SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203

(An autonomous institution)

DEPARTMENT OF

ELECTRICAL AND ELECTRONICS ENGINEERING

M.E (PSE)

QUESTION BANK

I SEMESTER

1916106 - ANALYSIS AND DESIGN OF POWER CONVERTERS

Regulation – 2019

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DEPARTMENT OF EEE

QUESTION BANK

SUBJECT : 1916106 - Analysis and Design of Power Converters

SEM / YEAR: I / 2021-22 (ODD)

UNIT I - SINGLE PHASE & THREE PHASE CONVERTERS				
Principle of phase controlled converter operation – single-phase full converter and semi- converter (RL,RLE load)- single phase dual converter – Three phase operation full converter and semi-converter (R,RL,RLE load)– reactive power – power factor improvement techniques –PWM rectifiers.				
PART – A				
Q.No	**Questions**	**BT Level**	**Competence**	**COs**
1.	Define power factor.	BT-2	Understand	CO1
2.	List out the different types of controlled rectifier.	BT-1	Remember	CO1
3.	Quote the expression for the RMS output voltage in single phase fully controlled rectifier with RLE load.	BT-1	Remember	CO1
4.	Generalize the expression for the Average and RMS output voltage in single phase semi converter.	BT-6	Create	CO1
5.	Evaluate the various applications of controlled converter.	BT-5	Evaluate	CO1
6.	Examine the function of freewheeling diode in controlled rectifier.	BT-3	Apply	CO1
7.	List the two configuration of single phase two pulse controlled rectifier.	BT-1	Remember	CO1
8.	Integrate the reverse recovery time in diode circuits.	BT-6	Create	CO1
9.	Draw the output current waveform of single phase semi controlled AC-DC converter fed RL load for $\alpha = 30^\circ$.	BT-2	Understand	CO1
10.	Give the power balance equation in converter circuits.	BT-2	Understand	CO1
11.	Define ripple and distortion factor.	BT-1	Remember	CO1
12.	Mention the performance parameters of GTO.	BT-5	Evaluate	CO1
13.	Define voltage ripple factor.	BT-1	Remember	CO1
14.	Describe the advantages of using a freewheeling diode in a semi converter circuit.	BT-2	Understand	CO1
15.	Differentiate the rectifier mode and inverter mode in single phase converters.	BT-4	Analyse	CO1
16.	Illustrate the effect of source inductance in single phase converters.	BT-3	Apply	CO1
17.	Examine the conditions required for operating the full converter in the inverter mode.	BT-3	Apply	CO1
18.	Explain the reactive power.	BT-4	Analyse	CO1
19.	Point out the power factor improvement techniques.	BT-4	Analyse	CO1
20.	Describe the PWM rectifiers.	BT-1	Remember	CO1

PART – B				
1.	Discuss on a single phase full converter feeding RLE load.	BT-2	Understand	CO1
2.	Describe the principle of operation of a single phase semi converter with freewheeling diodes. Sketch the circuit diagram and draw the waveforms for source voltage, output voltage, thyristor currents, diode currents, source current, load current and freewheeling diode current assuming a large inductor in the load. Derive the expression for average output voltage and also derive the expression for RMS output voltage.	BT-2	Understand	CO1
3.	Examine the principle of operation for a single phase full converter with R-L load and no freewheeling diode. Sketch the circuit diagram and draw the waveforms for source voltage, output voltage, load current and source current assuming a large inductor and no ripple in the output current. Derive the expression for RMS output voltage.	BT-1	Remember	CO1
4.	Analyse the single phase dual converter.	BT-4	Analyse	CO1
5.	Describe the principle of operation for a single phase full converter with R-L load and no free-wheeling diode. Sketch the circuit diagram and draw the waveforms for source voltage, output voltage, load current and source current assuming a large inductor and no ripple in the output current. Derive the expression for average output voltage.	BT-1	Remember	CO1
6.	Summarize the effect of overlap on the performance of half controlled converters. Discuss with circuit and output waveform the working of single phase fully controlled converter with RL load in discontinuous mode of operation.	BT-2	Understand	CO1
7.	A 3 phase bridge converter is used for obtaining a regulated Dc output voltage. The supply voltage is 440V and the firing angle is maintained at 60˚ so that the load current is 15 A; Calculate 1)DC output voltage 2)active and reactive power input 3)DC output voltage if freewheeling diode is connected 4) Derive the expression used.	BT-4	Analyse	CO1
8.	Examine on a three phase operation full controlled bridge converter.	BT-3	Apply	CO1
9.	Describe the Three phase operation of semi-converter R and RL load.	BT-1	Remember	CO1
10.	A six pulse thyristor converter connected on the secondary of delta /star connected 6.6 kV /415V ,50 Hz transformer is supplying to 460 V,200 A DC load. Identify the following (i) converter firing angle (ii)dc power delivered by the converter (iii)AC line current (iv)RMS value of the device current.	BT-1	Remember	CO1
11.	Generalize the Three phase operation of semi-converter RLE load.	BT-6	Create	CO1
12.	Demonstrate the power factor improvement techniques and explain the reactive power.	BT-3	Apply	CO1

