

**Government of Karnataka**  
**Department of Technical Education**  
**Board of Technical Examinations, Bengaluru**

Course Title: <b>POWER ELECTRONICS</b>	Course Code : <b>15EE51T</b>
Semester : <b>V</b>	Course Group : <b>Core</b>
Teaching Scheme (L:T:P) : <b>4:0:0</b> (in Hours)	Credits : <b>4 Credits</b>
Type of course : <b>Lecture +Assignments</b>	Total Contact Hours : <b>52</b>
CIE : <b>25 Marks</b>	SEE : <b>100 Marks</b>
Programme: Diploma in Electrical and Electronics Engg.	

**Pre-requisites** : Knowledge of Electrical machines, Analog & Digital Electronics

**Course Objectives** : To introduce the concept of semiconductors devices for high power supply and their applications

**COURSE TOPICS:**

Unit No	Unit Name	Hours
1	Power Semiconductor Devices	9
2	SCR Control Circuits	6
3	Ratings, Protection & Mounting of Thyristors	3
4	Converters	13
5	Power Supplies and Stabilizers	8
6	Applications	13
	<b>Total</b>	<b>52</b>

## Course Outcomes:

*On successful completion of the course, the student will be able to:*

1. Understand the basics of power semiconductor devices
2. Explain Thyristor control circuits
3. Generalize the protection of Thyristors
4. Analyze the working of DC and AC Converters
5. Describe the operation of power supplies.
6. Illustrate the applications of power Electronics.

## Composition of Educational Components

Questions for CIE and SEE will be designed to evaluate the various educational components (Bloom's Taxonomy) such as:

Sl. No.	Educational Component	Weightage (%)	Total Marks (Out of 145)
1	Remembering	10	15
2	Understanding	45	65
3	Application	45	65
<b>Total</b>		<b>100</b>	<b>145</b>

## Course Outcome linkage to Cognitive Level

Cognitive Level Legend: R- Remember, U- Understand, A- Application

Course Outcome		CL	Linked PO	Teaching Hrs
CO1	Understand the basics of power semiconductor devices	<i>R/U</i>	2,10	9
CO2	Explain Thyristor control circuits	<i>U/A</i>	2,4,10	6
CO3	Generalize the protection of Thyristors	<i>R/U</i>	2,10	3
CO4	Analyze the working of DC and AC Converters	<i>U/A</i>	4,10	13
CO5	Describe the operation of power supplies.	<i>U/A</i>	4,10	8
CO6	Illustrate the applications of power Electronics.	<i>U/A</i>	4,10	13
			<b>Total sessions</b>	<b>52</b>

### Course Content and Blue Print of Marks for SEE:

Unit No	Unit Name	Hour	Max. Marks per Unit	Questions to be set for (5marks) PART - A			Questions to be set for (10marks) PART - B			Marks weightage (%)
				R	U	A	R	U	A	
1	Understand the basics of power semiconductor devices	9	25	1	1		0.5	1		17
2	Explain Thyristor control circuits	6	15		1				1	10
3	Generalize the protection of Thyristors	3	10	1				0.5		7
4	Analyze the working of DC and AC Converters	13	35		1	1		1	1.5	24
5	Describe the operation of power supplies.	8	20			1		1	0.5	14
6	Illustrate the applications of power Electronics.	13	40		1	1		1	2	28
	<b>Total</b>	<b>52</b>	<b>145</b>	<b>9 (45 Marks)</b>			<b>10 (100 Marks)</b>			<b>100</b>

## Course-PO Attainment Matrix

Course	Programme Outcomes									
	1	2	3	4	5	6	7	8	9	10
<b>POWER ELECTRONICS</b>	-	2	-	3	-	-	-	-	-	3

**Level 3- Highly Addressed, Level 2-Moderately Addressed, Level 1-Low Addressed.**

Method is to relate the level of PO with the number of hours devoted to the COs which address the given PO.

If  $\geq 40\%$  of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 3

If 25 to 40% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 2

If 5 to 25% of classroom sessions addressing a particular PO, it is considered that PO is addressed at Level 1

If  $< 5\%$  of classroom sessions addressing a particular PO, it is considered that PO is considered not-addressed.

