Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem (Even) Examination May-2022

EE3CO02 / EX3CO02

Power Electronics Devices & Circuits

Programme: B.Tech. Branch/Specialisation: EE/EX

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c or d.

Q.1 i. In the SCR structure the gate terminal is located **1**

(a) Near the anode terminal

(b) Near the cathode terminal

(c) In between the anode & cathode terminal

(d) None of these

ii. For an SCR in the reverse blocking mode, (practically) **1**

(a) Leakage current does not flow

(b) Leakage current flows from anode to cathode

(c) Leakage current flows from cathode to anode

(d) Leakage current flows from gate to anode

iii. A half-wave rectifier circuit with a capacitive filter is connected to a 200 volts, 50 Hz ac line. The output voltage across the capacitor should be approximately **1**

(a) 300 volts (b) 280 volts

(c) 180 volts (d) 80 volts.

iv. The ripple factor of a full-wave rectifier circuit compared to that of a half wave rectifier circuit without filter is **1**

(a) Half of that for a half 'wave rectifier

(b) Less than half that for a half-wave rectifier circuit

(c) Equal to that of a half wave rectifier.

(d) None of these

P.T.O.

v. In a VSI (Voltage source inverter) **1**
(a) The internal impedance of the DC source is negligible
(b) The internal impedance of the DC source is very high
(c) The internal impedance of the AC source is negligible
(d) The IGBTs are fired at 0 degrees.

vi. What is the peak value of phase voltage in case of 3-phase VSI with 180° mode. The supply side consists of a constant dc voltage source of Vs. **1**
(a) Vs (b) 3Vs/2
(c) 2Vs/3 (d) 3Vs

vii. A chopper may be thought as a **1**
(a) Inverter with DC input
(b) DC equivalent of an AC transformer
(c) Diode rectifier
(d) DC equivalent of an induction motor

viii. The load voltage of a chopper can be controlled by varying the **1**
(a) Duty cycle (b) Firing angle
(c) Reactor position (d) Extinction angle

ix. The AC voltage controllers are used in _____ applications. **1**
(a) Power generation (b) Electric heating
(c) Conveyor belt motion (d) Power transmission

x. In a three phase half-wave cycloconverter _____ **1**
(a) Both inverting and converting action takes place
(b) Only inversion action takes place
(c) Only converting action takes place
(d) None of these

Q.2 i. Write a short note on: **3**
(a) Turn off methods of a thyristor (b) TRIAC.

ii. Explain V-I characteristics of Gate Turn-Off thyristor (GTO) with applications. **7**

OR iii. Define latching and holding currents as applicable to an SCR. Show these currents on its static V-I characteristics. **7**

Q.3 i. Explain classification of rectifier and Principle of phase controlled rectifier. **3**

ii. Explain with circuit diagram of a single-phase full converter bridge with RLE load. Draw voltage and current waveforms for continuous load current. **7**

OR iii. Compare midpoint & Bridge rectifier with circuit diagram, mode of operation, waveform and applications. **7**

Q.4 i. Explain single phase current source inverter. **3**

ii. Discuss the operating principle of a three-phase bridge inverter with a suitable diagram and waveform when each thyristor conducts for 120º. **7**

OR iii. Compare voltage source inverter & current source inverter. **7**

Q.5 i. Explain classification and principle operation of chopper. **3**

ii. Explain with circuit diagram and mode of operation of class E Chopper. **7**

OR iii. In a step-down chopper input voltage is 220 volt and average output voltage is 140 volts. If switching frequency is 1 KHz. Determine on and off time of switch in each cycle. Also explain duty cycle. **7**

Q.6 i. Explain basic principle of operation of cycloconverter. **3**

ii. Explain and derive single phase ac voltage controller with purely inductive load. **7**

OR iii. Explain with suitable waveform, three phase to three phase cycloconverter. **7**

