OR   iii.   Describe the current commutated chopper with waveforms and equivalent circuits. Write the applications of voltage commutated chopper.   **6**

Q.6   i.   Draw the single phase bidirectional ac voltage controller with RL load and explain its working principle with waveforms.   **4**

ii.   A single phase half wave ac voltage controller is connected with a load of R = 20Ω with an input voltage of 230V, 50Hz. If the firing angle of thyristor is 90º. Determine: **6**
(a) RMS output voltage
(b) Power delivered to load,
(c) Average value of thyristor current
(d) Average value of diode current

OR   iii.   Discuss the operating principle of single phase to single phase step-down cycloconverter using midpoint converters. Mention the conduction of various thyristors in the waveforms.   **6**

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Faculty of Engineering
End Sem (Even) Examination May-2018
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.   Turn on time of an SCR can be decreased by using a   **1**
(a) Rectangular pulse of high amplitude and narrow width
(b) Triangular pulse
(c) Rectangular pulse of low amplitude and wide width
(d) Trapezoidal pulse

ii.   In dynamic equalising circuit for series connected thyristors, the value of C is depends on   **1**
(a) Reverse recovery characteristics
(b) Turn off characteristics
(c) Turn on characteristics
(d) Rise time characteristics

iii.   In a single phase full bridge converter, the average dc output voltage is equal to   **1**
(a) $Vo = \frac{1}{\pi} \int_{\alpha}^{\pi} \sqrt{2V} sin\omega t \, . d\omega t$
(b) $Vo = \frac{1}{\pi} \int_{0}^{\pi+\alpha} \sqrt{2V} sin\omega t \, . d\omega t$
(c) $Vo = \frac{1}{\pi} \int_{\alpha}^{2\pi+\alpha} \sqrt{2V} sin\omega t \, . d\omega t$
(d) $Vo = \frac{1}{\pi} \int_{\alpha}^{\pi+\alpha} \sqrt{2V} sin\omega t \, . d\omega t$

iv.   The firing angle α, the dc output voltage of three phase full bridge converter is,   **1**
(a) $\frac{3\sqrt{3}Vm}{\pi} cos\alpha$ (b) $\frac{\sqrt{3}Vm}{2\pi} cos\alpha$
(c) $\frac{3\sqrt{3}Vm}{2\pi} cos\alpha$ (d) $\frac{3Vm}{\pi} cos\alpha$

v. A single phase full bridge voltage source inverter operates with R load, nature of output current is …………… **1**
(a) Square wave (b) Sinewave (c) Triangular wave (d) Pulse wave

vi. In MC murray commutation inverter circuit, the circuit turnoff time is **1**
(a) Independent of load current and depend on operating frequency
(b) Depend on load current and independent on operating frequency
(c) Depend on load current and also load power factor
(d) Independent of load current and depend on recovery period

vii. The output voltage of dc to dc converter can be controlled by **1**
(a) Amplitude modulation
(b) Frequency modulation
(c) Pulse width modulation
(d) Pulse width and frequency modulation

viii. In step up chopper, input voltage is 200V and output voltage is 400V. If the conduction time of semiconductor switch is 150 µs, the non-conducting time of semiconductor switch is…………… **1**
(a) 150µs   (b) 200µs   (c) 250µs   (d) 300µs

ix. Average value of output voltage of half wave ac voltage controller at firing angle α is equal to **1**
(a) 0   (b) $\frac{\sqrt{2V}}{2\pi}(\cos\alpha - 1)$
(c) $\frac{\sqrt{2V}}{2\pi}(\cos\alpha + 1)$ (d) $\frac{\sqrt{2V}}{\pi}(\cos\alpha - 1)$

x. A three phase to three phase cycloconverter using three phase bridge converter requires **1**
(a) 18 SCRs   (b) 36 SCRs   (c) 6 SCRs   (d) 12 SCRs

Q.2 i. Write a short note on **3**
(a) Over Voltage protection (b) Over current protection
(c) Gate protection

ii. What are the different triggering circuits of a SCR? Draw a resistance triggering circuit and explain its operation. What is the limitation of a R triggering circuit. **7**

OR iii. Draw the V-I characteristics of a TRIAC and explain different operating regions. What are the applications of TRIAC? **7**

Q.3 i. A single phase fully controlled bridge converter is supplied from 220V, 50 Hz ac supply and fed to a load which consists of R=12 ohm and large inductance so that load current is constant. If the firing angle is 45º, calculate (a) average output voltage, (b) average output current, (c) average current of thyristor, (d) RMS current of thyristor **4**

ii. With a neat circuit diagram describe the circulating and non-circulating mode of a dual converter. Draw the voltage waveforms of dual converter. **6**

OR iii. Draw the circuit diagram and waveform of three phase bridge converter with RL load. Explain its working principle at α=30º. **6**

Q.4 i. Define inverter. What are the types of inverter? What are the applications of inverter circuit? **3**

ii. Draw the circuit diagram of a single phase half bridge voltage source inverter with RL load and explain its operating principle and derive the expression for
(a) RMS value of output voltage (b) RMS output load current. **7**

OR iii. Discuss the operating principle of a three phase bridge inverter with a suitable diagram and waveform when each thyristor conducts for 180º? **7**

Q.5 i. Input to the step up chopper is 200 V. The output required is 600 V. If the conducting time of thyristor is 200 µsec. Compute
(a) Chopping frequency,
(b) If the pulse width is halved for constant frequency of operation, find the new output voltage. **4**

ii. Draw the circuit diagram of step up down chopper and describe its operating principle. Draw the voltage and current waveforms of step up and down chopper. Derive expressions for average output voltage and rms output voltage. What are the applications of step up and down chopper? **6**

P.T.O.