13.	Evaluate the inverter mode of operation for thyristor converters.	BT-5	Evaluate	CO1
14.	Explain the PWM rectifiers.	BT-4	Analyze	CO1
PART – C				
1	The single phase full converter has a RL load having L=6.5 mH, R= 0.5Ω and E=10V.The input voltage is V_s=120Vat (rms)60 Hz. Evaluate the following (a)the load current I_{LO} at $\omega t=\alpha=60^o$,(b)the average thyrsitor current I_A,(c)the rms thyristor current I_R,(d)the rms output current I_{rms},(e)the average output I_{dc}, and (f)the critical delay angle α_c.	BT-5	Evaluate	CO1
2	The single phase dual converter is operated from a 120V, 60 Hz supply and the load resistance is R=10Ω. The circulating inductance is L_r=40mH.delay angles are $\alpha_1=60^o$ and $\alpha_2=120^o$.Design the peak circulating current and peak current of converter1.	BT-6	Create	CO1
3	Integrate the single phase full converter feeding RLE load and PWM rectifiers.	BT-6	Create	CO1
4	Summarize the Three phase operation of semi-converter R and RL load and Evaluate the power factor improvement techniques and explain the reactive power.	BT-5	Evaluate	CO1

UNIT II - DC-DC CONVERTERS				
Limitations of linear power supplies, switched mode power conversion, Non-isolated DC-DC converters: operation and analysis of Buck, Boost, Buck-Boost, Cuk & SEPIC – under continuous and discontinuous operation – Isolated converters: basic operation of Flyback, Forward and Push-pull topologies.				
PART – A				
Q.No	**Questions**	**BT Level**	**Competence**	**COs**
1.	Define chopper.	BT-1	Remember	CO2
2.	Examine the pulse width modulation in control in dc chopper.	BT-1	Remember	CO2
3.	Discuss the frequency modulation in control in dc chopper.	BT-2	Understand	CO2
4.	Integrate the integral cycle control.	BT-6	Create	CO2
5.	What do you understand by time ratio control of DC-DC converter?	BT-5	Evaluate	CO2
6.	Discover the features of a boost converter.	BT-3	Apply	CO2
7.	Estimate the step-down converter with 100V input voltage and R = 12 ohms, if the switching frequency is 1.5 KHz, what should be the ON time to get a output voltage of 80V?	BT-2	Understand	CO2
8.	Generalize the advantages of dc chopper.	BT-6	Create	CO2
9.	List the basic types of DC-DC converters.	BT-1	Remember	CO2
10.	Describe the output voltage of a buck-boost converter dependent on duty ratio.	BT-2	Understand	CO2
11.	Name two applications for boost converters.	BT-1	Remember	CO2
12.	A single quadrant chopper operating on third quadrant is supplied with load voltage wave form consists of square pulses of duration of 5 ms and overall chopping time period of 2 s .calculate the voltage ripple factor.	BT-5	Evaluate	CO2
13.	Describe the various performance parameters of a DC to DC converter.	BT-1	Remember	CO2
14.	Compare the buck boost and cuk converter.	BT-4	Analyse	CO2
15.	Describe the SEPIC converter.	BT-2	Understand	CO2
16.	Examine the basic operation of Flyback converter.	BT-3	Apply	CO2
17.	Illustrate the disadvantage of current limit control in DC-DC converters.	BT-3	Apply	CO2
18.	Analyse the Push-pull topologies.	BT-4	Analyze	CO2
19.	Point out the DC-DC converter topology is suitable for electric vehicle drives.	BT-4	Analyze	CO2
20.	Label the control characteristics of buck converter.	BT-1	Remember	CO2
PART – B				
1.	Estimate the principle of operation of a buck converter with circuit diagram showing the various modes. Derive the expression for output voltage and continuous inductor current and capacitor current.	BT-2	Understand	CO2
2.	Discuss the Limitations of linear power supplies, switched mode power conversion.	BT-2	Understand	CO2
3.	Analysis of Boost converter and Explain the operation of boost converter with circuit diagram showing the various modes.	BT-4	Remember	CO2

