

HYBRID ELECTRIC VEHICLES

VIII Semester: EEE								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AEE019	Core	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
Contact Classes: 45		Tutorial Classes: 15		Practical Classes: Nil			Total Classes: 60	
I. COURSE OVERVIEW:								
<p>Electric and Hybrid Vehicles course deals with technical knowledge and practical expertise in commercial automobile technologies. As a part of this course, design, component selection and sizing at both system and vehicle level with a special focus on drives, battery modeling and control has been elaborated. A comprehensive overview of Electric and Hybrid Vehicles is emphasized on configuration, main issues and energy management strategies. This course also concludes with different control schemes used in motor drives and energy management systems.</p>								
II. OBJECTIVES:								
The course should enable the students to:								
<ul style="list-style-type: none"> I The concepts of modeling, design, and development of energy storage systems in hybrid electric vehicles. II The importance of hybrid electric vehicles to address the issues associated with environmental pollution and energy crisis. III The need of rapid control prototyping techniques to design and validate HEV high level and low level control system. IV The Know-how and aptitude towards future trends in Hybrid Electric Vehicles. 								
III. COURSE OUTCOMES:								
After successful completion of the course, students should be able to:								
CO 1	Summarize the various topologies and modeling techniques used in electric and hybrid vehicles for performance analysis.							Understand
CO 2	Analyze cost-effectiveness of different types of hybrid drive-trains for transmitting power to driving wheels.							Analyze
CO 3	Demonstrate the configuration and control of Electric motor drives for maximizing speed and torque.							Evaluate
CO 4	Choose the hybridization of Energy Storage Systems for reducing size.							Apply
CO 5	Select suitable Energy Storage Systems and drive train components for optimizing energy management.							Apply
IV. SYLLABUS:								
UNIT - I	INTRODUCTION						Classes: 08	
Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies; Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.								
UNIT - II	HYBRID ELECTRIC DRIVE TRAINS						Classes: 10	
Hybrid Electric Drive trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive train topologies, fuel efficiency analysis; Electric Drive trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive train topologies, fuel efficiency analysis.								

UNIT - III	ELECTRIC MOTORS FOR HYBRID ELECTRIC VEHICLES	Classes: 10
<p>Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, configuration and control of DC motor drives, configuration and control of Induction Motor drives.</p> <p>Configuration and control of permanent magnet motor drives, configuration and control of switch reluctance motor drives, drive system efficiency.</p>		
UNIT - IV	ENERGY STORAGE	Classes: 08
<p>Energy Storage: Introduction to energy storage requirements in hybrid and electric vehicles, Battery based energy storage and its analysis, fuel cell based energy storage and its analysis, super capacitor based energy storage and its analysis, flywheel based energy storage and its analysis, hybridization of different energy storage devices; sizing the drive system: matching the electric machine and the internal combustion engine (ICE), sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, communications, supporting subsystems.</p>		
UNIT - V	ENERGY MANAGEMENT STRATEGIES	Classes: 09
<p>Energy Management Strategies: 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.</p>		
Text Books:		
<ol style="list-style-type: none"> 1. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press, 2nd Edition, 2003. 2. James Larminie, John Lowry, "Electric Vehicle Technology", Wiley publications, 1st Edition, 2003. 3. Mehrdad Ehsani, Yimi Gao, Sebastian E Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals Theory and Design", CRC Press, 2nd Edition, 2004. 		
Reference Books:		
<ol style="list-style-type: none"> 1. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 1st Edition 2004. 2. B D McNicol, D A J Rand, "Power Sources for Electric Vehicles", Elsevier publications, 1st Edition, 1998. 3. Seth Leitman, "Build Your Own Electric Vehicle" McGraw-Hill, 1st Edition, 2013. 		
Web References:		
<ol style="list-style-type: none"> 1. https://www.ae.pwr.wroc.pl/filez/20110606092353_HEV.pdf 2. https://www.unep.org/transport/pcfv/PDF/HEV_Report.pdf 3. https://www.seai.ie/News_Events/Press_Releases/Costs_and_benefits.pdf 4. https://www.afdc.energy.gov/pdfs/52723.pdf 5. https://www.leb.eei.uni-langen.de/winterakademie/2010/report/content/course03/pdf/0308.pdf 		
E-Text Books:		
<ol style="list-style-type: none"> 1. https://www.onlinelibrary.wiley.com/book/10.1002/9781119998914 2. https://www.go2hev.com/hybrid-electric-vehicles-student-textbook.html 3. https://www.sciencedirect.com/science/book/9780444535658 4. https://www.accessengineeringlibrary.com/browse/hybrid-electric-vehicle-design-and-control-intelligent-omnidirectional-hybrids 		
Course Home Page:		