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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
Sixth Semester B.Tech Degree Examination June 2022 (2019 Scheme)



Course Code: EET306

Course Name: POWER ELECTRONICS

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks.

Marks

- 1 Explain the various mechanisms used for triggering an SCR (3)
- 2 Mention any two wide band gap materials used in power electronics industry and explain how it is advantageous over Silicon material. (3)
- 3 Explain the significance of freewheeling operation in a semiconverter (3)
- 4 A 230V, 50Hz, 1-pulse SCR controlled converter is triggered at a firing angle of 40° and the load current extinguishes at an angle of 210° . Find the circuit turn-off time, t_c . (3)
- 5 Define Modulation Index and Modulation Frequency in PWM. (3)
- 6 Draw the circuit diagram and output voltage and current waveform of a 1-phase ac voltage controller with RL load. (3)
- 7 Explain Current Limit Control in chopper circuits (3)
- 8 Draw the circuit diagram of a step-up/down chopper (3)
- 9 Draw and explain the block diagram of a closed loop speed control of an electric drive (3)
- 10 Explain the nature and classification of load torque. (3)

PART-B

Answer one full question from each module, each carries 14 marks.

Module I

- 11 a) With the help of a diagram, explain the Two Transistor analogy of an SCR, with necessary equations. (8)
- b) Draw the circuit symbol of an SCR, Power MOSFET and IGBT. Give a comparison between them based on their applications. (6)

OR

- 12 a) Explain the mechanism of turning-off an SCR using its Turn-off characteristics. (8)

- b) Explain the classification of Power Diodes based on their reverse recovery characteristics (6)

Module II

- 13 With a circuit diagram, explain the working of a 1-phase fully controlled bridge converter supplying RL load. Draw the output voltage and current waveforms for a firing angle of $\alpha=60^\circ$, assuming a continuous conduction. Also, derive an expression for the average value of output voltage. (14)

OR

- 14 a) With a circuit diagram and input and output voltage waveforms, explain the operation of three phase half-controlled converter feeding R load for a firing angle of $\alpha=90^\circ$. (10)
- b) A single-phase full converter delivers power to a resistive load R whose load voltage waveform is shown in Fig. 1. Obtain the equation for average output voltage, V_o . (4)

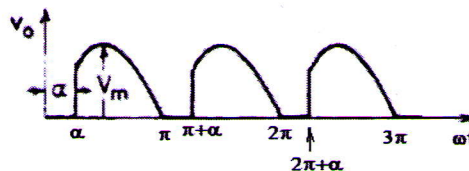


Fig. 1

Module III

- 15 a) Explain the working of a single-phase Full Bridge inverter with the help of a circuit diagram and relevant waveforms. (8)
- b) Explain the control techniques adopted to vary the output voltage of an Inverter (6)

OR

- 16 a) Explain the operation of a 3-phase voltage source inverter with 180° mode of operation. (10)
- b) Explain multiple pulse width modulation as applied to inverters (4)

Module IV

- 17 a) The graph showing the variation of output voltage, V_o with duty cycle, α shown in Fig.2. corresponds to which dc-dc converter? Explain its working with a circuit diagram. (8)

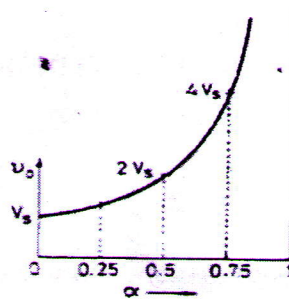


Fig. 2.

- b) With a circuit diagram, explain the operation of a two-quadrant chopper. (6)

OR

- 18 a) Draw and design a buck regulator having an input voltage of $V_s = 12V$. The required average output voltage is $V_a = 5V$ at load $R = 500$ and the peak-to-peak output ripple voltage is to be within 20 mV. The switching frequency is 25 kHz. If the peak-to-peak ripple current of inductor is limited to 0.8 A, determine (a) the duty cycle α (b) the filter inductance L (c) the filter capacitor C and (d) the critical values of L and C . (14)

Module V

- 19 a) Explain regenerative braking control as applied to a separately excited DC Motor (8)
 b) Explain the working of single-phase Half Wave converter fed DC drive (6)

OR

- 20 Explain the v/f control of a three-phase Induction motor drive (14)
