Centre for Outreach and Digital Education
Indian Institute of Technology Madras

IIT Madras CODE offers Certificate Program on

ELECTRIC VEHICLE ENGINEERING & DEVELOPMENT

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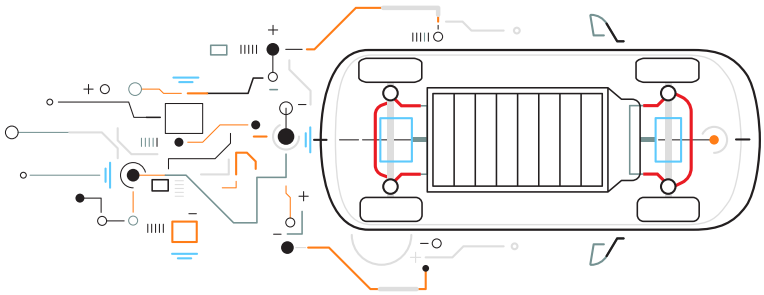

ABOUT THE COURSE

This course offers an in-depth exploration of electric vehicles (EVs), guiding students from basic concepts to advanced design and development. It covers the evolution of EVs, including hybrids, plug-in hybrids, and battery electric vehicles (BEVs).

Key modules include EV design processes, regulatory standards, and development cycles, emphasizing practical skills and industry-standard tools. Students will gain insights into powertrain configurations, battery technologies, and fuel cell systems, while learning to manage safety, design verification, and virtual engineering techniques. Special focus is given to different vehicle types, from two-wheelers and three-wheelers to cars, buses, and trucks. Ideal for those aiming to advance their expertise in EV engineering and contribute to the future of sustainable transportation.

Eligibility
B.Tech (any domain) with interest in Automotive EVs

Course Fees
Rs.47,200 (Rs. 40,000 + 18% GST)

Course Policy
Please refer HERE to read about policies on Admission, Pricing, Payment and Attendance.

Cohort Size: 100

Mode of Course:
30 hours of recorded videos and 15 hours of online live interactive sessions with the faculty.

Course start Date:
Jan 20, 2025.

CLICK HERE TO REGISTER

FACULTY PROFILE

Mr. Balaji has four decades of experience in Commercial Vehicle design and development, including key roles at Ashok Leyland, where he retired as General Manager of Product Development. He holds a B.E. in Mechanical Engineering from College of Engineering Guindy and PG Diplomas in Advanced Management and Marketing Management. Post-retirement, he provides consultancy services in electric mobility and vehicle development. Since October 2023, he has been a Professor of Practice at IIT Madras, teaching Electric Vehicle Engineering and guiding various CoEZET projects.

Mr. B. Balaji
Professor of Practice, IIT Madras

Module 1

Introduction to Electric Vehicles

Module Description: This module provides an introductory overview of Electric Vehicles (EVs), tracing the evolution from Internal Combustion Engine (ICE) vehicles to electric mobility.

- **Concepts Covered:** Introduction to different electric powertrain configurations, such as hybrids, plug-in hybrids, and battery electric vehicles (BEVs).
- **Learning Outcomes:** Understand the fundamental differences between ICE and electric vehicles, and the driving factors behind the transition to electric mobility.
- **Applications:** Lays the groundwork for deeper exploration into electric vehicle engineering and design.

Module 2

EV Design Process

Module Description: This module delves into the systematic processes involved in designing electric vehicles, introducing industry-standard design tools and methodologies.

- **Concepts Covered:** Systems Engineering, Design Thinking, Attribute Engineering, Quality Function Deployment (QFD), Design Failure Mode and Effects Analysis (DFMEA), and Design for Excellence (DFX).
- **Learning Outcomes:** Learn to apply structured design processes, enabling the creation of efficient and innovative vehicle designs while optimizing cost and performance.
- **Applications**: Facilitates efficient management of the vehicle development lifecycle, ensuring that designs meet customer expectations and regulatory standards.

Module 3

Vehicle Regulations

Module Description: This module focuses on the regulatory requirements specific to electric vehicles, ensuring compliance with national and international standards.

- **Concepts Covered:** Central Motor Vehicle Rules (CMVR), type approval procedures, environmental regulations, and safety standards for EVs.
- **Learning Outcomes:** Gain an understanding of the regulatory environment and how to ensure vehicle designs meet necessary standards.
- **Applications:** Essential for ensuring electric vehicles are compliant with market regulations and can be successfully commercialized.

Module 4

Vehicle Development Process

Module Description: A comprehensive look at the development process of electric vehicles, from initial concept to market readiness.

