



Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
B.Tech Degree S4 (Hons.) Examinations April 2026 (2024 Admn)

Course Code: HNEET409

Course Name: ANALYSIS OF POWER CONVERTERS

Max. Marks: 60

Duration: 2 hours 30 minutes

PART A

(Answer all questions. Each question carries 3 marks)

		CO	Marks
1	Explain the inversion mode of operation of a 1-phase full-converter.	CO1	(3)
2	Derive the expression for the input power factor of a single-phase full converter with continuous and ripple-free load current.	CO2	(3)
3	A buck converter is operated in continuous conduction mode with an input voltage of 10 V and an output voltage of 5 V. The load connected to the converter is 5 ohms. The converter is switched at 10 kHz. Determine the value of the inductor required to keep the peak-to-peak current ripple at 0.1 A.	CO3	(3)
4	Explain with circuit diagram the symmetric angle control in rectifiers.	CO3	(3)
5	Explain how the DC link voltage determines the output line voltage in a 3-phase Voltage Source Inverter (VSI).	CO4	(3)
6	Compare bipolar and unipolar PWM techniques with waveforms.	CO4	(3)
7	A single-phase voltage source inverter is connected to a load, and its current is controlled to follow a sinusoidal waveform using hysteresis current control. Using relevant waveforms, explain how the gate signals are obtained to turn the inverter switches ON and OFF based on the reference current and the hysteresis band.	CO5	(3)

- 8 Draw and explain the operation of a flying capacitor five level inverter. CO4 (3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module -1

- 9 a) Explain the operation of a single-phase fully converter feeding an RLE load under continuous and ripple-free load current conditions with relevant waveforms. CO1 (5)
- b) Derive the expression for the average output voltage of a three-phase fully controlled rectifier operating at a firing angle α , assuming a continuous and ripple-free load current. Explain the effect of source inductance on the output voltage. CO2 (4)
- 10 a) Explain the operation of a single-phase semi converter feeding an RLE load under continuous and ripple-free load current conditions with relevant waveforms. CO2 (5)
- b) Compare the performance of a Power MOSFET and an IGBT with respect to conduction losses in high-power applications. Why are IGBTs generally operate at low switching frequencies? CO1 (4)

Module -2

- 11 a) Explain the principle of extinction angle control and derive expressions for average output voltage and RMS current in a single-phase semi converter. CO2 (6)
- b) A buck-boost converter is operated in continuous conduction mode. The average current through the inductor is 1 A. If the absolute magnitudes of the input and output voltages are equal, determine the average current through the source and the load. CO3 (3)
- 12 a) Derive the expression for the output voltage of a buck converter operating in discontinuous conduction mode with necessary waveforms. CO3 (5)

- b) Explain the working of a single phase series semi-converter with necessary waveforms. CO2 (4)

Module -3

- 13 a) What is a space vector? Prove that the active voltage vectors of a 3-phase inverter are arranged in a hexagon. CO4 (4)
- b) With suitable circuit diagram, represent the switching sequence and waveform of V_{ab} for a 3-phase full-bridge inverter in 180° conduction mode supplying a delta-connected R load. CO4 (5)
- 14 Draw the circuit diagram and the load current waveforms of a single-phase square-wave inverter with a purely inductive load and show the devices conducting during each interval. CO4 (9)

Module -4

- 15 a) Draw the circuit schematic of one leg of a three-level diode-clamped inverter. Show the current paths when current flows from the load to the converter for the three distinct pole voltage levels. CO4 (5)
- b) Analyze the working of a hysteresis current controller in a PWM voltage source inverter and explain how current tracking is achieved. CO4 (4)
- 16 Draw the circuit diagram and output voltage waveform of a single-phase five-level cascaded H-bridge inverter. If the DC link of each H-bridge is V_{dc} , what are the different output voltage levels of the inverter? What is the maximum fundamental voltage the inverter can produce in square wave mode? CO4 (9)