## Course Content:

### Unit –I

**POWER SEMICONDUCTOR DEVICES**– Concept of power electronics, Power electronic devices-Power diode- Structure, Characteristics, types and applications, Power transistor-types, switching characteristics and applications, MOSFET-operation, transfer characteristics and applications, IGBT –structure and applications, SCR-layer diagram, transistor analogy, Characteristics, LASCR –structure and operation, GTO Triac-characteristics, triggering modes, DIAC- Characteristics, operation and applications

### Unit –II

**SCR CONTROL CIRCUITS**- Methods of turning on the SCR, General layout of firing circuit, R and RC Firing circuits, Pulse triggering using UJT, Digital firing scheme, Commutation and types.

### Unit –III

**RATINGS, PROTECTION & MOUNTING OF THYRISTORS**- Voltage and current ratings of SCR, Protection of SCR against Over voltage, Over current, di/dt and dv/dt, Types of Mounting of SCRs

### Unit –IV

**CONVERTERS** - Types of converters, Phase control, Full controlled bridge converter, dual converters, three phase converters, Choppers-definition, step up and step down choppers, different chopper configurations, inverters-definition, VSI and CSI, Half bridge inverter and full bridge inverter, three phase bridge inverter, cyclo converter-midpoint cyclo converter, step up and step down cyclo converter, advantages and disadvantages

### Unit –V

**POWER SUPPLIES AND STABILIZERS**- SMPS and operation, Buck, Boost, Buck-Boost and Flyback converter, power line disturbances, sources and effects power conditioners, Operation of relay type AC voltage stabilizer, advantages and disadvantages of Relay type stabilizer, AC servo voltage stabilizer, advantages and disadvantages, UPS- Battery size and required voltage for UPS, Offline UPS, Online UPS.

### Unit –VI

**APPLICATIONS- Power system applications**- Static AC circuit breaker, interconnection of renewable energy sources and energy storage systems to the utility, Grid Thyristor switched capacitors and Thyristor switched inductors (Reactors).

**Industrial applications** -Switch mode welder, Voltage source series resonant inverters in induction heating, solid state relay, speed control of shunt wound DC motor by armature voltage control method, soft starting of Induction motor, static slip recovery system in induction motor (static scherbius drive), speed control of Induction Motor by Variable voltage frequency method

**Domestic Applications**-High frequency lighting system, SCR battery charger.

### Reference Books:

1. Power Electronics by Dr P S Bimbhra , Khanna Publishers, New Delhi
2. Industrial Electronics and Control Biswanath Paul PHI Publication Edition-II
3. Thyristorised power controllers GK Dubey
4. Power and industrial Electronics by Harish C Rai
5. Power electronics by Mohan Undeland & Robbins, Wiley Publications
6. Modern Power Electronics by P.C.Sen
7. Power Electronics – RaghunathRao,
8. Voltage Stabilizers and cut outs-Mc Sharma , BPB Publications
9. Switch Gear and protection by J B Gupta , Katson Publication

### e-Resources:

[www.electricalengineeringinfo.com/2014/06/silicon...](http://www.electricalengineeringinfo.com/2014/06/silicon...)

### Course Delivery:

The Course will be delivered through lectures, classroom interaction, animations, group discussion, exercises and student activities, assignments.

## Course Assessment and Evaluation:

	What		To Whom	Frequency	Max Marks	Evidence Collected	Course Outcomes
<b>Direct Assessment</b>	<b>CIE (Continuous Internal Evaluation)</b>	I A Tests	Students	Three IA tests for Theory: (Average marks of Three Tests to be computed).	20	Blue Books	1 to 6
		Student Activity		05	Report of 2 pages	1 to 6	
		<b>TOTAL</b>		<b>25</b>			
	<b>SEE (Semester End Examination)</b>	End Exam	Students	End Of the Course	100	Answer Scripts at BTE	1 to 6
<b>Indirect Assessment</b>	Student Feedback on course		Students	Middle Of The Course	Feed Back Forms		1 to 6
	End Of Course Survey			End Of The Course	Questionnaires		1 to 6

\*CIE – Continuous Internal Evaluation      \*SEE – Semester End Examination

**Note:** I.A. test shall be conducted for 20 marks. Average marks of three tests shall be rounded off to the next higher digit.

