ST. ANNE'S COLLEGE OF ENGINEERING AND TECHNOLOGY

(Approved by AICTE, New Delhi. Affiliated to Anna University, Chennai)
ANGUCHETTYPALAYAM, PANRUTI – 607 106.

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

EE 3591 - POWER ELECTRONICS

V SEMESTER

Prepared by

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UNIT I - SWITCHING POWER SUPPLIES

SYLLABUS: MOSFET dynamic behavior - driver and snubber circuits - low power high switching frequency switching Power supplies, buck, boost, buck-boost converters – Isolated topologies – resonant converters - switching loss calculations and thermal design.

PART - A

Q.No	Questions	BT Level	Competence	COs
1.	Define the term pinch off voltage of MOSFET.	1	Remembering	CO1
2.	Define Duty cycle.	1	Remembering	CO1
3.	Name any two applications of SMPS.	1	Remembering	CO1
4.	Name the limitation of high frequency operation of a power electronic device.	1	Remembering	CO1
5.	Show the circuit diagram of a boost converter.	2	Understanding	CO1
6.	What is resonant converter? States its advantages.	2	Understanding	CO1
7.	Classify the switched mode regulators and write its advantages.	3	Applying	CO1
8.	Compare ZVS and ZCS.	5	Evaluating	CO1
9.	Why MOSFETs are not preferred for low frequency applications?	2	Understanding	CO1
10.	What do you mean by controlled switch?	2	Understanding	CO1
11.	What is the need of driver circuit?	2	Understanding	CO1
12.	What is the limitation of high frequency operation of a power electronic device?	2	Understanding	CO1
13.	What are the parameter involved in switching loss of power device?	3	Applying	CO1
14.	What are the advantage and disadvantages of buck/boost regulator?	3	Applying	CO1
15.	What is meant by buck regulator?	3	Applying	CO1
16.	What is meant by SMPS? Mention its two advantages.	4	Analysing	CO1
17.	What is meant by boost regulator?	4	Analysing	CO1
18.	What are the circuit configurations used for SMPS?	4	Analysing	CO1
19.	Give the uses of resonant switching.	5	Evaluating	CO1
20.	What is meant by resonant converter?	2	Understanding	CO1

PART - B

1.	Explain the working of buck converter with neat waveform and also derive the expression for peak to peak voltage across the capacitor. (13)	2	Understanding	CO1
2.	With a neat power circuit diagram, explain the operation of boost converter. Draw the load voltage and load current waveforms and derive the expression for the output voltage. (13)	2	Understanding	CO1
3.	Discuss L Type and M type zero current switching resonant converters. (13)	3	Applying	CO1
4.	Draw the power circuit diagram of a buck-boost regulator and explain its operation with equivalent circuit for different modes and its waveforms. (13)	2	Understanding	CO1

5.	What is resonant switching? Explain its concept with relevant circuit diagram. (13)	2	Understanding	CO1
6.	Explain the switching characteristics of MOSFET with the help of neat circuit diagram of waveforms. (13)	1	Remembering	CO1
7.	Explain the operation of flyback converter. (13)	1	Remembering	CO1
8.	Describe the working principle of boost converter with circuit and waveform. (13)	1	Remembering	CO1
9.	Explain the ZVS resonant converter with appropriate circuit and waveforms. (13)	1	Remembering	CO1
	PART - C			
1.	Explain the switching loss calculation thermal design of MOSFET. (15)	2	Understanding	CO1
2.	With neat diagram and waveform explain resonant DC-DC converter. (15)	1	Remembering	CO1

UNIT II - INVERTERS

SYLLABUS: IGBT: Static and dynamic behavior - single phase half bridge and full bridge inverters - VSI :(1phase and three phase inverters square wave operation) - Voltage control of inverters single, multi pulse, sinusoidal, space vector modulation techniques– various harmonic elimination techniques-CSI