4.	Explain the principle of operation of a Cuk converter with circuit diagram showing the various modes. If the input voltage is 15V and the duty cycle is 0.7 what is the output voltage.	BT-4	Analyse	CO2
5.	Examine the principle of operation of a buck-boost converter showing various modes.	BT-1	Remember	CO2
6.	Describe the Cuk converter and Derive the expression for continuous and discontinuous operation.	BT-2	Understand	CO2
7.	Analyse the buck-boost converter and Derive the expression for continuous and discontinuous operation.	BT-4	Analyse	CO2
8.	Illustrate the SEPIC converter and express the inductor and duty cycle of SEPIC converter.	BT-3	Apply	CO2
9.	Examine the Isolated converters.	BT-1	Remember	CO2
10.	Discuss the basic operation of a Flyback converter showing various modes and draw the steady state waveforms of discontinuous mode operation.	BT-2	Understand	CO2
11.	Generalize the Forward converter and draw the steady state waveforms in continuous mode operation.	BT-6	Create	CO2
12.	Illustrate the Push-pull converter configuration and Derive the expression for average output voltage.	BT-3	Apply	CO2
13.	The average output voltage of push pull converter is V_0=24V at a resistive load of R=0.8Ω.The on state voltage drops of transistors and diode are V_t=1.2V and V_d =0.7 V respectively. The turns ratio of the transformer is a =N_s/N_p = 0.25.Evaluate the following (1) the average input current (2) the efficiency (3) the average transistor current and (4) the peak transistor current. Assume duty cycle =0.5. Neglect the losses in the transformer, and the ripple current of the load. The	BT-5	Evaluate	CO2
14.	The average output voltage of flyback converter is V_0=24V at a resistive load of R=0.8Ω.The duty cycle ratiois k=50% and the switching frequency is f=1 k Hz.the on state voltage drops of transistors and diode are V_t=1.2V and V_d =0.7 V, respectively. The turns ratio of the transformer is a =N_s/N_p = 0.25.Point out the following (1) the average input current (2) the efficiency (3) the average transistor current and (4) the peak transistor current. Neglect the losses in the transformer, and the ripple	BT-4	Analyze	CO2
PART – C				
1	The buck regulator has an input voltage V_s= 12V.The required average output is V_a=5 V at R=500Ω and the peak to peak output ripple voltage is 20mV.The switching frequency is 25 kHz.If the peak to peak ripple current of inductor is limited to 0.8A,Evaluate the (1)the duty cycle (2)the filter inductance (3)the filter capacitor, and (4)the critical values of L and C.	BT-5	Evaluate	CO2

