# Fundamentals of Electric Vehicles

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| **Course Code** | 23EE2601 | **Year** | III | **Semester** | II |
| **Course Category** | **OE-II** | **Branch** | EEE | **Course Type** | Theory |
| **Credits** | 3 | **L-T-P** | 3-0-0 | **Prerequisites** | NIL |
| **Continuous Internal Evaluation:** | 30 | **Semester End Evaluation:** | 70 | **Total Marks:** | 100 |

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| **Course Outcomes** | | |
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| Upon successful completion of the course, the student will be able to | | BL |
| CO1 | **Understand** the concepts of Electric and hybrid electric vehicles, energy storage, and battery management systems for Electric vehicles. | L2 |
| CO2 | **Identify** the Main Components and power converters used in electric vehicles. | L3 |
| CO3 | **Apply** suitable power converters for EV applications and a suitable electric motor for the EV powertrain. | L3 |
| CO4 | **Analyze** the Architecture of HEV's and their applications. | L4 |
| CO5 | **Analyze** various storage and battery management systems for EVs. | L4 |

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**Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)**
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | | | | 2 | | | | | | | |
| CO2 | 3 | 2 | | | | 1 | | | | | 2 | | |
| CO3 | 3 | 2 | | | | 1 | | | | | 2 | | |
| CO4 | 3 | 2 | | | | 1 | | | | | 2 | | |
| CO5 | 3 | 3 | | | | 1 | | | | | 2 | | |
| Average | 3 | 2 | | | | 1 | | | | | 2 | | |

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| **Syllabus** | | |
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| **Unit No.** | **Contents** | **Mapped CO** |
| 1 | **Introduction to Electric Vehicles**<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. | CO1,CO2 |
| 2 | **Components of Electric Vehicles**<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. | CO1,CO2 CO3 |

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| 3 | **Motors for Electric Vehicles**<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). | CO1,CO3 |
| 4 | **Hybrid Electric Vehicles**<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. | CO1,CO4 |
| 5 | **Energy Sources for Electric Vehicles**<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. | CO1,CO5 |

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| **Learning Resources** |
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| **Text Books:** |
| 1. Iqbal Hussein - Electric and Hybrid Vehicles: Design Fundamentals - CRC Press - 2021.<br>2. Tom Denton, Hayley Pells - Electric and hybrid vehicles, 3rd Ed., 2024 |
| **Reference Books:** |
| 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. |
| **E-Resources:** |
| 1. MOOC at https://www.edx.org/learn/electric-cars<br>2. https://archive.nptel.ac.in/courses/108/106/108106170 |