



P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fourth Semester, B.E., - Electronics and Communication Engineering

Semester End Examination; June - 2016

Industrial Electronics

Time: 3 hrs

Max. Marks: 100

Note: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.
 ii) Justify any assumptions made.

UNIT - I

- 1 a. List any four types of power electronic converters with the help of circuit schematic and waveforms bring out the control characteristics of SCR, GTO and power BJT. 10
- b. Discuss the peripheral effects and their remedies in power electronic converters. 6
- c. What is an IGBT? What are its advantages over BJT? Draw the circuit symbol of IGBT. 4
- 2 a. With the help of switching model and switching waveforms explain the switching time of a power MOSFET. 8
- b. In the anti saturation base control circuit of Fig. Q 2(b), $V_{CC} = 120\text{ V}$, $R_C = 2\ \Omega$, $V_{D1} = 2.1\text{ V}$, $V_{D2} = 0.9\text{ V}$, $V_{BE} = 0.7\text{ V}$, $V_{BB} = 14\text{ V}$, $R_B = 3\ \Omega$ and $\beta = 15$. Determine;
 - (i) The collector current without clamping
 - (ii) The collector-emitter clamping voltage
 - (iii) The collector current with clamping.

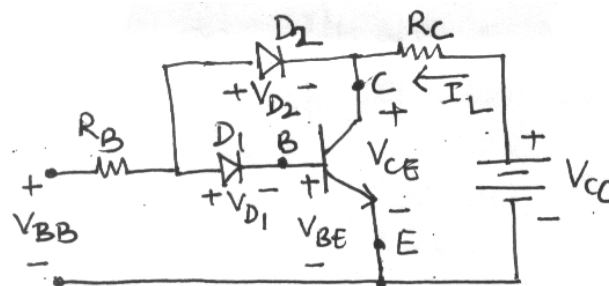


Fig. Q 2 (b)

- c. Explain the principle of proportional base control. 4

UNIT - II

- 3 a. Using the two-transistor analogy derive an expression for the anode current of a thyristor and list the factors that cause turn-on in thyristors. 8
- b. Two thyristors connected in parallel have V-I characteristics during On-state as desirable by $V_1 = 1 + (1.05 \times 10^{-3})i_1$ $V_2 = 0.9 + (0.85 \times 10^{-3})i_2$
 - i) Find the current they can conduct together without individually exceeding 500 A. 6
 - ii) What is the equalizing resistance to be connected in series with each thyristor to ensure that they can conduct together 950 A?

- c. Explain RC firing circuit for a single phase half-wave rectifier. 6
- 4 a. With relevant waveforms explain the turn-ON and turn-OFF times of a thyristor. 8
- b. Explain the needs to protect thyristors against high di/dt and dv/dt along with the methods used for the same. 7
- c. How many thyristors are required in a series string to withstand a dc voltage of 3500 V in steady state if the thyristors have a steady state voltage rating of 1000 V and the steady state derating factor is 30%? Assuming maximum difference in the leakage current of the thyristors to be 100 mA, calculate the value of voltage sharing resistance to be used. 5

UNIT - III

- 5 a. List the applications of AC voltage controllers with the help of neat diagram and waveforms explain the principle of phase controlled AC voltage controllers. 10
- b. Draw the circuit diagram of full wave AC voltage controller supplying an RL load.
A single phase full wave AC voltage controller supplies a purely resistive load of $R = 10 \Omega$ from an AC source of 230 V, 50 Hz. If the delay angle of the thyristors are equal $\alpha_1 = \alpha_2 = \pi/2$, Calculate; 10
- i) The rms output voltage and current
- ii) The input power factor
- iii) The average and rms values of thyristor current.
- 6 a. A single phase full converter with an RL load and operating from a 230 V, 50 Hz ac supply provides an average load current of 6 A at a delay angle of 45° . If the ripple content of the load current is negligible. Determine; (i) the dc load voltage and dc output power, (ii) the quantities mentioned in (i) when a freewheeling diodes is connected across the output power, (ii) the quantities mentioned in (i) when a freewheeling diode is connected across the output for the same load resistance and firing angle, iii) the dc load voltage and current if thyristor T_3 is open circuited. Assume same load resistance and firing angle and a free wheeling diode across the load. 10
- b. With the help of a neat circuit diagram and relevant waveforms, explain a single phase dual converter. Mention any two advantages of the circulating current mode operation of the same. 10

UNIT - IV

- 7 a. What is a step-down chopper? With the help of a neat circuit diagram and relevant waveforms explain the operation of a step-down chopper with RLE load, in the continuous current mode. 10
- b. Explain how the principle of a step-up chopper can be used to transfer energy from a low voltage DC source to a high voltage DC source. 6

- c. A step-up chopper has an input voltage of 200 V and an output voltage of 250 V. The blocking period in each cycle of operation is 0.6 ms. Find the period of conduction in each cycle. 4
- 8 a. What do you mean by frequency modulation control a dc-dc chopper? What are the drawbacks of this technique? 5
- b. List the various classes of choppers. Explain any two of them. 8
- c. In a step-down DC chopper with R load, the supply voltage $V_s = 240$ V dc, the load resistance $R = 15 \Omega$ and the voltage across the chopper switch when it is ON is $V_{ch} = 1.5$ V. If the chopping frequency is $f = 1.2$ kHz and the duty cycle is 60%, calculate 7
- (i) The average output voltage (ii) The rms output voltage
- (iii) The chopper efficiency (iv) The effective input resistance.

UNIT - V

- 9 a. With the help of neat circuit diagram and relevant waveforms explain a single phase full bridge inverter. 8
- b. List any two advantages and two disadvantages of current source inverters. 4
- c. A single phase half bridge inverter has a resistive load $R = 2.4 \Omega$ and the dc input voltage $V_s = 48$ V. Determine; 8
- i) The rms output voltage at the fundamental frequency
- (ii) The output power
- (iii) The average and peak values of the transistor current
- (iv) The peak reverse blocking voltage of each transistor.
- 10 a. What is the need to control the output voltage of inverters? Explain the sinusoidal PWM technique to control the output of a single phase inverter. 8
- b. With the help of a neat circuit diagram explain the operation of a push-pull converter. 6
- c. What is an uninterruptible power supply? With the help of neat diagrams explain the two commonly used configurations of uninterruptible power supply configurations. 6

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