**Reg. No. :** | | | | | | | | | | | | |

# 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 — ($10 \times 2 = 20$ marks)

1. What is a Snubber circuit?

2. Define the threshold gate voltage of power MOSFET.

3. What is the relation between $\alpha, \beta$ and $\gamma$ 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 450 and supplying load of 0.8 power factor. Determine input current to the converters.

PART B — ($5 \times 13 = 65$ 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 $3-\phi$ 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 convener (8)

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

(1) Avenge 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 phage 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 Ω 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 0.5 Ω. 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 1$\phi$ auto sequential commutated current source inverter and explain its operation with equivalent circuits for different modes and necessary waveforms. (9)

———————

Reg. No. : | | | | | | | | | | | | |

**Question Paper Code : 50540**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

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. Define ODF in a power BJT.

2. *"Snubber circuit for an SCR should primarily consist of capacitor only But, in actual practice, a resistor is used in series with the capacitor"*- Interpret.

3. What is the relation between $\alpha$, $\beta$ and $\gamma$ in single-phase fully controlled rectifier when operating with RL load?

4. What are the influences of pulse number of phase-controlled rectifiers on their output voltage ripple content?

5. What is a time ratio control?

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

7. Mention the types of UPS.

8. What is meant by overmodulation in SPWM? Mention its necessity.

9. A single-phase voltage controller has input voltage of 230V, 50Hz and a load of $R = 15\,\Omega$. For 6 cycles ON and 4 cycles OFF, determine the rms value of output voltage

10. A three phase six-pulse, 50 kVA, 415 V cycloconverter is operating at a firing angle of 450 and supplying load of 0.8 power factor. Determine input current to the converters.

PART B — (5 × 13 = 65 marks)

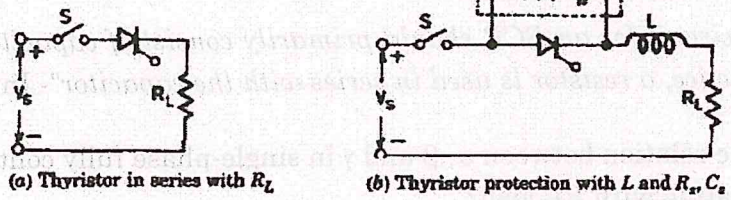
11. (a) (i) Discuss the basic structure and working of power IGBT. (6)

(ii) Draw the two-transistor model of SCR and derive an expression for anode current. (7)

Or

(b) (i) Explain in details the different SCR commutation methods. (9)

(ii) The figure shown beneath shows a thyristor controlling the power in a load resistance $R_L$. The supply voltage is 240 V dc and the specified limits for di/dt and dv/dt for the SCR are 50 A/μs and 300V/μs respectively. Determine the values of the di/dt inductance and the snubber circuit parameters $R_S$ and $C_S$. (4)




(a) Thyristor in series with $R_L$ (b) Thyristor protection with $L$ and $R_s$, $C_s$

12. (a) Explain the single phase fully controlled rectifier while feeding a load current of severe discontinuity. (13)

Or

(b) (i) Explain the effect of source inductance in the performance of the single-phase fully controlled rectifier. (9)

(ii) Discuss the involvement of phase-controlled rectifiers in light dimmer application. (4)

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 $\alpha$, express the following variables as functions of R, $V_{dc}$ and $\alpha$. (1 × 5 = 5)

(1) Average output voltage and *current*

(2) Output current at the commutation

(3) Average and RMS freewheeling diode currents

(4) RMS value of output voltage

(5) Average and RMS load currents

Or

(b) (i) Describe the working of L-type ZCS resonant dc to dc converter. (5)

(ii) Explain the working of class A chopper and arrive the output voltage relation. Also perform the steady state time domain analysis and obtain the output current equation. (8)

14. (a) (i) Draw the circuit diagram of $1\phi$ auto sequential commutated current source inverter and explain its operation with equivalent circuits for different modes and necessary waveforms. (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) Explain the basic principle of operation of a three-phase to single phase cycloconverter with circuit diagram and waveforms. Identify and mark the durations of rectification and inversion modes of converter groups for the *assumed load* angle. Obtain the fundamental rms value of output voltage/phase for an m-pulse cycloconverter. (13)

Or

(b) (i) With the suitable circuit, discuss about the matrix converter. (7)

(ii) A $1-\Phi$ AC voltage controller *has, a* resistive load of R = 10 Ω and input voltage is $V_S$ = 120 V, 60 Hz the delay angle of thyristor $T_1$ is $\alpha = \frac{\pi}{2}$. Determine, (6)

(1) the rms value of output voltage $V_0$

(2) the input PF and

(3) the average input current.

