

Branch Name:	Electrical Engineering
Program Code:	ET109
Course Name:	Electric and Hybrid Vehicles (Open Elective-I)
Course Code:	2ET1090681T
Pre-requisite Course:	Electrical Machines and Power Electronics.

Course Objectives:

1. The students will acquire the knowledge regarding Electrical Vehicles and Hybrid Electrical Vehicles.
2. Students will get basic concepts of Power Electronics converter operation and its operation.
3. Students can also get knowledge of Electrical Machine used in Electrical Vehicles.

Teaching and Examination Scheme:

Credit	Teaching Scheme Hours per week				Evaluation Scheme (Marks)								Total (Marks)
					Theory (Marks)				Practical (Marks)				
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
3	3	-	-	3	24	60	16	40	-	-	-	-	100

Course Contents:

Sr. No.	Topic	Total Hours	Weightage (%)
1	History of Electrical vehicles: Historical journey of Hybrid and Electric vehicles, economic and environmental impact of hybrid electric vehicle Dynamics of Electric and Hybrid vehicles, Dynamic equation, Adhesion, Dynamic wheel radius and slip.	12	25%
2	Converters for Electric and Hybrid vehicles: DC-DC Converters for EV and HEV Applications, Principle of set-up operation, Boost and Buck-Boost, Multi quadrant dc-dc converters, DC-DC Converters for EV and HEV Applications-2, DC-DC Inverters for EV and HEV Applications, Three phase DC-AC Inverters, Voltage control of DC-AC Inverters Using PWM.	12	25%
3	Electric Machine for Electric and Hybrid vehicles: Induction Motors, their configurations and optimization for HEV/EVs, Induction Motor drives, their control and applications in EV/HEVs, Permanent magnet motors, their configurations, Permanent Magnet Motor drives, their control and applications in EV/HEVs, PMBLDC motor , Dynamic Model of PM Machines, Control of PM machines.	08	20%
4	Energy storage and control system for Hybrid Electric vehicles. Energy Use in Conventional Vehicles, Energy Savings Potential of Hybrid electrical vehicles, Type of Batteries, Fuel Cell, Alternative and Novel Energy Sources, Energy management strategies and its general architecture, Rule and optimization based energy management strategies (EMS).	08	20%
5	Design of Hybrid Electric vehicles. Hybrid design philosophy , hybridness , series, mixed, and range extender (plug-in) hybrids , battery power and electric motor power, Case Study of Design of a BEV.	05	10%

Text Books:

1. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, Second Edition (Power Electronics and Applications Series) by Mehrdad Ehsani, CRC Press Electric and Hybrid Vehicles, 2017.
2. Electric and Hybrid Vehicles by Tom Denton, 2nd edition 2020.

Reference Books:

1. Electric Vehicle Machines and Drives: Design, Analysis and Application (Wiley – IEEE) by K. T. Chau, 2015

List of Open Source Software/learning website:

- nptel.ac.in/course.php

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	To know about History of Electrical vehicles	1 Remembering
CLO2	Understand about Converters for Electric and Hybrid vehicle.	2 Understanding
CLO3	Applying Electric Machine for Electric and Hybrid vehicles	3 Applying
CLO4	Design of Electrical Vehicles (electrical and mechanical aspects)	5 Evaluating
CLO5	Operation and working principle of electrical machine used in electric vehicles.	2 Understanding
CLO6	Selection and size of storage system.	4 Analyze

Mapping of CLOs with POs & PSOs:

Course Learning Outcomes	Program Outcomes (POs)												Program Specific Outcomes(PSOs)			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CLO1			L			M				L			L		L	
CLO2	L						M		M			L				L
CLO3				L		M		M			L	M		L		
CLO4		L			L			H	L				M		M	
CLO5	M				H					M				L		
CLO6		H	M		L		L				H	M			H	L

H: High, M: Medium, L: Low