



## Introduction to Electric Vehicles

Motor vehicles grant us freedom of travel and transportation of essential goods. However, combustion engines contribute to greenhouse gas emissions and associated global warming. The working principles of combustion engines and their greenhouse gas emissions will be detailed, and the latest advancements towards carbon-neutral motor vehicles will be introduced.

### Who Should Attend

The course is aimed at engineers, designers, technology and material experts, environmental specialists and health and safety personnel working in industry, business and local government with responsibilities towards the changes required to reduce the environmental impact of greenhouse gas emissions. Since everyone in society is affected by the changes required and has a role in achieving a successful result, the course is of universal interest to each of us.

### Aims

The course aims to provide learners with an introduction to electric vehicles, from the fundamental principles to the latest technological developments. This knowledge will be essential for anyone working in the automotive industry or anyone wanting to learn more about this important new technology.

### Learning Outcomes

After completing this module, the student should be able to demonstrate and understanding:

- of the working principles of a modern combustion engine to minimise greenhouse gas emissions
- of the legislation phasing out combustion engines and driving the development of electric vehicles
- of the different types of electric vehicles, including Hybrid Electric Vehicles, Plug-in Hybrid Electric Vehicles, Battery Electric Vehicles and Fuel-Cell Electric Vehicles
- of the fundamentals of electricity from atoms & electrons to generators
- of electric motors, including working principles and different types of motor with a focus on the Alternating Current induction three-phase motor
- of transmission systems, including working principles, different components and differences between transmission systems for combustion engines & electric motors

- of batteries, including working principles and different types of batteries with focus on the lithium-ion battery
- of hydrogen fuel cells including working principles and different types of fuel cells with focus on the Polymer Electrolyte Membrane fuel cell
- of energy recovery systems, including kinetic and thermal
- of control electronics, including inverters, capacitors, transistors, high-voltage cables and cooling systems
- of chassis design for electric vehicles, including weight distribution and crash-safety
- of the differences between combustion engines, batteries and fuel cells including life cycle assessment
- of the probable future of motor vehicles by sector
- of charging systems & infrastructure for Battery Electric Vehicles and Fuel-Cell Electric Vehicles

## Course Programme

- Evolution of Motor Vehicles: 10 most important cars in history, internal combustion engine, forced induction, emissions & legislation, types of electric vehicles
- Fundamentals of Electricity: atoms, electron configurations, electrical conductivity, current, voltage, resistance, power, Direct Current, Alternating Current, magnetism, generators, single phase, two phase, three phase
- Electric Motors: working principles, types & configurations, Alternating Current induction three phase motor, materials & manufacturing
- Transmission Systems: working principles, clutch, gearbox, differential, differences between transmission systems for engines & electric motors, materials & manufacturing
- Batteries: working principles, types & configurations, lithium-ion battery, materials & manufacturing
- Hydrogen Fuel-Cells: working principles, types & configurations, Polymer Electrolyte Membrane hydrogen fuel-cell, materials & manufacturing

## Course Delivery

The course is conveniently delivered through Swansea University's Learning Management System, Canvas, providing a seamless online learning experience. Students are granted a generous three-month period to complete the course, allowing for personalised learning at their own preferred pace.

Throughout the course, participants will engage in three progressive assessment quizzes, complemented by a comprehensive final written assessment that culminates their learning journey. All assessments are conveniently submitted through the secure and user-friendly platform, Canvas.

To ensure a supportive and enriching learning environment, expert guidance and assistance are readily available from our project lecturers and dedicated learning technologists. These experienced professionals can be easily reached through Canvas or via email.

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