Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S6 (S,FE) (FT/WP/S4 PT) Examination December 2025 (2019 Scheme)

Course Code: EET306

Course Name: POWER ELECTRONICS

Max. Marks: 100 Duration: 3 Hours

Graph sheets may be provided to answer questions 13 and 15

PART A

Answer all questions, each carries 3 marks. Marks

1		Why is dv/dt protection necessary in SCR circuits and how is it implemented?	(3)
2		Explain why SiC devices can operate at high frequency and temperature.	(3)
3		Explain the difference between continuous and discontinuous conduction in rectifiers.	(3)
4		A single-phase fully controlled bridge rectifier is connected to a 120 V, 50 Hz AC supply and a resistive load of 20 Ω. Calculate the average output voltage for a firing angle $\alpha = 45°$.	(3)
5		Explain the principle of single-pulse width modulation (PWM) in voltage control of inverters.	(3)
6		What is Total Harmonic Distortion in inverter output.	(3)
7		Explain how a 5V DC can be stepped up to 12V DC.	(3)
8		What is PWM control in DC-DC converters.	(3)
9		What are the advantages of electric drives.	(3)
10		What is meant by V/f control of an induction motor?	(3)

PART B

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

Module I

11	a)	Explain the turn-on and turn-off characteristics of SCR?	(6)
	b)	Compare Power MOSFET and IGBT in terms of structure and switching characteristics.	(8)

OR

12	a)	What are the requirements for gate triggering circuits in power devices? Why is isolation necessary?	(4)
	b)	Explain the construction and working of P-channel enhancement Power MOSFET, with neat diagram.	(10)

Module II

13 With a circuit diagram, explain the operation of three-phase half wave-controlled rectifier feeding R-Load. Draw the output voltage waveforms for $\alpha = 30^0$. (14)

OR

14 a) A single-phase fully controlled bridge converter is fed from 230 V, 50 Hz AC source supplying a resistive load of 20 Ω. Find a) Average load voltage and current for $\alpha = 60°$ (ii) Average current through each SCR. (7)

b) With the help of circuit diagram and waveforms explain the operation of single-phase half wave-controlled rectifier with R load. Derive the expression for output voltage. (7)

Module III

15 Explain the operation of a three-phase voltage source inverter in 120° conduction mode. Also, draw the phase and line voltage waveforms across a star-connected resistive (R) load. (14)

OR

16 a) Explain the principle of pulse width modulation for 1-phase inverters. Compare single-pulse, multiple-pulse, and sine-triangle PWM. (8)

b) Describe the operation of single-phase AC voltage controller for R load with waveforms and derive expression for output voltage. (6)

Module IV

17 a) With the help of neat circuit diagram, explain the operation of four quadrant chopper. (8)

b) A Buck converter is designed to step down a nominal input voltage 48 V to an output voltage 12 V. The converter operates at a switching frequency f = 100 kHz and supplies a load current I_0 =5 A. Maximum inductor current ripple is 20% of average load current. Calculate duty cycle and inductance value. (6)

OR

18 a) With neat circuit diagram, explain the working of buck regulator. Also derive the design expression for L and C. (8)

b) Explain how a two-quadrant (Type-D) chopper works, with relevant waveforms. (6)

Module V

19 a) Draw and explain the functional block diagram of an electric drive. (7)

b) Explain the operation of three-phase dual converter in simultaneous conduction mode used for speed control of a DC motor. (7)

OR

20 a) Explain how the speed of a three-phase induction motor can be controlled by varying the stator voltage. (6)

b) A separately excited DC motor is fed from a DC chopper operating from a 220 V DC supply. The motor has an armature resistance of $R_a = 2\,\Omega$. The average armature current is 10 A. The chopper duty ratio is 0.6. Neglect armature inductance. Find Average armature voltage, Back emf of the motor and Motor speed, if the back emf is directly proportional to speed and the emf constant is $k = 0.9$ V/rad/s. (8)

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