DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING AND TECHNOLY

Mamallapuram chennai

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK

V SEMESTER

EE6503 - POWER ELECTRONICS

Regulation – 2013

Academic Year 2018 – 19

UNIT I - POWERSEMI-CONDUCTOR DEVICES			
SYLLABUS: Study of switching devices, Diode, SCR,TRIAC, GTO, BJT, MOSFET, IGBT- Static and Dynamic characteristics - Triggering and commutation circuit for SCR- Design of Driver and snubber circuit.			
PART - A			
Q.No	**Questions**	**BT Level**	**Competence**
1.	Define the term pinch off voltage of MOSFET.	BTL-1	Remembering
2.	List the advantages of GTO over SCR.	BTL-1	Remembering
3.	Examine the current commutation of SCR.	BTL-1	Remembering
4.	Name the limitation of high frequency operation of a power electronic device.	BTL-1	Remembering
5.	Mention the advantages of 'RC' triggering over 'r' triggering.	BTL-1	Remembering
6.	Tabulate the various forced commutation techniques used to turn off SCR.	BTL-1	Remembering
7.	Distinguish between SCR and TRIAC.	BTL-2	Understanding
8.	Predict the secondary breakdown in BJT	BTL-2	Understanding
9.	Discuss reverse recovery time in diodes.	BTL-2	Understanding
10.	Summarize the conditions under which a transistor operates as a switch.	BTL-2	Understanding
11.	List any two advantages of TRIAC over SCR.	BTL-3	Applying
12.	Illustrate the need of snubber circuit.	BTL-3	Applying
13.	Classify the types of diodes.	BTL-3	Applying
14.	Compare the merits and demerits of IGBT and MOSFET	BTL-4	Analysing
15.	What is meant by commutation of SCR and list its types.	BTL-4	Analysing
16.	What are the advantages of GTO over SCR.	BTL-4	Analysing
17.	Define the pinch off voltage off MOSFET.	BTL-5	Evaluating
18.	Why are IGBT becoming popular in PE based applications?	BTL-5	Evaluating
19.	Draw TRIAC characteristics.	BTL-6	Creating
20.	Why TRIAC is not popular as compared to SCR? Justify	BTL-6	Creating
PART - B			
1.	Examine the structure and different modes of operation with the characteristics of TRIAC. (13)	BTL-1	Remembering
2.	(i) Describe the turn off characteristics of SCR and explain the mechanism of turn OFF. (7) (ii) Describe in detail about the current commutation method of turn off SCR. (6)	BTL-1 BTL1	Remembering Remembering
3.	Describe with circuit IGBT static I-V, transfer and turn –on and turn–off characteristics. (13)	BTL-1	Remembering

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4.	Describe the UJT triggering circuit with neat sketch. (13)	BTL-1	Remembering
5.	(i) Discuss the different modes of operation of thyristor with the help of its static V-I characteristics. (7) (ii) Discuss why TRIAC is rarely operated in I quadrant with –ve gate current and in III quadrant with +ve gate current. (6)	BTL-2 BTL-2	Understanding Understanding
6.	(i) Snubber circuit for an SCR should primarily consist of capacitor only. But in practice a resistor is used in series with the capacitor, Why-Discuss.(7) (ii) Discuss the dynamic characteristics of a thyristor during its turn –ON and turn-OFF process. Discuss briefly the nature of these curves.(6)	BTL-2 BTL-2	Understanding Understanding
7.	Summarize the various types of commutation circuits for SCR (13)	BTL-2	Understanding
8.	(i) Explain the static and switching characteristics of MOSFET. (7) (ii) Demonstrate the working of a complementary commutation(6)	BTL-3 BTL-3	Applying Applying
9.	Examine the basic structure of IGBT and Explain its working .Give its equivalent circuit and explain the turn ON and turn OFF processes (13)	BTL-3	Applying
10.	(i) Explain and draw steady state and switching characteristics ofSCR.(7) (ii) With a neat diagram explain how the snubber circuit protects the MOSFET.(6)	BTL-4 BTL-4	Analysing Analysing
11.	(i) Analyze the constructional details of an SCR. Sketch its schematic diagram and explain its operation.(7) (ii) Explain turn-ON and turn-OFF characteristics of SCR.(6)	BTL-4 BTL-4	Analysing Analysing
12.	(i) Analyze the various types of power diodes.(7) (ii) Explain and draw steady state and switching characteristics of SCR.(6)	BTL-4 BTL-4	Analysing Analysing
13.	Explain the principle of operation and characteristics of GTO (13)	BTL-5	Evaluating
14.	Design a suitable snubber circuit for BJT which is used as a switching device in AC to DC conversion circuit.(13)	BTL-6	Creating
	PART - C		
1.	Design the switching model, equivalent circuit and switching waveforms and times of MOSFET. (15)	BTL-5	Evaluating
2.	Design a suitable driver circuit for MOSFET which is used a switching device in AC to DC conversion circuit.(15)	BTL-5	Evaluating
3.	Design the switching model, equivalent circuit and switching waveforms and times of IGBT. (15)	BTL-6	Creating
4.	Design a suitable driver circuit and snubber circuit for SCR which is used a switching device in AC to DC conversion circuit.(15)	BTL-6	Creating

