

# GUJARAT TECHNOLOGICAL UNIVERSITY

**SUBJECT NAME: ELECTRIC AND HYBRID VEHICLES**

**BRANCH NAME: Electrical Engineering**

**SUBJECT CODE: 3710718**

**M.E. 1<sup>st</sup> SEMESTER**

**Type of course: Program Elective**

**Prerequisite:** Basic knowledge of power electronics and motor control

**Rationale:** The objective of this course is to provide basic understanding of the upcoming technology of electric and hybrid vehicles and to provide exposure to different aspects like sizing, design and control of drives used for hybrid and electric vehicle.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE(E)	PA (M)	PA (V)	PA (I)	
3	0	2	4	70	30	30	20	150

**Content:**

Sr. No.	Content	Total Hrs	% Weightage
1	<ul style="list-style-type: none"><li>History of hybrid and electric vehicles</li><li>Social and environmental importance of hybrid and electric vehicles</li><li>Impact of modern drive-trains on energy supplies</li><li>Basics of vehicle performance, vehicle power source</li><li>Characterization Transmission characteristics</li><li>Mathematical models to describe vehicle performance</li></ul>	8	18
2	<ul style="list-style-type: none"><li>Basic concept of hybrid traction,</li><li>Introduction to various hybrid drive-train topologies</li><li>Power flow control in hybrid drive-train topologies</li><li>Fuel efficiency analysis.</li></ul>	8	20
3	<ul style="list-style-type: none"><li>Introduction to electric components used in hybrid and electric vehicles</li><li>Configuration and control of DC Motor drives</li><li>Configuration and control of Introduction Motor drives</li><li>Configuration and control of Permanent Magnet Motor drives</li><li>Configuration and control of Switch Reluctance</li><li>Motor drives, drive system efficiency</li></ul>	9	25
4	<ul style="list-style-type: none"><li>Matching the electric machine and the internal combustion engine (ICE)</li><li>Sizing the propulsion motor, sizing the power electronics</li></ul>	9	20

	<ul style="list-style-type: none"> <li>• Selecting the energy storage technology</li> <li>• Communications, supporting subsystems</li> </ul>		
5	<ul style="list-style-type: none"> <li>• Introduction to energy management and their strategies used in hybrid and electric vehicle</li> <li>• Classification of different energy management strategies</li> <li>• Comparison of different energy management strategies</li> <li>• Implementation issues of energy strategies</li> <li>• Vehicle to grid and grid to vehicle</li> </ul>	7	17

### Suggested reading

1. Mehrdad Ehsani, Yimin Gao, Ali Emadi “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals Theory and Design”, CRC Press, Taylor and Francis group, FL, USA, 2<sup>nd</sup> ed., 2010.
2. Iqbal Hussain, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, FL, USA, 2011.
3. Ali Emadi, “Advanced Electric Drive Vehicles”, CRC Press, FL, USA, 2015.
4. Michael Nikowitz, “Advanced Hybrid and Electric Vehicles: System Optimization and Vehicle Integration”, Springer International Publishing, 2016.
5. James Larminie and John Lowry “Electric Vehicle Technology Explained”, John Wiley and Sons, 2<sup>nd</sup> ed., 2014.

### Course Outcomes :-

Students will be able to:

1. Demonstrate knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. Design and simulate electric drives used in vehicles / traction.

### List of Experiments:

Lab experiments shall target the following

- Modeling of electric vehicle sub-systems
- Modeling of electric vehicle sub-systems
- Control of electric drives (DC Machine, PMSM, BLDC, Induction motors) used for vehicles
- Simulation of converters used for charging
- Energy management strategies
- Design examples

### Major Equipment:

Simulation software like MATLAB, PSIM or Scilab and Power Electronic Converters as demanded by the course.

### List of Open Source Software/learning website:

1. Courses available through NPTEL.  
- website : nptel.ac.in (<https://nptel.ac.in/downloads/108103009>)