



**SARVAJANIK UNIVERSITY**  
**Sarvajani College of Engineering and Technology**  
**Bachelor of Technology**



**B.Tech. Semester VII**

**Subject Name: Electric and Hybrid Vehicles**

**Subject Code: BTEL15702**

<b>Type of course:</b>	<b>Open Elective courses (OEC)</b>								
<b>Prerequisite:</b>	Zeal to learn the subject								
<b>Rationale:</b>	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.								
<b>Teaching and Examination Scheme:</b>									
<b>TEACHING SCHEME</b>				<b>Theory Marks</b>			<b>Practical Marks</b>		<b>Total</b>
<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>	<b>TEE</b>	<b>CA1</b>	<b>CA2</b>	<b>TEP</b>	<b>CA3</b>	<b>100</b>
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:**

<b>Sr. No.</b>	<b>Topics</b>	<b>Teaching Hrs.</b>	<b>Module Weightage</b>
1.	<b>Electric and Hybrid Electric Vehicles:</b> 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.	<b>9</b>	<b>20%</b>
2.	<b>Energy storage</b> 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.	9	<b>20%</b>
3.	<b>Electric Drive for EV and HEV</b>	10	<b>20%</b>

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	Configuration and control of various drives for electric and hybrid vehicles, DC motor drives, induction motor drives, permanent magnet motor drives, switch reluctance motor drives.		
<b>4.</b>	<b>Design of Electric and Hybrid Electric Drive Trains:</b> 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	<b>30%</b>
<b>5.</b>	<b>Indian and Global Scenario</b> Technology scenario, market scenario, policies and regulations, payback and commercial model.	5	<b>10 %</b>

**Suggested Specification table with Marks (Theory/Practical):**

% Distribution of Marks					
R Level	U Level	A Level	N Level	E Level	C Level
<b>20</b>	<b>20</b>	<b>30</b>	<b>10</b>	<b>10</b>	<b>10</b>

**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 and teachers. 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 Technology	C.C. Chan and K.T. Chau	OXFORD University Press	2001	
4.	Electric Vehicle	James Larminie, J.	John Wiley &	2003	

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	Technology Explained	Lowry,	Sons Ltd		
5	Thermal Management of Electric Vehicle Battery Systems	Ibrahim Dinçer, Halil S. Hamut and Nader Javani	JohnWiley& 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	Explain the electric propulsion unit and its control for application of electric vehicles.	30%
CO-4	Apply the concepts of energy storage system and select it for electric and hybrid electric vehicle.	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			
CO-2	3	3	3	1	2	1	1		2	1	1	1			
CO-3	3	2	3	2	3	1	2		2	2	2	1			
CO-4	2	3	3	2	3	1	3	1	2	1	2	1			
CO-5	3	3	3		2	1	2	1			1	2			

**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>