UNIT II - PHASE-CONTROLLED CONVERTERSCONVERSION

SYLLABUS: 2-pulse, 3-pulse and 6-pulseconverters – performance parameters – Effect of source inductance - Gate Circuit Schemes for Phase Control – Dual converters.

Q.No	Questions	BT	Competence
1.	Define overlap angle.	BTL-1	Remembering
2.	List the some of the application of converters.	BTL-1	Remembering
3.	Examine the effect of source impedance on the performance of converter.	BTL-1	Remembering
4.	Express the displacement factor for two pulse converter.	BTL-2	Understanding
5.	Predict the circuit turn –off time for single phase full converter.	BTL-2	Understanding
6.	Illustrate the PIV of a thyristor.	BTL-3	Applying
7.	Classify the various modes of operation of single phase fully controlled bridge converter.	BTL-4	Analysing
8.	Distinguish between symmetric and asymmetric semiconductor configuration.	BTL-4	Analysing
9.	Why power factor of semi converter is better than full converter?	BTL-5	Evaluating
10.	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°	BTL-6	Creating
11.	Define input power factor.	BTL-1	Remembering
12.	What is meant by phase control?	BTL-1	Remembering
13.	Examine power factor of semi converter is better than full converter.	BTL-1	Remembering
14.	Describe the disadvantages of dual converter with circulating current mode of operation.	BTL-2	Understanding
15.	Predict by what power factor the DC output voltage of 6-pulse converter is reduced due to the effect of source inductance.	BTL-2	Understanding
16.	Examine the harmonic factor for converter.	BTL-3	Applying
17.	Examine the term voltage ripple factor.	BTL-3	Applying
18.	Explain the inversion mode of converter.	BTL-4	Analysing
19.	Summarize the roles of freewheeling diode in a controlled rectifier?	BTL-5	Evaluating
20.	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 230 V and 50Hz.Find the average value of the output voltage for a firing angle delay of 50°.	BTL-6	Creating
	PART - B		
1.	Describe the operation of three phase semiconverter with R load and also draw the output voltage waveforms for 30° and 90°. (13)	BTL-1	Remembering

