F 3208 (Pages : 3) Reg. No.....

Name.....

B.TECH. DEGREE EXAMINATION, NOVEMBER 2014

Fifth Semester

Branch : Electrical and Electronics Engineering

POWER ELECTRONICS (E)

(Old Scheme – Prior to 2010 Admissions)

[Supplementary/Mercy Chance]

Time : Three Hours Maximum : 100 Marks

Part A

Answer **all** *questions.*

Each question carries 4 *marks.*

1. Draw the static $v - i$ characteristics of a GTO and mark the salient features and operating modes / regions.
2. Draw the dynamic characteristics of a thyristor and show the reverse recovery charge in the characteristics.
3. In a circuit a thyristor with a gate-threshold current of 5.5 mA is subjected to a re-applied $\frac{dV}{dt}$ of 1300 $V/\mu s$. If, at this rate the thyristor turns ON without applying any gate pulse, evaluate the minimum possible value of the junction capacitance, assuming it to be a constant.
4. Two thyristors are connected in anti-parallel (parallel with back-to-back) in a circuit. A triggering circuit generates triggering pulses to these thyristors simultaneously. Do these pulses need to be electrically isolated? Give reasons for your answer with relevant illustrations.
5. Is it possible for a single-phase/three-phase fully controlled converter connected to all R-L load to operate continuously with firing angle $0 > 90°$? (There is no free-wheeling diode present across the load). Give reasons for your answer.
6. What are the advantages and disadvantages of a semi-converter when compared to a fully controlled converter?
7. What is meant by complimentary current commutation in choppers?
8. Differentiate between step-up and step-down choppers.
9. Explain briefly the square-wave operation of single-phase inverters.
10. Explain the ramp-comparison method of firing pulse generation scheme for a fully controlled converter.

(10 × 4 = 40 marks)

Turn over

Part B

Answer **all** *questions.*

Each full question carries 12 *marks.*

11. (a) Explain the turn-on process in a thyristor from an equivalent circuit. point-of-view, with relevant equations.

(b) Draw the static v–i characteristics of an IGBT and indicate the regions ill which the IGBT operate as a switch.

(8 + 4 = 12 marks)

Or

12. (a) An SCR is used in a circuit as shown in the Figure 1. The SCR is in the ON condition. An additional resistance is introduced in to the circuit by closing the switch labelled 'S'. What should be the minimum value of 'R' for the SCR to turn OFF when 'S' is open? The holding current of the SCR is 150 mA.

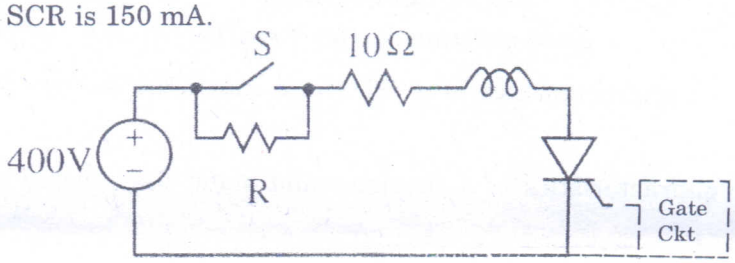

Figure 1 : A switching circuit [question 12(a)]

(b) A MOSFET is used in series with a diode, with the MOSFET's drain connected to the anode of the diode to form a composite switch. Show the polarity/polarities of the current(s) possible when the composite switch is in the ON condition and the polarities of voltage(s) which it will block when in the OFF condition in a $v - i$ plane.

(6 + 6 = 12 marks)

13. (a) A thyristor is used in a switching circuit. The power dissipated in the device is 100 W. If the thermal resistance of the device (from junction to casing) is 0.35° C/W. determine the thermal resistance (from sink to ambient) of the heat sink to be chosen in order to limit the device temperature at 110° C. The ambient temperature is 55° C.

(b) Draw the circuit of a line-synchronised relaxation oscillator with UJT for triggering a half-wave controlled rectifier.

(8 + 4 = 12 marks)

Or

14. (a) What are the issues in connecting thyristors in series? How are these addressed?

(b) Draw the RC-triggering circuit for a thyristor in a half-wave controlled rectifier and state the design considerations. What is the specific advantage of this circuit compared with R-trigger circuit?

(8 + 4 = 12 marks)

15. In a single-phase fully controlled bridge converter supplied from a 230 V, 50 Hz. a.c. bus. the no-load d.c. voltage is 150 V. The a.c. line reactance is 0.3 Ω. Determine the voltage drop due to commutation overlap for a d.c. load current of 10 A. At what value of load current will the average output voltage reduce to zero? Assume that d.c. load current is smooth, without any ripples.

Or

16 (a) A single-phase half-controlled converter is fed from an a.c. supply of 240V r.m.s. 50 Hz source. The converter feeds an RL load with large inductance. If the output average voltage at the load is 150V, estimate the firing angle for the thyristors. Show the waveform of the load voltage in this case.

(b) Draw the circuit diagram and waveforms for a three-phase half-wave converter operating with a firing angle of 60°.

17. Draw the schematic diagram of a 3-phase bridge inverter feeding star-connected resistive load. Show the triggering sequence for 120° conduction mode. Also show the waveforms of phase voltage and line-to-line of the load. Indicate the devices conducting during each interval.

(12 marks)

Or

18. (a) Explain the working of a series inverter with relevant waveforms.

(b) Which commutation scheme is employed in Mc Murray Inverter? Explain its working.

(6 + 6 = 12 marks)

19. (a) Give the schematic diagram and waveforms of a Type-C chopper. Indicate the quadrants in which it operates in a $v - i$ plane.

(b) What is a cycloconverter? What are its applications?

(6 + 6 = 12 marks)

Or

20. (a) A step-down chopper is supplied from a d.c. voltage of 400 V, and is connected to a highly inductive load. The switching frequency is 1 kHz. If the ON period of the switching device is 0.49 ms, sketch the voltage waveform across the R-L load, and find out the r.m.s. and average output voltage.

(b) Explain the cosine-comparison method of firing pulse generation.

(6 + 6 = 12 marks)

[5 × 12 = 60 marks]