Devi Ahilya University, Indore, India **Institute of Engineering & Technology**				**III Year B.E.** **(Mechanical Engineering)** **(Full Time)**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
5MERE5: Hybrid Vehicle	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
	3	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hrs. **Hybrid and Electrical Vehicle 3 Hours**							

Course Objective:

The course is designed

1. To render the information about Hybrid and electric vehicles.
2. To provide the knowledge of working of Hybrid electric Vehicles.
3. To Know about the Types of Storage Systems
4. To know about Energy Management Strategies of Hybrid and electric vehicle.

Pre requisites: I C Engines

COURSE CONTENTS

UNIT-I

Introduction : History of Electric Vehicles, Development towards 21st Century, Types of Electric Vehicles in use today – Battery Electric Vehicle, Hybrid (Internal Combustion Engines (ICE) & others), Fuel Cell Electric Vehicles (EV), and Solar Powered Vehicles. Introduction to HEV, Benefits and challenges. about engines and their types.

UNIT-II

Introduction to Hybrid Electric Vehicle: Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid Drive-train topologies, fuel efficiency analysis.

UNIT-III

Construction and Working of HEV: Classification of HEV: Series, Parallel and combination. Fundamentals of Conventional Vehicles and Powertrains in terms of braking performance and distribution, transmission system etc.

UNIT-IV

Types of Storage Systems: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE).

UNIT-V

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Introduction to various charging techniques and schematic of charging stations.

Course Outcome:

Students earned credits will develop ability to

CO1. Have the knowledge of HEV.

CO2.Understand the working of HEV.

CO3. Know about the Types of Storage Systems

CO4. Energy Management Strategies of Hybrid and electric vehicle.

BOOKS RECOMMENDED:

[1] James Larminie, J. Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd. 2003.

[2] M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.

[3] S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

[4] Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2003.

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Course Outcome:

Students earned credits will develop ability to

CO.No.	CO	PO
CO1	Have the knowledge of HEV.	PO1, PO2, PO5, PO7
CO2	Understand the working of HEV.	PO1, PO2, PO7
CO3	Know about the Types of Storage Systems.	PO1, PO2, PO3, PO5
CO4	Energy Management Strategies of Hybrid and electric vehicle.	PO1, PO2, PO7, PO11

CO-PO Relationship

CO	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO1	3	3			3		3					
CO2	3	3					2					
CO3	3	3	3		2							
CO4	3	3					2				2	
CO5												

* CO (rows) mention nil/very small/insignificant contribution to the PO(column)

1→ relevant and small significance 2 → medium or moderate and 3 →strong