

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Fifth Semester B.Tech Degree Regular and Supplementary Examination December 2020

Course Code: EE305**Course Name: POWER ELECTRONICS**

Max. Marks: 100

Duration: 3 Hours

*(Graph sheets may be supplied on demand)***PART A***Answer all questions, each carries 5 marks.*

Marks

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| 1 | Discuss how a thyristor may be subjected to over voltages. Discuss the method adopted for protect the thyristor from such over voltages. | (5) |
| 2 | What are the main features that the firing circuits for thyristors should possess?
Give the general layout of a firing circuit scheme and explain the function of various components used in it. | (5) |
| 3 | Compare circulating mode of operation of dual converter and non-circulating mode of operation of dual converter. | (5) |
| 4 | With neat circuit diagram, output voltage and output current waveforms, explain the working of single phase half bridge inverter with RL load. | (5) |
| 5 | Explain sinusoidal pulse modulation as used in PWM inverters. | (5) |
| 6 | Explain with circuit diagram and waveforms, the working of a single phase ACVC with R load. | (5) |
| 7 | Describe the principle of step up chopper. Sketch the input voltage, input current, output voltage and output current waveform. Derive an expression for the average output voltage in terms of input voltage and duty cycle. | (5) |
| 8 | The buck regulator has an input voltage 15 V. The average output voltage is 5 V at $R = 1 \text{ k}\Omega$ and the peak to peak output voltage ripple is 15 mV. The switching frequency is 30 kHz. If the peak to peak ripple current of inductor is limited to 0.5 A, find a) the duty cycle
b) the filter inductance
c) the filter capacitance | (5) |

PART B

Answer any two full questions, each carries 10 marks.

- 9 a) Draw the two-transistor model of a thyristor. Derive an expression for the anode current and based on that, discuss the turn on mechanism of a thyristor using gate triggering. (5)
- b) Explain the structure and principle of operation of a power diode. (5)
- 10 a) Discuss the problems associated with parallel operations of SCR and how these are overcome. (5)
- b) Draw the RC full wave triggering circuit of SCR and explain with relevant waveforms. (5)
- 11 a) A single phase fully controlled bridge rectifier feeds power to a resistive inductive load without a freewheeling diode across the load. Explain the continuous mode of operation with circuit diagram. Draw waveforms for source voltage, load voltage, load current and voltage across the SCR for a given firing angle α . (5)
- b) Derive an expression for average and RMS load voltages of single phase fully controlled bridge rectifier with RL load without a freewheeling diode across the load in terms of source voltage and firing angle. Assume continuous conduction. (5)

PART C

Answer any two full questions, each carries 10 marks.

- 12 A three phase semiconverter is connected to RLE load. Explain its working with neat circuit diagram and waveforms at firing angle $\alpha = 60^\circ$ and $\alpha = 120^\circ$. (10)
- 13 a) Explain the four quadrant operation of a single phase dual converter with circulating mode. (5)
- b) Explain the working of CSI with neat circuit diagram and waveforms. (5)
- 14 Illustrate the operation of a three phase voltage source bridge inverter operating in 120° conduction mode with output line voltage and phase voltage waveforms. (10)

PART D

Answer any two full questions, each carries 10 marks.

- 15 a) What is pulse width modulation? Define the terms modulation index and frequency modulation ratio. (5)
- b) A single phase full wave ACVC has a resistive load of 10Ω and the input

voltage is 230 V, 50 Hz. The delay angles of thyristors are $\alpha_1 = \alpha_2 = \alpha = 90^\circ$. (5)

Find RMS output voltage, and the input power factor.

- 16 a) Draw the circuit diagram of a single-phase full-wave AC voltage controller which uses only one thyristor, along with uncontrolled switching devices. Also explain its operation. What is the main advantage of this circuit? (5)
- b) Draw the circuit diagram of a four-quadrant chopper. Sketch the corresponding quadrant diagram and indicate the conducting devices on the diagram. (5)
- 17 a) With neat circuit diagram and waveform, explain the working of a buck-boost regulator. (5)
- b) Design filter inductance and capacitance of a buck- boost regulator. (5)