2	The buck –boost regulator has an input voltage V_s= 12V.The duty cycle is k=0.25 and The switching frequency is 25 kHz. The inductance L=150 μH and filter capacitance C=220μF.The average load current I_a= 1.25 A. Integrate (1)the average output voltage (2)the peak to peak output voltage ripple (3)the peak to peak ripple current of inductor (4)the peak current of the transistor (5)the critical values of L and C.	BT-6	Create	CO2
3	The input voltage of cuk converter V_s= 12V.The duty cycle is k=0.25 and The switching frequency is 25 kHz. The filter inductance L_2=150 μH and filter capacitance C_2=220μF.The energy transfer capacitance is C_1= 200 μF and inductance L_1=180 μH .The average load current I_a= 1.25 A. Compose the following (1)the average output voltage (2)the average input current (3)the peak to peak ripple current of inductor L_1 ,ΔI_1(4) the peak to peak ripple voltage of capacitor C_1, ΔVC_1(5) the peak to peak ripple current of inductor L_2 ,ΔI_2 (6) the peak to peak ripple voltage of capacitor C_2, ΔVC_2.	BT-6	Create	CO2
4	(i)Evaluate the fly back converter and draw the steady state waveforms of discontinuous mode operation. (ii)Compare fly back converter with forward converter.	BT-5	Evaluate	CO2

UNIT III- DESIGN OF POWER CONVERTER COMPONENTS				
Introduction to magnetic materials- hard and soft magnetic materials –types of cores , copper windings – Design of transformer –Inductor design equations –Examples of inductor design for buck/flyback converter-selection of output filter capacitors – selection of ratings for devices – input filter design.				
PART - A				
Q.No	**Questions**	**BT Level**	**Competence**	**COs**
1.	Describe the soft magnetic materials.	BT-2	Understand	CO3
2.	Quote the classification of magnetic materials.	BT-1	Remember	CO3
3.	Examine the hard magnetic materials.	BT-1	Remember	CO3
4.	Integrate the soft and hard magnetic materials.	BT-6	Create	CO3
5.	Evaluate the copper windings.	BT-5	Evaluate	CO3
6.	Classify the types of cores.	BT-3	Apply	CO3
7.	Define the filling factor.	BT-1	Remember	CO3
8.	Generalize the hysteresis loop.	BT-6	Create	CO3
9.	Summarize the laminated core.	BT-2	Understand	CO3
10.	Differentiate the powdered iron and carbonyl iron.	BT-2	Understand	CO3
11.	Tell the applications of nano-crystal line materials.	BT-1	Remember	CO3
12.	Evaluate the current density in the windings in transformer design.	BT-5	Evaluate	CO3
13.	Define the maximum flux density.	BT-1	Remember	CO3
14.	Point out the design equation of inductor in optimum effective permeability.	BT-4	Analyze	CO3
15.	Discuss the core loss of inductor design.	BT-2	Understand	CO3
16.	Illustrate the input selection capacitor.	BT-3	Apply	CO3
17.	Examine the output capacitors effect feedback.	BT-3	Apply	CO3
18.	Analyse the transient performance.	BT-4	Analyze	CO3
19.	Contrast the optimum flux density limited by saturation in transformer design.	BT-4	Analyze	CO3
20.	Define the inductance.	BT-1	Remember	CO3
PART - B				
1.	Discuss the magnetic materials.	BT-2	Understand	CO3
2.	i)Differentiate the soft and hard magnetic materials.(6) ii) Describe the hysteresis loop.(7)	BT-2	Understand	CO3
3.	Examine the magnetic component manufacturing sheet.	BT-1	Remember	CO3

