SARVAJANIK UNIVERSITY
SarvajanikCollege of Engineering and Technology
Bachelor of Technology

B.Tech. Semester VII

Subject Name: Electric Vehicles **Subject Code: BTEL14753**

Type of course: **Professional Elective courses (PEC)**

Prerequisite: Basic knowledge of Electrical Machines and Power Electronics

Rationale: Vehicle is an inevitable machine for the industry, individual and government. The fuel consumptions and air pollution have led the nations to be dependent on electric vehicles and needs a major change in the operation in context to energy saving and reduction of emission. The electric vehicle has fascinated the designers, researchers and manufacturers for the skilled persons needed in this era. The virtue of hybrid vehicles like cut down on fossil fuels while maintaining excellent performance and extended range has led to hybrid electric vehicle in all the concepts for the transportation.

Teaching and Examination Scheme:

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	-	-	

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course.

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage %
1.	**Electric and Hybrid Electric Vehicles** Introduction to Electric Vehicle, history of Electric Vehicles, Social and environmental importance of electric vehicles, Motion and dynamic equations of the electric vehicles: various forces acting on the vehicle in static and dynamic conditions. Introduction of Hybrid Electric Vehicle, basic concept of hybrid traction, hybrid electric drive-trains, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies.	**8**	**15**
2.	**Energy storage** Introduction to energy storage requirements in electric and hybrid vehicles, types of batteries used in electric and hybrid vehicles, introduction of fuel cell, super-capacitors, flywheel-based energy storage system, and comparison of different energy storage technologies.	8	**20**
3.	**Electric Drive for EV and HEV** Configuration and control of various drives for electric and hybrid	8	**20**

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	vehicles, DC motor drives, induction motor drives, permanent magnet motor drives, switch reluctance motor drives.		
4.	**Design of Electric and Hybrid Electric Drive Trains** Series hybrid electric drive train: operating patterns, control strategies, sizing of major components, power rating of traction motor, power rating of engine/generator. Parallel hybrid electric drive train: control strategies of parallel hybrid drive train, analysis of engine power capacity and electric motor drive capacity, transmission mechanism Introduction of series-parallel hybrid and complex hybrid configuration, driving cycles, types of driving cycles. Case study of 2-wheeler, 3-wheeler, and 4-wheeler electrical and hybrid vehicles.	12	**30**
5.	**Power Electronic Converter for Battery Charging** Charging methods for battery, Termination methods, charging from grid, Z-converter, Isolated bidirectional DC-DC converter, High-frequency transformer based isolated charger topology, Transformer less topology.	6	**10**
6.	**Indian and Global Scenario** Technology scenario, market scenario, policies and regulations, payback and commercial model.	3	**5**

Suggested Specification table with Marks (Theory/Practical):

% Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**20**	**30**	**10**	**10**	**10**

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

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

Reference Text Books:

Sr. No.	**Title of book /article**	**Author(s)**	**Publisher and details like ISBN**	**Year of publication**	**Publication Edition**
1	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Husain	CRC Press,	2003	
2.	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design	M. Ehsani, Y. Gao, S. Gay and Ali Emadi	CRC Press,	2005	
3.	Modern Electric Vehicle	C.C. Chan and	OXFORD	2001	

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	Technology	K.T. Chau	University Press		
4	Electric Vehicle Technology Explained	James Larminie, J. Lowry,	John Wiley & Sons Ltd	2003	
5	Thermal Management of Electric Vehicle Battery Systems	Ibrahim Dinçer, Halil S. Hamut and Nader Javani	John Wiley & Sons Ltd	2016	
6	Hybrid Electric Vehicles Principles And Applications With Practical Perspectives	Chris Mi, M. Abul Masrur, David Wenzhong Gao	Wiley Publication	2011	

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Describe upcoming technology and explore future trends of electric and hybrid electric vehicles.	10%
CO-2	Analyze different aspects of drive train topologies.	30%
CO-3	Analyse the electric propulsion unit and its control for application of electric vehicles.	30%
CO-4	Explore various energy storage techniques and battery charging topologies.	20%
CO-5	Select suitable motor and drive train for electric and hybrid vehicles.	10%

Mapping with PO:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	2	2	1		1		1	1		2	1	1			2
CO-2	3	3	3	1	2	1	1		2	1	1	1	3	1	1
CO-3	3	2	3	2	3	1	2		2	2	2	1	3	1	3
CO-4	2	3	3	2	3	1	3	1	2	1	2	1	3	1	3
CO-5	3	3	3		2	1	2	1			1	2	3		1

List of Open Source Software/learning website:

Online course: https://nptel.ac.in/course.html
Ocw.mit.edu/courses
https://www.eng.mcmaster.ca/mech/content/electric-and-hybrid-vehicles

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