

COURSE TITLE	ELECTRIC AND HYBRID VEHICLES
COURSE CODE	01EE1504
COURSE CREDITS	3

Objective:

- 1 The course introduces basic aspects of Electric and Hybrid Vehicle systems such as their configuration, energy storage devices, electric propulsion systems and parameters associated with such systems.

Course Outcomes: After completion of this course, student will be able to:

- 1 Differentiate among different types of vehicles and their configurations
- 2 Analyse various hybrid electric vehicle configuration
- 3 Decide suitable electric propulsion system for EV and HEV
- 4 Select appropriate source of energy for EV and HEV

Pre-requisite of course:Power Electronics

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	Introduction to Electric Vehicle Introduction, EV/ICEV Comparison, diagram of EV/HEV/PHEV/FCEV, fixed and variable gearing, single - and multiple-motor drives, in-wheel drives, life cycle of EV, tank to wheel and well to wheel efficiency, driving cycles Parameters of EV systems - weight and size parameters, force parameters, energy parameters, performance parameters	11
2	Hybrid Electric Vehicle Configurations and Control HEV configurations - series hybrid system, parallel hybrid system, series-parallel hybrid system, complex hybrid system, power flow control in series hybrid system, parallel hybrid system, series-parallel hybrid system, complex hybrid system, Case Study	10
3	Electric Propulsion System Introduction, the major requirements of the EV motor drive, functional block diagram of EV propulsion system, classification of EV motors, evaluation of EV motors, DC motor drives, induction motor drives, permanent-magnet motor drives, induction motor drives, permanent-magnet motor drives, switched reluctance motor drives	9

Contents : Unit	Topics	Contact Hours
4	Batteries and Chargers Batteries in electric and hybrid vehicles, battery parameters: battery capacity, open circuit voltage, terminal voltage, practical capacity, discharge rate, state of charge, state of discharge, depth of discharge, battery energy, specific energy, battery power, specific power, lead acid batteries, lithium batteries, battery capacity and voltage rating of batteries used in various EVs, Charger introduction, block diagram, onboard charger and offboard charger, electric vehicle charging modes and power ratings, battery swapping, advantages and challenges in battery swapping	10
5	Alternate Energy Storage Systems for EV Introduction, fuel cell, types of fuel cells, ultracapacitor, flywheel	2
Total Hours		42

Textbook :

- 1 Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Hussein, CRC Press, 2003
- 2 Modern Electric Vehicle Technology, C.C Chan, K.T Chau, Oxford University Press Inc., 2001
- 3 Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, CRC Press, 2009

References:

- 1 Electric Vehicle Technology Explained, Electric Vehicle Technology Explained, James Larminie, John Lowry, John Wiley & Sons, 2003
- 2 Hybrid Electric Vehicles: Energy Management Strategies, Hybrid Electric Vehicles: Energy Management Strategies, S. Onori, L. Serrao and G. Rizzoni, Springer London, 2016
- 3 Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Sheldon S. Williamson, Springer Science+Business Media New York, 2013
- 4 Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Chris Mi, M. Abul Masrur, David Wenzhong Gao, John Wiley & Sons, 2017

Suggested Theory Distribution:

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

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
20.00	30.00	25.00	15.00	10.00	0.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, case studies etc.
- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the class-room.
- 3 Students will use supplementary resources such as online videos.

Supplementary Resources:

- 1 <https://nptel.ac.in/courses/108/103/108103009/>
- 2 https://onlinecourses.nptel.ac.in/noc20_ee99/preview
- 3 <https://www.coursera.org/learn/electric-vehicles-mobility>
- 4 <https://www.edx.org/course/electric-cars-technology>
- 5 <https://www.edx.org/course/hybrid-vehicles>
- 6 <https://www.edx.org/course/electric-and-conventional-vehicles>
- 7 <https://www.edx.org/course/electric-cars-introduction>