Q.No	Questions	BT	Competence	COs
1.	List the various advantages of using PWM control of inverters	1	Remembering	CO4
2.	What is the advantage of 120 ^{o} mode of inverter operation	1	Remembering	CO4
3.	Define space vector modulation.	1	Remembering	CO4
4.	Tell why diodes should be connected in antiparallel	1	Remembering	CO4
5.	What is harmonic elimination by PWM?	1	Remembering	CO4
6.	What is meant by voltage source inverter?	1	Remembering	CO4
7.	Express the applications of a CSI.		Understanding	CO4
8.	Discuss PWM control and types of PW techniques.	2	Understanding	CO4
9.	What is a current source inverter?	2	Understanding	CO4
10.	What are the advantages of PWM control in inverter.	2	Understanding	CO4
11.	What is the function of feedback diodes in bridge inverter.	3	Applying	CO4
12.	Show the methods of reduction of harmonic content.	3	Applying	CO4

13.	What are the main differences between voltage-source and current source inverters?	3	Applying	CO4
14.	Compare SPWM and SVM	4	Analysing	CO4
15.	Differentiate CSI and VSI.	4	Analysing	CO4
16.	List the application of Inverters	4	Analysing	CO4
17.	What is meant by space vector modulation	5	Evaluating	CO4
18.	Evaluate the disadvantages of the harmonics present in the inverter system?	5	Evaluating	CO4
19.	Why thyristors are not preferred for Inverter?	1	Remembering	CO4
20.	State the necessity of return current diodes in inverter.	1	Remembering	CO4
	PART - B			
1.	Describe with circuit IGBT static I-V, transfer and turn –on and turn–off characteristics. (13)	1	Remembering	CO4
2.	Describe the operation of 3 phase bridge inverter for 120 degree mode of operation with aid of relevant phase and line voltage waveforms. (13)	1	Remembering	CO4
3.	Describe the principle of operation of 3 phase voltage source inverter with 180˚conduction mode with necessary waveforms and circuits. Also obtain the expression for line to line voltage. (13)	1	Remembering	CO4
4.	State the different methods of voltage control of inverters. Also describe about PWM control. (13)	1	Remembering	CO4
5.	Describe in detail, the various types of PWM methods available for voltage control employed in an inverter. (13)	1	Remembering	CO4
6.	Explain the SPWM and modified SPWM techniques for inverter switching. (13)	2	Understanding	CO4
7.	Describe the operation of 3 phase bridge inverter for 180 degree mode of operation with aid of relevant phase and line voltage waveforms. (13)	2	Understanding	CO4
8.	Explain the Principle of operation of 3-phase auto sequentially commutated CSI with power circuit. Draw the equivalent circuits and relevant waveforms. (13)	2	Understanding	CO4
9.	Examine the operation of single phase capacitor commutated CSI with R load. (13)	3	Applying	CO4
10.	Demonstrate the working of a single phase full bridge inverter supplying R, RL loads with relevant circuit and waveforms. (13)	3	Applying	CO4
11.	(i) Explain Multiple PWM. (7) (ii) Explain Sinusoidal PWM. (6)	4	Analysing	CO4

12.	Explain the different methods of voltage control adopted in an inverter with suitable waveforms. (13)	4	Analysing	CO4

PART - C				
1.	Explain in detail the different types of harmonic control of inverters. (15)	5	Evaluating	CO4
2.	With neat diagram explain the need for space vector modulations employed in inverters also explain the advantage SPVWM over other technique employed in inverters. (15)	4	Analysing	CO4

UNIT III - UNCONTROLLED RECTIFIERS

SYLLABUS: Power Diode – half wave rectifier – mid-point secondary transformer based full wave rectifier – bridge rectifier – voltage doubler circuit – distortion factor – capacitor filter for low power rectifiers – LC filters – Concern for power quality – three phase diode bridge.

