ELECTRIC VEHICLES

Course Code	23EE4702A	Year	IV	Semester(s)	I
Course Category	Professional Elective-V	Branch	EEE	Course Type	Theory
Credits	3	L-T-P	3-0-0	Prerequisites	Basics of Electrical Machines and Electronics
Continuous Internal Evaluation:	30	Semester End Evaluation:	70	Total Marks:	100

Course Outcomes	
Upon successful completion of the course, the student will be able to	
CO1	**Understand** the fundamentals, architecture and operating principles of Electric Vehicles (EV) and Hybrid Electric Vehicles (HEV)**. (L2)**
CO2	**Apply** and compare different configurations of hybrid electric vehicles and their operating modes. **(L3)**
CO3	**Analyze** and select appropriate electric motors for EV and HEV propulsion systems based on performance requirements. **(L4)**
CO4	**Apply** the working principles and applications of power electronic converters used in electric and hybrid vehicles**. (L3)**
CO5	**Analyze** different battery technologies and energy storage systems used in electric vehicles**. (L4)**

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2									2		
CO2	3	2	1			1					2	2	1
CO3	2	3	2			1					2	2	1
CO4	3	2	2			1					2	2	1
CO5	3	3	2			1					2	2	1

SYLLABUS		
Unit No.	**Contents**	**Mapped CO**
I	**Introduction** Fundamentals of vehicle - components of conventional vehicle and propulsion load; Drive cycles and drive terrain; Concept of electric vehicle and hybrid electric vehicle; History of hybrid vehicles - advantages and applications of Electric and Hybrid Electric Vehicles.	**CO1 CO2**

II	**Hybridization of Automobile** Architectures of HEVs - series and parallel HEVs - complex HEVs. Plug-in hybrid vehicle (PHEV) - constituents of PHEV - comparison of HEV and PHEV; Extended range hybrid electric vehicles (EREVs) - blended PHEVs - Fuel Cell vehicles and its constituents.	**CO1** **CO2** **CO3** **CO4**
III	**Special Machines for EV and HEVs** Characteristics of traction drive - requirement of electric motors for EV/HEVs. Induction Motor drives - their control and applications in EV/HEVs. Permanent magnet Synchronous motor: configuration - control and applications in EV/HEVs. Brushless DC Motors: Advantages - control of application in EV/HEVs. Switch reluctance motors: Merits limitations - converter configuration - control of SRM for EV/HEVs.	**CO3** **CO4**
IV	**Power Electronics in HEVs** Boost and Buck-Boost converters - Multi Quadrant DC-DC converters - DC-AC Inverter for EV and HEV applications - Three Phase DC-AC inverters - Voltage control of DC-AC.	**CO1** **CO4**
V	**Energy Sources for HEVs** Energy Storage - Battery based energy storage and simplified models of battery - fuel cells - their characteristics and simplified models - super capacitor based energy storage - its analysis and simplified models - flywheels and their modeling for energy storage in EV/HEV - Hybridization of various energy storage devices.	**CO5**

Learning Resources
Text Books
1. Ali Emadi - Advanced Electric Drive Vehicles - CRC Press - 2014. 2. Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2003.
Reference Books
1. MehrdadEhsani - YimiGao - Sebastian E. Gay - Ali Emadi - Modern Electric - Hybrid Electric and Fuel Cell Vehicles: Fundamentals - Theory and Design - CRC Press - 2004. 2. James Larminie - John Lowry - Electric Vehicle Technology Explained - Wiley - 2003. 3. H. Partab: Modern Electric Traction - DhanpatRai& Co - 2007. 4. Pistooa G. - “Power Sources - Models - Sustanability - Infrstructure and the market” - Elsevier 2008 5. Mi Chris - Masrur A. - and Gao D.W. - “ Hybrid Electric Vehicle: Principles and Applications with Practical Perspectives” 1995.
e-Resources
1. https://nptel.ac.in/courses/108106182 2. https://nptel.ac.in/courses/108102121