KBTCOE

Maratha Vidya Prasarak Samaj's

Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering

An Autonomous Institute affiliated to Savitribai Phule Pune University, Pune

Udoji Maratha Boarding Campus, Gangapur Road, Nashik - 422 013,

Maharashtra, India

Syllabus of Under-Graduate Program

Third Year B.Tech. Electrical Engineering – Honors in e-Mobility (2024 Pattern)

(As per NEP 2020)

Academic Year 2026-27

(Copy for Student Circulation Only)

25.03.2026

Third Year B.Tech. Electrical Engineering – Honors in e-Mobility
Curriculum Structure (2024 Pattern) Semester – V

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
108507	HON-1	Electric Vehicle Technology	3	2	-	40	60	25	25	150	3	1	-	4
Total			**3**	**2**	**0**	**40**	**60**	**25**	**25**	**150**	**3**	**1**	**0**	**4**

Third Year B.Tech. Electrical Engineering – Honors in e-Mobility
Curriculum Structure (2024 Pattern) Semester – VI

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
108607	HON-2	Energy Storage Systems and Battery Management	3	2	-	40	60	25	25	150	3	1	-	4
Total			**3**	**2**	**0**	**40**	**60**	**25**	**25**	**150**	**3**	**1**	**0**	**4**

Semester - V

Course Code: 108507		Course Name: Electric Vehicle Technology	
Teaching Scheme		**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week		**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Fundamentals of Electrical Machines, Power Electronics, and Control Systems.
- Basics of Batteries, Power Converters, and Electrical Drives.

Course Objectives:

- To introduce fundamental concepts, architecture and components of Electric Vehicles (EVs).
- To understand propulsion systems, traction characteristics, and energy flow in EVs.
- To familiarize students with EV charging methods, standards, and grid integration aspects.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the architecture and major subsystems of electric and hybrid electric vehicles.

CO2: Analyze traction characteristics, drive cycles, and performance parameters of EVs.

CO3: Select and design appropriate motors and converters for EV propulsion.

CO4: Evaluate charging techniques and power electronic interfaces for EVs.

CO5: Analyze grid integration and energy management strategies in EV systems.

Course Contents:

Unit-I: Introduction to Electric Vehicles 08 Hours

Need for electric mobility, environmental impact, EV configurations (BEV, HEV, PHEV, FCEV), EV components and architecture, comparison with conventional vehicles, EV subsystems overview.

Unit-II: Vehicle Dynamics and Propulsion Requirements 08 Hours

Traction mechanics: driving resistance, acceleration, gradient, and aerodynamic drag; tractive effort and power calculation; energy consumption; drive cycle analysis; regenerative braking concept.

Unit-III: Electric Propulsion Systems 08 Hours

Types of electric drives: DC motor, BLDC, PMSM, SRM; motor control methods; torque-speed characteristics; power converter topology for motor drives (DC-DC, DC-AC inverters); selection of motor and converter for EV propulsion.

Unit-IV: Charging Systems and Standards 08 Hours

EV charging topologies – On-board and off-board; AC and DC fast charging; Battery swapping; Wireless charging; Charging infrastructure components; Communication protocols (IEC 61851, CHAdeMO, CCS, Bharat Standards); Smart charging and V2G concepts.

Unit-V: Energy Management and Safety 08 Hours

EV energy management strategies, thermal management, protection circuits, insulation and safety standards; introduction to vehicle communication (CAN, LIN), fault detection, and predictive maintenance.

Learning Resources:

Text Books:

1. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press.
2. Mehrdad Ehsani, Y. Gao, and S. E. Gay, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, CRC Press.
3. Sandeep Dhameja, Electric Vehicle Battery Systems, Newnes.
4. Ali Emadi, Handbook of Automotive Power Electronics and Motor Drives, CRC Press.

Reference Books:

1. Chau, K.T., Electric Vehicle Machines and Drives: Design, Analysis and Application, Wiley.
2. James Larminie, Electric Vehicle Technology Explained, Wiley.
3. M. Ehsani, Vehicle Propulsion Systems, CRC Press.
4. NPTEL Courses: Electrical Vehicles (IIT Delhi), Power Electronics for EVs (IIT Kharagpur).

