Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–IV EXAMINATION – WINTER 2025

Subject Code:3140915 Date:01-12-2025

Subject Name:Power Electronics

Time:02:30 PM TO 05:00 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 and GTO.	**03**
	(b)	Draw the SCR static V-I characteristics and explain its behavior in forward conduction, forward blocking and reverse blocking modes.	**04**
	(c)	Describe three adverse effects of electromagnetic interference. Discuss briefly one remedial step to reduce EMI.	**07**
Q.2	**(a)**	Compare linear voltage regulator and switching voltage regulator.	**03**
	(b)	Explain working of 2-quadrent chopper.	**04**
	(c)	Explain working of 1-ϕ semi converter with the help of voltage and current waveform under resistive load.	**07**
		OR	
	(c)	Explain multi-quadrant operation of DC-DC converter.	**07**
Q.3	**(a)**	Explain the principle of pulse width modulation for inverter.	**03**
	(b)	State the advantages & disadvantages of current source inverter & voltage source inverter.	**04**
	(c)	Draw gate voltage and phase voltage waveform and explain 3 phase inverter operation for 120° conduction mode.	**07**
		OR	
Q.3	**(a)**	Describe unipolar and bipolar sinusoidal pulse width modulation for inverter.	**03**
	(b)	Describe the effect of high switching frequency on harmonics spectrum in single phase full bridge inverter.	**04**
	(c)	Discuss Space Vector Pulse Width Modulation Technique in brief.	**07**
Q.4	**(a)**	Describe the working of freewheeling diode in Phase controlled rectifier.	**03**
	(b)	Draw circuit of 1-ϕ half wave-controlled rectifier with R load. Draw waveforms for input voltage, output voltage and voltage at α=30˚.	**04**
	(c)	Explain working of 1-ϕ semi converter with the help of voltage and current waveform under resistive load.	**07**
		OR	
Q.4	**(a)**	Derive output voltage equation for single phase full wave rectifier	**03**

(b) Discuss about Midpoint CycloConvereter in brief. **04**

(c) Describe three phase full wave-controlled AC –DC converter with R load with circuit and waveform. **07**

Q.5 **(a)** Give four points of difference between on-off control and phase angle control. **03**

(b) Write a short note on matrix converter. **04**

(c) Explain working of 1-ϕ to 1-ϕ cycloconverter with input frequency 50Hz and output frequency 10Hz. **07**

OR

Q.5 **(a)** List any three industrial applications of ac voltage controller. Enumerate its merits and demerits. **03**

(b) Describe briefly three adverse effects of electromagnetic interference. Discuss briefly one remedial step to reduce EMI. **04**

(c) Show that the fundamental rms value of per-phase output voltage of low frequency for an m pulse cyclo-converter is given by **07**

$$Vor = Vph\left(\frac{m}{\pi}\right)\sin\left(\frac{\pi}{m}\right)$$

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Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3140915 Date:03-12-2024

Subject Name:Power Electronics

Time:02:30 PM TO 05:00 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)**	Explain IGBT with its physical construction diagram and characteristics.	**03**
	(b)	Draw the SCR static V-I characteristics and explain its behavior in forward conduction, forward blocking and reverse blocking modes.	**04**
	(c)	Describe the working of UJT Relaxation Oscillator circuit. Discuss its Design criterion.	**07**
Q.2	**(a)**	Describe briefly three adverse effects of electromagnetic interference. Discuss briefly one remedial step to reduce EMI	**03**
	(b)	Define and explain the need of snuber circuit. Draw such circuit for SCR and give guidelines for selecting its components.	**04**
	(c)	Discuss discontinuous mode of operation in buck boost converter with waveforms.	**07**
		OR	
	(c)	Draw the circuit of a single phase fully controlled converter with R-L load. Derive necessary equations and sketch output waveforms.	**07**
Q.3	**(a)**	What do you mean by freewheeling action? Explain How diode can provide freewheeling action?	**03**
	(b)	Give four points of difference between on-off control and phase angle control.	**04**
	(c)	Discuss the various techniques of improving power factor in phase controlled converters. Explain PWM techniques in detail with necessary waveforms.	**07**
		OR	
Q.3	**(a)**	Distinguish between full controlled bridge converter and half controlled bridge converter.	**03**
	(b)	Explain pulse transformer and opto-coupler	**04**
	(c)	Discuss operation of Flyback converter. Draw its circuit diagram and waveforms.	**07**
Q.4	**(a)**	Write advantages and disadvantages of PWM technique to generate gate Pulse.	**03**
	(b)	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)	**04**
	(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**
		OR	

Q.4	**(a)**	Derive AC voltage controller average output voltage equation.	**03**
	(b)	Explain the turn-on and turn-off characteristics of an SCR.	**04**
	(c)	Describe the working of a single phase full converter in the rectifier mode with RLE load. Derive an expression for the average output voltage in terms of source voltage and firing angle.	**07**
Q.5	**(a)**	Compare CSI and VSI.	**03**
	(b)	Explain Concept of switching voltage regulators and advantages	**04**
	(c)	Describe the working of series inverter with diagram and waveforms.	**07**
		OR	
Q.5	**(a)**	List any three industrial applications of ac voltage controller. Enumerate its merits and demerits.	**03**
	(b)	Explain working principle of Matrix converter.	**04**
	(c)	Describe the basic principle of operation of a single phase to single phase bridge type cycloconverter for continuous conduction	**07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3140915 Date:01-02-2024