- **Concepts Covered:** Development Validation Process (DVP), prototyping, validation standards, and iterative testing methods.
- **Learning Outcomes:** Learn the stages of vehicle development, from design and testing to final production, with a focus on ensuring reliability and performance.
- **Applications:** Critical for overseeing the entire lifecycle of EV development, from concept through production.

Module 5

Battery Electric Vehicles

Module Description: Explores the core principles and technologies behind Battery Electric Vehicles (BEVs), focusing on their design and operation.

- **Concepts Covered:** Motor requirements, energy flow, transmission mechanisms, and efficiency optimization techniques in BEVs.
- **Learning Outcomes:** Understand the unique characteristics of BEVs, including their advantages and challenges in terms of performance and efficiency.
- **Applications:** Crucial for designing and optimizing BEVs to meet specific performance metrics.

Module 6

Fuel Cell EVs

Module Description: Focuses on the design and operation of Fuel Cell Electric Vehicles (FCEVs), highlighting the role of hydrogen as a fuel source.

- **Concepts Covered:** Hydrogen production methods, fuel cell stack technology, integration of fuel cell systems in vehicles.
- **Learning Outcomes:** Gain insights into the construction, operation, and environmental benefits of FCEVs, and how they differ from BEVs.
- **Applications**: Enables exploration and development of FCEV technology, contributing to a diversified approach to electric mobility.

Module 7

Powertrain

Module Description: This module explores the core components and functionality of EV powertrains, including electric motors and drives.

- **Concepts Covered:** Electric motor types, powertrain efficiency, energy regeneration, and drivetrain configurations.
- **Learning Outcomes:** Understand the critical role of powertrain components in vehicle performance and efficiency.
- **Applications:** Vital for designing powertrains that optimize energy use and enhance vehicle performance.

Module 8

Batteries and Battery Energy Management

Module Description: A deep dive into the technology behind EV batteries, focusing on their design, management, and safety.

- **Concepts Covered:** Battery chemistries, energy density, thermal management, Battery Management Systems (BMS), and charging technologies.
- **Learning Outcomes:** Acquire in-depth knowledge of battery technology, including how to manage and ensure the safety of battery systems in EVs.
- **Applications:** Essential for integrating efficient, safe, and long-lasting battery systems into electric vehicles.

Module 9

Vehicle Topologies and Architecture

Module Description: This module introduces various vehicle topologies and architecture options available for electric vehicles.

- **Concepts Covered:** Propulsion systems, energy source configurations, series, parallel, and series-parallel hybrid configurations.
- **Learning Outcomes:** Develop the ability to design and evaluate different EV architectures, tailoring designs to specific performance and efficiency goals.
- **Applications:** Prepares students to innovate in vehicle design, adapting architectures to meet diverse market needs.

Module 10

Electric Two Wheelers - Scooters and Bikes

Module Description: This module examines the specific engineering challenges and design considerations for electric two-wheelers like scooters and bikes.

- **Concepts Covered:** Architecture of two-wheelers, motor application strategies, battery integration, and weight distribution.
- **Learning Outcomes:** Understand the unique engineering requirements of electric two-wheelers and how to optimize them for urban mobility.
- **Applications**: Critical for designing efficient and popular electric scooters and bikes, especially in densely populated urban areas.

Module 11

Electric Three Wheelers

Module Description: Focuses on the design and development of electric three-wheelers, addressing their unique challenges and market demand.

- **Concepts Covered:** Design and engineering considerations specific to three-wheelers, battery placement, and load balancing.
- **Learning Outcomes:** Learn the specific technical requirements and market needs for electric three-wheelers.
- **Applications:** Important for designing robust and efficient three-wheelers, often used in last-mile connectivity and urban transport.

Module 12

Electric Cars, Buses and Trucks

Module Description: A detailed exploration of electric vehicle architecture for larger vehicles like cars, buses, and trucks.

- **Concepts Covered:** BEV architecture, skateboard platforms, modular designs, specific considerations for heavy-duty vehicles.
- **Learning Outcomes:** Learn how to design and adapt vehicle architectures to suit various applications, from passenger cars to heavy-duty trucks.
- **Applications:** Crucial for developing scalable and adaptable EV platforms that can meet a wide range of market demands.

Module 13

Safety, Design Philosophy and Design Verification and Virtual Engineering

Module Description: Combines critical safety engineering principles with design philosophy and the role of virtual engineering tools in EV development.

- **Concepts Covered:** Safety regulations, functional safety (ISO 26262), battery safety protocols, virtual simulations, and CAE tools.
- **Learning Outcomes:** Understand how to implement safety features across EV systems and use simulations to test and refine designs.
- **Applications:** Enables cost-effective and rapid prototyping, ensuring designs meet safety standards while reducing development time and costs.

Indian Institute of Technology Madras

Contact Us

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