



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3170923

Semester – VII

Subject Name: Electrical and Hybrid Vehicle

Type of course: Professional Elective Course

Prerequisite:

Rationale:

Vehicle is an unavoidable machine for the industry, individual and government. The fuel consumptions have led the nations to be dependent on electric vehicles and needs a major change in the operation in context to energy saving. The electric vehicle has drawn attention of the designers, researchers and manufacturers for the skilled persons needed in this era. The energy saving concept has lead to hybrid electric vehicle in all the concepts for the transportation.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE Viva (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs
1	Introduction to Electric Vehicle: History of Electric Vehicles, Development towards 21 st Century, Types of Electric Vehicles in use today – Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Motion and Dynamic Equations of the Electric Vehicles: various forces acting on the Vehicle in static and dynamic conditions.	4
2	Induction 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, power flow control in hybrid drive-train topologies, fuel efficiency analysis.	4
3	Electric Drive Trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.	10
4	Types of Storage Systems:	10



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	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), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Calculation for the ratings.	
5	Modelling of Hybrid Electric Vehicle Range: Driving Cycles, Types of Driving Cycles, Range modelling for Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Case study of 2 wheeler, 3 wheeler and 4 wheeler vehicles.	10
6	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.	07

Suggested Specification table with Marks (Theory): (For BE only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	30	30	15	10	-

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

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

Reference Books:

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 Outcomes:

After completing the course, students will be able to:

Sr. No.	CO statement	Marks % weightage
CO-1	Select appropriate source of energy for the hybrid electric vehicle based on driving cycle.	25
CO-2	Analyze the power and energy need of the various hybrid electric vehicle.	25
CO-3	Measure and Estimate the energy consumption of the Hybrid Vehicles.	25
CO-4	Evaluate energy efficiency of the vehicle for its drive trains.	25

List of Open Source Software/learning website:

- Online course: <https://nptel.ac.in/course.html>
- [Ocw.mit.edu/courses](https://ocw.mit.edu/courses)
- <https://www.eng.mcmaster.ca/mech/content/electric-and-hybrid-vehicles>