**Note to IA verifier:** *The following documents to be verified by CIE verifier at the end of semester*

1. Blue books ( 20 marks)
2. Student suggested activities report for 5 marks evaluated through appropriate rubrics.
3. Student feedback on course regarding Effectiveness of Delivery of instructions & Assessment Methods.



## Course Contents with Lecture Schedule:

Lesson No./ Session No.	Contents	Duration
<b>Unit I</b>	<b>Introduction to power electronics</b>	<b>9 Hours</b>
1.	Describe the concept of power electronics Draw the layer structure of power diode and explain it. Draw V –I characteristics of power diode and explain. List & explain types of power diodes and their applications <b>Ref: 1 Ref: 2</b>	01 Hour
2.	List the types of Power transistors, explain BJT switching characteristics, BJT as a switch <b>Ref: 1</b>	01 Hour
3.	Explain the operation of N-channel enhancement MOSFET and draw its transfer characteristic curve, application of MOSFET <b>Ref: 1</b>	01 Hour
4.	Draw and Explain the structure of IGBT and application of IGBT <b>Ref: 5</b> Compare MOSFET, BJT and IGBT <b>Ref: 2</b>	01 Hour
5.	Draw the layer diagram of SCR and explain the concept of two transistor analogy of SCR. <b>Ref: 1</b>	01 Hour
6.	Explain the static V-I characteristic curve of SCR, Enumerate Reverse blocking , Forward blocking, forward conduction mode <b>Ref: 1</b>	01 Hour
7.	Define GTO. Explain the principle of operation and list its applications. <b>Ref: 1</b> Draw the layer structure of LASCR and explain its operation <b>Ref: 2</b>	01 Hour
8	Draw the layer structure and explain the operation of TRIAC Draw V-I characteristics & explain 4-Modes of turn on of TRIAC, state the preferred mode of turn-on <b>Ref: 1, Ref: 2</b>	01Hour
9	Explain the operation of DIAC and draw its V-I characteristic curve, application of DIAC. <b>Ref: 1</b> Explain the construction & operation of UJT. Draw & explain the V-I characteristics of UJT List the applications of UJT <b>Ref: 2</b>	01Hour
<b>UNIT II</b>	<b>SCR CONTROL CIRCUITS</b>	<b>6 Hours</b>
10	List and explain the methods of turn on of SCR Draw and explain the general layout of firing circuit <b>Ref:3, Ref 1</b>	01 Hour

11	Draw R firing circuit and explain with wave forms. Draw R-C firing circuit and explain with wave forms <b>Ref:1</b>	01 Hour
12	Draw synchronized UJT pulse trigger circuit and explain with waveforms. <b>Ref:3, Ref 1</b>	01 Hour
13	Draw the Digital firing scheme and explain with wave forms <b>Ref:3</b>	01 Hour
14	Define commutation, Explain line commutation, forced commutation and list the methods of forced commutation <b>Ref:1, Ref:2</b>	01 Hour
15	Explain Load commutation and complementary commutation <b>Ref:1</b>	01 Hour
<b>Unit III</b>	<b>Ratings ,Protection &amp; Mounting of Thyristors</b>	<b>3 Hours</b>
16	Explain voltage and current ratings of SCR and Reliability of SCR Define MTBF. <b>Ref:1 Ref:7</b>	01 Hour
17	Describe how SCR can be protected against overvoltage and over current, di/dt & dv/dt. <b>Ref:1</b>	01 Hour
18	Explain the different types of mounting of SCR. <b>Ref:1</b>	01 Hour
<b>Unit IV</b>	<b>CONVERTERS</b>	<b>13 Hours</b>
	<b>DC Converters</b>	
19	Explain the types of power electronic converters List the advantages and disadvantages of power electronic converters <b>Ref:1</b> Explain single quadrant semi converter, two quadrant full converter and dual converter. <b>Ref:3</b>	01 Hour
20	Explain smart power modules Explain principle of phase control with waveforms for resistive load. <b>Ref:1</b>	01 Hour
21	Explain single phase full converter RLE type with continuous load current <b>Ref:1</b>	01 Hour
22	Draw the circuit diagram of single phase Dual converter and explain the principle of operation. <b>Ref 2</b>	01 Hour
23	Explain the gating pulse requirement of 3 phase full converters <b>Ref 4</b>	01 Hour
24	Draw the circuit diagram of three phase bridge converter and explain 180 conduction mode with wave forms. <b>Ref:1</b>	01 Hour
25	Define DC Chopper. Draw the circuit of step down chopper and explain its operation Draw the circuit of step up chopper and explain its operation <b>Ref:1</b>	01 Hour
26	Draw the different chopper configurations- (A, B, C, D and E) and explain them. <b>Ref:1</b>	01 Hour