PART - A

Q.No	Questions	BT Level	Competence	COs
1.	State applications of uncontrolled rectifiers.	2	Understanding	CO2
2.	What is RF? Why RF of single phase half wave rectifier is high?	2	Understanding	CO2
3.	What is the advantages of freewheeling diode in single phase half wave rectifier feeding inductive load?	2	Understanding	CO2
4.	What is the ripple frequency of single phase half wave converter and single phase full wave converter?	2	Understanding	CO2
5.	For the single phase full bridge rectifier, what is output voltage if supply voltage is 23 V rms.	3	Applying	CO2
6.	What is the ripple frequency of three phase bridge rectifier?	3	Applying	CO2
7.	State the advantages of three phase rectifiers.	3	Applying	CO2
8.	What is the purpose of double rectifier circuit?	4	Analyzing	CO2
9.	Which components of output are filtered by C and LC filters?	4	Analysing	CO2
10	What is the PIV of single phase center tapped full wave rectifier and single bridge rectifier?	4	Analysing	CO2
11	What is the transformer utilization factor?	5	Evaluating	CO2
12	What is power factor? State its formula.	5	Evaluating	CO2
13	What is rectification efficiency?	3	Applying	CO2
14	Draw the circuit diagram of half wave rectifier?	3	Applying	CO2
15	State the disadvantages of three phase rectifiers.	2	Understanding	CO2
16	Write the difference between center tapped and bridge rectifier.	2	Understanding	CO2
17	Draw the circuit diagram of three phase bridge rectifier with RL load.	2	Understanding	CO2
18	Comparison of single phase half wave and full wave rectifiers.	4	Analysing	CO2
19	What is power diode?	3	Applying	CO2
20	What are the types of diode?	3	Applying	CO2

PART - B

1.	With the help of suitable diagram. Explain the dynamic characteristics of power diode. (13)	1	Remembering	CO2
2.	Draw the wave forms and explain the separation of single phase full wave rectifier with RL load. Draw the input and output wave forms. (13)	1	Remembering	CO2
3.	Explain the working function of single phase full wave center tapped rectifier with pure resistive load also draw the input and output wave forms. (13)	1	Remembering	CO2
4.	List the performance parameter of single phase bridge rectifier suppling RL load. (13)	1	Remembering	CO2
5.	Explain the operation of three phase star connected rectifier for R load with the help of waveform. (13)	2	Understanding	CO2

6.	With the help of circuit diagram and waveform explain the operation of three phase bridge rectifier for R load also draw its input and output voltage waveform. (13)	2	Understanding	CO2
7.	what is the need of filter circuit , explain LC filters. (13)	2	Understanding	CO2
8.	Draw the waveform and explain the C & LC filters. (13)	3	Applying	CO2
9.	Draw the wave forms and explain the separation of single phase full wave rectifier with RLE load. Draw the input and output wave forms. (13)	3	Applying	CO2
10	With the help of circuit diagram and waveform explain the operation of three phase bridge rectifier for RL load also draw its input and output voltage waveform. (13)	4	Analysing	CO2
	PART - C			
1.	Explain the working function of single phase full wave center tapped rectifier with R and RL load also draw the input and output wave forms. (15)	1	Remembering	CO3
2.	With the help of circuit diagram and waveform explain the operation of three phase bridge rectifier for RLE load also draw its input and output voltage waveform. (15)	1	Remembering	CO3

UNIT IV - CONTROLLED RECTIFIERS

SYLLABUS: SCR-Two transistor analogy based turn- ON – turn ON losses – thermal protection – controlled converters (1 pulse, 2 pulse, 3 pulse, 6 pulse) - displacement factor – ripple and harmonic factor - power factor mitigation, performance parameters – effect of source inductance - inverter angle limit.

