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Question Paper Code : 40494

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2021.

Fifth Semester

Electrical and Electronics Engineering

EE 8552 — POWER ELECTRONICS

(Common to B.E. Mechatronics Engineering)

(Regulations 2017)

(Codes/Tables/Charts to be Permitted. If any may be Indicated)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is a Snubber circuit?
2. Define the threshold gate voltage of power MOSFET.
3. What is the relation between α , β and γ in single-phase fully controlled rectifier when operating with RL load?
4. What is the basic function of an excitation system?
5. What is a time ratio control?
6. What is meant by the regenerative braking in the battery-operated vehicles?
7. Define modulation index.
8. What are harmonics?
9. What is ON-OFF control in ac voltage controllers?
10. A three phase six-pulse, 50 kVA, 415V cycloconverter is operating at a firing angle of 45° and supplying load of 0.8 power factor. Determine input current to the converters.

PART B — (5 × 13 = 65 marks)

11. (a) (i) Discuss the basic structure and working of power IGBT
(ii) Draw the two-transistor model of SCR and derive an expression for anode current.

Or

- (b) (i) Explain in details the different SCR commutation methods.
(ii) Discuss a typical driver circuit suitable for IGBT.
12. (a) Describe the working of 3- ϕ fully controlled bridge converter in the Rectifying mode and inversion mode. And derive the expression for average output voltage and rms output voltage.

Or

- (b) Explain the effect of source inductance in the performance of the single-phase fully controlled rectifier. (13)

13. (a) (i) With help of circuit diagram and waveforms explain the principle of working of boost converter (8)

- (ii) For a class chopper working with resistive load of R ohms, input voltage of V_{dc} and duty cycle α , express the following variables as functions of R, V_{dc} and α .

- (1) Average output voltage and current
- (2) Output current at the of commutation
- (3) Average and RMS freewheeling diode currents
- (4) RMS value of output voltage
- (5) Average and RMS load currents. (5)

Or

- (b) (i) Describe the working of any one resonant dc to dc converter (5)
(ii) Explain the waveforms of type A chopper. Derive the expression for current ripple when it feeds RL load. (8)

14. (a) (i) 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 120° and the resistive load is star connected. (10)
- (ii) Write short notes on the principle of UPS. (3)

Or

- (b) Explain the principle of space vector PWM applied to three phase VSI using the space vector diagram. (13)
15. (a) (i) Describe the operation of a 3-phase thyristorised AC voltage controller with neat power diagram and waveforms (8)
- (ii) Explain in detail about multistage control in ac voltage controllers. (5)

Or

- (b) (i) With the suitable circuit, discuss about the matrix converter (7)
- (ii) (1) Single phase AC voltage controller has, a resistive load of $R=10\Omega$ and input voltage is $V_s = 120 V$, $60 Hz$ the delay angle of thyristor T_1 is $\alpha = \frac{\pi}{2}$. Determine, the rms value of output voltage V_0 , the input PF and the average input current. (6)

PART C — (1 × 15 = 15 marks)

16. (a) (i) The buck regulator has an input range of $V_s=12V$. The regulated average output voltage is $V_a=5V$ at $R=500\Omega$ and the peak to peak output ripple voltage is $20mV$. The switching frequency is $25kHz$ if the peak to peak ripple current of inductor is limited to $0.8A$ determine
- (1) The duty cycle, K
- (2) The filter inductance, L
- (3) The filter capacitance, C and
- The critical value of L and C (10)

- (ii) A three phase fully controlled converter charges a battery from a three phase supply of 230V, 50Hz. The battery emf is 200V and its interval resistance is 0.5Ω . On account of inductance connected series with the battery, charging is constant at 20 A. Calculate (5)
- (1) firing angle
 - (2) supply power factor
 - (3) in case it is desired that power flows from dc source to ac load, find the firing angle for the same current.

Or

- (b) (i) The input to a three phase dual converter is 400V 50Hz. If peak value of circulating current is limited to a value 20 A find the value of inductance of the reactor for a firing angle of 60° (6)
- (ii) Draw the circuit diagram of 1ϕ auto sequential commutated current source inverter and explain its operation with equivalent circuits for different modes and necessary waveforms. (9)