

## POWER ELECTRONICS

**Course Code : EC 73**

**Credits : 04**

**L : P : T : S : 4 : 0 : 0 : 0**

**CIE Marks : 50**

**Exam Hours : 03**

**SEE marks : 50**

**Total Hours : 50**

**CIE + SEE : 100**

### **COURSE OBJECTIVES:**

1. To make students familiarize with the characteristics of power semiconductor devices.
2. To provide the complete knowledge of SCR with regard to its static & dynamic characteristic, protection and control techniques.
3. To make students understand and analyze applications of power electronic converters as-rectifiers, inverters, choppers and ac voltage converters.

### **COURSE OUT COMES:**

At the end of the course, the student will be able to:

<b>CO 1</b>	Apply the basic knowledge of semiconductor devices to interpret their construction, characteristics and specifications for various power devices.
<b>CO 2</b>	Write mathematical equations for commutation circuits and analyze control characteristics of ideal and practical power converters.
<b>CO 3</b>	Analyze different control strategies and apply the knowledge in the construction of practical circuits.
<b>CO 4</b>	Compare input and output parameters of power electronic converters (rectifiers and inverters) by analysing their operation and adapting appropriate control techniques.
<b>CO 5</b>	Distinguish various types of chopper circuits and assess the performance of these converters by taking up cases for study.
<b>CO 6</b>	Identify and select appropriate power converter for different applications.

### **Mapping of Course Outcomes to Program Outcomes:**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>	<b>PO11</b>	<b>PO12</b>
<b>CO1</b>	3	1	-	-	-	-	-	-	-	-	-	-
<b>CO2</b>	3	2	-	-	-	-	-	-	-	-	-	-
<b>CO3</b>	3	3	2	1	-	-	-	-	-	-	-	-
<b>CO4</b>	3	3	2	1	-	-	-	-	-	-	-	-
<b>CO5</b>	3	3	2	2	-	-	-	1	1	1	-	-
<b>CO6</b>	3	2	-	-	-	-	-	-	-	-	-	-

Module	COURSE CONTENT	Hours	CO's
1	<b>INTRODUCTION TO POWER ELECTRONICS:</b> Introduction, Applications of power electronics, Power semiconductor devices, Control characteristics, Types of power electronics circuits. Principle of operation of SCR, Static characteristics, two transistor model. Turn-on Methods, Dynamic Turn-on and turn-off characteristics, $di/dt$ and $dv/dt$ protection,	10	CO1
2	<b>THYRISTOR FIRING CIRCUITS :</b> Design of thyristor firing circuits using R, R-C, UJT with numerical problems. <b>THYRISTOR TURN OFF METHODS:</b> Natural and forced commutation, self-commutation, class A and class B types, Complementary commutation, auxiliary commutation, AC line commutation, with numerical problems.	10	CO2
3	<b>CONTROLLED RECTIFIERS:</b> Introduction, Principles of phase controlled converter operation, $1\phi$ fully controlled converters, $1\phi$ semi converters (all converters with R & RL load). <b>DC CHOPPERS:</b> Introduction, Principles of step down and step up choppers, Step down chopper with RL loads, Chopper classification, Switch mode regulators – buck, boost and buck – boost regulators.	10	CO3 CO5 CO6
4	<b>AC VOLTAGE REGULATORS :</b> Introduction, Principle of On-OFF and phase control, Single-phase, Bi-directional controllers (R & R-L Loads) with numerical problems. <b>INVERTERS :</b> Introduction, Principle of operation, Performance parameters, Single-phase bridge inverters.	10	CO4 CO5 CO6
5	<b>POWER ELECTRONIC APPLICATIONS :</b> Uninterruptible Power Supplies: Introduction, Classifications, Reliability of UPS Systems, Batteries for UPS. Switch mode power supplies block diagram with explanation. Battery charger, Automatic battery charger with trickle charging arrangement. Emergency lighting system.	10	CO4 CO5 CO6

**NOTE:** 1. Questions for CIE and SEE not to be set from self-study component.  
 2. Assignment Questions should be from self-study component only.

## SELF-STUDY COMPONENT:

Unit 1 : Static Characteristics of Power Diode, BJT, MOSFET, IGBT, TRIAC, DIAC.

Unit 2 : Gate Characteristics of SCR, Series and parallel operation of Thyristors.

Unit 3 : Chopper controlled DC shunt motor using class D commutation.

Unit 4 : Voltage control of 1 $\phi$  invertors, current source invertors, Variable DC link inverter.

Unit 5 : Voltage control of single phase inverters – single pulse width, multiple pulse-width.

## TEXT BOOKS:

1. M.H. Rashid, “Power Electronics”, *Pearson*, 3rd Edition, 2006.
2. M.D. Singh and Khanchandani K.B., “Power Electronics”, *T.M.H.*, 2nd Edition, 2001

## REFERENCES

1. L. Umanand, “Power Electronics Essentials and Applications”, *Wiley India Pvt Ltd*, Reprint, 2010.
2. G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, “Thyristorized Power Controllers”, *New Age International Publishers*.
3. Ned Mohan, Tore M. Undeland and William P. Robins, “Power Electronics – Converters, Applications and Design”, Third Edition, *John Wiley and Sons*, 2008.
4. R.S. Ananda Murthy and V. Nattarasu, “Power Electronics: A Simplified Approach”, *Pearson / Sanguine Technical Publishers*.

## ASSESSMENT PATTERN :

### CIE – Continuous Internal Evaluation Theory (50 Marks) :

Bloom's Category	Tests -3 CIEs	Assignments - 1 No.	AAT - 1 No.
<b>Marks (Out of 50)</b>	<b>30</b>	<b>10</b>	<b>10</b>
Remember	05	02	
Understand	05	02	01
Apply	10	02	03
Analyze	05	02	03
Evaluate			
Create	05	02	03

**AAT - Alternate Assessment Tool :** Quiz / Surprise Test / Seminar / Role Play / Group Discussion / Case Study / E-Course Certification / Mini Projects / Developing Products / Building, Models / Paper Presentation / Paper / Poster Publication / Programming Contest / General Science / Technical Quiz / Hackathons / Demonstration / Analysis / Optimization / Comparison of theoretical concepts using modern tools.