III Year B.Tech. EEE II-Semester

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ELECTRIC AND HYBRID VEHICLES

(Professional Elective-II)

Prerequisite: Electrical Machines, Power Electronics, Control Systems.

Course Objectives:

- To understand the fundamental concepts, principles of Hybrid and Electric Vehicles.
- To Analyze and design the hybrid and electric vehicles.
- To know the various aspects of hybrid and electric drive train such as their configuration, types of electric machines that can be used energy storage devices, etc.

UNIT 1: (~10 Lecture Hours)
Introduction: Introduction to Hybrid electric vehicles: History of hybrid and electric vehicles. Social and environmental importance of hybrid and electric vehicles.
Vehicle fundamentals: Vehicle resistance, Dynamic equation, Tire-Ground Adhesion and Maximum Tractive effort, Power train tractive effort and vehicle speed. Vehicle power plant and transmission characteristics, Vehicle performance. Operating fuel economy braking performance.

UNIT 2: (~8 Lecture Hours)
Energy storage: Introduction to energy storage requirements in hybrid and electric vehicles. Electro chemical batteries and it's analysis, Ultra capacitors and it's analysis, Ultra high speed flywheels and it's analysis, Hybridization of Energy storages.

UNIT 3: (~8 Lecture Hours)
Electric Vehicles: Configurations of Electric vehicles, Performance of Electric vehicles: Traction motor characteristics, Tractive effort and transmission requirement: Gears, Clutch, Brakes, Ideal gearbox, EV motor sizing, Tractive effort in normal driving, Energy consumption.

UNIT 4: (~8 Lecture Hours)
Hybrid Electric Vehicles: Internal combustion Engines, Concept of hybrid electric drive trains, Architectures of hybrid electric drive trains, Series Hybrid electric drive trains,

Parallel Hybrid electric drive trains, Series parallel Hybrid electric drive trains and complex electric drive train.

UNIT 5: (~10 Lecture Hours)
Electric Propulsion Systems: Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC motor drives, configuration and control of Induction motor drives, configuration and control of Permanent magnet Motor drives, configuration and control of Switch reluctance motor drives, Drive system efficiency.
Introduction to energy management strategies: Regenerative braking.

Course Outcomes:

At the end of this course, Students will demonstrate the ability to

- Identify the difference between conventional vehicles and Electric Vehicles.
- Understand the models to describe hybrid vehicles and their performance, various battery sources and energy storage systems.
- Apply the concepts of electrical machines, Power Electronics for the design of Electrical Vehicles.
- Analyze the various vehicle technologies, Drive trains, Energy storage devices and energy management strategies.
- Evaluate the suitable combination of electric motors, power electronic converters, and battery. Evaluate energy management strategies.
- Develop the efficient and effective Hybrid Electric Vehicles.

Textbooks:

1. Mehrdad Ehsani, YiminGAo, Sebastein E.Gay, Ali Emadi "Modern Electric, Hybrid and Fuel Cell Vehicles Fundamentals - Theory and Design", CRC Press, 2005.
2. Iqbal Husain, " Electric and Hybrid Vehicles Design Fundamentals", CRC Press, 2003
3. James Larminie, John Lowry "Electric Vehicle Technologu" John Wiley & Sons Ltd., 2003

Reference Books:

1. C. Mi, M. A. Masrur, D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao, G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.

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