

# CBCS Scheme

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15EE53

Fifth Semester B.E. Degree Examination, Dec.2017/Jan.2018

## Power Electronics

Time: 3 hrs.

Max. Marks: 80

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

### Module-1

- 1
- With the help of circuit diagram, input and output waveforms explain working of different types of power electronic converters. (08 Marks)
  - The reverse recovery time of a diode is  $5\mu\text{s}$  and rate of fall of diode current is  $80\text{A}/\mu\text{s}$ . Calculate : i) the storage charge  $Q_{RR}$  ii) Peak reverse current  $I_{RR}$ . (04 Marks)
  - List the parameters on which the performance of rectifier is evaluated. (04 Marks)

OR

- 2
- Briefly explain different types of power diodes. (06 Marks)
  - Explain the peripheral effects of power electronic equipments. (06 Marks)
  - The bridge rectifier has an AC source with  $V_m = 100\text{V}$  at 60Hz and a series load (RL) with  $R = 10\Omega$  and  $L = 10\text{mH}$ . Calculate :  
i) Average current in the load  
ii) Average currents in the diodes. (04 Marks)

### Module-2

- 3
- Explain the switching characteristics of MOSFET. (05 Marks)
  - Explain the anti-saturation control of BJT. (05 Marks)
  - The  $\beta$  of bipolar transistor varies from 12 to 75. The load resistance is  $1.5\Omega$ . The supply voltage  $V_{CC} = 40\text{V}$  and base input voltage is 6V. If  $V_{CE(sat)} = 1.2\text{V}$ ,  $V_{BE(sat)} = 1.6\text{V}$  and  $R_B = 0.7\Omega$ , calculate : i) ODF ii) Forced  $\beta$  iii) total power loss in transistor. (06 Marks)

OR

- 4
- List and explain the switching limits of power BJT. (08 Marks)
  - The base drive circuit of anti-saturation control has supply voltage 400V, collector resistance  $4\Omega$ ,  $V_{d1} = 3.6\text{V}$ ,  $V_{d2} = 0.9\text{V}$ ,  $V_{BE(sat)} = 0.7\text{V}$ . The voltage to the base circuit is 15V.  $R_B = 1.1\Omega$  and  $\beta = 12$ . Find : i) Collector current without clamping ii) collector clamping voltage  $V_{CE}$  and ii) Collector current with clamping. (08 Marks)

**Module-3**

- 5 a. Explain the V-I characteristics of SCR. Also define : i) holding current and ii) Latching current. (06 Marks)
- b. Explain different methods of turning on of thyristor. (06 Marks)
- c. For the SCR shown in Fig.Q5(c), has a latching current of 20mA and is fired by a pulse width of  $50\mu\text{s}$ . Determine whether the SCR turns on or not and comment on the result obtained. (04 Marks)

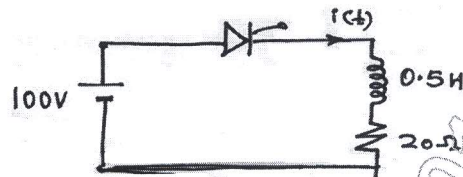


Fig.Q5(c)

OR

- 6 a. With the help of two transistor model, derive an expression for anode current of a thyristor and explain why gate loses its control over the device once thyristor is turned on. (08 Marks)
- b. A string of SCRs are connected in series to withstand a DC voltage of 15KV. The maximum leakage current and recovery charge difference of thyristor are 10mA and  $150\mu\text{C}$  respectively. A derating factor of 20% is applied for steady state and transient state voltage sharing's of thyristors. If the maximum steady state voltage sharing is 1000V. Calculate : i) steady state voltage sharing resistance R for each thyristor ii) transient voltage capacitance  $C_1$  and iii) string efficiency. (08 Marks)

**Module-4**

- 7 a. With the help of circuit diagram and waveforms, explain the working of single – phase full converter with R-L load. (08 Marks)
- b. A single –phase full wave AC voltage controller has an input voltage of 150V (rms) and a load of  $8\Omega$ . The firing angle of thyristor is  $60^\circ$ . Find : i) average output voltage ii) rms output voltage iii) output power and iv) input P.F. (08 Marks)

OR

- 8 a. Explain the working of single – phase full wave AC voltage controller with resistive load. Draw relevant circuit, waveforms. Derive an expression for rms output voltage. (08 Marks)
- b. A single – phase circulating current dual converter is fed by 230V, 50Hz supply. The load is resistive. The peak current of converter 1 is 39.7A. The firing angles are  $45^\circ$  and  $135^\circ$  respectively. If peak – circulating current is 11.5A, Find : i) inductance of current limiting reactor ii) load resistance. (08 Marks)

**Module-5**

- 9 a. Explain the working of step-up chopper. Draw the relevant waveforms. Derive an expression for average output voltage. (06 Marks)
- b. A step-down chopper has an input voltage of 200V and a load of  $8\Omega$  resistance. The voltage drop across thyristor is 2V and the chopping frequency is 800Hz. The duty cycle is 0.4. Find : i) average output voltage ii) rms output voltage iii) chopper efficiency. (06 Marks)
- c. Briefly explain the factors that influence the performance of inverter. (04 Marks)

OR

- 10 a. Explain the voltage control of single –phase inverter using : i) multiple pulse width modulation ii) sinusoidal pulse width modulation. (08 Marks)
- b. With the help of circuit diagram, explain the operation of different types of choppers. (08 Marks)