4.	i)Analysis the physical aspects of breakdown.(7) ii) Contrast the wires with rectangular cross section.(6)	BT-4	Analyze	CO3
5.	Examine the iron based soft magnetic materials.	BT-1	Remember	CO3
6.	Summarize the nanocrystal line materials.	BT-2	Understand	CO3
7.	Comparison and applications of the core materials in power electronics.	BT-4	Analyze	CO3
8.	Illustrate the optimum flux density unlimited by saturation in transformer design.	BT-3	Apply	CO3
9.	Define core loss and describe the optimum effective permeability in inductor design.	BT-1	Remember	CO3
10.	Examine the input capacitor selection.	BT-1	Remember	CO3
11.	Design an inductor for a buck converter with suitable specifications.	BT-6	Create	CO3
12.	Illustrate the selection of output capacitor.	BT-3	Apply	CO3
13.	Summarize the flyback converter in inductor design.	BT-5	Evaluate	CO3
14.	Analyse the design methodology for an inductor design.	BT-4	Analyze	CO3
PART C				
1	Summarize the types of cores and copper windings.	BT-5	Evaluate	CO3
2	Design a centre tapped rectifier transformer with suitable specifications.	BT-6	Create	CO3
3	Design an inductor for a flyback converter with suitable specifications.	BT-6	Create	CO3
4	Evaluate the selection of input and output filter capacitors.	BT-5	Evaluate	CO3

UNIT IV - RESONANT DC-DC CONVERTERS

Switching loss, hard switching, and basic principles of soft switching- classification of resonant converters- load resonant converters – series and parallel – resonant switch converters – operation and analysis of ZVS, ZCS converters comparison of ZCS/ZVS- Introduction to ZVT/ZCT PWM converters.

PART - A

Q.No	Questions	BT Level	Competence	COs
1.	Describe the switching loss.	BT-2	Understand	CO4
2.	Define the hard switching.	BT-1	Remember	CO4
3.	Quote the basic principle of soft switching.	BT-1	Remember	CO4
4.	Generalize the load resonant converter.	BT-6	Create	CO4
5.	Compare the hard switching and soft switching.	BT-5	Evaluate	CO4
6.	Classify the resonant converter.	BT-3	Apply	CO4
7.	List the advantage of resonant converter.	BT-1	Remember	CO4
8.	Integrate the series resonant converter.	BT-6	Create	CO4
9.	What are the advantages of soft switching over hard switching?	BT-2	Understand	CO4
10.	Different the series and parallel resonant converter.	BT-2	Understand	CO4
11.	Define the resonant switch converter.	BT-1	Remember	CO4
12.	Compare the ZCS and ZVS.	BT-5	Evaluate	CO4
13.	Quote the basic operation of the ZVS.	BT-1	Remember	CO4
14.	Explain the basic operation of the ZCS.	BT-4	Analyse	CO4
15.	Give the advantage of ZVS.	BT-2	Understand	CO4
16.	Show the wave form of Buck-Boost ZVS Quasi resonant DC-DC Converter.	BT-3	Apply	CO4
17.	Illustrate the waveform of Buck-Boost ZCS Quasi resonant DC-DC converter.	BT-3	Apply	CO4
18.	Explain the ZVT PWM converter.	BT-4	Analyze	CO4
19.	Contrast the ZCT PWM converter.	BT-4	Analyse	CO4
20.	Quote the high-frequency equivalent circuit of zero-voltage transition PWM converters.	BT-1	Remember	CO4
	PART - B			
1.	Summarize the basic principles of soft switching and hard switching.	BT-2	Understand	CO4
2.	Describe the classification of resonant converters.	BT-2	Understand	CO4
3.	Examine the series loaded resonant converter continuous mode and discontinuous mode.	BT-1	Remember	CO4
4.	Analyse the parallel loaded resonant converter continuous mode and discontinuous mode.	BT-4	Analyse	CO4
5.	Examine the Full-Bridge Series-Resonant Converter.	BT-1	Remember	CO4
6.	Estimate the Full-Bridge Series-Parallel-Resonant Converter.	BT-2	Understand	CO4
7.	Compare the Zero Current Switching (ZCS)/ Zero Voltage Switching (ZVS).	BT-4	Analyse	CO4
8.	Examine the Zero-Current-Switching Quasi-Resonant Boost Converter.	BT-3	Apply	CO4
9.	Describe the Zero-Voltage-Switching Quasi-Resonant Buck Converter.	BT-1	Remember	CO4
10.	Examine the Zero-Voltage-Switching Quasi-Resonant Boost Converter.	BT-1	Remember	CO4