2.	Examine the circuit and output wave form working of single phase two pulse fully controlled converter with RL load discontinuous current mode of operation.(13)	BTL-1	Remembering
3.	Analyze the effect of source inductance in the operation of single phase fully controlled converter with relevant diagram and analysis. (13)	BTL-4	Analysing
4.	(i) 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. (7) (ii) Describe the working of single phase dual converter in two modes. (6)	BTL-2 BTL-2	Understanding Understanding
5.	A 230 V ,50 Hz supply is connected to load resistance of 12Ω through half wave controlled rectifier .If the firing angle is 60m degree ,Calculate (i) Average output voltage (4) (ii) Rms output voltage (3) (iii)Ratio of rectification and (3) (iv)Transformer utilization factor (3)	BTL-3	Applying
6.	Explain the operation of a three phase ,fully controlled bridge converter with associated waveforms (13)	BTL-4	Analysing
7.	Summarize the operation of single phase two pulse midpoint converter with relevant voltage and current waveforms. (13)	BTL-5	Evaluating
8.	(i) Label the operating principle of single phase dual converter (7) (ii) A single phase full converter is connected with R-load .The source voltage is 230 V 50 Hz.The average load current is 10A For R=20 Ω find the firing angle (6)	BTL-1 BTL1	Remembering Remembering
9.	Describe with the neat sketch of voltage and current waveform of a circulating current type dual converter (13)	BTL-1	Remembering
10.	Discuss the operation of dual converter with complete circuit diagram and waveform. (13)	BTL-2	Understanding
11.	Describe the working of a single phase full converter in the rectifier mode with RL load. Discuss how one pair of SCRs is commutated by an incoming pair of SCRs. Illustrate your answer with the waveforms of source voltage load voltage and source current. Assume(13)	BTL-2	Understanding

12.	(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 (b) Calculate the dc output voltage and current if a freewheeling diode is used at the output for the same firing angle(7) (ii) Examine the single phase half wave rectifier circuit with RL load and freewheeling diode. (6)	BTL-3 BTL-3	Applying Applying
13.	(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)	BTL-4 BTL-4	Analysing Analysing
14.	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)	BTL-6	Creating
PART - C			
1.	Design a suitable gate schemes for 2-pulse converters used to convert AC to DC which uses phase control technique.(15)	BTL-5	Evaluating
2.	Design a suitable source inductance for 3-pulse converters used to convert AC to DC which uses phase control technique. (15)	BTL-5	Evaluating
3.	Design a suitable gate schemes for 6-pulse converters used to convert AC to DC which uses phase control technique. (15)	BTL-6	Creating
4.	Design a suitable source inductance for 6-pulse converters used to convert AC to DC which uses phase control technique. (15)	BTL-6	Creating

UNIT III - DC TO DC CONVERTER

SYLLABUS: Step-down and step-up chopper-control strategy–Forced commutated chopper–Voltage commutated, Current commutated, Load commutated, Switched mode regulators-Buck, boost, buck- boost converter, Introduction to Resonant Converters.

PART - A

Q.No	Questions	BT Level	Competence
1.	Define Duty cycle	BTL-1	Remembering
2.	Define DC Chopper and write down the application of DC chopper	BTL-1	Remembering
3.	Name any two application of SMPS.	BTL-1	Remembering
4.	What is constant frequency control of chopper	BTL-1	Remembering
5.	What is time control in DC to DC converter.	BTL-1	Remembering
6.	What is meant by 'current limit control ' of a chopper.	BTL-1	Remembering
7.	What is the effect of load inductance on the load current waveform in the case of DC chopper	BTL-2	Understanding
8.	Write down the control strategies for chopper circuit?	BTL-2	Understanding
9.	Show the circuit diagram of boost converter	BTL-2	Understanding
10	What is a resonant converter	BTL-2	Understanding
11	Write the advantages of resonant converters.	BTL-3	Applying
12	Classify the advantages of switched mode regulators	BTL-3	Applying
13	Briefly state the working of four quadrant DC chopper	BTL-3	Applying
14	Explain load commutated chopper?	BTL-4	Analysing
15	Differentiate voltage and current commutated chopper?	BTL-4	Analysing
16	Why forced commutation is used in DC chopper	BTL-4	Analysing
17	What is the disadvantages of frequency modulation chopper	BTL-5	Evaluating
18	Compare ZVS and ZCS	BTL-5	Evaluating
19	Design the circuit of a step down chopper	BTL-6	Creating
20	Generalize the purpose of commutation circuit in a chopper	BTL-6	Creating

