



Course Title: Essentials of Electric & Hybrid Vehicles

Course Code:

Credit Units: 4

Level: UG

L	T	P/S	SW/FW	No. of PSDA	TOTAL CREDIT UNITS
4	-	-	-		4

Course Objectives:

The aim of this course is to enrich the students' knowledge with technologies used in electric and hybrid electric vehicles. With the increasing global shift to renewable resources, this course will provide a platform for the students to learn and implement their ideas in the future- a future where a transformed transportation sector will comprise of only electric vehicles.

Pre-requisites:

Basic electrical engineering, Electrical machines, power electronics, control systems, Engineering Mechanics

Course Contents/Syllabus:

	Weightage (%)
Module I: Introduction to electric (EV) and hybrid electric (HEV) vehicles	10
Electric and hybrid vehicles: basic differences with conventional, Architectures and modes, Power flow and typical drive cycles, drivability, fuel economy, and emissions, Vehicle dynamics	
Module II: Basic components and mathematical modeling	20
IC engine operation and characteristics, electric propulsion systems: motor, power electronics and drives, energy storages: batteries, supercapacitors, and flywheels, fuel cells, fundamentals of regenerative braking.	
Module III: Energy/power and battery management	25
BMS basics: tasks, methods to determine battery states, battery life, temperature control, cell balancing, hardware implementation; power/energy management of hybrid vehicles: types and basic control mechanisms, optimization problems, case studies	
Module IV Charging system basics	25
Plug-in electric/hybrid vehicle battery and charging characteristics, charging system components, levels and standards, types of connectors, impacts on grid	

Student Learning Outcomes:

After completion of this course the students will have

1. An ability to understand the different architectures of electric and hybrid vehicles, study the behavior of individual components, and link them together to build the entire powertrain model.
2. An understanding of the differences with conventional vehicles and appreciate the need to introduce new hybrid/electric vehicle technologies in the transportation sector
3. A basic understanding of charging systems, charging control, and energy management strategies

Pedagogy for Course Delivery:

- Class room Lectures, assignments, Quiz.
- Seminars and discussions

Assessment/ Examination Scheme:

Theory L/T (%)	Lab/Practical/Studio (%)	Total
100	-	100

Theory Assessment (L&T):

Continuous Assessment/Internal Assessment					End Term Examination
Components (Drop down)	A	C T	S/V/Q	HA	EE
Weightage (%)	5	10	8	7	70

Textbook:

- 1) Ehsani, M., Gao, Y., & Emadi, A. (2009). *Modern electric, hybrid electric, and fuel cell vehicles: fundamentals, theory, and design*. CRC press.
- 2) Wei Liu (2013). *Introduction to Hybrid Vehicle System Modeling and Control*

For reference:

- 3) Husain, I. (2011). *Electric and hybrid vehicles: design fundamentals*. CRC press.
- 4) Guzzella, L., & Sciarretta, A. (2007). *Vehicle propulsion systems* (Vol. 1). Springer-Verlag Berlin Heidelberg.
- 5) *Hybrid Electric Vehicle System Modeling and Control* (Automotive Series) Hardcover – Import, 31 Mar 2017