UNIVERSITY OF WARWICK

Proposal Form for New or Revised Modules (MA1 - version 7 - April 2014)

Approval information	
Approval Type	☐ New module ☒ Revised module ☐ Discontinue module
Date of Introduction/Change	October 2017
If new, does this module replace another? If so, enter module code and title:	
If revised/discontinued, please outline the rationale for the changes:	Revised as part of the curriculum refresh.
Confirmation that affected departments have been consulted:	Changes were made in consultation with the School of Engineering and WMG.

Module Summary	
1. Module Code (if known)	ES4B7
2. Module Title	Vehicle Propulsion
3a. Lead department:	School of Engineering
3b. Teaching Split (if known):	100% WMG
4. Name of module leader	Mr HG Neal
5. Level	UG: ☐ Level 4 (Certificate) ☐ Level 5 (Intermediate) ☐ Level 6 (Honours) PG: ☒ Level 7 (Masters) ☐ Level 8 (Doctoral) See Guidance Notes for relationship to years of study
6. Credit value(s) (CATS)	15
7. Principal Module Aims	To provide the scientific and technological foundations for understanding the operation, performance and design of vehicle propulsion units.
8. Principal Learning Outcomes	By the end of the module the student will be able to

Module Summary	
	• Demonstrate a deep and systematic understanding of how the sciences of thermodynamics and fluid mechanics impact on the operation, performance and design of internal-combustion engines. • Demonstrate a deep and systematic understanding of the design, operating parameters and operating characteristics of the internal combustion engine. • Demonstrate a deep and systematic understanding of past, current and emerging alternative vehicle propulsion technology. • Interpret the requirements for, and operating characteristics of, HEV enabling technology and the complexity of technology integration. • Evaluate the diverse justifications for vehicle hybridisation and electrification. • Flexibly and creatively apply knowledge in unfamiliar contexts, synthesises ideas or information in innovative ways, and generate transformative solutions. • Demonstrate effective presentation and time management skills.
9. Timetabled Teaching Activities (summary)	Lectures 30hr, Examples Classes 2 x 1hr: **Total 32 hr**
10. Departmental Web-link	go.warwick.ac.uk/es4b7
11. Other essential notes	Advice and feedback hours are available for answering questions on the lecture material.
12. Assessment methods (summary)	Written group assignment, including peer assessment (18%), group presentation, including peer assessment (12%), exam (70%).

For use by Strategic Planning and Analytics Office only - Do not fill in this section

Level	JACS3 Code	Teaching Split
		If not provided in 3b above

External Credit Level		Scheme	

Module Context

13. Please list all departments involved in the teaching of this module. If taught by more than one department, please indicate percentage split.

WMG

14. Availability of module

Degree Code	Title	Study Year	C/OC/ A/B/C	Credits
H331	Automotive Engineering (MEng) and variants	**4**	**A**	
H332	Automotive Engineering (MEng) with an Intercalated Year	**5**	**A**	
H333	Automotive Engineering (MEng) with a year in Research	**5**	**A**	
H107	Engineering (MEng) and variants	**4**	**A**	
H109	Engineering (MEng) with an Intercalated Year	**5**	**A**	
H110	Engineering (MEng) with a year in Research	**5**	**A**	
HH37	Manufacturing & Mechanical Engineering (MEng) and variants	**4**	**A**	**15**
HH38	Manufacturing & Mechanical Engineering (MEng) with an Intercalated Year	**5**	**A**	
HH39	Manufacturing & Mechanical Engineering (MEng) with a year in Research	**5**	**A**	
H311	Mechanical Engineering (MEng) and variants	**4**	**B/C**	
H312	Mechanical Engineering (MEng) with an Intercalated Year	**5**	**B**	
H313	Mechanical Engineering (MEng) with a year in Research	**5**	**B**	

15. Minimum number of registered students required for module to run

10

16. Pre- and Post-Requisite Modules

None

Module Content and Teaching

17. Teaching and Learning Activities *(totals for module – please see guidance)*		
Module duration (weeks)	**10**	
Lectures	**30**	
Seminars		
Tutorials		
Project Supervision		
Demonstration		
Practical Class/Workshops	**Examples classes, term 3. 2 x 1hr**	
Supervised time in studio/workshop		
Fieldwork		
External visits		
Work based learning		
Placement		
Year abroad		
Other activity *(please describe): e.g. distance-learning, intensive weekend teaching etc.*	**Guided Independent Learning 118 hours**	
18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations	3 Hours	**70**
Practical Examinations		
Assessed essays/coursework	Group Report, including peer assessment (4000 words) Group Presentation, including peer assessment	**18** **12** **0**
18a. Final chronological assessment *(please see guidance*)	**Exam**	

19. Methods for providing feedback on assessment.
Feedback from group report, feedback from group presentation.
20. Outline Syllabus
IC Engines Types & Applications Ideal Reciprocating Engine Cycles Actual Engine Cycles & their Analysis IC Engine Performance Calculations