	<b>A C Converters</b>	
27	Define inverter List and explain the 2 main types of inverters ( VSI and CSI) List the differences between VSI and CSI. <b>Ref:2, Ref 4</b>	01 Hour
28	Draw the circuit diagram of half bride inverter and its operation with wave forms Draw the circuit diagram of full bride inverter and its operation with wave forms. <b>Ref:1</b>	01 Hour
29	Draw the circuit diagram of three phase 180 <sup>0</sup> mode voltage source inverter and its operation with wave forms. <b>Ref:1</b>	01 Hour
30	Define cycloconverter. Draw the circuit of mid- point step down cyclo converter and explain its operation with waveforms. <b>Ref 2</b>	01 Hour
31	Draw the circuit of mid- point step up cyclo converter and explain its operation with waveforms. <b>Ref: 1</b> List the advantages and disadvantages of cyclo converters <b>Ref 2</b>	01 Hour
<b>Unit V</b>	<b>POWER SUPPLIES AND STABILIZERS</b>	<b>8Hours</b>
32	Draw the Block diagram of SMPS and explain its operation List the applications of SMPS <b>Ref: 2</b>	01 Hour
33	Draw the circuit diagram of Buck and boost converter (regulator) and explain its operation. <b>Ref: 2</b>	01 Hour
34	Draw the circuit diagram of Buck-boost and fly back converter (regulator) and explain its operation. <b>Ref: 2</b>	01 Hour
35	Define the different types of power line disturbances List the sources and effects of power line disturbances Describe how power conditioners provide effective suppressing of some or all of these electrical disturbances <b>Ref:5</b>	01 Hour
36	Describe the operation of relay type AC voltage stabilizer with the help of diagram. List the advantages and disadvantages of Relay type stabilizer <b>Ref: 7, Ref: 8</b>	01 Hour
37	Draw the diagram of AC servo voltage stabilizer and explain its operation List the advantages and disadvantages . <b>Ref: 2</b>	01 Hour
38	Define UPS, Determine Battery size and required voltage for UPS. <b>Ref:6</b>	01 Hour
39	Draw the block diagram of offline UPS and explain its operation Draw the block diagram of online UPS and explain its operation <b>Ref: 2</b>	01 Hour
<b>Unit VI</b>	<b>APPLICATIONS</b>	<b>13 Hours</b>
40	Draw the circuit diagram of static AC circuit breaker and explain its operation with waveforms <b>Ref: 1</b>	01 Hour

41	Explain the operation of Thyristor switched capacitors and Thyristor switched inductors (Reactors) <b>Ref: 5</b>	01 Hour
42	Draw the circuit diagram and explain single phase high frequency photo voltaic interface to grid <b>Ref: 5</b>	01 Hour
43	Draw and explain the circuit for interconnection of wind and hydro generator	01Hour
44	Draw the block diagram of interconnecting energy storage systems for utility load levelling <b>Ref: 5</b>	01Hour
45	Draw the block diagram & explain the operation of Switch mode welder.	01 Hour
46	Draw the block diagram and explain the operation of Voltage source series resonant inverters in induction heating <b>Ref: 5</b>	01 Hour
47	Explain speed control of shunt wound DC motor by armature voltage control method. <b>Ref: 2</b>	01 Hour
48	Explain with circuit diagram soft starting of Induction motor <b>Ref: 5</b> Explain with circuit diagram static slip recovery <b>Ref: 1</b>	01 Hour
49	Explain speed control of Induction Motor by Variable voltage frequency method. <b>Ref 2</b>	01 Hour
50	Draw the circuit diagram and explain the speed control of 3 phase slip ring induction motor by static variation of external rotor resistance. <b>Ref 1</b>	01 Hour
51	Draw the circuit and explain the operation of DC Solid state Relay using opto-coupler. Draw the circuit and explain the operation of AC Solid state Relay using opto-coupler. <b>Ref 1</b>	01 Hour
52	Draw the block diagram of High frequency lighting system and explain its operation. Draw the circuit & explain SCR charger circuit for 12 V battery. <b>Ref 5</b>	01 Hour