11.	Generalize the Zero-Current-Switching Quasi-Resonant Buck Converter.	BT-6	Create	CO4
12.	Illustrate the Buck-Boost ZVS Quasi Resonant DC-DC Converter.	BT-3	Apply	CO4
13.	Summarize the Zero-Voltage Transition PWM Converters.	BT-5	Evaluate	CO4
14.	Analyse the Zero-Current Transition Converters	BT-4	Analyse	CO4
	PART C			
1	Summarize the series loaded resonant converter and parallel loaded resonant converter.	BT-5	Evaluate	CO4
2	Design a transformer single-capacitor phase-controlled series-resonant converter with a transformer center - tapped rectifier. The specifications are V_I = 270 to 300 V, Vo = 28 V, and R_{Lmin} = 10 Ω. Assume the resonant frequency f_0 = 150 kHz, the inverter efficiency η_I= 94%, and the rectifier efficiency η_R = 95%. Draw the efficiency of the designed converter η as a function of load resistance RL.	BT-6	Create	CO4
3	Design a buck-boost ZVS Quasi Resonant half-wave DC-DC converter to meet the following specifications: V_I = 12 V, V_o = 48 V, $P_{o\ min}$=4W and $P_{o\ max}$ =20 W.	BT-6	Create	CO4
4	Evaluate the Buck-Boost ZCS Quasi Resonant DC-DC Converter.	BT-5	Evaluate	CO4

UNIT V - AC-AC CONVERTERS

Principle of on-off and phase angle control – single phase ac voltage controller – analysis with R & RL load – Three phase ac voltage controller – principle of operation of cyclo converter – single phase and three phase cyclo converters – Introduction to matrix converters.

PART - A

Q.No	Questions	BT Level	Competence	COs
1.	Describe the On - Off control of AC voltage regulators.	BT-2	Understand	CO5
2.	Define the phase angle control of AC voltage regulators.	BT-1	Remember	CO5
3.	Examine the advantages of sequence control in ac voltage controllers.	BT-1	Remember	CO5
4.	Write the static characteristics of TRIAC.	BT-6	Create	CO5
5.	Mention the application of AC voltage controller.	BT-5	Evaluate	CO5
6.	A single phase voltage controller feeds an induction motor and a heater. Comment on whether the fundamental and harmonics are useful for the system operation.	BT-3	Apply	CO5
7.	List the applications of three phase AC voltage controllers.	BT-1	Remember	CO5
8.	Integrate the three phase AC voltage controller.	BT-6	Create	CO5
9.	Discuss the advantages and disadvantages of unidirectional ac voltage controllers.	BT-2	Understand	CO5
10.	Distinguish between two stage and multi-stage sequence control of AC voltage regulator.	BT-2	Understand	CO5
11.	Examine the Cyclo Converter.	BT-1	Remember	CO5
12.	Evaluate the effects of load inductance on the performance of Cyclo Converter.	BT-5	Evaluate	CO5
13.	List the applications of Cyclo Converter.	BT-1	Remember	CO5
14.	Differentiate the Cyclo converter and a dc link converter.	BT-4	Analyze	CO5
15.	Estimate the effect of harmonics in Cyclo Converter.	BT-2	Understand	CO5
16.	Discover the power factor control is employed in Cyclo Converter.	BT-3	Apply	CO5
17.	Illustrate an intergroup reactor is required for 3-phase Cyclo Converter.	BT-3	Apply	CO5
18.	Select the type of Cyclo Converter required for forced commutation? Why is it required?	BT-4	Analyse	CO5
19.	Explain the matrix converter.	BT-4	Analyse	CO5
20.	Quote the types of Cyclo Converters.	BT-1	Remember	CO5

