NIRMA UNIVERSITY

Institute:	**Institute of Technology**
Name of Programme:	**M. Tech. in Electrical Engineering (Electric Vehicular Technology)**
Semester:	**I**
Course Code:	**6EE103**
Course Title:	**EV Architecture and Systems**
Course Type:	(√ **Core**/ □ Value Added Course / □ Department Elective / □ Institute Elective/ □ University Elective/ □ Open Elective / □ Any other)
Year of Introduction:	**2022 – 23**

L	T	Practical component				C
		LPW	PW	W	S	
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Course Learning Outcomes (CLOs):

At the end of the course, the students will be able to –

1. correlate electric vehicles with fossil fuel driven vehicles **(BL4)**
2. apply the concept of Electric Vehicle powertrain and drivetrain **(BL3)**
3. analyze hybrid electric vehicles, communication protocols and grid integration **(BL4)**
4. examine energy management strategies and HVAC systems in Electric Vehicles and Hybrid Electric Vehicles **(BL5)**

Syllabus: **Teaching Hours: 45**

Unit-1: Electric Vehicle Fundamentals **06**

Introduction, electric vehicle development-past present and future, electric vehicles and environment, comparison with internal combustion engine driven vehicle, components – powertrain and drivetrain, overview of various OEM platforms.

Unit-2: Electric Vehicle PowerTrain and DriveTrain **11**

Concept & types of power train, power train components,
Concept & different types of drive train, transmission efficiency, differential, auxiliary systems of EV

Unit-3: Hybrid Electric Vehicles **10**

Hybrid Electric vehicles – Classification – Micro, Mild, Full, Plug-in, Types–series, parallel and series-parallel configurations, I/C engine rating, hybrid drive train topologies, analysis and control of Hybrid Electric vehicle systems, fuel efficiency analysis

Unit-4: Energy Management Strategies **06**

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

Unit-5: Automotive HVAC **07**

Refrigerants, classification of refrigerants - Elements of refrigeration systems, Vapour

compression refrigeration cycle, factors affecting the performance of a vapour compression system - Vapour absorption system and working principle, comparison between vapour compression and vapour absorption systems, Air conditioning system, types and working principles, air distributions systems

Unit-6: Vehicular Communication and Grid Integration **05**

Overview of vehicular communication protocols-within vehicle, grid integration, standards for grid integration, concept of driverless car, concept of cybersecurity standards for connected vehicles

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Laboratory Experiments:

This shall consist of at least 10 experiments / simulations based on the above syllabus.

Suggested Readings:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, John Wiley & Sons.
2. Iqbal Husain, Electric and Hybrid Vehicles Design Fundamentals, CRC Press, Taylor and Francis Group.
3. Sandeep Dharmeja, Electric Vehicle Battery Systems, Newnes.
4. K. T. Chau, Zheng Wang, Chaos in Electrical Drive Systems: Analysis, Control & Applications, John Wiley and Sons.
5. Chung Chow Chan, K. T. Chau, Modern Electric Vehicle Technology, Oxford University Press.
6. Michael H Westbrrok, The Electric Car - Development and Future of Battery, Hybrid and Fuel Cell Cars, IEE Power and Energy Series 38, The Institution of Electrical Engineers.
7. International standards in use, relevant research papers and articles.

Suggested List of Experiments (not restricted to the following):
(Only for Information)

1. Simulation and analysis of two and three-wheeler vehicle drive train.
2. Simulation and analysis of central mounted front wheel drive system.
3. Simulation and analysis of central mounted rear wheel drive system.
4. Simulation and analysis of four-wheel drive system (04 hours).
5. Simulation and analysis of various drive cycles (04 hours).
6. Simulation of series hybrid electric vehicle.
7. Simulation of parallel hybrid electric vehicle.
8. Simulation of series-parallel hybrid electric vehicle (04 hours).
9. To demonstrate effect of aerodynamic drag on vehicle propulsion.
10. Analysis of engine performance for various loading conditions (04 hours).
11. To demonstrate air conditioning system for vehicular applications.

L = Lecture, T = Tutorial, P = Practical, C = Credit