PART - A

Q.No	Questions	BT Level	Competence	COs
1.	Define overlap angle.	1	Remembering	CO3
2.	Show the power factor of semi converter is better than full converter.	1	Remembering	CO3
3.	Examine the effect of source impedance on the performance of converter.	1	Remembering	CO3
4.	Express the displacement factor for two pulse converter.	2	Understanding	CO3
5.	Predict the circuits turn –off time for single phase full converter.	2	Understanding	CO3
6.	Classify the various modes of operation of single phase fully controlled bridge converter.	4	Analysing	CO3
7.	Distinguish between symmetric and asymmetric semi converter configuration.	4	Analysing	CO3
8.	Why power factor of semi converter is better than full converter?	5	Evaluating	CO3
9.		2	Understanding	CO3
10	List some of the application of converters.	1	Remembering	CO3
11	A two pulse converter is fed with a 230V, 50 Hz supply. The load on the converter is a pure resistance of R=10 Ω. Obtain the average output voltage for a firing angle of α =135°	6	Creating	CO3
12	Examine the harmonic factor for converter.	3	Applying	CO3
13	Examine the term voltage ripple factor.	3	Applying	CO3
14	Explain the inversion mode of converter.	4	Analysing	CO3
15	Summarize the roles of freewheeling diode in a Full converter.	5	Evaluating	CO3
16	A single phase full converter feeds power to RLE load with R= 6Ω, E=60V.The full load inductance value is very large so as to maintain the load current continuous and ripple free .The ac source voltage is 230V and 50Hz. Find the average value of the output voltage for a firing angle delay of 50°.	6	Creating	CO3
17	Define harmonic factor of the input current.	2	Understanding	CO3
18	What is freewheeling diode, and what is its purpose? State its advantages.	2	Understanding	CO3
19	What is the effect of inductive load in the performance of a three phase bridge rectifier?	2	Understanding	CO3
20	List various applications of phase controlled converters.	2	Understanding	CO3

PART - B

1.	Describe the operation of three phase semi converter with R load and also draw the output voltage waveforms for 30° and 90°. (13)	1	Remembering	CO3
2.	Explain the operation of a single phase full converter with RLE load using relevant waveforms. Obtain the expressions for its average output voltage and RMS value of output voltage. (13)	1	Remembering	CO3

3.	Analyze the effect of source inductance in the operation of single phase fully controlled converter with relevant diagram and analysis. (13)	4	Analysing	CO3
4.	Discuss the effect of series inductance on the performance of the single phase full converter indicating clearly the conduction of various thyristors during one cycle. (13)	2	Understanding	CO3
5.	A 230 V, 50 Hz supply is connected to load resistance of 12Ω through half wave controlled rectifier. If the firing angle is 60 degree, Calculate (i) Average output voltage. (4) (ii) RMS output voltage. (3) (iii)Ratio of rectification and (3) (iv)Transformer utilization factor. (3)	3	Applying	CO3
6.	Explain the operation of a three phase, fully controlled bridge converter with associated waveforms. (13)	4	Analysing	CO3
7.	Summarize the operation of single phase two pulse midpoint converter with relevant voltage and current waveforms. (13)	5	Evaluating	CO3

8.	(i) A single phase bridge converter is utilized to produce regulated DC output voltage. The input voltage is 230 V and the load current is 8A for a firing angle of 30 degree. (a) Calculate the dc output voltage. (3) (b) Calculate the dc output voltage and current if a freewheeling diode is used at the output for the same firing angle. (4) (ii) Examine the single phase half wave rectifier circuit with RL load and freewheeling diode. (6)	3	Applying	CO3
9.	(i) A three phase full converter charges a battery from a three –phase supply of 230 V, 50Hz. The battery is 200 V and its internal resistance is 0.5 Ω. On account of inductance connected in series with the battery, charging current is constant at 20 A. Compute firing angle delay and supply power factor. (7) (ii) Explain briefly the working of dual converter with a neat circuit diagram. (6)	4	Analysing	CO3
10	A single phase half wave rectifier with an AC voltage of 150V has a pure resistive load of 9 Ω. The firing angle of the thyristor is π/2. Determine the (i) Rectification Efficiency (ii) Form Factor (iii) Transformer derating factor (iv) Peak inverse voltage of the SCR (v) Ripple factor of the SCR. Assume the transformer ratio is 2:1. (13)	6	Creating	CO3
	PART - C			
1.	Explain the operation of the SCR with the help of two transistor analogy. Also drive an expression for anode current. (15)	2	Understanding	CO3

2.	Explain the operation of single phase full wave mid- point converter to RL load , with the help of circuit diagram and waveform. Also explain the effect of freewhelling diode. (15)	2	Understanding	CO3

