

Enrollment No./Seat No.:

GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering - SEMESTER - V EXAMINATION - WINTER 2025

Subject Code: N115AL01

Date: 06-12-2025

Subject Name: Power Electronics for Electrical Vehicles

Time: 10:30 AM TO 01:00 PM

Total Marks: 70

Instructions

- 1. Attempt all questions.**
- 2. Make suitable assumptions wherever necessary.**
- 3. Figures to the right indicate full marks.**
- 4. Simple and non-programmable scientific calculators are allowed.**

	Marks
Q.1 (a) State the difference between Electric Vehicle and Hybrid Electric Vehicle.	03
(b) What is Tractive Effort? Write the formula and explain its significance in vehicle motion.	04
(c) Describe the architecture and working principle of a Series Hybrid Electric Drive Train with a neat block diagram.	07
Q.2 (a) Differentiate between SiC MOSFET and GaN MOSFET based on their material properties and advantages.	03
(b) Compare BLDC and PMSM drives used in EVs with respect to efficiency, torque control, and cost.	04
(c) Explain the working and characteristics of MOSFET in power electronic circuits. Discuss its advantages and limitations in automotive applications.	07
OR	
(c) Describe the construction, working, and switching characteristics of an IGBT. Compare it with MOSFET in terms of efficiency, speed, and applications.	07
Q.3 (a) What are uncontrolled rectifiers? Explain briefly the working of a single-phase diode bridge rectifier.	03
(b) Explain the quadrant operation of a DC–DC converter with the help of a voltage–current quadrant diagram.	04
(c) Evaluate the selection criteria for electric motors in EV applications. Explain how vehicle type, load characteristics, and efficiency goals influence the choice of motor drive.	07
OR	
(a) What is the principle of operation of a DC–DC chopper? Mention one automotive application.	03
(b) Explain the operation of a single-phase full-bridge inverter with resistive and inductive loads.	04
(c) Analyze how Induction Motor drives are implemented in Electric Vehicles. Explain the control strategy and speed–torque characteristics.	07

- Q.4 (a)** What is the effect of load inductance on the output of a rectifier? **03**
- (b)** Justify why high-frequency switching DC–DC converters are preferred in compact electric vehicle powertrains. **04**
- (c)** Compare Voltage Source Inverters (VSI) and Current Source Inverters (CSI) in terms of circuit configuration, waveform, and application in automotive drives. **07**

OR

- (a)** What is the function of freewheeling diode in a controlled rectifier circuit? **03**
- (b)** Justify the use of three-phase inverters instead of single-phase inverters for traction motor drives in electric vehicles **04**
- (c)** Explain the working and advantages of a multilevel inverter. Analyze how it improves output waveform quality and reduces harmonic distortion in EV applications **07**
- Q.5 (a)** Evaluate the advantages and limitations of Lithium-ion batteries compared to Lead-acid batteries for electric vehicle applications **03**
- (b)** Briefly explain the function of an ultra-capacitor in an Electric Vehicle powertrain. **04**
- (c)** Examine how Active Cell Balancing circuits improve the efficiency and life cycle of EV batteries **07**

OR

- (a)** Assess the impact of charging rate (slow vs. fast charging) on battery life, efficiency, and thermal performance. **03**
- (b)** Differentiate between on-board and off-board charging systems. **04**
- (c)** Draw and explain the basic block diagram of a Battery Management System (BMS) used in Electric Vehicles. **07**
