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Question Paper Code : 10582

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2025.

Fifth Semester

Electrical and Electronics Engineering

EE 8552 — POWER ELECTRONICS

(Common to : Mechatronics Engineering)

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Differentiate the voltage-controlled devices from current controlled devices

2. Draw a snubber circuit applicable to SCR.

3. Define pulse number.

4. Relate: firing angle, extinction angle and conduction angle in the working of single phase fully controlled rectifier in the continuous load current mode.

5. A chopper is operating at a frequency of 2kHz on a 230 V DC input. If the load voltage is 150V, calculate the conduction and non-conduction periods of thyristor in each cycle.

6. Define: Duty cycle.

7. Define THD.

8. Mention the purpose of integral body diodes.

9. Mention the advantages of phase angle control over the on-off control in the operation AC voltage controllers.

10. Differentiate the matrix converter from the cyclo-converter.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Explain static and switching characteristics of IGBT by indicatring various components of turn-on and turn-off times. (10)

(ii) Compare power MOSFET and Power BJT. (3)

Or

(b) Enumerate the various commutation techniques used for thyristors.

12. (a) Describe the working of single phase fully controlled rectifier feeding RL load with help of mode diagrams and waveforms in both rectification and inversion modes.

Or

(b) (i) For a three-phase dual converter, derive an expression for the circulating current in terms of supply voltage, reactor inductance, firing angle delay etc. Relevant voltage and current waveforms, needed for this derivation, must be sketched. (9)

(ii) With a suitable circuit, explain the working of light dimmer circuit. (4)

13. (a) (i) Explain the waveforms of type A chopper. Derive the expression for current ripple when it feeds RL load. (9)

(ii) A step-up chopper gives 275 V when connected with an ideal voltage source of 220 V dc. If t_{off} of PWM pulse is 15 μs, calculate the pulse width, and the switching frequency. (4)

Or

(b) (i) Describe the working of four quadrant chopper. (8)

(ii) The buck regulator has an input range of Vs= 12 V. The regulated average output voltage is Va = 5 V at R = 500 Ω and the peak to peak output ripple voltage is 20 mV. The switching frequency is 25 kHz if the peak to peak ripple current of inductor is limited to 0.8 A. Determine. (5)

(1) The duty cycle.

(2) The filter inductance.

(3) The filter capacitance, C and.

(4) The critical value of L and C.

14. (a) With neat sketches, explain the operation of three phase voltage source inverter. Draw phase and line voltage waveforms on the assumption that each thyristor conducts for 180° and the resistive load is star connected.

Or

(b) (i) Mention the drawbacks of square wave operation of single -phase. Explain how the PWM methods (multi-pulse modulation, SPWM and modified SPWM) overcome them. (9)

(ii) Discuss about general layout, types and working principle of UPS.(4)

15. (a) Describe the operating principle of single-phase-to-phase step up cycloconverter with the help of mid-point and bridge type configurations. Illutrate your answer with appropriate circuit and waveforms. The conductions of various thystritors must also be indicated in the waveforms.

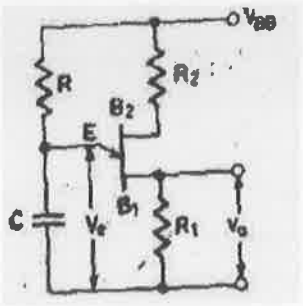
Or

(b) What are the effects of load Inductance on the performance of ac voltage controllers? Explain about its remedial with all the relevant waveforms and explanation.

PART C — ($1 \times 15 = 15$ marks)

16. (a) (i) A relaxation oscillator using an UJT, shown in the figure, is to be designed for triggering an SCR. The UJT has the following data :

$\eta = 0.72$, I_p=0.6 mA, V_p = 18.0 V, V_p = 18V, V_v = 1V, I_v = 2.5mA, R_{BB}=5kΩ, Normal leakage current with emitter open = 4.2 mA, The firing frequency is 2kHz. For C = 0.04 μF, compute the value of R, R_1 and R_2. (8)



(ii) A single phase cycloconverter has input voltaged of 230V, 50Hz and load of R = 10 Ω. Output frequency is one third of input frequency. For a firing angle delay of 30°, calculate (7)

(1) the rms value of output voltage
(2) the rms current value of each converter
(3) the rms current value of each thyristor
(4) the input PF

Or

(b) (i) A single-phase semiconverter is supplied from 230V. 50Hz source. The load consists of R = 10 Ω, E = 100V, and a large inductance so as to render the load current level. For a firing delay angle values of 30°, determine (A) average output voltage (B) average to output current (C) average and rms values of thyrsitor currents (D) average and rms values of diode currents (E) input power factor and (F) circuit turnoff time. (7)

(ii) A battery is charged from 3-phase supply mains of 230V, 50Hz through a 3 phase semi-converter. The battery emf is 190V and its internal resistance is 0.5 Ω. An inductor connected in series with the battery renders the charging current of 20 A ripple free. Compute the firing angle delay and the supply power factor. (8)