UNIT V - AC PHASE CONTROLLERS				
SYLLABUS: TRIAC triggering concept with positive and negative gate pulse triggering, TRIAC based phase controllers - various configurations for SCR based single and three phase controllers.				
PART - A				
Q.**No**	**Questions**	BT **Level**	**Competence**	**COs**
1.	What are the two types of ac voltage controllers? Which one of these is preferred and why?	1	Remembering	CO5
2.	List the merits and demerits of AC voltage controller.	1	Remembering	CO5
3.	Why half wave AC voltage regulator not used.	1	Remembering	CO5
4.	List the merits and demerits of ac voltage controller.	1	Remembering	CO5
5.	What is the principle of ON-OFF control of AC controller?	1	Remembering	CO5
6.	Compare on-off and phase-angle ac voltage controllers.	1	Remembering	CO5
7.	Give the expression for RMS and average output voltage of single phase half wave ac voltage controller.	2	Understanding	CO5
8.	Explain the term sequence control of ac voltage controller.	2	Understanding	CO5
9.	Give the advantage of sequence control of ac voltage regulators.	2	Understanding	CO5
10	List the applications of AC voltage controller.	2	Understanding	CO5
11	What are the effects of load inductance on the performance of ac voltage controllers?		Applying	CO5
12	What is an ac voltage controller?	3	Applying	CO5
13	What type of gating signal is used in single phase ac voltage controller with RL load.	3	Applying	CO5
14	Write any two important applications of ac voltage controllers.	4	Analysing	CO5
15	Differentiate phase control and sequence control of voltage controller.	5	Evaluating	CO5
16	Explain the necessity of FACTS Devices in the power system and write its classification	4	Analysing	CO5
17	What are the different control techniques for ac regulator?	4	Analysing	CO5
18	Compare integral cycle control and phase control in AC voltage controller.	5	Evaluating	CO5
19	Why is half wave ac voltage regulator not used?	4	Analysing	CO5
20	Write the output R.M.S voltage for single phase ac voltage controller with resistance load.	5	Evaluating	CO5

PART - B				
1.	Draw and Describe the circuit diagram of single phase AC voltage controller with RL load. Explain the circuit operation with necessary waveforms. (13)	1	Remembering	CO5
2.	Describe the operation of two stage sequence control of Ac voltage controller. (13)	1	Remembering	CO5
3.	A single phase full wave AC voltage controller has an input voltage of 230V 50Hz and it is feeding a resistive load of 10 Ohms. If the firing angle of thyristor is 110 degree. Calculate the output RMS voltage, input power factor and average current of thyristor. (13)	2	Understanding	CO5
4.	A resistive load of 5 Ohm is fed through a single phase full wave AC voltage controller from 230V 50 Hz source. If the firing angle of thyristor is 120 degree. Calculate the (i) Output RMS voltage. (5) (ii) Input power factor. (4) (iii)Average current of thyristor. (4)	2	Understanding	CO5
5.	(i) Explain about the construction and working principles of HVDC Systems and also explain about its types (7) (ii)Explain about the working of Welding and its effects (6)	2	Understanding	CO5
6.	With the aid of circuit diagram and waveform explain the operation of power factor control in Ac voltage regulator. (13)	2	Understanding	CO5
7.	Explain with circuit diagram and waveform the principle of operation of three phase AC voltage controller with neat diagram. (13)	2	Understanding	CO5
8.	Design a converter circuit for FACTS Devices and explain the operation with a neat diagram. (13)	3	Applying	CO5
9.	Explain TRIAC triggering concept with positive and negative gate pulse triggering. (13)	3	Applying	CO5
10.	Explain various configurations of SCR based single phase controller. (13)	3	Applying	CO5
PART - C				
1.	Explain various configuration of SCR based three phase controller. (15)	4	Analysing	CO5
2.	Explain TRIAC based single phase controller. (15)	4	Analysing	CO5

Course Outcomes:

Cos	Course Outcome
CO1	Understand the operation of semiconductor devices and dynamic characteristics and to design &analyze the low power SMPS
CO2	Analyze the various uncontrolled rectifiers and design suitable filter circuits
CO3	Analyze the operation of the n-pulse converters and evaluate the performance parameters
CO4	Understand various PWM techniques and apply voltage control and harmonic elimination methods to inverter circuits.
CO5	Understand the operation of AC voltage controllers and its applications.