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Question Paper Code : 60577

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2026.

Fifth Semester

Electrical and Electronics Engineering

EE8552 – POWER ELECTRONICS

(Common to : Mechatronics Engineering)

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give examples for uncontrolled, semi-controlled, and fully controlled power Semiconductor devices.
2. Why is isolation required in gate drivers?
3. State one advantage of using a TRIAC in light dimmer circuits.
4. Why is controlled rectification used in alternator excitation?
5. What is the role of a chopper in electric vehicles?
6. What is meant by voltage regulation in SMPS?
7. Why are high-frequency inverters used in induction heating?
8. Differentiate between Online UPS and Offline UPS.
9. What is meant by multistage sequence control?
10. What is an integral cycle control?

PART B — (5 × 13 = 65 marks)

11. (a) With appropriate diagrams, discuss in detail the construction, operation, and characteristics of GTO.

Or

- (b) Explain in detail the construction, operation and characteristics of power IGBT with relevant circuit diagrams.

12. (a) Describe the working of single-fully controlled bridge converter in the Rectifying mode and Inversion mode. And derive the expressions for average output voltage and rms output voltage.

Or

- (b) What is the influence of voltage source impedance on the Current transfer from the incoming SCRs to the outgoing SCRs? Study its effect on the output voltage of single-phase full converter.
13. (a) Explain the working principle of step-down (buck) and step-up (boost) choppers with suitable waveforms. Derive output voltage expressions and discuss control strategies.

Or

- (b) (i) Classify choppers based on the quadrants of Operation. Explain in detail the operation of a Class E (Four-Quadrant) chopper with a circuit diagram. (9)
- (ii) Explain in detail the regenerative braking using choppers in electric vehicles. (4)
14. (a) With neat sketches, explain in detail 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) With relevant circuit diagrams and mode diagrams and waveforms explain the working of any one type of CSI.
15. (a) (i) Explain the working of phase angle controlled single phase ac voltage controller feeding RL load. (5)
- (ii) Explain the working principle of matrix converters Discuss advantages and limitations. (8)

Or

- (b) (i) Discuss the working of single-phase to single phase cycloconverter. (7)
- (ii) Explain the role of AC voltage controllers in welding applications. Discuss control requirements and benefits. (6)

PART C — ($1 \times 15 = 15$ marks)

16. (a) (i) AMOSFET used in a power converter is switched at 300 kHz. The voltage across the device, when it is OFF is 100V and the load current carrier when it is ON is 3A. Assuming the MOSFET takes 100 Nano seconds for turn off and operated at a duty cycle of 60%, design the turn off snubber for the MOSFET. Also design a turn ON snubber assuming the current rise time as 500n seconds. (8)
- (ii) The input to a three-phase dual converter is 400V 50Hz. If peak value of circulating current is limited to a value 20A, find the value of inductance of the reactor for a firing angle of 60° . (7)

Or

- (b) (i) For the single phase fully controlled bridge is connected to RLE load. The source voltage is 230 V, 50 Hz. The average load current of 10A continuous over the working range. For $R = 0.4\Omega$ and $L = 2$ mH, Compute
- (1) firing angle for $E = 120V$
- (2) firing angle for $E = -120V$ (10)
- (ii) A battery powered electric vehicle uses a dc motor drive, controlled by a DC chopper working at 10kHz. The battery voltage is 220V. the minimum turn-on and off-time of the chopper switch (an inverter grade SCR) are $2 \mu s$ and $25 \mu s$, respectively. Determine the minimum and the maximum dc voltage that the chopper can deliver to the motor. (5)