Marking Scheme
EE3CO02/ EX3CO02 Power Electronics Devices & Circuits

Q.1 i.   Turn on time of an SCR can be decreased by using a   **1**
           (a) Rectangular pulse of high amplitude and narrow width
     ii.   In dynamic equalising circuit for series connected thyristors, the   **1**
           value of C is depends on
           (a) Reverse recovery characteristics
     iii. In a single phase full bridge converter, the average dc output   **1**
           voltage is equal to
           (d) $Vo = \frac{1}{\pi}\int_{\alpha}^{\pi+\alpha}\sqrt{2V}sin\omega t\,.\,d\omega t$
     iv.   The firing angle α, the dc output voltage of three phase full   **1**
           bridge converter is,
           (a) $\frac{3\sqrt{3}Vm}{\pi}cos\alpha$
     v.   A single phase full bridge voltage source inverter operates with R   **1**
           load, nature of output current is ……………
           (a) Square wave
     vi.   In MC murray commutation inverter circuit, the circuit turnoff   **1**
           time is
           (b) Depend on load current and independent on operating
           frequency
     vii. The output voltage of dc to dc converter can be controlled by   **1**
           (d) pulse width and frequency modulation
     viii. In step up chopper, input voltage is 200V and output voltage is   **1**
           400V. If the conduction time of semiconductor switch is 150 µs,
           the non-conducting time of semiconductor switch is……………
           (a) 150µs
     ix.   Average value of output voltage of half wave ac voltage   **1**
           controller at firing angle α is equal to
           (b) $\frac{\sqrt{2V}}{2\pi}(\cos\alpha - 1)$
     x.   A three phase to three phase cycloconverter using three phase   **1**
           bridge converter requires
           (b) 36 SCRs

Q.2 i.   Write a short note on   **3**
           (a) Over Voltage protection   1 mark
           (b) Over current protection   1 mark
           (c) Gate protection   1 mark
     ii.   Different triggering circuits of a SCR   2 marks   **7**
           Circuit diagram   2 marks
           Waveform   2 marks
           Limitation of an R triggering circuit.   1 mark
OR   iii. V-I characteristics of a TRIAC   2 marks   **7**
           Different operating regions.   3 marks
           Applications of TRIAC.   2 marks

Q.3 i.   (a) Average output voltage=140.1V   1 mark   **4**
           (b) Average output current= 11.65A   1 mark
           (c) Average current of thyristor= 5.8375A   1 mark
           (d) RMS current of thyristor= 8.256A   1 mark
     ii.   Circuit diagram of the circulating and non-circulating mode of a   **6**
           dual converter.   3 marks
           Draw the voltage waveforms of dual converter.   3 marks
OR   iii. Circuit diagram   2 marks   **6**
           Waveform.   2 marks
           Working principle   2 marks

Q.4 i.   Define inverter.   1 mark   **3**
           Types of inverter   1 mark
           Application of inverter circuit   1 mark
     ii.   Circuit diagram   1 mark   **7**
           Waveform   2 marks
           (i) RMS value of output voltage   2 marks
           (ii) RMS output load current.   2 marks
OR   iii. circuit diagram   2 marks   **7**
           Waveform   3 marks
           Explanation with derivation   2 marks

Q.5 i.   Chopping frequency=3.33kHz   2 marks   **4**
           If the pulse width is halved for constant frequency of operation,
           find the new output voltage=300V   2 marks

	ii.	Circuit diagram	1 mark	**6**
		Voltage and current waveforms	2 marks	
		Expressions for average output voltage and rms output voltage.		
			2 marks	
		Applications of step up and down chopper	1 mark	
OR	iii.	Circuit Diagram of current commutated chopper	2 marks	**6**
		Waveforms and equivalent circuits	2 marks	
		Applications of voltage commutated chopper.	2 marks	
Q.6	i.	Circuit diagram	2 marks	**4**
		Voltage and current waveforms	2 marks	
	ii.	(a) RMS output voltage = 199.185V	1.5 marks	**6**
		(b) power delivered to load= 1983.73watt	1.5 marks	
		(c) average value of thyristor current = 2.587A	1.5 marks	
		(d) average value of diode current= -5.174A	1.5 marks	
OR	iii.	Circuit diagram	2 marks	**6**
		Voltage and current waveforms	2 marks	
		Explanation	2 marks	

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