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Name:

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (R,S) / (WP), S4 (PT) Exam April 2025 (2019 Scheme)

Course Code: EET306 Course Name: POWER ELECTRONICS

Max. Marks: 100

Duration: 3 Hours

Marks

Pages: 3UC

PART A

Answer all questions, each carries 3 marks.

- 1 What advantages do wide bandgap devices offer for power electronics (3) applications?
- 2 Define latching current and holding current of an SCR. Which is higher, the (3) latching current or the holding current?
- 3 A single phase fully controlled rectifier is feeding a resistive load. Can the average (3) voltage across the resistive load be zero? Justify.
- 4 A thyristor is connected in series with a 10 ohm resistor and an AC supply of (3) 230V, 50Hz. The average current through the resistor is 10A. If the thyristor is triggered during each positive half-cycle, calculate the triggering angle.
- 5 Derive the RMS of output voltage of a single-phase full-wave AC voltage (3) converter feeding a resistive load at a firing angle α.
- 6 What are the benefits and drawbacks of using pulse width modulation compared (3) to square wave operation in a voltage source inverter?
- 7 A boost converter running in continuous conduction mode has a switching (3) frequency of F. If the switching frequency is doubled, with all other conditions remaining constant, what will happen to the inductor current ripple and the output capacitor voltage ripple?
- 8 Derive the expression for output voltage ripple for a buck converter operating in (3) continuous conduction mode.
- 9 How are the load torques classified based on the speed-torque relationship? Give (3) an example for each type of load torque.
- 10 In the speed control of a three-phase induction motor, what are the advantages of (3) keeping voltage to frequency ratio constant?

PART B

Answer one full question from each module, each carries 14 marks.

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Module I

11	a)	Explain the turn-on	process of a t	hyristor us	sing the two-transistor	analogy.	(10)
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b) What is the need for isolation in a gate drive circuit? How is it achieved? (4)

OR

- 12 a) Draw and explain the switching characteristics of an IGBT during turn-on with (9) relevant waveforms.
 - b) How do the gate drive requirements of a power MOSFET differ from power BJT? (5)For higher switching applications which is preferred?

Module II

- 13 a) Derive the expression for the input power factor of a single-phase uncontrolled (8) rectifier feeding a constant current load.
 - b) Draw the voltage across the load of a three-phase fully controlled rectifier feeding (6) a constant current load operating at a firing angle of 60 degrees.

OR

- 14 a) Derive the expression for the THD of the AC input current of a single-phase (8) controlled rectifier feeding a constant current load.
 - b) Draw the voltage across the load of 3 phase half-wave controlled rectifier feeding (6)
 a constant current load operating at a firing angle of 60 degree.

Module III

- a) Describe, using appropriate waveforms and circuit diagrams, why switches in a
 current source inverter must block bidirectional voltage, while switches in a
 voltage source inverter must conduct bidirectional current.
 - b) A single-phase full-bridge voltage source inverter is fed from a 400V DC (6) source. A pulse of 120 degrees duration is used to trigger the appropriate devices in each half-cycle. Determine the RMS value of the fundamental component of the output voltage.

OR

- 16 a) A three-phase voltage source inverter is supplied from a 600V DC source. For a (9) star connected resistive load of 30 ohm per phase with 180 degree device conduction, determine the following parameters: i) The total power consumed by the load, ii) RMS current through the load, iii) RMS current through switch.
 - b) With waveforms explain the difference between unipolar and bipolar PWM (5) methods in a single-phase voltage source inverter.

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Module IV

- 17 a) Explain the current limit control in DC-DC converters with relevant diagrams. (8)
 - b) In a boost converter, the duty ratio is adjusted to regulate the output voltage at (6) 48V. The input voltage is 12V. The output power is 120W. The switching frequency is 10kHz. Determine the value of inductance required to keep the peak-to-peak current in the inductor twice the average current through it.

OR

- 18 a) A buck-boost converter is operated at 25kHz, has input voltage of 20V and has an (8) output voltage of 20V. The output is connected to a resistance of 5Ω and C of 100 micro-Farads. The peak-to-peak ripple in inductor current is 2A. Determine the following: i) Duty cycle, ii) The inductance of buck-boost converter, iii) Peak-to-peak ripple voltage across output capacitor.
 - b) Explain how the output voltage varied in a DC-DC converter using a pulse width (6) modulation scheme?

Module V

- 19 a) Describe the working of a four-quadrant chopper feeding a separately excited (8)DC motor in all the four quadrants with relevant circuit diagram and waveforms.
 - b) A separately excited DC motor is operated from the AC mains through a single (6) phase controlled rectifier. Draw the circuit diagram of the above system and explain how the speed on the motor is controlled.

OR

- 20 a) With a neat circuit diagram explain the simultaneous and non-simultaneous (8) operation of a three-phase dual converter.
 - b) A separately excited DC motor is connected to a DC source through a step-down (6) chopper. Draw the circuit diagram of the above system and explain how the speed on the motor is controlled.

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