Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV EXAMINATION – SUMMER 2025

Subject Code: 3140915 Date:27-05-2025

Subject Name: Power Electronics

Time: 10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Draw and explain static characteristics of SCR.	**03**
	(b)	Describe bipolar PWM techniques in detail.	**04**
	(c)	Discuss three-phase semi converter connected to RL load in continuous conduction mode with circuit diagram and waveforms of output voltage/current for firing angle of 30^0.	**07**
Q.2	**(a)**	Discuss the need of freewheeling diode in phase-controlled rectifier.	**03**
	(b)	Discuss the requirement of Snubber circuit for reliable operation of an SCR.	**04**
	(c)	Derive output voltage equation for single phase full wave controlled rectifier with R load. Assume α is firing angle.	**07**
		OR	
	(c)	Explain working of single phase to single phase step down cycloconverter with circuit diagram and waveforms for continuous and discontinuous load current.	**07**
Q.3	**(a)**	SCR is not suitable for dc to ac converter for low power applications. Justify.	**03**
	(b)	Describe the SVPWM control technique in brief.	**04**
	(c)	Explain the working of three phase 120^0 mode voltage source inverter. Also draw the necessary waveforms and circuit diagrams.	**07**
		OR	
Q.3	**(a)**	Classify different techniques for voltage control of inverter. Discuss any one in brief.	**03**
	(b)	Describe the SPWM control technique in detail.	**04**
	(c)	Explain the working of three phase 180^0 mode voltage source inverter. Also draw the necessary waveforms and circuit diagrams.	**07**
Q.4	**(a)**	Discuss the operation of DC/DC Flyback converter.	**03**
	(b)	Discuss the effect of high switching frequency on harmonics spectrum in single phase full bridge voltage source inverter.	**04**
	(c)	Describe the dual converter operation with circulating current mode in case of single phase input supply. Also draw the voltage and current waveforms.	**07**
		OR	
Q.4	**(a)**	Discuss single phase full wave AC voltage controller with circuit diagram and necessary waveforms.	**03**
	(b)	Discuss matrix converter with necessary circuit diagram.	**04**
	(c)	Explain integral cycle control of AC voltage controllers with necessary equations and waveforms.	**07**
Q.5	**(a)**	Explain the basic structure of IGBT with schematic diagram.	**03**
	(b)	Discuss two transistor model of SCR.	**04**
	(c)	Explain multi-quadrant operation of DC-DC converter.	**07**

OR

Q.5	**(a)**	Explain the basic structure of MOSFET with schematic diagram.	**03**
	(b)	List out the various SCR turn on methods. Discuss any one in detail.	**04**
	(c)	Explain the working of buck converter with necessary circuit diagrams and waveforms.	**07**

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2024

Subject Code:3140915 Date:10-07-2024

Subject Name: Power Electronics

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Draw only basic structure of power MOSFET and IGBT and name each layer and part.	**03**
	(b)	Draw the symbol of Transistor, SCR, MOSFET, IGBT, DIAC, TRIAC, GTO.	**04**
	(c)	Describe three different modes of operation of a thyristor with the help of its static V-I characteristics.	**07**
Q.2	**(a)**	Draw circuit of 1-ϕ half wave-controlled rectifier with R load. Draw waveforms for input voltage, trigger pulses at α=30˚, output voltage and voltage across the switching device.	**03**
	(b)	Write significance of freewheeling diode in control rectifier with necessary circuit diagram and waveforms.	**04**
	(c)	Draw the circuit diagram of three-phase full converter connected to RL load with continuous conduction. Draw the waveforms of output voltage, output current for firing angle equal to 45°.	**07**
		OR	
	(c)	Explain working of 3-ϕ A.C. voltage controller with star connected R load using circuit diagram and waveforms of input phase voltages, triggering waveforms and output R phase voltage for α=60˚.	**07**
Q.3	**(a)**	What is buck regulator? Draw circuit diagram and waveforms for voltage across freewheeling diode, current through inductor.	**03**
	(b)	Explain buck converter with relevant waveforms.	**04**
	(c)	Describe the principle of step-up chopper. Derive an expression for the average output voltage in terms of input dc voltage and duty cycle. State the assumptions made.	**07**
		OR	
Q.3	**(a)**	What do you mean by Pulse Width Modulation? State advantages and disadvantages of PWM technique.	**03**
	(b)	Distinguish between on-off control and phase angle control.	**04**
	(c)	Draw gate voltage and phase voltage waveform and explain 3 phase inverter operation for 120˚ conduction mode.	**07**
Q.4	**(a)**	Describe positions of space vector on the basis of switching states.	**03**
	(b)	Classify of different techniques for voltage control of inverter. Explain anyone.	**04**
	(c)	Describe Full-bridge single-phase voltage source inverter with circuit diagram and waveform.	**07**
		OR	