PART - B

1.	With neat diagrams,describe the construction and working of step-down and step up chopper and steady state analysis..Give its application.(13)	BTL-1	Remembering
2.	Explain the control strategies of chopper(13)	BTL-1	Remembering
3.	Explain the working of buck converter with neat waveform and also derive the expression of peak to peak voltage across the capacitor.(13)	BTL-1	Remembering
4.	With neat sketch and output waveforms explain the working of a boost converter.(13)	BTL-1	Remembering
5.	Discuss L Type and M type zero current switching resonant converter(13)	BTL-2	Understanding
6.	Draw the power circuit diagram of a buck-boost regulator and explain its operation with equivalen circuit for different modes and waveforms(13)	BTL-2	Understanding
7.	What is resonant switching? Explain its concept with relevant circuit diagram. (13)	BTL-2	Understanding

8.	A step down DC Chopper has input voltage of a 230V with 10Ohms load resistor connected, voltage drop across chopper is 2 V when it is ON. For duty cycle of 0.5.Calculate (i) average and RMS value of output voltage(7) (ii)Power delivered to load. (6)	BTL-3	Applying
9.	(i) A type –'A' chopper has supply voltage Vs and duty cycle of 0.4 and 0.6 for these duty cycles, calculate (i) average and rms values of output voltage(3) (ii)output power for R load of 10 Ohm(2) (iii)ripple factor (2) (ii) Explain the operation of step up chopper and derive an expression for its output voltage(6)	BTL-3 BTL-3	Applying Applying
10	Describe the voltage commutated chopper with neat sketch.(13)	BTL-4	Analysing
11	Explain in detail the different modes of operation of current commutated chopper with relevant circuit diagram(13)	BTL-4	Analysing
12	Explain in detail the different modes of operation of load commutated chopper with relevant circuit diagram(13)	BTL-4	Analysing
13	Draw and explain the block schematic of SMPS and mention its advantages over linear power supply.(13)	BTL-5	Evaluating
14	A battery operated electric car is controlled by a voltage commutated chopper. The battery voltage is 100V, starting current is 100A,thyristor turnoff time is 20µsec,chopper frequency is 400Hz. Design the value of commutating capacitor C and commutating inductor L.(13)	BTL-6	Creating
	PART - C		
1.	For a current commutated chopper, peak commutating current is twice the maximum possible load current. The source voltage is 230V dc and main SCR turn-off time is 30µsec.For a maximum load current of 200A,Evaluate a) The value of the commutating inductor and capacitor.(5) b) Maximum capacitor voltage(5) c) The peak commutating current. (5)	BTL-5	Evaluating
2.	A load commutated chopper, fed from a 230V dc source has a constant load current of 50A.For a duty cycle of 0.4 and a chopping frequency of 2kHz, Evaluate the a) the value of commutating capacitance(4) b) average output voltage(4) c) circuit turn-off time for one SCR pair(4) d) total commutation interval(3)	BTL-5	Evaluating
3.	Design the filter component for a buck converter which has an input voltage of 12V and output voltage of 5V.The peak to peak output ripple voltage is 20mV and peak to peak ripple current is limited to 0.8A.the switching frequency is 25kHz.(15)	BTL-6	Creating

4.	Design a zero voltage switching resonant converter and explain the operation in different modes with waveforms(15)	BTL-6	Creating

UNIT IV - INVERTERS

SYLLABUS: Single phase and three phase voltage source inverters (both 120˚ mode and 180˚ mode) –Voltage & harmonic control -- PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - multiple PWM – Introduction to space vector modulation – Current source inverter.

