

SCR Turn on and Turn off Methods -SCR Turn-On methods -list various methods - basic concepts - gate triggering -forward voltage triggering- resistance triggering-temperature triggering-light triggering- dv/dt triggering-SCR Turn-Off methods-list various methods-basic concepts-Thyristor protection circuits-snubber circuits.
Specifications of SCR -List parameters (Datasheet interpretation only)

CO2	**Summarize the principle and operation of controlled rectifiers.**		
M2.01	Illustrate the operation of single phase half wave controlled rectifier	4	Understanding
M2.02	Explain the operation of single phase full wave controlled rectifier	5	Understanding
M2.03	Summarize the operation of single phase semi controlled rectifiers	2	Understanding
M2.04	Outline the operation of three phase controlled rectifiers	3	Understanding
	Series Test 1	1	

Contents:

Single phase half wave controlled rectifiers - Terms and definitions-controlled rectifiers-firing angle-conduction angle-freewheeling diode -Types of controlled rectifiers (listing only)
Single phase half wave controlled rectifier**s-**circuit diagram, waveforms and operation(R load - RL load with and without freewheeling diode)

Single phase full wave controlled rectifiers -circuit diagram, waveforms and operation-bridge rectifier (with R load ,RL load only,RL load and freewheeling diode -continuous mode only)-centre tapped rectifier(with R load)
Single phase semi controlled rectifier - circuit diagram, waveforms and operation(with RL load)

Three phase bridge converter with resistive load(basic diagram with concept only)

CO3	**Summarize the principle and operation of DC and AC Converters**		
M3.01	Summarize the operation of DC choppers	3	Understanding
M3.02	Illustrate the classification of DC chopper	5	Understanding
M3.03	Explain the operation of buck and boost converters	2	Understanding
M3.04	Summarize the operation of cycloconverters	2	Understanding

Contents:

DC Chopper - basic principle of operation with waveforms- equation of output voltage - simple problems- control strategies-constant frequency control -variable frequency control
Types of choppers -concept of quadrant operations- circuit diagram and basic concepts of choppers -single quadrant (Type A, Type B)-two quadrant(Type C, Type D)-four quadrant (Type E)-Applications of chopper
Buck and boost converters-(operation with diagram only)
Cycloconverters -types- single phase to single phase step up cycloconverter (midpoint type)

CO4	**Summarize various inverters and electric drives**		
M4.01	Explain the operation of basic inverters	4	Understanding
M4.02	Illustrate the operation of bridge inverters	6	Understanding
M4.03	Outline the operation of SMPS and UPS	3	Understanding
M4.04	Classify various electric drives.	3	Understanding
	Series Test II	1	

Contents:
Inverter- requirements of a practical inverter-Classification - circuit diagram and working-series inverter- parallel inverter-concept of CSI and VSI
Bridge inverters - concept of feedback diodes-single phase bridge inverter - half bridge - full bridge (circuit diagram-working-waveformsfor RL load). Three phase bridge inverter - 180 degree conduction mode-circuit diagram with waveforms for R loads only-Voltage control methods - Principle of pulse width modulation- single PWM - sinusoidal PWM
SMPS - list different types-block diagram of SMPS- servo voltage stabilizers- (Block diagram-operation)
UPS-configurations -block diagram and operation -offline -online -line interactive
Electric drives-introduction- types -advantages-basic block diagram

Text /Reference:

T/R	**Book Title/Author**
T1	P.S. Bimbhra, Power Electronics, Khanna Publications, Co., New Delhi (ISBN: 9788174092151).
T2	M.D.Singh and Khanchandani K.B, Power Electronics. Secondedition, McGraw Hill Publishing Co. Ltd, New Delhi,2008,(ISBN:9780070583894)
R1	Muhammed H Rashid, Power Electronics Circuits Devices and Applications, Pearson Education India,Noida,2014.(ISBN: 9788131702468)

R2	Jain Alok,Power Electronics and its Applications, Penram International Publishing,Mumbai,2006 (ISBN:9788187972136)
R3	Dr.B R Gupta,Singhal,Power Electronics K Kataria &Sons,2009(ISBN: 9788185749532)
R4	Sen P.C., Power Electronics, McGraw-Hill Publishing Company Limited, New Delhi. ISBN:9780074624005
R5	V.R.Moorthy oxford publishers power electronics device circuits and industrial applications

Online resources

Sl.No	Website Link
1	NPTEL >> Courses >> Electrical Engineering >> Power Electronics https://nptel.ac.in/courses/108102145 https://nptel.ac.in/courses/108101038 https://nptel.ac.in/courses/108101126 https://nptel.ac.in/courses/108108077
2	**www.electrical4u.com/electrical-engineering-articles/power-electronics**
3	www.swayam.gov.in
4	www.youtube.com
5	wikipedia.org
6.	IEEE papers/journals on power electronics transactions