IC Engine Maps and Characteristics
Combustion Thermochemistry
Alternative Fuels for SI & CI Engines
Induction & Exhaust Processes
Flow through Inlet & Exhaust Valves
Fuel Metering & Mixture Preparation in SI Engines
In-Cylinder Charge Motion & Turbulence
Combustion in SI Engines
Compression Ignition Engines
Diesel Engine Combustion & Heat Release
Exhaust Emissions & Air Pollution
Emission Control & Catalytic Converters
Exhaust After Treatment Systems
Engine Heat Balance & Thermal Loading
Engine Heat Transfer
Alternative Engines (Gas Turbines, Rotary Engines, Stirling & Steam Engines, Hydrogen Engine, Fuel Cells)
Motivations for HEV technology
Hybrid powertrain architectures and case studies
Energy storage technology
Power electronics and electric machines
Hybrid vehicle integration

21. Illustrative Bibliography

Pulkrabek, W.W., 2013, Engineering fundamentals of the internal combustion engine, 2nd ed., Pearson Prentice Hall
Van Basshuysen and Schäfer, 2016 Internal Combustion Engines Handbook: Basics, Components, Systems, and Perspectives, 1st Edition, SAE
Heywood, J.B., 2010, Internal combustion engine fundamentals, London : McGraw-Hill
Stone, R., 2012, Introduction to internal combustion engines, 3rd. ed., Basingstoke : Macmillan
Stotsky, Alexander A. 2009, Automotive Engines Control, Estimation, Statistical Detection, Springer, 1st Edition
J Miller, 2010, Propulsion Systems for Hybrid Vehicles, Institution of Engineering and Technology.
A Emadi, 2014, Advanced Electric Drive Vehicles, CRC Press.

22. Learning outcomes

Successful completion of the module leads to the learning outcomes. The learning outcomes identify the knowledge, skills and attributes developed by the module.

Learning Outcomes should be presented in the format "By the end of the module students should be able to..." using the table at the end of the module approval form:

Resources
23. List any additional requirements and indicate the outcome of any discussions about these.
N/A

Approval	
24. Module leader's signature	Howard Neal
25. Date of approval	Teaching Policy Committee Chair's Action 4 April 2017
26. Name of Approving Committee (include minute reference if applicable)	School of Engineering and WMG Teaching Policy Committee
27. Chair of Committee's signature	Professor Gill Cooke
28. Head of Department(s) signature	Professor Nigel Stocks

Examination Information		
A1. Name of examiner (if different from module leader)		
A2. Indicate all available methods of assessment in the table below		
% Examined	**% Assessed by other methods**	**Length of examination paper**
70	**30**	**3 hours**
A3. Will this module be examined together with any other module (sectioned paper)? If so, please give details below.		
A4. How many papers will the module be examined by?	☒ 1 paper	☐ 2 papers
A5. When would you wish the exam take place (e.g. Jan, April, Summer)?	**Summer**	
A6. Is reading time required?	☐ Yes	☒ No
A7. Please specify any special exam timetable arrangements.		
A8. Stationery requirements		
No. of Answer books?	**1**	
Graph paper?	**Y**	
Calculator?	**Y**	
Any other special stationery requirements (e.g. Data books, tables etc)?	ES4B7 Equations booklet to be provided.	
A9. Type of examination paper		
Seen?	☐ Yes	☒ No
Open Book?	☐ Yes	☒ No
Restricted?	☐ Yes	☒ No
If restricted, please provide a list of permitted texts:		

LEARNING OUTCOMES		
(By the end of the module the student should be able to....)	**Which teaching and learning methods enable students to achieve this learning outcome? (reference activities in section 15)**	**Which summative assessment method(s) will measure the achievement of this learning outcome? (reference activities in section 16)**
Demonstrate a deep and systematic understanding of how the sciences of thermodynamics and fluid mechanics impact on the operation, performance and design of internal-combustion engines.	Lectures, group presentation, group report	Group presentation, group report, exam
Demonstrate a deep and systematic understanding of the design, operating parameters and operating characteristics of the internal combustion engine.	Lectures, group presentation, group report	Group presentation, group report, exam
Demonstrate a deep and systematic understanding of past, current and emerging alternative vehicle propulsion technology.	Lectures, group presentation, group report	Group presentation, group report, exam
Interpret the requirements for, and operating characteristics of, HEV enabling technology and the complexity of technology integration.	Lectures, group presentation, group report	Group presentation, group report, exam
Evaluate the diverse justifications for vehicle hybridisation and electrification.	Lectures, group presentation, group report	Group presentation, group report, exam
Flexibly and creatively apply knowledge in unfamiliar contexts, synthesises ideas or information in innovative ways, and generate transformative solutions.	Lectures, group presentation, group report	Group presentation, group report, exam
Demonstrate effective presentation and time management skills	Lectures, group presentation, group report	Group presentation, group report, exam