PART C — (1 × 15 = 15 marks)

16. (a) (i) The buck regulator has an input range of $V_S$ = 12 V. The regulated average output voltage is $V_a$ = 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 (10)

(1) The duty cycle, K

(2) The filter inductance, L

(3) The filter capacitance, C and the critical value of L and C.

(ii) A single phase two pulse bridge converter feeds power to RLE load with R = 10 Ω, L = 10 mH E = 100 V, ac voltage is 250V, 50 Hz for continuous conduction. Find the average value of load current for a firing angle of 50°. In case one of the SCR's gets open circuited, find the new value of average load current assuming the output current as continuous. (5)

Or

(b) (i) A three-phase to single-phase cycloconverter employs a six-pulse bridge circuit and fed from 400V, 50Hz supply through a delta/star connected transformer whose per phase turns ratio 3:1. For a output frequency of 2Hz, the load reactance is $\omega_o L$ = 3 Ω. The load resistance is 4 Ω. The commutation overlap and thyristor turn-off limit the firing angle in the inversion mode to 165°. Compute (7)

(1) Peak value of rms output voltage

(2) rms output current

(3) output power

(ii) For a single-phase voltage controller feeding a resistive load, show that power factor is given by the expression $\left[\frac{1}{\pi}\left\{(\pi-\alpha)+\frac{1}{2}\sin 2\alpha\right\}\right]^{1/2}$. (8)

Reg. No. : | | | | | | | | | | | | |

# Question Paper Code : 20984

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2023.

Fifth Semester

Electrical and Electronics Engineering

EE 3591 – POWER ELECTRONICS

(Common to: Mechanical and Automation Engineering/Mechatronics Engineering and Robotics and Automation)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Thermal Resistance and give its unit.
2. Compare resonant converters with hard switched converters.
3. List and define different time durations associated with the dynamic characteristics of IGBT.
4. State the objective of selective harmonic distortion in Converters.
5. Draw the LC filter and mention its corner frequency.
6. Draw the very common snubber circuit for a power diode.
7. Define Distortion factor.
8. List any two industrial applications that need controllable dc power.
9. Define AC voltage controllers.
10. State the demerits of AC voltage controllers.

PART B — (5 × 13 = 65 marks)

11. (a) Explain the basic step down (buck) converter with required diagram and waveform.

Or

(b) Explain the operation of parallel loaded half bridge resonant dc to dc converter with suitable sketch.

12. (a) Explain the operation of single phase half bridge inverter with suitable diagram and also describe the carrier-based sinusoidal PWM (SPWM) scheme with necessary waveform.

Or

(b) Explain the schematic of standard three-phase VSI topology and also explain the square wave operation of three phase VSI [use wave forms]

13. (a) Draw and illustrate the operation of single-phase idealized diode bridge rectifiers with input and output waveforms with appropriate labeling in waveforms.

Or

(b) (i) Draw and explain the working principle of Voltage Doubler (Single-Phase Rectifiers) (8)

(ii) Explain the Concerns and remedies for line-current harmonics and low power factor. (5)

14. (a) Explain the Two-transistor behavioral model of a thyristor along with thermal protection with suitable sketch.

Or

(b) Explain the operation of single phase full wave midpoint converter with suitable sketch and waveforms.

15. (a) Explain the operation of single phase AC controller with R load with required sketch.

Or

(b) Explain about the pulse and high frequency carrier gating of single phase AC controller with RL load using required sketch.

PART C — (1 × 15 = 15 marks)

16. (a) Illustrate the design of Suitable buck converter for an off grid solar PV system of suitable rating with required diagram [Assume your own system]

Or

(b) Illustrate the design of Suitable buck boost bidirectional converter for an hybrid system of suitable rating [solar PV and utility system] with required diagram [Assume your own system]

---

Reg. No. : | | | | | | | | | | | | |

**Question Paper Code : 51017**

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2024

Fifth/Sixth Semester

Electrical and Electronics Engineering

EE 3591 – POWER ELECTRONICS

(Common to : Mechanical and Automation Engineering / Mechatronics Engineering / Robotics and Automation)

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is the purpose of using driver circuit?
2. What is switching power loss?
3. Draw the equivalent circuit for IGBT.
4. Define Space Vector Modulation.
5. What is Bridge Rectifier?
6. Define Distortion Factor.
7. Write the necessity for thermal protection in converters.
8. Define harmonic factor.
9. Draw the VI characteristics of TRIAC.
10. What is positive gate pulse triggering?