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/108106179
2. https://nptel.ac.in/courses/108105231

List of Practicals: (Any 8)

1. Study of Electric Vehicle architecture and identification of major components.
2. Simulation of vehicle performance parameters (tractive effort, acceleration, range).
3. Torque–speed characteristics of DC and BLDC motor drive (Hardware/Software).
4. Modeling of EV drive cycle and energy consumption using MATLAB/Simulink.
5. Study of EV charging methods and calculation of charging time and efficiency.

6. Design and simulation of DC-DC converter for EV propulsion system.
7. Study of regenerative braking and energy recovery system.
8. Demonstration of BMS communication and protection features (Software demo).
9. Measurement of motor efficiency under varying load conditions.
10. Mini-project: Development of EV subsystem model (drive or charging module).

Semester - VI

Course Code: 108607		Course Name: Energy Storage Systems and Battery Management
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Basic Electrical Engineering, Electrical Machines, and Power Electronics.
- Fundamentals of Chemistry and Electrochemistry.

Course Objectives:

- To provide understanding of electrochemical energy storage technologies and their characteristics.
- To study design, modeling, and management of batteries for EV and renewable applications.
- To understand safety, protection, and thermal management aspects of battery systems.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain working principles and types of energy storage systems.

CO2: Evaluate performance parameters of different battery chemistries.

CO3: Design and analyze battery management systems (BMS).

CO4: Apply modeling and monitoring techniques for SOC and SOH estimation.

CO5: Understand battery safety, charging protocols, and thermal management.

Course Contents:

Unit-I: Fundamentals of Energy Storage Systems 08 Hours

Classification of energy storage systems: mechanical, electrical, electrochemical, chemical, and thermal. Supercapacitors, flywheels, fuel cells, and hybrid energy storage; comparison of various storage technologies for EVs.

Unit-II: Electrochemical Batteries 08 Hours

Battery basics: primary vs secondary cells; lead-acid, Ni-Cd, Ni-MH, Li-ion, Li-polymer, and solid-state batteries; battery performance parameters – capacity, energy density, power density, efficiency, cycle life, Peukert's law.

Unit-III: Battery Modeling and Sizing **08 Hours**

Equivalent circuit models, mathematical modeling of Li-ion cells; capacity determination; battery sizing for EVs; effect of temperature and aging; charge/discharge characteristics and state estimation.

Unit-IV: Battery Management Systems **08 Hours**

BMS architecture and functions, sensors and data acquisition, SOC and SOH estimation techniques, balancing (passive/active), protection strategies, communication protocols, BMS integration with powertrain.

Unit-V: Charging, Safety and Thermal Management **08 Hours**

Charging methods (constant current, constant voltage, multi-stage), fast charging, cell equalization, battery pack design and safety standards (AIS-038, IEC 62660), cooling systems – air, liquid, PCM-based.

Learning Resources:

Text Books:

1. H.J. Bergveld, W.S. Kruijt, and P.H.L. Notten, Battery Management Systems: Design by Modelling, Springer.
2. M. A. Roscher, Battery Management Systems and SOC Estimation, Wiley.
3. Davide Andrea, Battery Management Systems for Large Lithium-Ion Battery Packs, Artech House.
4. NPTEL Course: Energy Storage Systems – IIT Madras.

Reference Books:

1. Linden & Reddy, Handbook of Batteries, McGraw Hill.
2. Larminie & Lowry, Electric Vehicle Technology Explained, Wiley.
3. O'Kane, Advanced Battery Management Systems for EVs, Elsevier.

Web link for MOOC / NPTEL Links:

1. https://nptel.ac.in/courses/108105101
2. https://nptel.ac.in/courses/108105231

List of Practicals: (Any 8)

1. Study of characteristics of Li-ion and Lead-acid battery.
2. Measurement of charge/discharge curves and efficiency.
3. Simulation of SOC and SOH estimation using open-source software.
4. Study of BMS architecture and components.
5. Design of passive and active cell balancing circuits.
6. Study of battery thermal management system (simulation/demo).

7. Battery pack sizing and design for given EV range.
8. Measurement of battery parameters using BMS test setup.
9. Study of charging methods and calculation of charging time.
10. Mini-project on data acquisition and logging for a battery module.

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