Q.4	**(a)**	Write advantages of SVPWM technique over SPWM techniques.	**03**
	(b)	Derive output voltage equation for single phase half wave rectifier.	**04**
	(c)	Explain cause of presence of harmonics in output of inverter. Explain 4 effects of switching frequency on harmonic spectrum.	**07**
Q.5	**(a)**	List any three industrial applications of ac voltage controller. Enumerate its merits and demerits.	**03**
	(b)	What is a cycloconverter? Enumerate some of its industrial applications.	**04**
	(c)	Describe three phase full-wave controlled AC –DC converter with R load with circuit and waveform.	**07**

OR

Q.5	**(a)**	Write a short note on matrix converter.	**03**
	(b)	Explain working of Dual converter with circuit diagram.	**04**
	(c)	Explain working of 1-ϕ to 1-ϕ cycloconverter with input frequency 50Hz and output frequency 10Hz.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– IV(NEW) EXAMINATION – SUMMER 2023

Subject Code:3140915 Date:27-07-2023

Subject Name:Power Electronics

Time:10:30 AM TO 01:00 PM Total Marks:70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Draw the symbol of Transistor, MOSFET, IGBT, DIAC, TRIAC, GTO.	**03**
	(b)	Explain construction, VI characteristics of SCR.	**04**
	(c)	Draw and explain any three triggering methods for Thyristors.	**07**
Q.2	**(a)**	Give classification and types of DC-DC converter topologies.	**03**
	(b)	Define Holding current, latching current for SCR.	**04**
	(c)	A step up chopper has input voltage of 220 V and output voltage of 660V. if the turn off time is 100 microsecond. Compute turn on time.	**07**
		OR	
	(c)	A boost converter has an input voltage of 6 V. The average output voltage is 15 V. The switching frequency is 20 kHz. Find the duty cycle.	**07**
Q.3	**(a)**	Explain Buck converter with circuit diagram and waveform.	**03**
	(b)	Explain working of Flyback converter with circuit and waveform.	**04**
	(c)	Describe Full-bridge single-phase voltage source inverter with circuit diagram and waveform.	**07**
		OR	
Q.3	**(a)**	Write advantages of SVPWM technique over SPWM techniques.	**03**
	(b)	State the term Harmonic Factor, THD, LOH, DF with respect to converter.	**04**
	(c)	Explain three phase inverter with 120^0 mode of conduction with circuit and waveform.	**07**
Q.4	**(a)**	Write significance of freewheeling diode in control rectifier.	**03**
	(b)	Define the term Harmonics, its causes and effects.	**04**
	(c)	Explain single phase full wave controlled rectifier with RL load with circuit and waveform.	**07**
		OR	
Q.4	**(a)**	Explain UJT relaxation oscillator circuit.	**03**
	(b)	A single phase full wave AC-DC converter is supplied by 230 V 50 Hz supply. The load consists of R=10 ohm. A firing angle delay of 30^0. Determine the average output voltage, Average output current.	**04**
	(c)	Describe three phase full wave controlled AC –DC converter with R load with circuit and waveform.	**07**
Q.5	**(a)**	Write advantages disadvantages and application of single phase full wave AC voltage controller.	**03**
	(b)	Describe application of TRIAC as Single-phase Fan regulator with circuit diagram and waveform.	**04**
	(c)	Explain single phase Cycloconverter with circuit and waveform.	**07**

