B.Tech III Year II Semester

JNTUA COLLEGE OF ENGINEERING (AUTONOMOUS) PULIVENDULA

19AME64a – HYBRID AND ELECTRICAL VEHICLES

(Professional Elective-II)

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

- To provide good foundation on hybrid and electrical vehicles.
- To address the underlying concepts and methods behind power transmission in hybrid and electrical vehicles.
- To familiarize energy storage systems for electrical and hybrid transportation.
- To design and develop basic schemes of electric vehicles and hybrid electric vehicles.

UNIT – 1: Introduction to Hybrid and Electric Vehicles **10 Hrs**

History of hybrid and electric vehicles, Need for hybrid and electric vehicles and their limitations. Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Specifications of hybrid and electric vehicles.

Learning Outcomes:

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

- Summaries the concepts and recent trends in electrical and hybrid vehicles. **L2**
- Demonstrate the need for hybrid and electric vehicles and their limitations. **L2**
- Compare modern drive-trains with conventional drive-trains. **L2**
- Outline the specifications of hybrid and electric vehicles. **L2**

UNIT – II: Hybrid Electric Drive-trains & Electric Drive-trains **10 Hrs**

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.

Learning Outcomes:

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

- Choose a suitable drive scheme for developing an hybrid and electric vehicles depending on resources. **L1**
- Explain power flow control in hybrid drive-train topologies. **L2**
- Compare hybrid electric drive-trains and electric drive-trains. **L2**
- Analyze the fuel efficiency of hybrid and electric vehicles. **L4**

UNIT – III: Electric Propulsion unit **10Hrs**

Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Learning Outcomes:

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

- Choose a suitable drive scheme for developing a hybrid and electric vehicles depending on resources. **L3**
- Explain power flow control in hybrid drive-train topologies. **L2**
- Compare hybrid electric drive-trains and electric drive-trains. **L2**

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UNIT – IV: Energy Storage **8 Hrs**

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.

Learning Outcomes:

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

- Explain fundamental electrochemistry of battery operation and performance requirements for hev, phev, erev and full electric vehicles. **L2**
- Summarize different approaches to estimating state of charge, state of health, power and energy. **L2**
- Outline the functions performed by a battery management system. **L2**
- Select various battery testing procedures and verification of battery performances. **L3**
- Compare different energy storage devices. **L2**

UNIT – V: Sizing the drive system **8 Hrs**

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,

Design Considerations For Electric Vehicles: Various Resistance- Transmission efficiency- Vehicle mass- Electric vehicle chassis and Body design considerations- Heating and cooling systems- Power steering- Tire choice- Wing Mirror, Aerials and Luggage racks.

Learning Outcomes:

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

- Illustrate matching the electric machine and the internal combustion engine. **L2**
- Select the energy storage technology. **L3**
- Design and develop basic schemes of electric and hybrid electric vehicles. **L3**

Text Books:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2/e, CRC Press, 2003.
2. Amir Khajepour, M. Saber Fallah, Avesta Goodarzi, Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach, illustrated edition, John Wiley & Sons, 2014.
3. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

Reference Books:

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. John G. Hayes, G. Abas Goodarzi, Electric Powertrain: Energy Systems, Power Electronics and Drives for Hybrid, Electric and Fuel Cell Vehicles, 1/e, Wiley-Blackwell, 2018.

Course Outcomes:

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

- Explain the working of hybrid and electric vehicles. **L2**
- Choose a suitable drive scheme for developing a hybrid and electric vehicles depending on resources. **L3**
- Develop the electric propulsion unit and its control for application of electric vehicles. **L3**
- Choose proper energy storage systems for vehicle applications. **L3**
- Design and develop basic schemes of electric vehicles and hybrid electric vehicles. **L3**