PART - A

Q.No	Questions	BT Level	Competence
1.	List the various advantages of using PWM control of inverters	BTL-1	Remembering
2.	What is the advantage of 120 ° mode of inverter operation over	BTL-1	Remembering
3.	Define space vector modulation.	BTL-1	Remembering
4.	Tell why diodes should be connected in antiparallel inverter	BTL-1	Remembering
5.	What is harmonic elimination by PWM?	BTL-1	Remembering
6.	What is meant by voltage source inverter?	BTL-1	Remembering
7.	Express the applications of a CSI.	BTL-2	Understanding
8.	Discuss PWM control and types of PW techniques.	BTL-2	Understanding
9	What is a current source inverter?	BTL-2	Understanding
10	What are the advantages of PWM control in inverter.	BTL-2	Understanding
11	What is the function of feedback diodes in bridge inverter.	BTL-3	Applying
12	Show the methods of reduction of harmonic content.	BTL-3	Applying
13	Why is series inverter called so?	BTL-3	Applying
14	Compare SPWM and SVM	BTL-4	Analysing
15	Differentiate CSI and VSI.	BTL-4	Analysing
16	List the application of VSI	BTL-4	Analysing
17	What is meant by space vector modulation	BTL-5	Evaluating
18	Evaluate the disadvantages of the harmonics present in the inverter system?	BTL-5	Evaluating
19	Why thyristors are not preferred for Inverter?	BTL-6	Creating
20	State the necessity of return current diodes in inverter.	BTL-6	Creating

PART - B

1.	Describe the operation of 3 phase bridge inverter for 120 degree mode of operation with aid of relevant phase and line voltage waveforms.(13)	BTL-1	Remembering
2.	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)	BTL-1	Remembering
3.	State the different methods of voltage control inverters. Describe about PWM control in inverter.(13)	BTL-1	Remembering
4.	Describe in detail, the various types of PWM methods available for voltage control employed in an inverter..(13)	BTL-1	Remembering
5.	Explain the SPWM and modified SPWM techniques for inverter switching.	BTL-2	Understanding
6.	Write in detail about voltage and harmonic control with neat diagram. (13)	BTL-2	Understanding
7.	Discuss the circuit diagram of current source inverter and explain its operation with relevant waveforms(13)	BTL-2	Understanding
8.	Examine the operation of single phase capacitor commutated CSI with R load. (13)	BTL-3	Applying

9.	Demonstrate the working of a single phase full bridge inverter supplying R, RL loads with relevant circuit and waveforms. (13)	BTL-3	Applying
10	(i) Explain Multiple PWM(7) (ii) Explain Sinusoidal PWM(6)	BTL-4	Analysing
11	Explain the different methods of voltage control adopted in an inverter with suitable waveforms(13)	BTL-4	Analysing
12	With neat diagram explain the need for space vector modulation employed in inverters also explain the advantage SPVWM over other technique employed in inverters. (13)	BTL-4	Analysing
13	Explain in detail the different types of harmonic control of inverters(13)	BTL-5	Evaluating
14	Design a circuit diagram and explain the operation of modified mcmurray half bridge Inverter with different mode of operation. (13)	BTL-6	Creating
	PART C		
1	Design and develop the gating signal using a modified pulse width modulation for an inverter.(15)	BTL-5	Evaluating
2	Evaluate the performance parameters of inverter. (15)	BTL-5	Evaluating
3	Design a suitable gate scheme for proper functioning of three phase voltage source inverter in 120^{o} operating mode and obtain phase and line voltage waveforms(15)	BTL-6	Creating
4	Design a suitable gate scheme for proper functioning of three phase voltage source inverter in 180^{o} operating mode and obtain phase and line voltage waveforms (15)	BTL-6	Creating