PART - B

Q.No	Questions	BT Level	Competence	COs
1.	(i) Derive the RMS output voltage for a single phase half controlled ac voltage controller with R-load.(07) (ii) Draw the voltage and current waveform with R load and R-L load and justify the shape of the waveform.(06)	BT-2	Understand	CO5
2.	(i)Discuss the circuit diagram and waveforms for a single phase full control ac voltage controller with R-L load. (07) (ii) Derive the expression for RMS Output voltage with R load. (06)	BT-2	Understand	CO5
3.	Examine the operation of a 3phase AC voltage regulator having six thyristors with neat sketches of voltage waveforms. Derive the expression for the RMS output voltage, RMS load current and RMS thyristor current for a single phase full wave AC voltage controller for R load.	BT-1	Remember	CO5

4.	Explain with circuit diagram and waveform the principle of phase control of single phase controller with RL load and obtain expression for voltage and power factor.	BT-4	Analyse	CO5
5.	Describe the expression for RMS output voltage, RMS load current and RMS thyristor current of a single phase full wave AC voltage controller for RL load.	BT-1	Remember	CO5
6.	Summarize the principle of on – off and phase angle control.	BT-2	Understand	CO5
7.	Point out the expression for output voltage equation for a Cyclo converter.	BT-4	Analyse	CO5
8.	Illustrate three phase to three phase Cyclo converter with relevant circuit arrangements. Draw and explain the control circuit block diagram for a Cyclo converter with non-circulating current mode.	BT-3	Apply	CO5
9.	Describe the single phase to single phase step down Cyclo converter.	BT-1	Remember	CO5
10.	Examine the single phase to single phase step up Cyclo converter.	BT-1	Remember	CO5
11.	Integrate the fundamental RMS value of per-phase output voltage of low frequency for an m-pulse Cyclo converter. Write short notes on force commutated Cyclo converter. What are the effects of load inductance in the performance of a Cyclo converter?	BT-6	Create	CO5
12.	Illustrate the circuit and waveforms explain operating principle of three phase to three phase Cyclo converter with circulating current.	BT-3	Apply	CO5
13.	A 3 phase voltage controller feeds an RL load the value of R= 5Ω and L=5.3 MH the controller is supplied with 440 V ,50 Hz supply for α=30˚.determine(1)conduction angle (2)average output voltage (3)RMS output voltage (4)power factor (5)derive the expression for instantaneous current.	BT-5	Evaluate	CO5
14.	(i)Analyse the matrix converter.(07) (ii)Explain the three phase to single phase Cyclo converter.(06)	BT-4	Analyse	CO5
	PART - C			
1	A single phase full wave ac voltage controller has a resistive load of 5Ω and an input voltage 230 V, 50 Hz. The firing angle of thyristors T_1 and T_2 is 120 degree. Evaluate the (i) the RMS value of load voltage (ii)input power factor ,(iii)average value of current of thyristor (iv)RMS current of thyristor (v)load power.	BT-5	Evaluate	CO5
2	Examine the operation of a 3phase AC voltage regulator having six thyristors with neat sketches of voltage waveforms. Derive the expression for the RMS output voltage, RMS load current and RMS thyristor current for a single phase full wave AC voltage controller for R load.	BT-6	Create	CO5
3	How do you select a component for a drive applications, what are all the parameters to be calculated? Illustrate with an example.	BT-6	Create	CO5
4	(i)Compare the Cyclo converter and DC link converter. (ii)Explain the matrix converter.	BT-5	Evaluate	CO5

Course Outcomes:

Cos	Course Outcome
CO1	Ability to acquire the knowledge on Analyze various single phase and three phase power converters.
CO2	Ability to acquire the knowledge on design dc-dc converter topologies for a broad range of power conversion applications
CO3	Ability to understand the Develop improved power converters for any stringent application requirements.
CO4	Ability to acquire the knowledge Analyze of Resonant switch dc-dc converters.
CO5	Ability to understand the Design ac-ac converters for variable frequency applications.