NARASIMHA REDDY ENGINEERING COLLEGE
(Autonomous)
Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad
Accredited by NAAC with A Grade, Accredited by NBA

ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

Course Title : POWER ELECTRONICS

Course Code : 23EE501

Regulation : NR23

Course Objectives

- To Design/develop suitable power converter for efficient control or conversion of power in drive applications
- To Design / develop suitable power converter for efficient transmission and utilization of power in power system applications.

Course Outcomes (CO's)

CO1 Apply the basic operation and characteristics of various power semiconductor devices and intelligent power module.
CO2 Design AC/DC rectifier circuit
CO3 Evaluate chopper circuits
CO4 Examine three phase inverter circuits
CO5 Create AC voltage controller circuits

UNIT–I

Power Switching Devices

S.No	Questions	BT	CO	PO
	Part – A (Short Answer Questions)			
1	Define latching current of SCR.	L1	CO1	PO1
2	What are the different methods to turn on the thyristor?	L1	CO1	PO1
3	What are the parameters involved in switching loss of power device?	L1	CO1	PO1
4	Why are IGBT becoming popular in their application to controlled converters?	L1	CO1	PO1
5	Write down the applications of IGBT?	L1	CO1	PO1
6	What are the advantages of MOSFET?	L1	CO1	PO1

7		Define the term pinch off voltage of MOSFET	L1	CO1	PO1
8		Define latching and holding current of SCR.	L1	CO1	PO1
9		What is meant by commutation and write down its types.	L1	CO1	PO1
10		Compare MOSFET and BJT?	L1	CO1	PO1
Part – B (Long Answer Questions)					
11	a)	Describe the current commutation technique to turn off the SCR with neat sketch and waveforms.	L2	CO1	PO1, PO2
	b)	Explain the concept of series and parallel connections of SCRs	L2	CO1	PO1, PO2
12	a)	Explain the operation of IGBT with the help of neat structural diagram and suitable wave forms.	L1	CO1	PO1
	b)	Explain the operation of two transistor analogy	L2	CO1	PO1, PO2, PO3
13	a)	With neat sketch explain the turn on and turn off characteristic of SCR**.**	L2	CO1	PO1, PO2, PO3
	b)	Discuss in detail the static and switching characteristic of power IGBT.	L2	CO1	PO1, PO2
14	a)	Explain the switching performance of BJT with relevant waveforms indicating clearly the turn-on, turn-off times and their components	L2	CO1	PO1, PO2
	b)	Explain the switching characteristics of power IGBT with neat circuit diagram and waveforms.	L2	CO1	PO1
15	a)	Explain the switching performance of MOSFET with relevant waveforms indicating clearly the turn-on, turn-off times and their components	L2	CO1	PO1, PO2
	b)	Compare and contrast the performance characteristics of IGBT and MOSFET	L1	CO1	PO1
16	a)	Explain the switching performance of SCR with relevant waveforms indicating clearly the turn-on, turn-off times and their components.	L2	CO1	PO1, PO2, PO3
	b)	Draw the basic structure of an IGBT and explain its operation	L2	CO1	PO1

UNIT–II

AC-DC Converters (Phase Controlled Rectifiers)

S.No	Questions	BT	CO	PO
Part – A (Short Answer Questions)				
1	Mention some of the applications of controlled rectifier.	L1	CO2	PO 1
2	Give any two differences single phase full and semi converter?	L1	CO2	PO 1

3	What is dual converter?	L1	CO2	PO 1
4	What is the function of freewheeling diodes in controlled rectifier?	L1	CO2	PO 1
5	What is commutation angle or overlap angle?	L1	CO2	PO 1
6	What is meant by input power factor in controlled rectifier?	L1	CO2	PO 1
7	What is meant by rectification mode in single phase fully controlled converter?	L1	CO2	PO 1
8	What is the difference between half controlled & fully controlled bridge rectifier?	L1	CO2	PO 1
9	Why is power factor of semi converter better than full converter?	L1	CO2	PO 1
10	What is the effect of source impedance on the performance converter?	L1	CO2	PO 1

Part – B (Long Answer Questions)					
11	a)	A 230v,50hz supply is connected to load resistance of 12ohm through half controlled rectifier, if the firing angle is 60 degree determine, (i) Average output voltage (ii) Rms output volage (iii) Ratio of rectification (iv) TUF	L1	CO2	PO1
	b)	Describe the effect of source inductance on the performance of a single phase full converter indicating clearly the conduction of various thyristors during one cycle. Derive the expression for its output voltage.	L2	CO2	PO1 , PO2
12	a)	A single phase full bridge converter is connected to 'R' load. The source voltage is of 230 V, 50 Hz. The average load current is of 10 A. For R = 20 Ω find the firing angle.	L2	CO2	PO1
	b)	Explain the principle of operation of single phase dual converter with neat power circuit diagram.	L2	CO2	PO1 , PO2
13	a)	Describe the operation of a single phase two pulse bridge converter using 4 SCR'S using RLE load with relevant waveforms.	L2	CO2	PO1 , PO2
	b)	Explain the operation of a single phase full bridge converter with RL load for continuous and discontinuous load currents.	L1	CO2	PO1
14	a)	Describe the operation of a single phase two pulse bridge converter using 4 SCR'S using RL load with relevant waveforms.	L1	CO2	PO1
	b)	A 220v, 1kw R load is supplied by 220v,50Hz source through 1ϕ fully controlled converter. Determine the following for 800w output. A) average output voltage b) rms value of i/p current c) fundamental component of input current d) displacement factor.	L1	CO2	PO1

