

Name of Faculty	:	Faculty of Engineering & Technology
Name of Program	:	Master of Technology (M. Tech)
Course Code	:	MPS04
Course Title	:	Electric & Hybrid vehicles
Type of Course	:	Programme Elective (PE)
Year of Introduction	:	2023-24

Prerequisite	:	Electrical Drives
Course Objective	:	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.
Course Outcomes	:	At the end of this course, students will be able to:
	CO1	To Apply the knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
	CO2	To Remember the concept of hybrid type system.
	CO3	To Understand the management of hybrid type system.
	CO4	To Create and simulate electric drives used in vehicles / traction.

Teaching and Examination Scheme

Teaching Scheme (Contact Hours)			Credits	Examination Marks				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	SEE	CIA	SEE	CIA	
3	0	2	4	70	30	30	20	150

Legends: L-Lecture; T-Tutorial/Teacher Guided Theory Practice; P - Practical, C - Credit, SEE - Semester End Examination, CIA - Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

Course Content

Unit No.	Topics	Teaching Hours	Weightage	Mapping with CO
1	Introduction to Hybrid & Electric Vehicles: History of hybrid and electric vehicles Social and environmental importance of hybrid and electric vehicles Impact of modern drivetrains on energy supplies Basics of vehicle performance, vehicle power source Characterization Transmission characteristics Mathematical models to describe vehicle performance.	08	18%	CO1
2	Hybrid Drives:	08	18%	CO1, CO4

	Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies Power flow control in hybrid drive-train topologies Fuel efficiency analysis.			
3	Electric Drives importance in Hybrid system: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives Configuration and control of Permanent Magnet Motor Drives Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	10	22%	CO2, CO4
4	Energy utilization in Electric machine: Matching the electric machine and the internal combustion engine (ICE) Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology Communications, supporting subsystems.	10	22%	CO1
5	Energy management in Hybrid Vehicles: Introduction to energy management and their strategies used in hybrid and electric vehicle Classification of different energy management strategies Comparison of different energy management strategies Implementation issues of energy strategies Vehicle to grid and grid to vehicle.	09	20%	CO1, CO3

Suggested Distribution of Theory Marks Using Bloom's Taxonomy						
Level	Remembrance	Understanding	Application	Analyse	Evaluate	Create
Weightage	30	30	15	15	05	05

NOTE: This specification table shall be treated as a general guideline for the students and the teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Suggested List of Experiments/Tutorials

Sr. No.	Name of Experiment/Tutorial	Teaching Hours
1	Study of electric & hybrid vehicles system.	4
2	Modelling of electric vehicle sub-systems.	4
3	Modelling of hybrid vehicle sub-systems.	4
4	Control of electric drives (DC Machine, PMSM, BLDC, Induction motors) used for vehicles.	4
5	Simulation of converters used for charging in MATLAB.	4
6	Energy management strategies.	4
7	Hybrid & Electric vehicle Design examples.	4

Major Equipment/ Instruments and Software Required

Sr. No.	Name of Major Equipment/ Instruments and Software
1	MATLAB Simulink
2	PSCAD

Suggested Learning Websites

Sr. No.	Name of Website
1	www.nptel.com
2	https://www.edx.org/learn/hybrid-vehicles
3	https://www.sae.org/learn/content/acad06/

Reference Books

Sr. No.	Name of Reference Books
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, 2nd ed., 2010
2	James Larminie and John Lowry "Electric Vehicle Technology Explained", John Wiley and Sons, 2nd ed., 2014
3	Ali Emadi, "Advanced Electric Drive Vehicles", CRC Press, FL, USA, 2015.
4	Iqbal Hussain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, FL, USA, 2011.