



# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

## COURSE CONTENT

### HYBRID ELECTRIC VEHICLES

#### I Semester: EPS

Course Code	Category	Hours / Week			Credits	Maximum Marks		
BPSE08	Core	L	T	P	C	CIA	SEE	Total
		3	-	-	3	40	60	100
Contact Classes: 45	Tutorial Classes: Nil	Practical Classes: Nil			Total Classes: 45			
Prerequisite: None								

#### I. COURSE OVERVIEW:

This course will help students to acquire fundamental concepts and principles of hybrid electric vehicles (HEV). It will give an idea about design and analyze HEVs, electric machine and the internal combustion. It also covers the application of electric drives in vehicles / traction and strategies of energy management in HEVs

#### II. COURSES OBJECTIVES:

**The students will try to learn**

- I. How to recognize EV/HEV technical and economic objectives
- II. The mechanism of battery and motors in terms of functionality, control and integration.
- III. How to identify efficient EV/HEV architectures such as P1, P2, P3 and P4
- IV. The basic EV marketing strategy.

#### III. COURSE OUTCOMES:

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

- CO1 Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals
- CO2 Analyze the use of different power electronics devices and electrical machines in hybrid electric vehicles.
- CO3 Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology
- CO4 Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration, performance analysis and Energy Management strategies in HEVs.
- CO5 Develop the electric propulsion unit and its control for hybrid electric Vehicles.

#### **IV. COURSE CONTENT:**

##### **MODULE - I: INTRODUCTION TO HYBRID AND ELECTRIC VEHICLES (09)**

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, basics of vehicle performance, vehicle power source characterization transmission characteristics, mathematical models to describe vehicle performance.

##### **MODULE-II: HYBRID TRACTION (09)**

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive train topologies, fuel efficiency analysis.

##### **MODULE -III: CONFIGURATION AND CONTROL OF DRIVES (09)**

Introduction to electric components used in hybrid and electric vehicles, configuration and control of dc motor drives, configuration and control of introduction motor drives.

Configuration and control of permanent magnet motor drives configuration and control of switch reluctance, motor drives, drive system efficiency

##### **MODULE -IV: ELECTRIC MACHINE AND THE INTERNAL COMBUSTION ENGINE (09)**

Matching the electric machine and the internal combustion engine (ICE), sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems

##### **MODULE -V: ENERGY MANAGEMENT AND STRATEGIES (09)**

Introduction to energy management and their strategies used in hybrid and electric vehicle, classification of different energy management strategies comparison of different energy management strategies Implementation issues of energy strategies

#### **V. TEXTBOOKS:**

1. Sira Ramirez, R Silva Origoza, "Control Design Techniques in Power Electronics Devices" Springer, 1st Edition, 2004.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, "Sliding mode control of switching Power Converters", 1st Edition, 2002.

#### **VI. REFERENCE BOOKS:**

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design fundamentals, CRC Press, 1st Edition 2003.
2. Mehrdad Ehsani, YimiGao, Sebastian E Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 1st Edition 2004.
3. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 1st Edition 2003.
4. Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

#### **VII. ELECTRONICS RESOURCES:**

1. NPTEL Introduction to Hybrid and Electric Vehicles, IIT Guwahati
2. NOC: Fundamentals of Electric vehicles: Technology & Economics, IIT Madras

#### **VIII. MATERIALS ONLINE**

1. Course template
2. Tutorial question bank
3. Tech-talk topics
4. Assignments
5. Model question paper-I
6. Model question paper-II
7. Lecture notes
8. Early learning readiness videos (ELRV)
9. Power point presentations