15	a)	Explain the working of a three phase full converter with 'R' load for the firing angles of 60° and 90°.	L2	CO2	PO1, PO2
	b)	Explain the operation of 3 phase half controlled converter with neat waveforms. also derive an expression for the average output voltage	L1	CO2	PO1
16	a)	A single phase semi converter is operated from 120 V 50 Hz ac supply. The load current with an average value I_{dc} is continuous and ripple free firing angle $\alpha = \pi/6$. Determine i. Displacement factor ii. Harmonic factor of input current iii. Input power factor.	L2	CO2	PO1, PO2
	b)	Explain the operation of single phase half controlled rectifier with inductive load	L1	CO2	PO1

UNIT–III

DC-DC Converters (Chopper/SMPS)

S.No	Questions	BT	CO	PO
Part – A (Short Answer Questions)				
1	What are the applications of dc chopper?	L1	CO3	PO1
2	What is meant by step-up and step-down chopper?	L1	CO3	PO1
3	What are the two types of control strategies?	L1	CO3	PO1
4	What is meant by FM control in a dc chopper?	L1	CO3	PO1
5	What are the disadvantages of FM control?	L1	CO3	PO1
6	Write down the expression for the average output voltage for step down and step up chopper.	L1	CO3	PO1
7	Differentiate between constant frequency & variable frequency control	L1	CO3	PO1
8	What are the advantages of SMPS over phase controlled rectifiers?	L1	CO3	PO1
9	Define current limit control in DC–DC converter?	L1	CO3	PO1
10	Distinguish between time ratio control and current limit control?	L1	CO3	PO1
Part – B (Long Answer Questions)				
11 a)	A step-up chopper has input voltage of 220 V and output voltage of 660 V. If the non-conducting time of thyristor chopper is 100 μs, compute the pulse width of output voltage. Incase pulse width is halved for constant frequency operation, find the new output voltage.	L1	CO3	PO1
b)	Explain the various modes of operation of Boost DC-DC converter with necessary waveforms.	L1	CO3	PO1
12 a)	Explain the working of Buck–Boost converter with sketch and waveforms and also drive the expression for output voltage	L1	CO3	PO1

	b)	Discuss the principle of operation of DC-DC step up chopper with suitable waveform. Derive an expression for its average DC output voltage.	L1	CO3	PO1
13	a)	Discuss the principle of operation of DC-DC step down chopper with suitable waveform. Derive an expression for its average DC output voltage.	L1	CO3	PO1
	b)	A step-down dc chopper has a resistive load of R = 15Ω and input voltage E_{dc} = 200 V. When the chopper remains ON, its voltage drop is 2.5 for a duty cycle of 0.5. Calculate (1) Average and r.m.s value of output voltage (2) Power delivered to the load.	L3	CO3	PO1, PO2, PO3
14	a)	Draw the circuit of Buck-Boost regulator and explain its working principle with necessary waveform in detail.	L1	CO3	PO1
	b)	Draw the circuit of buck regulator and explain its working principle with necessary waveforms.	L1	CO3	PO1
15	a)	Write short notes on switch mode power supply	L1	CO3	PO1
	b)	Explain the various modes of operation of Boost DC-DC converter with necessary waveforms.	L1	CO3	PO1
16	a)	A dc chopper input voltage of 200v and resistive load of R = 8Ω resistance. Voltage drop across thyristor is 2v and chopping frequency 800 Hz the duty cycle is 0.5. Calculate (1) Average and r.m.s value of output voltage (2) Chopper efficiency and input resistance by the source.	L2	CO3	PO1, PO2
	b)	Draw the circuit of buck regulator and explain its working principle with necessary waveforms.	L3	CO3	PO1, PO2, PO3

