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

**Enrollment No.....**

# Faculty of Engineering

## End Sem (Even) Examination May-2019

## 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 a thyristor, the magnitude of anode current will **1**
(a) Increase if gate current is increased
(b) Decrease if gate current is descreased
(c) Increase if gate current is decreased
(d) Not change with any variation in gate current

ii. Turn-on time of an SCR in series with RL circuit can be reduced by **1**
(a) Increasing circuit resistance R
(b) Decreasing R
(c) Increasing circuit inducctance L
(d) Decreasing L

iii. In a single-phase semiconvertor, with discontinuous conduction and extinction angle $\beta > \Pi$, freewheeling diode conducts for **1**
(a) $\alpha$ (b) $\beta - \Pi$ (c) $\Pi + \alpha$ (d) Zero dergee

iv. The effect of source inductance on the performance of single-phase and three-phase full converters is to **1**
(a) Reduce the ripples in the load current
(b) Make discontinuous current as continuous
(c) Reduce the output voltage
(d) Increase the load voltage

v. If, for a single-phase half-bridge inverter, the amplitude of output voltage is Vs and the output power is P, then their corresponding value for a single-phase full-bridge inverter are. **1**
(a) Vs, P (b) Vs/2, P/2 (c) 2Vs, 2P (d) 2Vs, P.

P.T.O.

vi. In a CSI, if frequency of output voltage is f Hz, then frequency of voltage input to CSI is. **1**
(a) f (b) 2f (c) f/2 (d) 3f

vii. In dc choppers, if Ton is the on-period and f is the chopping frequency, then output voltage in term of input voltage Vs is given by **1**
(a) Vs.Ton/f (b) Vs.f/Ton (c) Vs/f.Ton (d) Vs.f.Ton

viii. A step down chopper has Vs as the source voltage and α as the duty cycle. The output voltage for this chopper is given by **1**
(a) Vs (1 + α) (b) Vs /(1 - α)
(c) Vs (1 - α) (d) Vs /(1 + α)

ix. A single-phase half wave ac voltage controller feed a load R. for a firing angle of 180 degree, a PMMC voltmeter across the load read **1**
(a) Vm/2 (b) –Vm/Π (c) –Vm/2Π (d) Zero

x. The number of thyristors required for single-phase to single-phase cycloconverter of the mid-point type and for three phase to three-phase 3-pulse type cycloconverter are respectively. **1**
(a) 4, 6 (b) 8, 18 (c) 4, 18 (d) 4, 36

Q.2 i. Compare an UJT firing circuit with R and RC firing circuit. **3**

ii. Draw and explain **7**
(a) Switching characteristics of thyristors during tum-on and turn-off.
(b) V-I characteristics of SCR also define latching current and holding current.

OR iii. Explain the need of commutation in thyristor circuit. What are the different method of commutation scheme? Explain voltage commutation with a neat schematic and waveform. **7**

Q.3 i. Describe how a freewheeling diode improves power factor in a converter system. **3**

ii. Explain full wave controlled rectifier with R and R-L load on discontinious operation with reference to circuit diagram, input - output waveform at firing angle 60 degree and drive the output voltage equation. **7**



OR iii. Explain three phase half wave controlled rectifier with R and R-L load on discontinious operation with reference to circuit diagram, input-output waveform and output voltage equation at firing angle 60 degree. **7**

Q.4 i. What is pulse width modulation. List the various PWM techniques. How do these differ from each other. **3**

ii. Draw and explain Forced-commutated Modified McMurray thyristor inverter with circuit diagram of all operating mode also draw the input-output waveform. **7**

OR iii. Draw and explain the working of a three-phase bridge inverter at 180 degree conduction mode of star connected resistive load with an appropriate circuit diagram and waveform. **7**

Q.5 i. Explain the constant frequency and variable frequency control strategies of chopper with proper waveform. **3**

ii. Describe the various types of chopper configurations with appropriate diagram. **7**

OR iii. Describe the principle of operation of step up and step down dc chopper. Drive an expression for its average dc output voltage. **7**

Q.6 Attempt any two:

i. Draw the circuit diagram and output voltage waveform of Single phase full wave ac voltage controller feeding a resistive load and also drive the expression of power factor. **5**

ii. Explain three-phase to single-phase cycloconverter with appropriate circuit diagram and waveform. **5**

iii. Describe the basic principle of working of single-phase to single-phase step-down and step-up cycloconverter with appropriate circuit diagram and waveform. **5**

