

## FUNDAMENTALS OF ELECTRIC VEHICLES

|                                        |                   |                                 |       |                      |        |
|----------------------------------------|-------------------|---------------------------------|-------|----------------------|--------|
| <b>Course Code</b>                     | 23EE2601          | <b>Year</b>                     | III   | <b>Semester</b>      | II     |
| <b>Course Category</b>                 | Open Elective -II | <b>Branch</b>                   | EEE   | <b>Course Type</b>   | Theory |
| <b>Credits</b>                         | 3                 | <b>L-T-P</b>                    | 3-0-0 | <b>Prerequisites</b> | BEEE   |
| <b>Continuous Internal Evaluation:</b> | 30                | <b>Semester End Evaluation:</b> | 70    | <b>Total Marks:</b>  | 100    |

| Course Outcomes                                                       |                                                                                                                                |
|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| Upon successful completion of the course, the student will be able to |                                                                                                                                |
| <b>CO1</b>                                                            | <b>Understand</b> the use and advantages of different types of electric vehicles. (L2)                                         |
| <b>CO2</b>                                                            | <b>Apply</b> suitable power converters for EV applications and a suitable electric motor for the EV powertrain. (L3)           |
| <b>CO3</b>                                                            | <b>Analyze</b> HEV configuration for a specific application. (L4)                                                              |
| <b>CO4</b>                                                            | <b>Demonstrate</b> various storage systems and battery management systems for EVs.(L3)                                         |
| <b>CO5</b>                                                            | <b>Submit</b> a report on concepts of Electric, hybrid vehicles, energy storage, and management systems for Electric vehicles. |

| 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 | PO12 | PSO1 | PSO2 |
| CO1                                                                                                                           |     |     |     |     |     |     |     |     |     |      |      |      |      |      |
| CO2                                                                                                                           | 3   |     |     |     |     | 3   | 3   |     |     |      |      | 2    | 3    | 2    |
| CO3                                                                                                                           | 3   | 3   |     |     |     | 3   | 2   |     |     |      |      | 2    | 3    | 2    |
| CO4                                                                                                                           | 3   |     |     |     |     | 3   | 3   |     |     |      |      | 2    | 2    | 3    |
| CO5                                                                                                                           |     |     |     |     |     |     |     |     | 2   | 3    |      |      | 2    | 2    |

| SYLLABUS |                                                                                                                                                                                                                                                                                                                                                                                             |                          |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| Unit No. | Contents                                                                                                                                                                                                                                                                                                                                                                                    | Mapped CO                |
| I        | <b>Introduction to Electric Vehicles</b><br>Fundamentals of vehicles – Vehicle model – Calculation road load and tractive force –Components of conventional vehicles – Drawbacks of conventional vehicles – Need for electric vehicles– Advantages and applications of Electric Vehicles – History of Electric Vehicles – EV Market in India and outside India –Types of Electric Vehicles. | <b>CO1</b><br><b>CO5</b> |
| II       | <b>Components of Electric Vehicles</b><br>Main components of Electric Vehicles – Electric Traction Motor and Controller –Power Converters – Rectifiers used in EVs – Bidirectional DC–DC Converters – Voltage Source Inverters – PWM inverters used in EVs.                                                                                                                                 | <b>CO2</b><br><b>CO5</b> |

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|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| III | <b>Motors for Electric Vehicles</b><br>Characteristics of traction drive – requirements of electric machines for EVs – Comparison of Different motors for Electric and Hybrid Vehicles – Induction Motors – Synchronous Motors – Permanent Magnetic Synchronous Motors – Brushless DC Motors – Switched Reluctance Motors (Construction details and working only). | <b>CO2</b><br><b>CO5</b> |
| IV  | <b>Hybrid Electric Vehicles</b><br>Evolution of Hybrid Electric Vehicles – Advantages and Applications of Hybrid Electric Vehicles – Architecture of HEVs – Series and Parallel HEVs – Complex HEVs – Range extended HEVs – Examples – Merits and Demerits.                                                                                                        | <b>CO3</b><br><b>CO5</b> |
| V   | <b>Energy Sources for Electric Vehicles</b><br>Batteries– Types of Batteries – Lithium-ion – Nickel-metal hydride – Lead-acid – Comparison of Batteries – Battery Charging – Fast Charging – Battery Management System – Ultra capacitors – Flywheels – Compressed air energy storage (CAES)– Fuel Cell – it's working.                                            | <b>CO4</b><br><b>CO5</b> |

| Learning Resources                                                                                                                                                                                                                                                                                                                                          |  |
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| <b>Text Books:</b>                                                                                                                                                                                                                                                                                                                                          |  |
| 1. Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2021.<br>2. Tom Denton, Hayley Pells - Electric and hybrid vehicles, Third Edition, 2024                                                                                                                                                                                 |  |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                                                                                                     |  |
| 1. Kumar - L. Ashok - and S. Albert Alexander. Power Converters for Electric Vehicles. CRC Press - 2020.<br>2. Chau - Kwok Tong. Electric vehicle machines and drives: design, analysis and application. John Wiley & Sons - 2015.<br>3. Berg - Helena. Batteries for electric vehicles: materials and electrochemistry. Cambridge University Press - 2015. |  |
| <b>E-Resources:</b>                                                                                                                                                                                                                                                                                                                                         |  |
| 1. <a href="https://www.edx.org/learn/electric-cars">https://www.edx.org/learn/electric-cars</a><br>2. <a href="https://archive.nptel.ac.in/courses/108/106/108106170">https://archive.nptel.ac.in/courses/108/106/108106170</a>                                                                                                                            |  |