B.Tech IV Year I Semester

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

19AEE76c- HYBRID ELECTRIC VEHICLES

(Professional Elective-IV)

L	T	P	C
3	0	0	3

Course Objectives: The objectives of the course are to make the students learn about

- Understand working of different configurations of electric vehicles
- Understand hybrid vehicle configuration and its components, performance analysis
- Understand the properties of batteries and its types.
- Understand of electric vehicle drive systems.
- Understand of hybrid electric vehicles.

UNIT – I: Introduction to Electric Vehicles

Sustainable Transportation - EV System - EV Advantages – Vehicle Mechanics - Performance of EVs - Electric Vehicle drive train - EV Transmission Configurations and Components-Tractive Effort in Normal Driving - Energy Consumption - EV Market - Types of Electric Vehicle in Use Today - Electric Vehicles for the Future.

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn about the fundamentals of EV system **L1**
- Learn about the vehicle mechanics and its performance **L1**
- Learn about the advantages over conventional vehicles **L2**
- Learn about the types of Electric Vehicles **L4**
- Learn about the future scope of these vehicles **L5**

UNIT – II: Electric Vehicle Modeling

Rolling Resistance - Transmission Efficiency -Consideration of Vehicle Mass - Tractive Effort - Modeling Vehicle Acceleration - Modeling Electric Vehicle Range -Aerodynamic Considerations - Ideal Gearbox Steady State Model - EV Motor Sizing - General Issues in Design.

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn about the electric vehicle modeling like rolling resistance, efficiency **L1**
- Learn about the tractive effort developed by the EV **L2**
- Learn about the Modeling of Electric Vehicle Range **L3**
- Learn about the considerations of aerodynamic in EV design **L4**
- Learn about the EV motor sizing with general issues considerations **L5**

UNIT – III: Batteries

Introduction to electric vehicle batteries - electric vehicle battery efficiency - electric vehicle battery capacity - electric vehicle battery charging - electric vehicle battery fast charging - electric vehicle battery discharging - electric vehicle battery performance – testing.

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn about the introduction of batteries related to the EVs **L1**
- Learn about the EVs battery performance details **L2**
- Learn about the testing of batteries for EVs **L3**

UNIT – IV: Hybrid Electric Vehicles

HEV Fundamentals -Architectures of HEVs- Interdisciplinary Nature of HEVs - State of the Art of HEVs - Advantages and Disadvantages - Challenges and Key Technology of HEVs - Concept of Hybridization of the Automobile-Plug-in Hybrid Electric Vehicles - Design and Control Principles of Plug-In Hybrid Electric Vehicles - Fuel Cell Hybrid Electric Drive Train Design - HEV Applications for Military Vehicles.

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn about the fundamentals of HEV **L1**
- Learn about the advantages and disadvantages of HEV over conventional ones **L2**
- Learn about the challenges and technologies related to HEVs **L3**
- Learn about the hybridization concept in HEV **L4**
- Learn about the design and applications of fuel cell hybridization **L5**

UNIT – V: Advanced Topics

Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles - The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks – Sizing Ultra capacitors for Hybrid Electric Vehicles.

Learning Outcomes:

At the end of this unit, the student will be able to

- Learn about the advanced topics related to the charging of vehicles **L1**
- Learn about the charging power levels in the electric vehicles **L2**
- Learn about the impact of plug in hybrid electric vehicles on distribution network **L3**
- Learn about the sizing of capacitors related to HEV **L4**
- Learn about the infrastructure for plug in electric & Hybrid vehicles **L5**

Text Books:

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles – Fundamentals, Theory and Design– Mehrdad Ehsani, Uimin Gao and Ali Emadi - Second Edition - CRC Press, 2010.
2. Electric Vehicle Technology Explained - James Larminie, John Lowry - John Wiley & Sons Ltd, - 2003.
3. Electric Vehicle Battery Systems – Sandeep Dhameja – Newnes - New Delhi – 2002.

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
3. Hybrid electric Vehicles Principles and applications with practical perspectives -Chris Mi, Dearborn - M. AbulMasrur, David Wenzhong Gao - A John Wiley & Sons, Ltd., - 2011.
4. Electric & Hybrid Vehicles – Design Fundamentals - Iqbal Hussain, Second Edition, CRC Press, 2011.
5. **Research Papers:**
   i) The Impact of Plug-in Hybrid Electric Vehicles on Distribution Networks: A Review and Outlook - Robert C. Green II, Lingfeng Wang and MansoorAlam - 2010 IEEE.
   ii) Sizing Ultra capacitors for Hybrid Electric Vehicles - H. Douglas P Pillay -2005 IEEE.
   iii) Review of Battery Charger Topologies, Charging Power Levels, and Infrastructure for Plug-In Electric and Hybrid Vehicles - Murat Yilmaz, and Philip T. Krein, - IEEE transactions on power electronics, vol. 28, no. 5, May 2013.

Course Outcomes:

At the end of this Course the student will be able to

- Choose a suitable drive scheme for developing an electric hybrid vehicle depending on resources. **L1**
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles. **L2**
- Choose proper energy storage systems for vehicle applications. **L3**
- Identify various communication protocols and technologies used in vehicle networks. **L4**