ES4B7-15 Vehicle Propulsion

21/22

Department
School of Engineering
Level
Undergraduate Level 4
Module leader
Emma Rushforth
Credit value
15
Module duration
10 weeks
Assessment
100% coursework
Study location
University of Warwick main campus, Coventry

Description

Introductory description

ES4B7-15 Vehicle Propulsion

Module web page

Module aims

At the end of this module students will be able to critically analyse a range of common propulsion technologies such as ICE, electrification and hybrid solutions.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

Propulsion choices.
Motivation for using HEVs
Preliminary concepts: Thermodynamic processes
Engine power cycles
Ignition and valve timing
Combustion fundamentals in SI and CI engines

Actual fuel-air cycles: Otto, diesel and two-stroke
Mixture preparation: stoichiometric, rich and lean mixtures
Combustion and exhaust formation
Emission norms, testing and control
Engine force balance and performance characteristics
Engine performance testing and turbocharging
Vehicle transmission
Vehicle power and traction requirements calculation
Engine sizing for HEV application
Hybrid vehicle architecture
Electric Machines: Principles and Modelling
Design of PM synchronous motors
Switched reluctance (stepper) and induction motors
Control of permanent magnet, stepper and induction motors
Energy storage technologies: electrical and mechanical
Battery modelling and characterisation
Battery pack design, management and control systems
Fuel cells

Learning outcomes

By the end of the module, students should be able to:

- Be familiar with the design and operating parameters and internal-combustion engine operating characteristics.
- Interpret the requirements for and operating characteristics of HEV enabling technology and the complexity of technology integration.
- Critically analyse the diverse justifications for vehicle hybridisation and electrification.

Indicative reading list

Borgnakke, C. and Sonntag, R.E., 2019, Fundamentals of Thermodynamics, 10th edition, Wiley.
Yunus C. and Michael B., 2019, Thermodynamics: An Engineering Approach, 9th edition, McGraw Hill.
Heywood, J.B., 2018, Internal Combustion Engine Fundamentals 2E, 2nd edition, McGraw Hill.
Ganesan, V., 2013, Internal Combustion Engines, 4th edition, Tata McGraw Hill.
Stone, R., 2012, Introduction to Internal Combustion Engines, 4th edition, Macmillan.
Mi C., Masrur MA., 2017, Hybrid electric vehicles: principles and applications with practical perspectives, 2nd edition, Wiley.
J Miller, 2010, Propulsion Systems for Hybrid Vehicles, IET.
A Emadi, 2014, Advanced Electric Drive Vehicles, 1st edition, CRC Press.

Subject specific skills

Ability to be pragmatic, taking a systematic approach and the logical and practical steps necessary for, often complex, concepts to become reality.
Ability to develop economically viable and ethically sound sustainable solutions

Transferable skills

Appreciation of the global dimensions of engineering, commerce and communication
Be professional in their outlook, be capable of team working, be effective communicators, and be able to exercise responsibility and sound management approaches.
Exercise initiative and personal responsibility, including time management, which may be as a team member or leader.
Numeracy: apply mathematical and computational methods to communicate parameters, model and optimize solutions.
Plan self-learning and improve performance, as the foundation for lifelong learning/CPD

Study

Study time

Type	Required
Seminars	18 sessions of 2 hours (24%)
Other activity	2 hours (1%)
Private study	112 hours (75%)
Total	150 hours

Private study description

Guided Independent Learning 112 hours

Other activity description

Examples class (exam revision)

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group A1

	Weighting	Study time
QMP - Quiz 1 QMP online remote test	30%	
QMP - Quiz 2 QMP online remote test	30%	
Group report A group report with peer assessment	40%	

Feedback on assessment

Individual and cohort feedback for all assessments.

Availability

Courses

This module is Option list A for:

- Year 4 of UESA-H336 MEng Automotive Engineering
- Year 4 of UESA-H114 MEng Engineering
- Year 4 of UESA-HH76 MEng Manufacturing and Mechanical Engineering
- Year 5 of UESA-HH38 MEng Manufacturing and Mechanical Engineering with Intercalated Year
- Year 5 of UESA-HH77 MEng Manufacturing and Mechanical Engineering with Intercalated Year
- Year 4 of UESA-H311 MEng Mechanical Engineering

This module is Option list B for:

- UESA-H311 MEng Mechanical Engineering
    - Year 4 of H311 Mechanical Engineering
    - Year 4 of H30L Mechanical Engineering with Automotive Engineering
    - Year 4 of H30G Mechanical Engineering with Business Management
    - Year 4 of H30P Mechanical Engineering with Fluid Dynamics
    - Year 4 of H30H Mechanical Engineering with Sustainability
- Year 4 of UESA-H318 MEng Mechanical Engineering with Exchange Year
- Year 5 of UESA-H317 MEng Mechanical Engineering with Intercalated Year

This module is Option list C for:

- UESA-H311 MEng Mechanical Engineering
    - Year 4 of H30J Mechanical Engineering with Appropriate Technology
    - Year 4 of H30M Mechanical Engineering with Robotics

- Year 4 of H30N Mechanical Engineering with Systems Engineering