**Student Activity (any one to be submitted with 3 pages self HAND WRITTEN report):**

1. Identify various power switching devices used commercially and study their applications
2. Study various control circuits used in Practise in converters & inverters
3. Study various ratings of power semiconductor devices and select it for a particular application
4. Visit nearby MUSS and collect details of power electronic applications
5. Study commercially available power supplies
6. Prepare a report on application of power electronic devices in industries

**MODEL OF RUBRICS / CRITERIA FOR ASSESSING STUDENT ACTIVITY ( Course Coordinator)**

Dimension	Scale					Students score (Group of five students)				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	1	2	3	4	5
1	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	3				
2	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	2				
3	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	5				
4	Descriptor	Descriptor	Descriptor	Descriptor	Descriptor	4				
<b>Note: Concerned faculty (Course coordinator) must devise appropriate rubrics/criteria for assessing Student activity for 5 marks</b>						14/4				
<b>One activity on any one CO (course outcome) may be given to a group of FIVE students</b>						=3.5				
<b>Grand Average/Total</b>						≈4				

**Example only: MODEL OF RUBRICS / CRITERIA FOR ASSESSING STUDENT ACTIVITY-  
Task given- Industrial visit and report writing**

Dimension	Scale					Students score (Five students)				
	1 Unsatisfactory	2 Developing	3 Satisfactory	4 Good	5 Exemplary	1	2	3	4	5
1. Organisation	Has not included relevant info	Has included few relevant info	Has included some relevant info	Has included many relevant info	Has included all relevant info needed	3				
2. Fulfill team's roles & duties	Does not perform any duties assigned	Performs very little duties	Performs partial duties	Performs nearly all duties	Performs all duties of assigned team roles	2				
3. Conclusion	Poor	Less Effective	Partially effective	Summarises but not exact.	Most Effective	5				
4. Conventions	Frequent Error	More Error	Some Error	Occasional Error	No Error	4				
Total marks						14/4=3.5				
						≈4				

## FORMAT OF I A TEST QUESTION PAPER (CIE)

Test/Date and Time	Semester/year	Course/Course Code	Max Marks			
Ex: I test/6 <sup>th</sup> week of sem 10-11 Am	V/VI SEM		20			
	Year:					
Name of Course coordinator :						
Units: __ CO's: ____						
Question no	Question	MARKS	CL	CO	PO	
1						
2						
3						
4						

**Note: Internal Choice may be given in each CO at the same cognitive level (CL).**

**MODEL QUESTION PAPER (CIE)**

Test/Date and Time	Semester/year	Course/Course Code	Max Marks		
1 <sup>st</sup> Test/ 6 <sup>th</sup> week, 9 Feb 16, 10-11 AM	V SEM, E & E Engg	<b>Power Electronics</b>	20		
	Year: 2015-16	Course code: 15EE51T			
Name of Course coordinator : Units Covered : 1 and 2 Course Outcomes : 1 and 2 <b>Instruction :</b> (1). <i>Answer all questions</i>					
Question No.	Question		CL	CO	PO
1	List the types of power diode or Define GTO (2 Marks)		R	CO1	2
2	Explain the 4-Modes of turn on of TRIAC (4 marks) Or Explain the construction of UJT		U	CO1	2
3	Explain line commutation and forced commutation (5 marks) Or Explain the methods of turn on of SCR		U	CO2	4
4	Draw R firing circuit and explain with wave forms (9 marks) Or Draw synchronized UJT pulse trigger circuit and explain with waveforms		A	CO2	4
CL: Cognitive Level, R-Remember, U-Understand, A-Application, PO: Program Outcomes					

<b>Sl. No.</b>	<b>Educational Component</b>	<b>Weightage (%)</b>	<b>Total Marks (Out of 20)</b>
1	Remembering	10	2
2	Understanding	45	9
3	Application	45	9
<b>Total</b>		<b>100</b>	<b>20</b>