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## Marking Scheme

## EE3CO02 / EX3CO02 Power Electronics Devices & Circuits

| | | | |
|---|---|---|---|
| Q.1 | i. | In a thyristor, the magnitude of anode current will<br>(d) Not change with any variation in gate current | **1** |
| | ii. | Turn-on time of an SCR in series with RL circuit can be reduced by<br>(d) Decreasing L | **1** |
| | iii. | In a single-phase semiconvertor, with discontinuous conduction and extinction angle $\beta > \Pi$, freewheeling diode conducts for<br>(b) $\beta - \Pi$ | **1** |
| | iv. | The effect of source inductance on the performance of single-phase and three-phase full converters is to<br>(c) Reduce the output voltage | **1** |
| | v. | If, for a single-phase half-bridge inverter, the amplitude of output voltage is Vs and the output power is P, then their corresponding value for a single-phase full-bridge inverter are.<br>(c) 2Vs, 2P | **1** |
| | vi. | In a CSI, if frequency of output voltage is f Hz, then frequency of voltage input to CSI is.<br>(b) 2f | **1** |
| | vii. | In dc choppers, if Ton is the on-period and f is the chopping frequency, then output voltage in term of input voltage Vs is given by<br>(d) Vs.f.Ton | **1** |
| | viii. | A step down chopper has Vs as the source voltage and $\alpha$ as the duty cycle. The output voltage for this chopper is given by<br>(b) Vs /(1 - $\alpha$) | **1** |
| | ix. | A single-phase half wave ac voltage controller feed a load R. for a firing angle of 180 degree, a PMMC voltmeter across the load read<br>(b) –Vm/Π | **1** |
| | x. | The number of thyristors required for single-phase to single-phase cycloconverter of the mid-point type and for three phase to three-phase 3-pulse type cycloconverter are respectively.<br>(c) 4, 18 | **1** |
| Q.2 | i. | Compare an UJT firing circuit with R and RC firing circuit.<br>1 mark for each comparison (1 mark * 3) | **3** |
| | ii. | Draw and explain | **7** |
| | | (a) Switching characteristics 3.5 marks | |
| | | (b) V-I characteristics of SCR 3.5 marks | |
| OR | iii. | Need of commutation in thyristor circuit 1.5 marks | **7** |
| | | Method of commutation scheme 1.5 marks | |
| | | Voltage commutation 4 marks | |
| Q.3 | i. | Freewheeling diode | **3** |
| | | Cicuit diagram 1 mark | |
| | | Explanation 2 marks | |
| | ii. | Circuit diagram 2 marks | **7** |
| | | Explanation 1 mark | |
| | | Input-output waveform 2 marks | |
| | | Output equation 2 marks | |
| OR | iii. | Circuit diagram 2 marks | **7** |
| | | Explanation 1 mark | |
| | | Waveform 2 marks | |
| | | Equation 2 marks | |
| Q.4 | i. | Pulse width modulation definition 1 mark | **3** |
| | | Name of PWM techniques 1 mark | |
| | | Difference from each other 1 mark | |
| | ii. | Circuit diagram of different mode 3 marks | **7** |
| | | Explanation 2 marks | |
| | | Waveform 2 marks | |
| OR | iii. | Circuit diagram 2 marks | **7** |
| | | Expression 2 marks | |
| | | Waveform 3 marks | |
| Q.5 | i. | Constant frequency 1.5 marks | **3** |
| | | Variable frequency 1.5 marks | |
| | ii. | Various configurations 3 marks | **7** |
| | | Corcuit diagram 2 marks | |
| | | Explanation 2 marks | |

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|---|---|---|---|---|
| OR | iii. | Principle of operation of step up and step down | | **7** |
| | | | 3 marks | |
| | | Circuit diagram | 2 marks | |
| | | Expression of equation | 2 marks | |
| Q.6 | | Attempt any two: | | |
| | i. | Circuit diagram | 2 marks | **5** |
| | | Output voltage waveform | 2 marks | |
| | | Expression of equation | 1 mark | |
| | ii. | Three-phase to single-phase cycloconverter | | **5** |
| | | Circuit diagram | 2 marks | |
| | | Output voltage waveform | 3 marks | |
| | iii. | Principle of working of single-phase to single-phase step-down and step-up | | **5** |
| | | Circuit diagram | 2 marks | |
| | | Output voltage waveform | 3 marks | |

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