SARVAJANIK UNIVERSITY

Sarvajanik College of Engineering and Technology

Bachelor of Technology

Mechanical Engineering Department
B. Tech. Semester VI

Course Name: **Electric, Hybrid and Fuel cell Vehicles** **Course Code: BTME19621**
Type of course: **Honors -Advances in Automobile Engineering**
Prerequisite: Passion for Automobile Technologies and new trends in it.
Rationale of Course: This course introduces the fundamental concepts, principles, analysis and design of hybrid, electric and fuel cell vehicles. The electric car has caught the interest of designers, researchers, and manufacturers in terms of the qualified personnel required in this period. In all transportation models, the energy-saving notion has led to hybrid electric vehicles.

Teaching and Examination Scheme:

Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	
4	0	2	5	60	25	15	30	20	150

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 the course.

Contents:

Sr. No.	Content	Total Hrs	Module Weightage
1	**Introduction:** History of Electric Vehicles, Progress Towards the Twenty-First Century, and Current Electric Vehicle Types – Battery Electric Vehicles, Hybrid (ICE & Others), Fuel Cell EVs, and Solar Powered Vehicles.	10	15%
2	**Induction to Hybrid Electric Vehicles:** Hybrid and electric vehicles' social and environmental importance, as well as the impact of current drivetrains on energy supplies. Electric	14	30%

	Hybrid Drivetrains: The fundamentals of hybrid traction, as well as an introduction to various hybrids Power flow control in hybrid drive-train topologies, drive-train topologies		
3	**Battery:** Fundamentals – Types, parameters, capacity, discharge rate, state of charge, state of discharge, deep dissipation, technical properties, battery pack design (Series and Paraller conenction), battery properties.	**10**	**10%**
4	**Drive Train For Electric Vehicles:** Components – gears, differential, clutch, brakes, regenerative braking, motor sizing, transmission configuration	**10**	**10%**
5	**Modeling Hybrid Electric Vehicle Range:** Driving Cycles, Types of Driving Cycles, Range Modeling for Battery Electric Vehicles, Hybrid (ICE and others), Fuel Cell EVs, and Solar Powered Vehicles	**16**	**35%**

Percentage Distribution of Marks as per Bloom's Taxonomy (Theory/Practical):

Percentage Distribution of Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20	**30**	**15**	**10**	**15**	**5**

Legends: R: Remembrance, **U:** Understanding; **A:** Application, **N:** Analyse, **E:** Evaluate **C:** Create and above Levels

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	Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals	Mehrdad Ehsani, Yimin Gao, Ali Emadi	CRC Press	2010	5th
2	Electric Vehicle Battery Systems	Sandeep Dhameja	Newnes	2000	6th
3	Hybrid Electric Vehicles: Energy Management Strategies	S. Onori, L. Serrao and G. Rizzoni	Springer	2015	
4	Electric and Hybrid Vehicles: Design Fundamentals	Iqbal Hussein	CRC Press	2003	

Course Outcome:

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Comparison of different electric vehicle layouts function.	30
CO-2	Distinguish the hybrid vehicle's configuration and components, as well as its performance.	20
CO-3	Summarize the properties of batteries and its types	15
CO-4	Examine the various hybrid electric vehicle's power and energy requirements.	20
CO-5	Review of hybrid electric vehicles.	15

Mapping with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO-1	3	0	2	0	2	2	3	0	0	0	0	3	1	0	3
CO-2	3	3	2	2	3	1	3	0	3	3	3	3	1	0	2
CO-3	3	1	3	1	3	1	1	0	2	3	0	3	1	0	3
CO-4	3	3	3	2	3	3	3	1	2	1	0	3	2	0	2
CO-5	3	2	3	2	3	3	3	2	3	3	3	3	1	0	2
Rationale*	**15**	**9**	**13**	**7**	**14**	**10**	**13**	**3**	**10**	**10**	**6**	**15**	**6**	**0**	**12**

***Rationale of CO-PO-PSO mapping*:** This course highly maps with Program outcomes 1, 3, 5,7,12 and Program Specific Outcomes 1, 3 as it states that the course will develop engineering knowledge, design / development of solutions, modern tool usage, environment and sustainability, life-long learning and finally it will lead to, convert conceptual knowledge of mechanical engineering to real life application and apply their technical, managerial and other soft skills in their professional life.

List of Practical:

1. Study of Battery parameters of batteries for electric vehicle.
2. Modelling and Simulating Battery Performance for Design Optimization
3. Study of fuel cells and their characteristics.
4. Study of different types of battery charging system.
5. Understand battery management systems.
6. Case Studies: Design of a Battery Electric Vehicle (BEV). Collecting information on different vehicle bodies with photographs.

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List of Assignments:

1. Designing Drive Train
2. Fuel Cell Analysis

Major Instrument:

1. Multimeter
2. Hydrometer
3. Li-ion Cells
4. Battery