



Diploma branch in which subject is offered: - Automobile Engineering

Objective: The course aims to impart understanding of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.

Credits Earned: 04

Course Outcomes:

After learning the course, the students should be able to:

- Describe about working principle of electric vehicles.
- Explain the construction and working principle of various motors used in electric vehicles.
- Understand about working principle of electronics and sensor less control in electric vehicles.
- Describe the different types and working principle of hybrid vehicles.
- Illustrate the various types and working principle of fuel cells.

Pre-requisite of course: Basic working principles of Motors.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE	IA	CSE	Viva	Term work	
3	0	2	4	50	30	20	25	25	150

Contents:

Sr. No.	Topics	Teaching hrs.	Weightage
1	Introduction to electric vehicles: Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types. Battery plug-in and life. Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar	7	15
2	Electric vehicle motors: Motors (DC, Induction, BLDC) – Types, Principle, Construction, Control. Electric Drive Trains (EDT) – Series	12	23



	HEDT (Electrical Coupling) – Power Rating Design, Peak Power Source (PPS); Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling. Switched Reluctance Motors (SRM) Drives – Basic structure, Drive Converter, Design.		
3	Electronics and sensor-less control in ev: Basic Electronics Devices – Diodes, Thyristors, BJTs, MOSFETs, IGBTs, Convertors, Inverters. Safety – Risks and Guidance, Precautions, High Voltage safety, Hazard management. Sensors - Autonomous EV cars, self-drive Cars, Hacking; Sensor less – Control methods- Phase Flux Linkage-Based Method, Phase Inductance- Based, Modulated Signal Injection, Mutually Induced Voltage-Based, Observer-Based.	11	22
4	Hybrid vehicles: Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, EV. Layout and Architecture – Series, Parallel and Series-Parallel Hybrid, Propulsion systems and components. Regenerative Braking, Economy, Vibration and Noise reduction. Hybrid Electric Vehicles System – Analysis and its Types, Controls.	10	20
5	Fuel cells for electric vehicles: Fuel cell – Introduction, Technologies & Types, Obstacles. Operation principles, Potential and I-V curve, Fuel and Oxidation Consumption, Fuel cell Characteristics – Efficiency, Durability, Specific power, Factors affecting, Power design of fuel Cell Vehicle and freeze capacity. Lifetime cost of Fuel cell Vehicle – System, Components, maintenance.	10	20

References:

a) List of Books

1. Hybrid Electric Vehicle System Modeling and Control - Wei Liu, General Motors, USA, John Wiley & Sons, Inc., 2017.
2. Hybrid Electric Vehicles – Teresa Donateo, Published by ExLi4EvA, 2017
3. Electric and Hybrid Vehicles Power Sources, Models, Sustainability, Infrastructure and the Market Gianfranco Pistoia Consultant, Rome, Italy, Elsevier Publications, 2017.
4. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Mehrdad Ehsani Yimin Gao Stefano Longo Kambiz M. Ebrahimi, Taylor & Francis Group, LLC, 2018.
5. Hybrid, Electric & Fuel-Cell Vehicles Jack Erjavec, Delmar, Cengage Learning.
6. Electric and Hybrid Vehicles, Tom Denton, Taylor & Francis, 2018.



Suggested Theory distribution:

The suggested theory distribution as per Bloom’s taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyse	Evaluate	Create
35%	40%	25%	0	0	0

Suggested List of Tutorials/Experiments:

1. Study of various components of electric car.
2. Demonstration of wiring layout of electric vehicle.
3. V/f control of three-phase induction motor.
4. Speed control of BLDC motor in two-wheeler.
5. Speed control of SRM motor in three-wheeler.
6. Application of DC series motor in an electric vehicle.
7. Current/Voltage Control of an Electric vehicle.
8. Sensor & Actuators in an Electric Vehicle.
9. Demonstration of charging circuit in an electric vehicle.
10. Demonstration of electric hybrid vehicle.
11. A Case Study on “storage of hydrogen in designing the Fuel Cell”

Instructional Method:

1. Power point presentation showing various nomenclature of different components of engine and transmission system to design various dimensions.
2. Chart showing various nomenclatures of different components of engine transmission system.
3. Assignments during tutorials for basic design of different components of engine and transmission system.