III Year I Semester **L T P C**

Code:20EE5640 **4 0 0 4**

ELECTRIC VEHICLE BATTERIES AND CHARGING SYSTEMS

Preamble: This course enables the students to understand various aspects of batteries and charging infrastructure used in electric vehicles.

Course Objectives

1. Understand the importance of batteries in electric vehicles
2. Demonstrate various technical parameters of batteries and battery packs
3. Summarize battery management techniques

Course Outcomes

1. Distinguish between various types of batteries used for EV applications
2. Elaborate various technical parameters of batteries
3. Model batteries in simulated environment
4. Illustrate various battery management issues in electric vehicles
5. Demonstrate various connectors and charging systems used in electric vehicles

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1			3	1					2				2		3
CO2			3	1					2				2		3
CO3			3	1					2				2		3
CO4			3	1					2				2		3
CO5			3	1					2				2		3

1 – Weak, 2 – Moderate and 3 – Strong

Unit – I: Energy Storage System **12 Hours**

Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries–Li-ion & Li-poly, Metal Air Battery, Zine Chloride battery; Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System.

Unit – II: Battery Characteristics and Parameters **12 Hours**

Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications: Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters, Heat generation- Battery design-Performance criteria for Electric vehicle batteries- Vehicle propulsion factors- Power and energy requirements of batteries- Meeting battery performance criteria- setting new targets for battery performance.

Unit – III: Battery Modelling **12 Hours**

General approach to modelling batteries, simulation model of a rechargeable Li-ion battery, simulation model of a rechargeable NiCd battery, Parameterization of the NiCd battery model.

Unit – IV: Battery Pack and Battery Management System **12 Hours**

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management System: Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests.

Unit – V: Mobility and Connectors **12 Hours**

Connectors- Types of EV charging connector, North American EV Plug Standards, DC Fast Charge EV Plug Standards in North America, CCS (Combined Charging System), CHAdeMO, Tesla, European EV Plug Standards.

Text Books:

1. Emadi, A. (Ed.), Miller, J., Ehsani, M., "Vehicular Electric Power Systems" Boca Raton, CRC Press, 2003.
2. Husain, I. "Electric and Hybrid Vehicles" Boca Raton, CRC Press, 2010.

Reference Books:

1. Tariq Muneer and Irene Illescas García, "The automobile, In Electric Vehicles: Prospects and Challenges", Elsevier, 2017.
2. Sheldon S. Williamson, "Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles", Springer, 2013