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

Enrollment No.....

Faculty of Engineering

End Sem Examination May-2023

EE3CO42 / EE3CO02 / EX3CO02 Power Electronics

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. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. An SCR is a- **1**

(a) 4-layer, 3-junction devices (b) 4-layer, 4-junction devices

(c) 4-layer, 2-junction devices (d) 3-layer, single junction device

ii. The GTO can be turned off- **1**

(a) By positive gate pulse

(b) By a negative gate pulse

(c) By negative anode-cathode voltage

(d) By removing the gate pulse

iii. In a three-phase half wave 6-pulse mid-point type diode rectifier, each diode conducts for **1**

(a) 120° (b) 60° (c) 90° (d) 180°

iv. A single-phase full converter with B-2 type of connection has a continuous load current waveform. The thyristor pairs T3, T4 is triggered at ωt = _____. **1**

(a) 0 (b) α (c) π+α (d) π-α

v. Inverters converts- **1**

(a) DC power to DC power (b) DC power to AC power

(c) AC power to AC power (d) AC power to DC power

vi. The output voltage from a single-phase full wave bridge inverter varies from- **1**

(a) Vs to –Vs (b) Vs to zero

(c) Vs/2 to zero (d) –Vs/2 to Vs/2

vii. Which device can be used in a chopper circuit? **1**

(a) BJT (b) MOSFET (c) GTO (d) All of these

P.T.O.

viii. What is the duty cycle of a chopper? **1**
(a) T_{on}/T_{off} (b) T_{on}/T (c) T/T_{on} (d) T_{off} X T_{on}

ix. AC voltage controllers convert- **1**
(a) Fixed AC to fixed DC (b) Variable AC to variable DC
(c) Fixed AC to variable AC (d) Variable AC to fixed AC

x. Applications of cyclo-converters include- **1**
(a) Speed control of ac drives (b) Induction heating
(c) Static VAR compensation (d) All of these

Q.2 i. Define latching and holding currents as applicable to an SCR. **2**

ii. Draw & explain V-I characteristics of SCR. **3**

iii. Describe GTO with the help of symbol and characteristics. Give the merits and demerits of a GTO as compared to SCR. **5**

OR iv. Draw and explain UJT firing circuit with the help of its waveform. **5**

Q.3 i. A single-phase half wave-controlled rectifier with R load is fed from a 220V, 50Hz AC supply. When R=10Ω and α=45º, determine average DC output voltage and current. **4**

ii. Draw & explain full wave B-2 converter in rectifying mode with suitable circuit diagram and relevant waveforms also calculate V_{dc} & V_{rms} value. **6**

OR iii. Draw & explain circuit diagram and its relevant waveform of symmetrical & asymmetrical half-controlled converter with RL load at α=30º. **6**

Q.4 i. What is pulse width modulation? List the various PWM techniques. **4**

ii. Discuss the principle of working of a three-phase bridge inverter with appropriate circuit diagram. Draw line and phase voltage waveforms on the assumption that each thyristor conducts for 180º and resistive load is star connected. **6**

OR iii. Describe the working of a series inverter with appropriate circuit diagram and waveforms. **6**

Q.5 i. Define chopper. What are the types of choppers? What are the applications of chopper circuit? **4**

ii. Explain the operating principle of DC chopper with a suitable diagram. Draw the voltage and current waveform of chopper. **6**

OR iii. A step-down chopper has a load resistance of 20Ω and input DC voltage is 200V. When the chopper switch is ON, the voltage across **6**

semiconductor is 2 V. If the switching frequency is 1.5kHz and duty ratio is 40%, determine (a) average DC output voltage (b) rms output voltage (c) efficiency.

Q.6 i. What is an AC voltage controller? List some of its industrial applications. Enumerate its merits and demerits. **4**

ii. What is cyclo-converter? What are the types of cyclo-converter? What are the advantage and application of cyclo-converter? **6**

OR iii. Discuss the operating principle of single phase to single phase step down cycloconverter using bridge converter. Mention the conduction of various thyristor in the waveform. **6**

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Marking Scheme

EE3CO42 Power Electronics

EE3CO02-EX3CO02 Power Electronics Devices & Circuits

Q.1	i)	a) 4-layer, 3-junction device	**1**
	ii)	b) by a negative gate pulse	**1**
	iii)	b) 60°	**1**
	iv)	c) π+α	**1**
	v)	b) dc power to ac power	**1**
	vi)	a) Vs to –Vs	**1**
	vii)	d) All of the mentioned	**1**
	viii)	b) Ton/T	**1**
	ix)	c) fixed ac to variable ac	**1**
	x)	d) all of the mentioned	**1**
Q.2	i.	Define latching and	**1**
		holding currents as applicable to an SCR.	**1**
	ii.	Draw &	**1**
		explain V-I characteristics of SCR?	**2**
	iii.	Describe GTO with the help of symbol and	**1**
		characteristics.	**2**
		Give the merits and	**1**
		demerits of a GTO as compared to SCR.	**1**
OR	iv.	Draw and	**2**
		explain UJT firing circuit with the help of	**2**
		its waveform?	**1**
Q.3	i.	A single-phase half wave-controlled rectifier with R load is fed from a 220V, 50Hz AC supply. When R=10Ω and α=45°, determine average DC output voltage and current.	**2**
		Vo=84.56V,	**2**
		Io=8.456A.	
	ii.	Draw & explain full wave B-2 converter in rectifying mode with suitable circuit diagram and	**3**
		relevant waveforms also	**2**
		calculate Vdc & Vrms value?	**1**
OR	iii.	Draw & explain circuit diagram and its relevant	**4**
		waveform of symmetrical & asymmetrical half-controlled converter with RL load at α=30°.	**2**

Q.4	i.	What is pulse width modulation?	**2**
		List he various PWM techniques.	**2**
	ii.	Discuss the principle of working of a three-phase bridge inverter with appropriate circuit diagram.	**3**
		Draw line and phase voltage waveforms on the assumption that each thyristor conducts for 180° and resistive load is star connected.	**3**
OR	iii.	Describe the working of a series inverter with appropriate circuit, waveform	**4,2**
Q.5	i.	Define chopper.	**1**
		What are the types of choppers?	**2**
		What are the applications of chopper circuit?	**1**
	ii.	Explain the operating principle of DC chopper with a suitable diagram.	**4**
		Draw the voltage and current waveform of chopper.	**2**
OR	iii.	A step-down chopper has a load resistance of 20Ω and input DC voltage is 200V. When the chopper switch is ON, the voltage across semiconductor is 2 V. If the switching frequency is 1.5kHz and duty ratio is 40%, determine (a) average DC output voltage (b) rms output voltage (c) efficiency.	**2*3=6**
Q.6	i.	What is an AC voltage controller?	**2**
		List some of its industrial applications.	**1**
		Enumerate its merits and demerits.	**1**
	ii.	What is cycloconverter?	**2*3=6**
		What are the types of cycloconverter?	
		What are the advantage and application of cycloconverter?	
OR	iii.	Discuss the operating principle of single phase to single phase step down cycloconverter using bridge converter. Marks	**4**
		Mention the conduction of various thyristor in the waveform.	**2**