## Model QUESTION Paper BANK:

Course Title: **POWER ELECTRONICS**

Course Code: 15EE51T

### CO1 - Understand the basics of power semiconductor devices

#### .Unit 1 -Introduction to power electronics

##### Cognitive Level: REMEMBER

1. Draw the layer structure of power diode
2. List types of power diode and their applications
3. List the types of Power transistors and their applications
4. Draw the transfer characteristic curve and list the applications of MOSFET
5. Draw the structure of IGBT and list the applications of IGBT
6. Draw the layer diagram of SCR
7. Enumerate Reverse blocking, Forward blocking, forward conduction mode
8. Define GTO and list its applications
9. Draw the layer structure of TRIAC and list its applications
10. state the preferred modes of turn-on of TRIAC
11. Draw the V-I characteristic curve of DIAC and list its applications
12. Draw the layer diagram of UJT and list the applications of UJT

##### Cognitive Level: UNDERSTAND

1. Describe the concept of power electronics.
2. Draw V-I characteristics of power diode and explain
3. Explain BJT switching characteristics
4. Explain with circuit diagram the operation of BJT as a switch
5. Explain the operation of N-channel enhancement MOSFET
6. Draw and Explain the structure of IGBT
7. Draw the layer diagram of SCR and explain the concept of two transistor analogy
8. Explain the static V-I characteristic curve of SCR
9. Explain the principle of operation GTO
10. Draw the layer structure of LASCR and explain its operation
11. Draw V-I characteristics & explain 4-Modes of turn on of TRIAC
12. Explain the operation of DIAC
13. Explain the construction of UJT
14. Draw & explain the V-I characteristics of UJT
15. List the differences between MOSFET, BJT and IGBT

## **CO2- Explain Thyristor control circuits**

### **Unit 2 - SCR CONTROL CIRCUITS**

#### **Cognitive Level: UNDERSTAND**

1. Explain the methods of turn on of SCR
2. Draw and explain the general layout of firing circuit
3. Describe commutation
4. Identify the types of commutation
5. Explain line commutation and forced commutation
6. Explain Load commutation and complementary commutation

#### **Cognitive Level: Analysis**

1. Draw R firing circuit and explain with wave forms.
2. Draw R-C firing circuit and explain with wave forms
3. Draw synchronized UJT pulse trigger circuit and explain with waveforms
4. Draw the Digital firing scheme and explain with wave forms

## **CO3- Generalize the protection of Thyristors**

### **Unit 3 -Ratings, Protection& mounting of thyristors**

#### **Cognitive Level: REMEMBER**

1. Define reliability and MTBF
2. List the different types of mounting of SCR

#### **Cognitive Level: UNDERSTAND**

1. Explain voltage and current ratings of SCR
2. Explain reliability of SCR
3. Describe how SCR can be protected against overvoltage and overcurrent,  $di/dt$  &  $dv/dt$
4. Explain the different types of mounting of SCR

## **CO4- Analyze the working of DC and AC Converters**

### **Unit 4 -CONVERTERS**

#### **Cognitive Level: UNDERSTAND**

1. Explain the types of power electronic converters
2. Explain single quadrant semi converter, two quadrant full converter and dual converter.
3. Explain two quadrant full converter
4. Explain dual converter
5. Explain smart power modules
6. Draw the circuit diagram of single phase Dual converter and explain the principle of operation.

7. Explain the gating pulse requirement of 3 phase full converters
8. Draw the circuit of step down chopper and explain its operation
9. Draw the circuit of step up chopper and explain its operation
10. Draw the different chopper configurations- (A , B , C , D and E) and explain them
11. Explain VSI
12. Explain CSI
13. Explain cycloconverters

### **Cognitive Level: Analysis**

1. List the advantages and disadvantages of power electronic converters
2. Explain principle of phase control with waveforms for resistive load
3. Explain single phase full converter RLE type with continuous load current
4. Draw the circuit diagram of three phase bridge converter and explain 180° conduction mode with wave forms
5. List the differences between VSI and CSI
6. Draw the circuit diagram of half bridge inverter and its operation with wave forms
7. Draw the circuit diagram of full bridge inverter and its operation with wave forms
8. Draw the circuit diagram of three phase 180° mode voltage source inverter and its operation with wave forms
9. Draw the circuit of mid- point step down cycloconverter and explain its operation with waveforms
10. Draw the circuit of mid- point step up cycloconverter and explain its operation with waveforms.
11. List the advantages and disadvantages of cyclo converters

