

# 1153AU110 ELECTRIC AND HYBRID VEHICLES

L T P C

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## 1. Preamble

This course is intended for learning the Fundamentals of Automobile Hybrid vehicles. This course gives the brief ideas of Hybrid vehicles propulsion methods- Hybrid architecture- Hybrid power plant specifications- Fuel cell technology - and Non electric Hybrid propulsion systems.

## 2. Pre-requisite

NIL

## 3. Links to other courses

- Automotive Electrical and Electronics.
- Automotive Transmission

## 4. Course Educational Objectives

Students undergoing this course are expected to

- To develop the basic knowledge of the students in electric and hybrid vehicles.
- To develop the skills of the students in the area of working and types of electric motors.
- To develop the detailed knowledge about batteries.

## 5. Course Outcomes

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
C01	Illustrate the concept of electric vehicles and its propulsion systems.	K2
C02	State the concept of hybrid architecture and power plant	K2
C03	List the energy storage systems.	K2
C04	Explain about the fuel cells.	K2
C05	Illustrate the non electric hybrid propulsion systems.	K2

## 6. Correlation of COs with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	H	H		M						L	
CO2	H	H	H		M						L	
CO3	H	H	H		M						L	
CO4	H	H	H		M						L	
CO5	H	H	H		M						L	

H- Strong; M-Medium; L-Low

## 7. Course Content:

**UNIT I Introduction to Road Vehicles and Propulsion System**

L-9

Hybrid Vehicles: Performance Characteristics of Road Vehicles; Calculation of Road Load- Predicting Fuel Economy- Grid Connected Hybrids.

Propulsion Methods: DC Motors Series Wound- Shunt Wound- Compound Wound and Separately Excited Motors AC Motors Induction- Synchronous- Brushless DC Motor- Switched Reluctance Motors.

**UNIT II Hybrid Architecture and Power Plant Specifications** **L-9**

Hybrid Architecture: Series - Parallel and Series Parallel Configuration Locomotive Drives- Switching- Load Tracking Architecture. Pre-transmission Parallel and Combined Configurations Mild Hybrid- Power Assist- Dual Mode- Power Split- Power Split with Shift- Continuously Variable Transmission (CVT) - Wheel Motors.

Hybrid Power Plant Specifications: Grade and Cruise Targets- Launching and Boosting- Braking and Energy Recuperation- Drive Cycle Implications- Engine Friction Reduction - Engine Downsizing and Range and Performance- Usage Requirements.

**UNIT III Drive System and Energy Storage Technology** **L-9**

Sizing the Drive System - Matching Electric Drive and ICE - Sizing the Propulsion Motor - Power Electronics. Energy Storage Technology - Battery Basics - Lead Acid Battery - Different Types of Batteries - Battery Parameters.

**UNIT IV Fuel Cells** **L-9**

Fuel Cell Characteristics- Fuel Cell Types – Alkaline Fuel Cell- Proton Exchange Membrane; Direct Methanol Fuel Cell- Phosphoric Acid Fuel Cell- Molten Carbonate Fuel Cell- Solid Oxide fuel Cell- Hydrogen Storage Systems- Reformers- Fuel Cell EV- Super and Ultra Capacitors- Flywheels.

**UNIT V Non-Electric Hybrid Propulsion Systems** **L-9**

Nonelectric Hybrid Propulsion Systems: Short Term Storage Systems Flywheel Accumulators. Continuously Variable Transmissions Hydraulic Accumulators Hydraulic Pumps/Motors- Pneumatic Hybrid Engine Systems Operation Modes

**TOTAL: 45 periods**

**8. Text Books**

1. Hybrid and Alternative Fuel Vehicles (2nd Edition) (Professional Technician) by James D. Halderman and Tony Martin (Feb 7, 2010)
2. How Your Car Works: Your Guide to the Components & Systems of Modern Cars, Including Hybrid & Electric Vehicles (Rac Handbook) by ArvidLinde (Oct 15, 2011)

**9. References**

1. Electric and Hybrid Vehicles by Iqbal Husain (Jul 16, 2011)
2. Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives by Chris Mi, M. AbulMasrur and David WenzhongGao (Jul 5, 2011)