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)**	What is an IGBT? Sketch the equivalent circuit and transfer characteristics of an IGBT.	**03**
	(b)	Draw the SCR static V-I characteristics and explain its behavior in forward conduction, forward blocking and reverse blocking modes.	**04**
	(c)	Draw and explain the resistance triggering and R-C triggering circuits.	**07**
Q.2	**(a)**	Draw only switching characteristics of SCR during turn-on and turn-off process.	**03**
	(b)	State the advantages & disadvantages of current source inverter & voltage source inverter.	**04**
	(c)	Draw gate voltage and phase voltage waveform and explain 3 phase inverter operation for 120° conduction mode	**07**
		OR	
	(c)	Explain Space Vector Pulse Width Modulation Technique in brief.	**07**
Q.3	**(a)**	What is pulse width modulation? List the various PWM techniques.	**03**
	(b)	Classify of different techniques for voltage control of inverter. Explain anyone.	**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	
Q.3	**(a)**	What is the purpose of connecting diodes in antiparallel with thyristors in inverter circuits?	**03**
	(b)	Derive output voltage equation for single phase half wave rectifier.	**04**
	(c)	Explain working of 1-ϕ semi converter with the help of voltage and current waveform under resistive load.	**07**
Q.4	**(a)**	Describe the working of freewheeling diode in phase-controlled rectifier.	**03**
	(b)	Write advantages disadvantages and application of single-phase full wave AC voltage controller.	**04**
	(c)	Explain multi-quadrant operation of DC-DC converter.	**07**
		OR	
Q.4	**(a)**	Draw only the possible configurations of a single-phase voltage controller.	**03**
	(b)	Describe application of TRIAC as Single-phase Fan regulator with circuit diagram and waveform.	**04**
	(c)	Explain AC Voltage controllers with (i) on-off control method and (ii) integral cycle control method.	**07**

Q.5	**(a)**	What is a cycloconverter? Enumerate some of its industrial applications.	**03**
	(b)	Write a short note on matrix converter.	**04**
	(c)	Explain the operation of three-phase to single phase cycloconverters.	**07**

OR

Q.5	**(a)**	Draw the basic circuit diagram of 3-phase to 3-phase cycloconverter.	**03**
	(b)	Explain the snubber circuit and its design.	**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 – WINTER 2022

Subject Code:3140915 Date:21-12-2022

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 only basic structure of power MOSFET and IGBT and name each layer and part.	**03**
	(b)	Explain buck converter with relevant waveforms.	**04**
	(c)	Describe three different modes of operation of a thyristor with the help of its static V-I characteristics.	**07**
Q.2	**(a)**	Write advantages and disadvantages of PWM technique to generate gate pulse.	**03**
	(b)	Derive inverter output voltage.	**04**
	(c)	Draw circuit diagram and necessary waveforms of single phase fully controlled center-tapped ac to dc converter with R load. Derive equation for V_{RMS}.	**07**
		OR	
	(c)	Describe the working of a single phase full converter in the rectifier mode with RLE load. Derive an expression for the average output voltage in terms of source voltage and firing angle.	**07**
Q.3	**(a)**	Explain the difference between line commutated and force-commutated inverters.	**03**
	(b)	Distinguish between on-off control and phase angle control.	**04**
	(c)	Explain working of 3 phase bridge inverter with star connected resistive load with 120˚ mode using gate signals, output phase voltage and line voltage.	**07**
		OR	
Q.3	**(a)**	What do you mean by Pulse Width Modulation? State advantages and disadvantages of PWM technique.	**03**
	(b)	Derive an expression for the resistance used for static voltage equalization for a series connected string.	**04**
	(c)	Discuss Space Vector Pulse Width Modulation Technique in brief.	**07**
Q.4	**(a)**	Derive only expression of RMS output voltage of single phase full wave AC voltage controller with R load.	**03**
	(b)	Write a note on Matrix converter.	**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.4	**(a)**	Explain RC firing circuit of SCR.	**03**
	(b)	Derive output voltage equation for single phase half wave rectifier.	**04**

(c) Explain the working principal of buck-boost converter with circuit diagram of different modes of operation. **07**

Q.5 **(a)** List any three industrial applications of ac voltage controller. Enumerate its merits and demerits. **03**

(b) Derive output voltage equation of single phase AC Voltage controller. **04**

(c) Show that the fundamental rms value of per-phase output voltage of low-frequency for an m pulse cyclo-converter is given by **07**

$$Vor = Vph\left(\frac{m}{\pi}\right)\sin\left(\frac{\pi}{m}\right)$$

OR

Q.5 **(a)** Write any six applications of Power Electronics. **03**

(b) For type A chopper, dc source voltage = 230 V, load resistance 10 Ω. Take a voltage drop of 2 V across chopper when it is on. For a duty cycle of 0.4, calculate (i) average and rms values of output voltage and (ii) chopper efficiency. **04**

(c) Discuss why 3-phase to 1-phase cyclo-converter requires positive and negative group phase-controlled converters. Under what conditions, the groups work as inverters or rectifiers? **07**

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