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Question Paper Code : 91914

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

Fifth Semester

Electrical and Electronics Engineering

EE 3591 — POWER ELECTRONICS

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why N channel structure is used in power MOSFET?

2. Draw the gate charge test circuit for the power MOSFET.

3. What is selective harmonic elimination?

4. Define THD.

5. Give the relation for the peak ripple voltage for a single-phase full-wave diode rectifier feeding a R load with a capacitor directly connected across the load.

6. Define distortion factor.

7. List different power factor improvement methods available for controlled rectifiers.

8. Relate : firing, conduction and extinction angles in single-phase fully controlled rectifier working with continuous load current.

9. Mention the draw backs of integral cycle control.

10. What is necessity of train of pulses instead of single gate pulse?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Describe the switching characteristics of power MOSFETs. (6)

(ii) Explain anyone isolated DC-DC converter based SMPS circuit. (7)

Or

(b) (i) Explain the working of buck-boost converter in continuous current mode. (7)

(ii) Provide the loss calculation of a power MOSFET in a buck converter and suggest a heat sink selection procedure. (6)

12. (a) With neat sketch, 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) Enumerate the working of the single-phase capacitor commutated CSI with relevant diagrams. (6)

(ii) Explain the principle of SVPWM suitable for three-phase VSI with the help of a space vector diagram. (7)

13. (a) (i) With help of suitable diagrams, explain the working of the mid-point secondary transformer based full wave rectifier. (6)

(ii) Enumerate the working of voltage doubler circuit. (7)

Or

(b) Describe the three-phase full-wave diode bridge rectifier with a circuit diagram and relevant wave forms for R load. Derive expressions for average and rms values of output voltage and obtain VRF, FF, rectifier efficiency and TUF.

14. (a) (i) Draw the two-transistor model of SCR and derive an expression for anode current. (6)

(ii) Show that the effect of source inductance is like adding an equivalent resistance of $\frac{\omega L_s}{\pi}\Omega$ in series with the internal rectifier voltage. (7)

Or

(b) 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.

15. (a) (i) For a single-phase voltage controller feeding a resistive load, show that power factor is given by the expression (7)

$$\left[\frac{1}{\pi}(\pi-\alpha)+\frac{1}{2}\sin 2\alpha\right]^{1/2}$$

(ii) Provide a short notes on positive and negative gate pulse triggering of TRIAC. (6)

Or

(b) Describe the operation of the 3-phase thyristorised AC voltage controller with neat power diagram and waveforms in any one configuration.

PART C — (1 × 15 = 15 marks)

16. (a) (i) Provide the steps involved in the design of an RCD snubber for the power MOSFET. (7)

(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 0.8A. Determine. (8)

(1) The duty cycle (2)

(2) The filter inductance (2)

(3) The filter capacitance, (C) and (2)

(4) The critical value of L and C. (2)

Or

(b) (i) A three-phase bridge inverter deliver power to a resistive load from a 450 V dc source. For a star connected load of 10Ω per phase determine for both (A) 1800 mode and (B) 120° mode (8)

(1) rms value of load current

(2) rms value of thyristor current

(3) load power

(ii) A single-phase two-pulse diode rectifier has input supply of 230V, 50 Hz and the load resistance R = 300 Ω. Calculate the value of inductance to be connected in series with R so as to limit the current ripple factor to 5%. Find the value of L in case R = 30 Ω. Determine also the value of CRF without L. (7)