UNIT V - AC TO AC CONVERTERS			
SYLLABUS: Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistage sequence control - single phase and three phase cyclo converters – Introduction to Matrix converters.			
PART - A			
Q.No	Questions	BT Level	Competence
1.	Write the principle of operation of cycloconverter.	BTL-1	Remembering
2.	List the advantage of AC to AC converter.	BTL-1	Remembering
3.	Why half wave AC voltage regulator not used.	BTL-1	Remembering
4.	What is a matrix converter?	BTL-1	Remembering
5.	What is the principle of ON-OFFcontrol of AC controller	BTL-1	Remembering
6.	What is meant by negative group in cycloconverter	BTL-1	Remembering
7.	Give the expression for RMS and average output voltage of single phase half wave ac voltage controller.	BTL-2	Understanding
8.	Explain the term sequence control of ac voltage controller.	BTL-2	Understanding
9.	Give the advantage of sequence control of ac voltage	BTL-2	Understanding
10	List out the applications of AC voltage controller.	BTL-2	Understanding
11	Examine the types of cycloconverters	BTL-3	Applying
12	Enumerate some of the industrial applications of a	BTL-3	Applying
13	What type gating signal is used in single phase ac voltage	BTL-3	Applying
14	Explain cycloconverter	BTL-4	Analysing
15	Differentiate phase control and sequence control of voltage controller	BTL-4	Analysing
16	What is the control of firing angle in AC voltage controller	BTL-4	Analysing
17	Evaluate the application of cycloconverters	BTL-5	Evaluating
18	Compare integral cycle control and phase control in AC voltage controller.	BTL-5	Evaluating
19	Generalize a positive converter group in cycloconverter.	BTL-6	Creating
20	Mention the advantages of matrix converter over conventional converter.	BTL-6	Creating
PART - B			
1.	Describewith circuit diagram and waveform principle of phase control of single phase controller with RL load and obtain expression for voltage and power factor.(13)	BTL-1	Remembering
2.	Describe the operation of two stage sequence control of Ac voltage controller.(13)	BTL-1	Remembering
3.	Decribe the operating principle of single phase to single phase cycloconverter with continuous and discontinuous load current with circuit and waveform.(13)	BTL-1	Remembering
4.	Write a short note on the following (i)Integral cycle control(7) (ii)stepup cycloconverter(6)	BTL-2	Understanding

5.	Discuss the operation of three phase to three phase cycloconverter with neat diagram and waveforms.(13)	BTL-2	Understanding
6.	(i) What is the importance of power factor control in a converter?Explain it in details.(7) (ii) Write a short note on Matrix converter.(6)	BTL-2	Understanding
7.	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 thyrisitor is 110 degree. Calculate the output RMS voltage , input power factor and average current of thyristor (13)	BTL-3	Applying
8.	A single phase voltage controller has input voltage of 230V 50Hz and a load of R=15 Ohm. For 6 cycles ON and 4 cycles OFF. Calculate (i)RMS output voltage (5) (ii)Input pf(4) (iii)Average and rms thyristor currents.(4)	BTL-3	Applying
9.	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)	BTL-3	Applying
10	(i) What is meant by Multistage sequence control? Explain it with relevant circuit diagram.(7) (ii) Compare single phase and three phase cloconverters.(6)	BTL-4	Analysing
11	With the aid of circuit diagram and waveform explain the operation of power factor control in Ac voltage regulator.(13)	BTL-4	Analysing
12	Explain with circuit diagram and waveform principle of operation of three phase AC voltage controller with neat diagram.(13)	BTL-4	Analysing
13	Compare the advantages and disadvantages of Cycloconverter and DC link converter.(13)	BTL-5	Evaluating
14	Design a matrix converter and explain the operation with a neat diagram(13)	BTL-6	Creating
PART - C			

1.	A single phase fullwave ac voltage controller has a resistive load of 5 Ohm and an input voltage 230 V,50Hz. The firing angles of thyristors T1 and T2 is 120 degree.Evaluate (i)the rms value of load voltage(3) (ii)input power factor(3) (iii)average value of current of thyristor(4) (iv)rms current of thyristor(3) (v)load power(3)	BTL-5	Evaluating
2.	A 1 Ø full wave ac voltage controller feeds a load of R=20Ω with an input voltage of 230V,50 HZ .firing angle for both the thyristor is 45 º.Evaluate 1.rms value of output Voltage(3),2.Calculate load power and input power factor(3),3.average and rms current of Thyristors(2). Also calculate above parameters when both thyristor firing angle is 30 degree.(15)	BTL-5	Evaluating
3.	Design a single phase full wave ac voltage controller with resistive load and obtain the rms output voltage and load current expression(15)	BTL-6	Creating
4.	Design a single phase to single phase step down cycloconverter with centre –tapped transformer configuration and also explain the operation with output current and voltage waveforms.(15)	BTL-6	Creating