

# CBCS Scheme

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15EE53

## Fifth Semester B.E. Degree Examination, June/July 2018 Power Electronics

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing one full question from each module.

### Module-1

- With neat circuit diagram, input and output wave form, explain the different types of power electronic converters. (08 Marks)
  - Discuss the peripheral effects of power electronics equipments. (04 Marks)
  - Discuss the major industrial applications of power electronic converter circuits. (04 Marks)

OR

- With the help of neat waveform, explain the reverse recovery characteristics of a power diode. And also obtain an expression for peak reverse current. (08 Marks)
  - With neat circuit diagram and waveforms, explain the operation of single phase full wave rectifier with RL load. Derive the expression for rms output current for continuous load current. (08 Marks)

### Module-2

- With neat circuit diagram and switching times explain steady state and switching characteristics of power MOSFET. (08 Marks)
  - Give the list of base drive control circuits for BJT. With a neat diagram explain Anti saturation control. (08 Marks)

OR

- With necessary waveforms explain the switching characteristics of an IGBT. (05 Marks)
  - In the bipolar transistor circuit shown in Fig Q4(b)  $\beta$  varies between 10 to 60. The load resistance  $R_c = 5\Omega$ ,  $V_{CC} = 100V$ ,  $V_{BB} = 8V$ , if  $V_{CE(sat)} = 2.5V$  and  $V_{BE(sat)} = 1.75V$ , calculate :
    - The value of  $R_B$  that results in saturation with an ODF of 5
    - The forced  $\beta$  value and
    - Power loss in the transistor. (05 Marks)

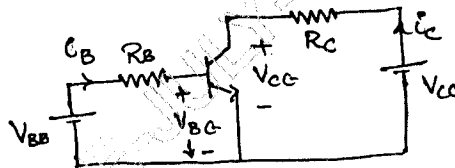


Fig Q4(b)

- Discuss the importance of providing isolation of gate 1 base drive from power circuit and explain the two methods. (06 Marks)

### Module-3

- Derive an expression for the anode current of thyristor with help of two transistors analogy. (05 Marks)
  - With the current diagram and waveforms explain the working of UJT triggering technique of SCR. (05 Marks)
  - Design the values of di/dt inductor and RG snubber components for an SCR working in a 230V system. Given di/dt rating is  $90A/\mu s$  and dV/dt rating is  $200V/\mu s$ . Effective series resistance is  $1.5\Omega$  and damping factor is 0.6. (06 Marks)

OR

- 6 a. With the help of neat sketch, explain the static V-I characteristics of an SCR. Define latching current, holding current and breakover voltage. (06 Marks)
- b. Ten thyristors are used in string to withstand a D.C voltage of  $V_s = 15\text{kV}$ . The maximum leakage current and recovery charge differences of thyristors are  $10\text{mA}$  and  $150\mu\text{C}$  respectively. Each thyristor has a voltage sharing resistor of  $R = 56\text{k}\Omega$  and capacitance of  $C_1 = 0.5\mu\text{F}$ . Determine :
- The maximum steady state voltage sharing
  - Steady state voltage derating factor
  - The maximum transient voltage sharing
  - The transient voltage derating factor
- (06 Marks)
- c. Explain the V-I characteristics of TRIAC. (04 Marks)

**Module-4**

- 7 a. With necessary waveforms, explain the operation of a single phase AC voltage controller with RL load. Derive the expression for rms output voltage. (08 Marks)
- b. A single phase full wave A.C voltage controller has an input voltage of  $230\text{V}$  and a load resistance of  $10\Omega$ . The firing angle is  $45^\circ$ . Calculate :
- RMS output voltage
  - The output power
  - The input p.f
- (08 Marks)

OR

- 8 a. With circuit diagram and waveforms, explain the operation of a three phase dual converter. (08 Marks)
- b. The single phase dual converter is operated from a  $120\text{V}$ ,  $60\text{Hz}$  supply and the load resistance is  $R = 10\Omega$ . The circulating inductance is  $L_r = 40\text{mH}$ , delay angle are  $\alpha_1 = 60^\circ$  and  $\alpha_2 = 120^\circ$ . Calculate the peak circulating current and the peak current of converter - 1. (04 Marks)
- c. What are the significance of circulating current in dual converters. (04 Marks)

**Module-5**

- 9 a. Classify the different types of choppers the help of circuit and quadrant diagram. Explain the operation of four quadrant chopper. (08 Marks)
- b. For the chopper circuit shown in Fig. 9(b), the duty cycle is  $0.5$  and chopping frequency  $f = 5\text{KHz}$ . Determine :
- Minimum instantaneous load current
  - Peak instantaneous load current
  - Maximum peak - to - peak current in load
  - Average and rms load current.
- (08 Marks)

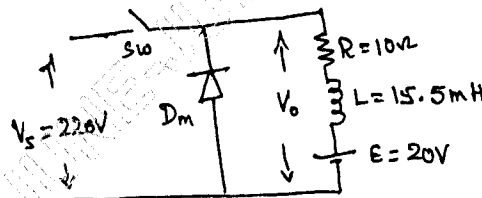


Fig Q9(b)

OR

- 10 a. With a neat circuit diagram and waveforms explain  $180^\circ$  mode of operation of a three phase's inverter. Give the expression for line and phase voltages for one cycle. (08 Marks)
- b. Explain sinusoidal pulse width modulation technique of voltage control of single phase inverter. (04 Marks)
- c. Discuss the advantages of the current source inverter over voltage source inverter. (04 Marks)