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# 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

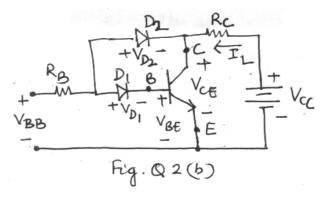
Time: 3 hrs Max. Marks: 100

 ${\it Note:}\ i)\ {\it Answer}\ {\it FIVE}\ {\it full}\ {\it questions},\ {\it selecting}\ {\it ONE}\ {\it full}\ {\it question}\ {\it from}\ {\it each}\ {\it unit}.$ 

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.
  - b. Discuss the peripheral effects and their remedies in power electronic converters.
  - c. What is an IGBT? What are its advantages over BJT? Draw the circuit symbol of IGBT.
- 2 a. With the help of switching model and switching waveforms explain the switching time of a power MOSFET.
  - b. In the anti saturation base control circuit of Fig. Q 2(b),  $V_{CC}=120$  V,  $R_{C}=2$   $\Omega$ ,  $V_{D1}=2.1$  V,  $V_{D2}=0.9$  V,  $V_{BE}=0.7$  V,  $V_{BB}=14$  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.



c. Explain the principle of proportional base control.

#### **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.
  - b. Two thyristors connected in parallel have V-I characteristics during On-state as desirable by  $V_1 = 1 + (1.05 \times 10^{-3}) i_1 \quad V_2 = 0.9 + (0.85 \times 10^{-3}) i_2$ 
    - i) Find the current they can conduct together without individually exceeding 500 A.
    - ii) What is the equalizing resistance to be connected in series with each thyrestor to ensure that they can conduct together 950 A?

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c. Explain RC firing circuit for a single phase half-wave rectifier.

4 a. With relevant waveforms explain the turn-ON and turn-OFF times of a thyristor.

b. Explain the needs to protect thyristors against high di/dt and dv/dt along with the methods used for the same.

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.

## **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.
  - 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;
    - 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<sub>3</sub> is open circuited. Assume same load resistance and firing angle and a free wheeling diode across the load.
  - 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.

#### **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.
  - 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.

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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	4
	cycle.	
8 a.	What do you mean by frequency modulation control a dc-dc chopper? What are the	5
	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	8
	bridge inverter.	0
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	
	$V_s = 48 \text{ V. Determine};$	
	i) The rms output voltage at the fundamental frequency	8
	(ii) The output power	Ü
	(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	8
	technique to control the output of a single phase inverter.	Ü
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	6
	commonly used configurations of uninterruptible power supply configurations	9