UNIT–IV
AC-DC Inverters

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		What are the applications of an inverter?	L1	CO4	PO 1
2		What is meant by forced commutation?	L1	CO4	PO 1
3		Why thyristors are not preferred for inverters?	L1	CO4	PO 1
4		Why diodes should be connected in ant parallel with the thyristors in inverter circuits?	L1	CO4	PO 1
5		How is the inverter circuit classified based on commutation circuitry?	L1	CO4	PO 1
6		What is meant by PWM control?	L1	CO4	PO 1
7		What are the advantages of PWM control?	L1	CO4	PO 1
8		What are the disadvantages of the harmonics present in the inverter system?	L1	CO4	PO 1
9		What are the methods of reduction of harmonic content?	L1	CO4	PO 1
10		What are the different types of PWM methods for voltage control within inverter?	L1	CO4	PO 1
Part – B (Long Answer Questions)					
11	a)	With a neat sketch and output voltage waveforms, explain the working of three phase bridge inverter in 180 degree mode of operation.	L1	CO4	PO 1
	b)	Describe the working of a 1-φ full bridge inverter using R load with relevant circuit and waveforms.	L2	CO4	PO1 , PO2
12	a)	With a neat sketch and output voltage waveforms, explain the working of three phase bridge inverter in 120 degree mode of operation.	L1	CO4	PO 1
	b)	Describe the working of a 1-φ half bridge inverter using RL load with relevant circuit and waveforms.	L1	CO4	PO 1
13	a)	What is PWM? List the various PWM techniques and explain any one of them	L1	CO4	PO 1
	b)	Describe the working of a 1-φ full bridge inverter using RL load with relevant circuit and waveforms.	L1	CO4	PO 1
14	a)	Explain the following PWM techniques used in inverter. a. Sinusoidal PWM b. Multiple PWM.	L1	CO4	PO 1
	b)	Describe the working of a 1-φ half bridge inverter using R load with relevant circuit and waveforms.	L1	CO4	PO 1
15	a)	Describe the working of a 1-φ half bridge inverter using R& RL load with relevant circuit and waveforms.	L1	CO4	PO 1

	b)	What is PWM? List the various PWM techniques and explain any one of them	L1	CO4	PO 1
16	a)	Describe the working of a 1-φ full bridge inverter using R& RL load with relevant circuit and waveforms.	L1	CO4	PO 1
	b)	Explain the following PWM techniques used in inverter. a. Sinusoidal PWM b. Multiple PWM.	L1	CO4	PO 1

UNIT–V

AC-AC Converters

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		What is Integral cycle or ON-OFF control?	L1	CO5	PO1
2		What is the formula for duty cycle in ON-OFF control method?	L1	CO5	PO1
3		What is meant by cyclo-converter?	L1	CO5	PO1
4		What are the disadvantages of continuous gating signal?	L1	CO5	PO1
5		What are the applications of phase controlled converter or ac voltage controllers?	L1	CO5	PO1
6		What are the types of ac voltage controller?	L1	CO5	PO1
7		What are the two types of cyclo-converters?	L1	CO5	PO1
8		What is meant by step-up and step down cyclo-converters?	L1	CO5	PO1
9		What is meant by positive converter group in a cyclo converter?	L1	CO5	PO1
10		What are the applications of cyclo-converter	L1	CO5	PO1
Part – B (Long Answer Questions)					
11	a)	Explain the operation of 1- φ AC voltage controller with RL load.	L1	CO5	PO1
	b)	Explain the operation of 1ϕ to 1ϕ step up cyclo converter with power circuit and waveforms**.**	L1	CO5	PO1
12	a)	Explain the operation of 1ϕ to 1ϕ step down cyclo converter with power circuit and waveforms**.**	L1	CO5	PO1
	b)	A 1- φ sinusoidal AC voltage controller has input voltage 230v, 50Hz and a load of R=15Ω. For 6 cycles ON and 4 cycles OFF determine. i) rms output voltage ii) input PF iii) avg & rms thyristor currents.	L2	CO5	PO1, PO2
13	a)	Describe the operation of single phase ac voltage controller with the help of voltage and current waveform. Also derive the expression for average value of the output voltage.	L1	CO5	PO1
	b)	Explain the operation of 1- φ AC voltage controller with R load.	L1	CO5	PO1
14	a)	A resistive load of 5Ω is fed through a 1ϕ full wave AC voltage controller from 230v, 50Hz source. If firing angle of thyristor is 120 degree. Find the rms output voltage, input power factor and average current of thyristor.	L1	CO5	PO1
	b)	Explain the operation of 1ϕ to 1ϕ step up cyclo converter with power circuit and waveforms**.**	L1	CO5	PO1
15	a)	A 1- φ sinusoidal AC voltage controller has input voltage 230v, 50Hz and its feeding resistive load of 10ohms .if firing angle of thyristor is 110 degree. Find i) rms output voltage ii) input PF iii) avg & rms thyristor currents	L1	CO5	PO1
	b)	Explain the operation of TRIAC with the help of neat structural diagram and suitable wave forms.	L1	CO5	PO1
16	a)	Discuss in detail the static and switching characteristic of TRIAC	L1	CO5	PO1
	b)	Explain the operation of 1ϕ to 1ϕ step down cyclo converter with power circuit and waveforms**.**	L1	CO5	PO1

* **Blooms Taxonomy Level (BT)** (L1 – Remembering; L2 – Understanding; L3 – Applying;L4 – Analyzing; L5 – Evaluating; L6 – Creating)

Course Outcomes (CO)

Program Outcomes (PO)

Prepared By: Mrs. CH PRASANNA
Assisstant Professor (Dept. of EEE)