## **CO5- Describe the operation of power supplies.**

### **Unit V -POWER SUPPLIES AND STABILIZERS**

### **Cognitive Level: UNDERSTAND**

1. Draw the Block diagram of SMPS and explain its operation
2. Draw the circuit diagram of Buck -boost converter (regulator) and explain its operation.
3. Describe the different types of power line disturbances
4. Describe how power conditioners provide effective suppressing of some or all electrical disturbances
5. Describe the operation of relay type AC voltage stabilizer with the help of diagram.
6. Draw the diagram of AC servo voltage stabilizer and explain its operation
7. Draw the block diagram of OFF line UPS and explain its operation
8. Draw the block diagram of ON line UPS and explain its operation

### **Cognitive Level: Analysis**

1. List the applications of SMPS
2. List the sources and effects of power line disturbances
3. List the advantages and disadvantages of Relay type stabilizer
4. List the advantages and disadvantages of servo stabilizer
5. Determine Battery size and required voltage for UPS

## CO6- Illustrate the applications of power Electronics

### Unit VI-APPLICATIONS

#### Cognitive Level: UNDERSTAND

1. Explain with block diagram static excitation system for alternators
2. Draw the schematic diagram of bi polar HVDC system and explain its operation
3. Draw the circuit diagram and explain single phase high frequency photo voltaic interfaced to grid
4. Draw and explain the circuit for interconnection of wind and hydro generator
5. Draw the block diagram of interconnecting energy storage systems for utility load levelling
6. Draw the block diagram & explain the operation of Switch mode welder
7. Draw the block diagram and explain the operation of Voltage source series resonant inverters in induction heating
8. Explain the operation of Thyristor switched capacitors and thyristor switched inductors
9. Draw the circuit and explain the operation of DC Solid state Relay using opto coupler
10. Draw the circuit and explain the operation of AC Solid state Relay using opto coupler
11. Draw the block diagram of High frequency lighting system and explain its operation.

#### Cognitive Level: Analysis

1. Draw the circuit diagram of static AC circuit breaker and explain its operation with waveforms
2. Explain speed control of shunt wound DC motor by armature voltage control method.
3. Explain with circuit diagram soft starting of Induction motor
4. Explain with circuit diagram static slip recovery
5. Explain speed control of Induction Motor by Variable voltage frequency method.
6. Draw the circuit diagram and explain the speed control of 3 phase slip ring induction motor by static variation of external rotor resistance
7. Draw the circuit & explain SCR charger circuit for 12 V battery

**Model Question Paper:**  
**Code:15EE51T**

**Power Electronics**

V Semester Examination  
Diploma in Electrical and Electronics Engg.

**Time: 3 Hours**

**Max Marks: 100**

- Note:** i) Answer any SIX questions from PART - A. Each question carries 5 marks.  
ii) Answer any SEVEN Questions from PART - B. Each question carries 10 marks.

**PART – A**

1. Draw the transfer characteristic curve and list the applications of MOSFET
2. Explain the principle of operation GTO
3. Explain the methods of turn on of SCR
4. Define reliability and MTBF
5. Explain Voltage source inverter
6. Draw the circuit diagram of half bridge inverter and its operation
7. List the advantages and disadvantages of servo stabilizer
8. Explain the operation of Thyristor switched capacitors
9. Explain with circuit diagram soft starting of Induction motor

**PART – B**

- 10 (a) Draw & explain the V-I characteristics of UJT **5**  
(b) Explain with circuit diagram the operation of BJT as a switch **5**
- 11 (a) Draw the V-I characteristic curve of DIAC and list its applications **(5)**  
(b) Describe how SCR can be protected against overvoltage **(5)**
- 12 Draw the Digital firing scheme and explain with wave forms **(10)**
- 13 (a) List the sources and effects of power line disturbances **(5)**  
(b) List the advantages and disadvantages of power electronic converters **(5)**
- 14 Draw the circuit diagram of single phase Dual converter and explain the principle of operation. **(10)**
- 15 Draw the circuit diagram of three phase bridge converter and explain 180 conduction mode with wave forms **(10)**
- 16 Draw the Block diagram of SMPS and explain its operation
- 17 Explain Switched mode welder with diagram **(10)**
- 18 Explain speed control of Induction Motor by Variable voltage frequency method **(10)**
- 19 Draw the circuit diagram of static AC circuit breaker and explain its operation with waveforms

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