PART B — (5 × 13 = 65 marks)

11. (a) Describe the following characteristics of MOSFET.
    (i) Steady – state characteristics. (7)
    (ii) Switching characteristics. (6)

Or

(b) Explain with neat diagram the classifications of resonant converters. (13)

12. (a) Discuss with neat diagram the behaviour of IGBT.

(i) Static behaviour (7)

(ii) Dynamic behaviour (6)

Or

(b) Discuss in detail with neat diagram about the programmed harmonic elimination switching technique. (13)

13. (a) With sketches and derivations, compare the output performance of single-phase half-wave rectifier with single-phase full-wave rectifier. (13)

Or

(b) Discuss in detail with neat diagram the effect of current commutation in three–phase full bridge rectifier and the principle of operation of voltage doubler circuit. (13)

14. (a) Explain in detail about the following

(i) The operation of two transistor analogy of the SCR. (7)

(ii) Turn ON losses and the thermal protection of SCR. (6)

Or

(b) Describe the effect of source inductance on

(i) Single phase converter. (7)

(ii) Three phase converter. (6)

15. (a) With sketches explain the structure and operation of TRIAC. Also discuss about the VI characteristics of TRIAC. (13)

Or

(b) Explain in detail of the following single–phase AC voltage controller.

(i) Unidirectional controller. (7)

(ii) Bidirectional controller. (6)

PART C — (1 × 15 = 15 marks)

16. (a) The single-phase half-bridge inverter as shown in Figure.16 (a) has a resistive load of R = 2.4Ω and the DC input voltage is $V_S$ = 48 V. Determine (i) The rms output voltage at the fundamental frequency $V_{O1}$, (ii) The output power $P_O$ (iii) The average and peak currents of each transistor (iv) the peak reverse blocking voltage $V_{BR}$ of each transistor (v) the THD.

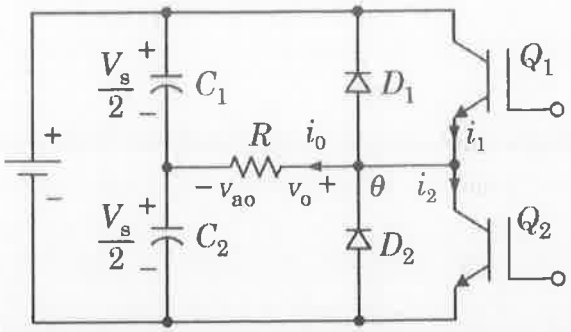



Figure 16(a)

Or

(b) The single-phase full converter as shown in Figure 16(b) is operated with symmetric angle control. The load current with an average value of $I_a$ is continuous, where the ripple content is negligible. (i) Express the input current of converter in Fourier series, and determine the HF of input current, DF, and input PF. (ii) If the conduction angle is $\beta = \pi/3$ and the peak input voltage is $V_m$ = 169.83 V, Calculate $V_{DC}$, $V_{rms}$. HF, DF and PF.

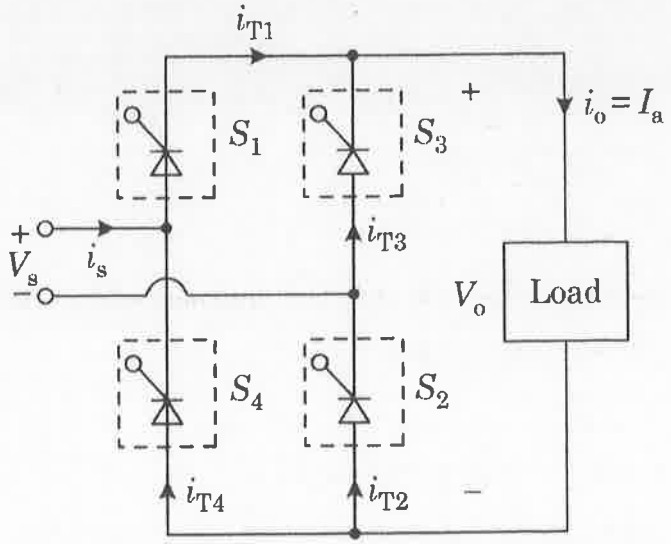



Figure 16(b)