

6 <sup>th</sup> Semester	REL6D002	Electric and Hybrid Vehicles	L-T-P 3-0-0	3 Credits
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**Module I: (10 Hours)**

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

**Module II: (10 Hours)**

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

**Module III: (10 Hours)**

Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives. Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.

**Module IV: (10 Hours)**

Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology. Battery Management System(BMS)/Energy Management System (EMS): Need of BMS, Rule based control and optimization based control, Software- based high level supervisory control, Mode of power transfer, Behaviour of drive motor. Electric Vehicles charging station: Type of Charging station, Selection and Sizing of charging station.

**Books:**

- [1] Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003
- [2] James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
- [3] Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

**Digital Learning Resources:**

Course Name: Introduction to Hybrid and Electric Vehicles  
 Course Link: <https://nptel.ac.in/courses/108/103/108103009/>  
 Course Instructor: Dr. Praveen Kumar and Prof. S. Majhi, IIT Guwahati

Course Name: Electric Vehicles - Part 1  
 Course Link: <https://nptel.ac.in/courses/108/102/108102121/>  
 Course Instructor: Prof. Amit Jain, IIT Delhi

Course Name: Fundamentals of Electric vehicles: Technology & Economics  
 Course Link: <https://nptel.ac.in/courses/108/106/108106170/>  
 Course Instructor: Prof. Ashok Jhunjunwala et al, IIT Madras