OR

Q.5	**(a)**	Explain two transistor model of Thyristor.	**03**
	(b)	Explain working of Dual converter with circuit diagram.	**04**
	(c)	Explain Matrix converter with circuit and waveform.	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (NEW) EXAMINATION – SUMMER 2022

Subject Code:3140915 Date:11-07-2022

Subject Name:Power Electronics

Time:10:30 AM TO 01:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			MARKS
Q.1	**(a)**	Draw circuit of 1-ϕ half wave controlled rectifier with R load. Draw waveforms for input voltage, trigger pulses at $\alpha=30^{\circ}$, output voltage and voltage across the switching device.	**03**
	(b)	Explain forward blocking and forward conduction mode of operation for SCR using sketch of SCR forward V-I characteristics.	**04**
	(c)	Explain operation of IGBT using sectional view.	**07**
Q.2	**(a)**	What is buck regulator? Draw circuit diagram and waveforms for voltage across freewheeling diode, current through inductor.	**03**
	(b)	Explain working of 2-quadrent chopper.	**04**
	(c)	Explain working of half bridge inverter with R-L load using circuit diagram and waveforms of triggering signal, output voltage, output current, voltage across switch and voltage across diode.	**07**
		OR	
	(c)	Explain working of 3-ϕ A.C. voltage controller with star connected R load using circuit diagram and waveforms of input phase voltages, triggering waveforms and output R phase voltage for $\alpha=60^{\circ}$.	**07**
Q.3	**(a)**	Describe positions of space vector on the basis of switching states.	**03**
	(b)	For boost regulator, derive the formula of rise time and fall time of inductor current. Also derive the formula of output voltage.	**04**
	(c)	Explain cause of presence of harmonics in output of inverter. Explain 4 effects of switching frequency on harmonic spectrum.	**07**
		OR	
Q.3	**(a)**	Enlist control techniques for output voltage control of switching regulators. Explain briefly any one of them.	**03**
	(b)	Describe unipolar and bipolar sinusoidal pulse width modulation for inverter.	**04**
	(c)	Derive the expression for RMS value of output voltage for 1-ϕ full wave bi-directional controller. Find RMS value of output voltage for 230V ac input with $\alpha=45^{\circ}$.	**07**
Q.4	**(a)**	Enlist power factor improvement techniques for AC-DC converter. Explain briefly any one of them.	**03**
	(b)	Explain the principle of pulse width modulation for inverter.	**04**
	(c)	Analyze briefly 7 technical parameters required for selection of power electronic switch.	**07**
		OR	

Q.4	**(a)**	Derive an expression for average value of output voltage for 1-ϕ half wave controlled rectifier with RL load.	**03**
	(b)	Determine four applications of inverters in power system.	**04**
	(c)	Determine 7 important parameters which can be derived from datasheet of SCR.	**07**
Q.5	**(a)**	Compare 120° and 180° modes of conduction on the basis of 1) conduction of number of device 2) conduction of each device 3) output phase voltage (draw waveform for each case)	**03**
	(b)	Describe briefly three adverse effects of electromagnetic interference. Discuss briefly one remedial step to reduce EMI.	**04**
	(c)	Explain working of 1-ϕ current source inverter with necessary waveforms.	**07**
		OR	
Q.5	**(a)**	Enlist 3 applications of DC-DC converter.	**03**
	(b)	The single phase half bridge inverter has the Dc input of 100V. The load resistance is 10Ω. Determine 1) RMS value of output voltage 2) The fundamental component of RMS value	**04**
	(c)	Explain working of 1-ϕ to 1-ϕ cycloconverter with input frequency 50Hz and output frequency 10Hz.	**07**

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