

COURSE CODE: 1154EE115	COURSE TITLE: <b>HYBRID ELECTRIC VEHICLES</b>	L	T	P	C
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**COURSE CATEGORY:**

University Elective

**PREAMBLE :**

This course aims in providing the fundamental knowledge on electric and hybrid power trains, introduction to the principle of regenerative braking and environmental advantages of electric & hybrid vehicles.

**PREREQUISITE COURSES:**

Basic Electrical & Electronics Engineering, Basic Mechanical & Construction Engineering

**RELATED COURSES:**

Automobile Engineering, Electrical Machines, Automotive Electrical & Electronic Systems

**COURSE EDUCATIONAL OBJECTIVES:**

The objectives of the course are to make the students,

- An overview of the vehicle propulsion principle
- An understanding of the electric vehicles and its powertrains
- The fundamental knowledge on hybrid electric vehicles
- An elaborate knowledge on regenerative braking
- Broad analytical knowledge on advantages of electric vehicles on environment

**COURSE OUTCOMES :**

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

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
C01	Enumerate the principle of vehicle propulsion and braking	K1
C02	Demonstrate the structure of an electric vehicle	K2
C03	Illustrate the working principle of a Hybrid Electric Vehicle	K2
C04	Identify and solve the problems in regenerative braking	K2
C05	Articulate the effects of electric and hybrid vehicles on environment	K2

**CORRELATION OF COs AND POs**

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
C01						L						
C02								H				
C03								H				
C04			M			M						
C05										H		

**COURSE CONTENT:**

<b>UNIT I</b>	<b>FUNDAMENTALS OF VEHICLE PROPULSION</b>	<b>9</b>
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General Description of Vehicle Movement- Vehicle Resistance- Dynamic Equation- Power Train Tractive Effort and Vehicle Speed- Vehicle Power Plant and Transmission Characteristics- Vehicle Performance- Operating Fuel Economy- Brake Performance

<b>UNIT II</b>	<b>ELECTRIC VEHICLE&amp; PROPULSION SYSTEMS</b>	<b>9</b>
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Configurations of EVs- Performance of EVs- Traction Motor Characteristics- Tractive Effort and Transmission Requirement- Vehicle Performance- Tractive Effort in Normal Driving- Energy Consumption- Principle of Operation and Performance-DC Motor Drives-Induction Motor Drives-Permanent Magnet BLDC Motor Drives-SRM Drives

<b>UNIT III</b>	<b>HYBRID ELECTRIC VEHICLES</b>	<b>9</b>
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HEV-Types of HEVs-Series & Parallel HEVs-Advantages & Disadvantages-Series-Parallel Combination-Design of an HEV-Hybrid Drivetrains-sizing of components-rated vehicle velocity

<b>UNIT IV</b>	<b>REGENERATIVE BRAKING</b>	<b>9</b>
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Braking Energy Consumed in Urban Driving- Braking Energy versus Vehicle Speed- Braking Energy versus Braking Power- Braking Energy versus Braking Power- Braking Energy versus Vehicle Deceleration Rate- Braking Energy on Front and Rear Axles- Brake System of EV, HEV, and FCV- Parallel Hybrid Braking System- Fully Controllable Hybrid Brake System

<b>UNIT V</b>	<b>ELECTRIC VEHICLES &amp; ENVIRONMENT</b>	<b>9</b>
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Vehicle Pollution: the Effects- Vehicles Pollution: a Quantitative Analysis- Vehicle Pollution in Context- Alternative and Sustainable Energy Used via the Grid- Using Sustainable Energy with Fueled Vehicles- The Role of Regulations and Law Makers-Case study of rechargeable battery vehicles.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**

1. Husain I. Electric and hybrid vehicles: design fundamentals. CRC press; 2011 Jun 27.
2. Larminie, James, and John Lowry. "Electric vehicle technology explained, 2003." John Wiley&Sons, Ltd.
3. Ehsani, Mehرداد, Yimin Gao, and Ali Emadi. Modern electric, hybrid electric, and fuel cell vehicles: fundamentals, theory, and design. CRC press, 2009.

**REFERENCE BOOKS:**

1. Emadi, Ali, ed. Handbook of automotive power electronics and motor drives. CRC press, 2005.
2. Soylyu, Seref, ed. Electric Vehicles: The Benefits and Barriers. InTech, 2011.
3. Soylyu, Seref. "Electric Vehicles–Modelling and Simulations." InTech Europe, Rijeka, Croatia (2011).