**17EE41E2-ELECTRICAL AND HYBRID VEHICLES**

 **(EEE)**

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| **Course Category:** | Professional Elective | **Credits:** | 3 |
| **Course Type:** | Theory | **Lecture-Tutorial-Practical:** | 3-0-0 |
| **Pre-requisite:** | Basics of Electrical engineering | **Sessional Evaluation:****External Exam Evaluation:****Total Marks:** | 4060100 |

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| **Course Objectives:** | To make the student learn about: |
| 1. The importance of electric vehicle systems
2. The basics of electric vehicle components and storage
3. The basics of battery technology
4. The various charging types and comfort
5. The safety methods in hybrid vehicle
6. The application of electric vehicle in smart grid
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| **Course Outcomes:** | Upon successful completion of the course , the students will be able to: |
| **CO1** | Understand the importance of electric vehicle systems |
| **CO2** | Understand the basics of electric vehicle components and storage |
| **CO3** | Understand the basics of battery technology |
| **CO4** | Understand the various charging types and comfort |
| **CO5** | Understand the safety methods in hybrid vehicle |
| **CO6** | Understand the application of electric vehicle in Smart grid |
| **Course Content:** | **UNIT –I****Electric vehicles**: History of modern transportation, importance of different transportation development strategies to future oil supply, introduction to electric vehicles, history of hybrid and electric vehicles, social, environmental importance and key challenges of hybrid and electric vehicles, specifications of PHEVs, BEVs, EVs, plug-in hybrid vehicle characteristics, the future of electric vehicles.**UNIT-II****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.**UNIT-III****Battery technology:** Types of batteries, properties of batteries, working principle and construction of lead-acid, nickel cadmium, nickel metal hydride, lithium ion batteries, maintenance and charging of batteries, diagnosing lead-acid battery faults, advanced battery technology, developments in electrical storage. **UNIT-IV****Charging and starting systems:** Requirements of the charging system, charging system principles, alternators and charging circuits, diagnosing charging system faults, advanced charging system technology, new developments in charging systems, requirements of the starting system, starter motors and circuits, types of starter motor, diagnosing starting system faults starting system technology, new developments in starting systems. **UNIT-V** **Hybrid electric vehicle drive train and safety:** Requirement of drive train, architecture of hybrid drive train, sizing of components, series configuration, parallel configuration, parallel and series configuration, security-airbags and belt tensioners, diagnosing comfort and safety system faults, advanced comfort and safety systems technology, new developments in comfort and safety systems.**UNIT-VI** **Emerging technologies**: Introduction electric vehicle supply equipments, smart vehicles in smart grid, vehicle-to-grid technologies, unidirectional and bidirectional, need of charging station selection (CSS) server, smart grid technologies, applications / benefits, smart meter, smart charger, purpose and benefits. |
| **Text books****&****Reference books:** | **Text books:** 1. “Modern electric, hybrid electric and fuel cell vehicles: fundamentals,  theory, and design”, by M. Ehsani, Y. Gao, and A. Emadi, 2nd Edition,  CRC Press, Aug. 2009. 2. “Automobile electrical and electronic systems”, by Tom Denton,  Elsevier Butterworth-Heinemann, 3rd Edition, 2004. 3.“Advanced electric drive vehicles”, by A. Emadi , CRC Press,  1st Edition Oct. 2014. 4. “Hybrid electric vehicles: principles and applications with practical  perspectives”, by [Chris Mi](https://onlinelibrary.wiley.com/action/doSearch?ContribAuthorStored=Mi%2C+Chris), [M. Abul Masrur](https://onlinelibrary.wiley.com/action/doSearch?ContribAuthorStored=Masrur%2C+M+Abul), 2nd Edition, November  2017, John Wiley & Sons Ltd.**Reference books:** 1.“Electric & hybrid vehicles – design fundamentals”, by Iqbal Hussain,  2nd Edition, CRC Press, 2011. 2.“Electric vehicle technology explained”, by James Larminie, John  Wiley & Sons, 2003. 3.“Smart Grid: technology and applications”, by Janaka Ekanayake, Nick  Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, John  Wiley & sons inc, 2012. |
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