22EEHO307	HYBRID ELECTRIC VEHICLES	SEMESTER IV

PREREQUISTIES	CATEGORY	PEC	Credit		
		L	T	P	TH
Electric Drives, Electric Vehicles	Hours/Week	3	0	0	3

Course Objectives:

1. This course introduces the fundamental concepts, principles and analysis of hybrid and electric vehicles.

UNIT I	HISTORY OF HYBRID ELECTRIC VEHICLES	9	0	0	9

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, Capabilities, Automation system computer facilities.

UNIT II	HYBRID ELECTRIC VEHICLES - INTRODUCTION	9	0	0	9

Micro hybrid vehicles, mild hybrid vehicles, full hybrid vehicles, Parallel Hybrid vehicles, series Hybrid Vehicles, Series-Parallel Hybrid vehicles, plug-in hybrid vehicles, power flow diagrams for various operating modes. Plug-in Hybrid Vehicles: Operating principle, architectures: series-parallel-series-parallel, challenges related to grid connection. Range-extended Electric Vehicles: Classification and configurations, Fuel Cell Electric Vehicles, Solar electric Vehicles, Electric Bi-cycles and their propulsion systems, Vehicle-to- grid, vehicle- to-home concepts, Concept of Hybrid Electric Vehicles.

UNIT III	ELECTRIC PROPULSION UNIT	9	0	0	9

Electric components used in electric vehicles, Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives, Drive system efficiency.

UNIT IV	ELECTRIC DRIVE-TRAINS	9	0	0	9

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

UNIT V	EV MODELLING AND SIMULATION	9	0	0	9

Modelling of BEV-Forward looking Model-Driver Perspective, Backward Looking Model-Drive Cycle Perspective, Modelling of Driver, Modelling of Brake Control Unit, Modelling of Vehicle Control Strategy, Modelling of Vehicle Chassis

Sizing of Components- Steady State Energy Balance Equation, Powertrain Dimensioning-Peak vs Continuous performance, Type of Drive cycles, Types of Control Strategy, Analysis-Performance, Range, Consumption Prediction

Total (45L+0T)= 45 Periods

Text Books:

1. Goodarzi, Gordon A., Hayes, John G, Electric powertrain: energy systems, power electronics & drives for hybrid, electric & fuel cell vehicles, Wiley 2018
2. Wei Liu, Introduction of Hybrid Vehicle system Modelling and Control, Wiley student edition 2013.
3. Mehradad Eshani, Yimin Gao, Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Fundamentals, Theory and Design, Second Edition, CRC Press, Taylor and Francis Group, 2010.
4. James Larminie John Lowry, Electric Vehicle Technology Explained, Second Edition, Wiley, 2012.
5. Ali Emadi, Mehrdad Ehsani, John M. Miller, 'Vehicular Electric Power Systems: Land, Sea, Air, and Space Vehicles', CRC Press, 2003.
6. Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press, 2003, 2ndEdition.

Reference Books:

1. RiK De Doncker, Advanced Electric Drives – Analysis , Modeling ,Control, Springer publications
2. De Doncker, Rik, Pulle, Duco W.J., Veltman, Andre, Advanced Electrical Drives, First Edition, CRC Press, Taylor and Francis Group, 2011.
3. Ned Mohan, Power Electronics Convertor, Applications, and Design, Third Edition, Wiley, 2002.
4. Electric and Hybrid Vehicles Design Fundamentals, Iqbal Husain, Second Edition, CRC Press, Taylor and Francis Group, 2011.
5. Sandeep Dhameja, 'Electric Vehicle Battery Systems', Newnes, 2002.

6.	Chris Mi, M. Abul Masrur, David Wenzhong Gao, 'Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives', Wiley, 2011.
E-Reference	
1	https://nptel.ac.in/courses/108/106/108106170/
2	https://nptel.ac.in/courses/108/102/108102121/

Course Outcomes: Upon completion of this course, the students will be able to:			**Bloom's Taxonomy Mapped**
CO1	:	Plan the selection of electrical machines for hybrid and electric vehicles.	L3: Applying
CO2	:	Analyze the drive-train topologies and advanced propulsion techniques	L4: Analyzing
CO3	:	Understand the concepts of electric vehicles, hybrid electric vehicles and their impact on environment	L2: Understanding
CO4	:	Evaluate modelling and simulation of EV	L5: Evaluating
CO5	:	Demonstrate the power system of various vehicular system.	L6: Creating

COURSE ARTICULATION MATRIX

COs/ POs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS O1**	**PS O2**	**PS O3**
CO1	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
CO2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
CO3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
CO4	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
CO5	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
Avg	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1

3/2/1-indicates strength of correlation (3- High, 2-Medium, 1- Low)