MODULE SPECIFICATION

Module Title:	Advanced Engine Thermodynamics and Powertrain	**Level**:	7	**Credit Value**:	20

Module code:	ENG756	**Is this a new module?**	Yes	**Code of module being replaced**:	N/A

Cost Centre:	GAPC	JACS3 **code**:	H330

Trimester(s) in which to be offered:		**With effect from:**	September 17

School:	Applied Science, Computing and Engineering	**Module Leader:**	O.Durieux

Scheduled learning and teaching hours	52 hrs
Guided independent study	148 hrs
Placement	0 hrs
Module duration (total hours)	200 hrs

Programme(s) in which to be offered	Core	Option
MSc Automotive Engineering	✓	☐

Pre-requisites
None

Office use only
Initial approval February 17
APSC approval of modification N/A Version 1
Have any derogations received Academic Board approval? Yes ✓ No ☐

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Module Aims
This module aims to provide students with an in-depth understanding of engine thermodynamic of real engines. The module also includes knowledge for the optimisation of modern powertrains so as to prepare students to solve practical problems and to carry out research and development.

Intended Learning Outcomes			
At the end of this module, students will be able to		Key Skills	
1	Develop a full analysis of the real combustion process taking place in ICE. Predict and solve combustion anomalies.	KS1	KS2
		KS3	KS4
		KS6	
2	Demonstrate a comprehensive understanding of fuel cells and alternative energy sources.	KS1	KS2
		KS3	KS4
		KS6	
3	Analyse the operations of vehicle transmission and braking systems from an efficiency point of view. Design and match powertrain systems (and sub-systems).	KS1	KS2
		KS3	KS4
		KS6	
4	Analyse the performances and design an electric/hybrid electric powertrain.	KS1	KS2
		KS3	KS4
		KS6	
Transferable/key skills and other attributes			
Application of science in technology, design for efficiency, environmental issues awareness, mathematical applications.			

Derogations
A derogation from regulations has been approved for this programme: Students are required to achieve a minimum overall module mark of 50%, with each element of assessment (where there is more than one assessment) requiring a minimum mark of 40%.

Assessment:

All intended learning outcomes will be assessed by means of one 3 hour exam.

Analytical and descriptive questions will typically be proposed, the student will not have the choice in the questions to be answered.

Assessment number	Learning Outcomes to be met	Type of assessment	Weighting (%)	Duration (if exam)	Word count (or equivalent if appropriate)
1	1,2 ,3, 4	Examination	100%	3 hrs	

Learning and Teaching Strategies:

The module will be delivered through lectures, tutorials and student-driven investigative work assisted by the use of computer based design and simulation software when available. Relevant video material and practical demonstrations will be used to strengthen topics from within the module.

Syllabus outline:

Otto and Diesel Cycle Engines Analyses:
Efficiencies of real engines,
Ignition, normal and abnormal combustions in SI and CI engines,
Combustion chamber design.
Emissions and emissions control (HC,Nox and particles), engine management systems.
Fuels and additives,
Dynamic behaviour of valve gear including valve operating systems.

Alternative Powertrains:
Electric and hybrid electric powertrain: design, performance and efficiency analysis.
Atkinson cycle for hybrid engines, battery types.
Fuel Cells : Solid polymer fuel cells (SPFC)
Sources of hydrogen for SPFC (Steam reforming, partial oxidation reforming.), storage.

Ancillaries:
Engine lubricants and lub systems.

Transmission and Driveline:
Friction Clutches
Gear theory (helical, hypoid and planetary)
Manual, automatic, continuously variable transmission: Power flow and control
Differentials.

Bibliography:
Essential reading
Pulkrabek (2013); *Engineering Fundamentals of the Internal Combustion Engine*; 2nd Ed, Prentice. Hall Stokes A (1999); *Manual Gearbox Design*; Butterworth Heinemann. Makartchouk A (2002); *Diesel Engine Engineering: Thermodynamics, Dynamics, Design and Control*; Marcel Dekker Ltd.
Indicative reading
Hiereth H. (2007); *Charging the Internal Combustion Engine*; Springer-Verlag.