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Marking Scheme

EE3CO02 / EX3CO02 Power Electronics Devices & Circuits

Q.1	i.	In the SCR structure the gate terminal is located (b) Near the cathode terminal	**1**
	ii.	For an SCR in the reverse blocking mode, (practically) (c) Leakage current flows from cathode to anode	**1**
	iii.	A half-wave rectifier circuit with a capacitive filter is connected to a 200 volts, 50 Hz ac line. The output voltage across the capacitor should be approximately (d) 80 volts.	**1**
	iv.	The ripple factor of a full-wave rectifier circuit compared to that of a half wave rectifier circuit without filter is (b) Less than half that for a half-wave rectifier circuit	**1**
	v.	In a VSI (Voltage source inverter) (a) The internal impedance of the DC source is negligible	**1**
	vi.	What is the peak value of phase voltage in case of 3-phase VSI with 180° mode. The supply side consists of a constant dc voltage source of Vs. (c) 2Vs/3	**1**
	vii.	A chopper may be thought as a (b) DC equivalent of an AC transformer	**1**
	viii.	The load voltage of a chopper can be controlled by varying the (a) Duty cycle	**1**
	ix.	The AC voltage controllers are used in _____ applications. (b) Electric heating	**1**
	x.	In a three phase half-wave cycloconverter _____ (a) Both inverting and converting action takes place	**1**
Q.2	i.	(a) Turn off methods of a thyristor (b) TRIAC.	**3**
		Introduction & Types — 2 marks	
		Characteristics or Diagram — 1 mark	
	ii.	V-I characteristics of Gate Turn-Off thyristor (GTO) with applications	**7**
		Introduction — 2 marks	
		Diagram — 1 mark	
		V-I characteristics — 2 marks	
		Applications — 2 marks	
OR	iii.	Statement of latching currents — 2 marks	**7**
		Statement of holding currents — 2 marks	
		latching and holding currents in V-I characteristics — 3 marks	
Q.3	i.	Classification of rectifier — 1.5 marks	**3**
		Principle of phase controlled rectifier. — 1.5 marks	
	ii.	Derivation for output voltage and current — 3 marks	**7**
		Circuit Diagram — 2 marks	
		Waveforms — 2 marks	
OR	iii.	Midpoint & Bridge rectifier	**7**
		Circuit Diagram — 2 marks	
		Mode of operation — 2 marks	
		Waveforms — 2 marks	
		Application — 1 mark	
Q.4	i.	Single phase current source inverter	**3**
		Circuit Diagram — 1 mark	
		waveforms — 2 marks	
	ii.	Operating principle of a three-phase bridge inverter	**7**
		Derivation for output voltage and current — 2 marks	
		Circuit Diagram — 2 marks	
		waveforms — 3 marks	
OR	iii.	Compare voltage source inverter & current source inverter.	**7**
		Circuit Diagram — 2 marks	
		Advantage — 2 marks	
		Disadvantage — 2 marks	
		Application — 1 mark	
Q.5	i.	Classification of chopper — 1.5 marks	**3**
		Principle operation of chopper — 1.5 marks	
	ii.	Circuit diagram and mode of operation of class E Chopper.	**7**
		Explanation — 1 mark	
		Circuit Diagram — 2 marks	
		mode of operation — 2 marks	
		waveforms — 2 marks	

OR	iii.	On and off time of switch in each cycle		**7**
		Given	1 mark	
		Used formula	2 marks	
		Solution with answer	2 marks	
		Explanations of duty cycle	2 marks	
Q.6	i.	Basic principle of cycloconverter	1.5 marks	**3**
		Circuit Diagram of cycloconverter	1.5 marks	
	ii.	Single phase ac voltage controller with purely inductive load		**7**
		Derivation for output voltage and current	2 marks	
		Circuit Diagram	2 marks	
		waveforms	3 marks	
OR	iii.	Three phase to three phase cycloconverter		**7**
		Derivation for output voltage and current	2 marks	
		Circuit Diagram	2 marks	
		Waveforms	3 marks	

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