UNIVERSITY OF WARWICK

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

Approval information	
Approval Type	☒ Revised module
Date of Introduction/Change	01/10/2017
If new, does this module replace another? If so, enter module code and title:	
If revised/discontinued, please outline the rationale for the changes:	Revision to capture incremental module developments since last document issue.
Confirmation that affected departments have been consulted:	Changes have been made in consultation between the School of Engineering and WMG.

Module Summary	
1. Module Code (if known)	ES3B5
2. Module Title	Engines and Heat Pumps
3a. Lead department:	School of Engineering
3b. Teaching Split (if known):	100 % School of Engineering
4. Name of module leader	Dr Z. Tamainot-Telto
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 CATS
7. Principal Module Aims	Mechanical Engineers are expected to have a working knowledge of the thermodynamic basis of a number of types of engine and refrigerators / heat pumps, together with the principles (such as the Second Law) that constrain their performance. This module addresses those requirements.

Module Summary	
8. Principal Learning Outcomes	At the end of the module, the student should be able to: • Understand the Second Law of Thermodynamics as applied to the complex processes occurring in internal combustion engines. • Carry out complex thermodynamic analyses of various engine cycles. • Discriminate between different types of engine cycle and their application. • Perform complex thermodynamic analyses of refrigeration and heat pump cycles. • Carry out complex calculations relating to the combustion of fuels. • Demonstrate practical skills in a professional and scientific manner. • Apply numerical and mathematical skills to the solution of mechanical and related engineering problems and communicate solutions • Communicate an appreciation of the place and use of thermodynamic equipment in society.
9. Timetabled Teaching Activities (summary)	• 30 sessions (1 hour each) • 1 session (3 hour) of Lab demonstration components with assessed coursework • 2 sessions (1 hour each) of Revision lectures Total 35 hours
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year3/es3b5
11. Other essential notes	Advice and feedback hours are available for answering questions on the lecture material (theory and examples).
12. Assessment methods (summary)	10% Assessed coursework 90 % written exam

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.

100% Engineering

14. Availability of module

Degree Code	Title	Study Year	C/OC/ A/B/C	Credits
H106	BEng Engineering	3	O	15
H107	MEng Engineering (plus variants)	3	O	
H109	MEng Engineering with intercalated year	3	O	
H110	MEng Engineering with a year in research	3	O	
H310	BEng Mechanical Engineering	3	Core	
H311	MEng Mechanical Engineering (plus variants)	3	Core	
H312	MEng Mechanical Engineering with intercalated year	3	Core	
H313	MEng Mechanical Engineering with a year in research	3	Core	

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

1 (core).

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 weeks
Lectures	30 hours
Seminars	-
Tutorials	2 hours (2 x 1 hr Revision Sessions)
Project Supervision	-
Demonstration	3 hours (1 x 3 hrs / session)
Practical Class/Workshops	-
Supervised time in studio/workshop	-
Fieldwork	-
External visits	-

Module Content and Teaching		
Work based learning	-	
Placement	-	
Year abroad	-	
Other activity *(please describe): e.g. distance-learning, intensive weekend teaching etc.*	Guided independent learning (115 h).	
18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations	3 Hours	90%
Practical / Oral Examinations	-	**-**
Assessed essays/coursework	Laboratory-type assignment of around 8 pages	10%
18a. Final chronological assessment *(please see guidance*)	Written examination (90%)	

19. Methods for providing feedback on assessment.

- Coursework will be returned with marks and detailed feedback.
- Model solutions to examination type questions.
- Support through advice and feedback hours.
- Cohort level feedback on examinations

20. Outline Syllabus

1. Second Law of Thermodynamics
2. Properties of working fluids
3. Entropy of perfect gases
4. Otto cycle engines
5. Diesel cycle engines
6. Rankine cycle engines
7. Fuels and combustion
8. Air Conditioning, Refrigeration and Heat pump cycles

21. Illustrative Bibliography

Required Textbook:

Efstathios, M., Nanofluidics : thermodynamic and transport properties. E-book. Springer, 2014.

Miloslav, P., The Thermodynamics of linear fluids and fluid mixtures. E-book, Springer, 2014

G.F.C. Rogers and Y.R. Mayhew, Thermodynamic and transport properties of fluids, 5th ed., Oxford Blackwell, 1995.

Recommended Textbook:

Y.A. Çengel & M.A. Boles, Thermodynamics: an engineering approach, 7th ed., London: McGraw Hill, 2011.

Kenneth A. Kroos & Merle C. Potter, Thermodynamics for Engineers, SI Edition, Cengage Learning, 2015

Jonh R.Reisel, Principles of Engineering Thermodynamics, SI Edition, Cengage Learning, 2016

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.

Approval

24. Module leader's signature	Dr Z. Tamainot-Telto
25. Date of approval	Teaching Policy Committee Chair's Action 6 september 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 Gillian Cooke
28. Head of Department(s) signature	Professor David Towers

Examination Information		
A1. Name of examiner (if different from module leader)	N/A	
A2. Indicate all available methods of assessment in the table below		
% Examined	**% Assessed by other methods**	**Length of examination paper**
90	10	3 hours
A3. Will this module be examined together with any other module (sectioned paper)? If so, please give details below.		
N/A		
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.		
Any special exam timetable arrangements will be done by the Centre in conjunction with the ESO.		
A8. Stationery requirements		
No. of Answer books?	**2 each**	
Graph paper?	**Yes**	
Calculator?	**Yes**	
Any other special stationery requirements (e.g. Data books, tables etc)?	**Engineering Data Book** **Thermodynamics Tables** (G.F.C. Rogers and Y.R. Mayhew, Thermodynamic and transport properties of fluids : SI units (5th ed.), Oxford : Blackwell, 1995)	
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)**
Understand the Second Law of Thermodynamics as applied to the complex processes occurring in internal combustion engines	Lectures, private study, example classes.	Unseen examination.
Carry out complex thermodynamic analyses of various engine cycles.	Lectures, private study, example classes.	Unseen examination.
Discriminate between different types of engine cycle and their application.	Lectures, laboratory session	Unseen examination.
Perform complex thermodynamic analyses of refrigeration and heat pump cycles.	Lectures, private study, example classes.	Unseen examination.
Carry out complex calculations relating to the combustion of fuels.	Lectures, private study, example classes.	Unseen examination.
Demonstrate practical skills in a professional and scientific manner.	Laboratory sessions with a Water Chiller or Air Conditioning unit.	Unseen examination.
Apply numerical and mathematical skills to the solution of mechanical and related engineering problems and communicate solutions.	Lectures, private study, example classes	Self-marking against published answers Unseen examination
Communicate an appreciation of the need for and use of thermodynamic equipment in society.	Lectures, private study, example classes.	Unseen examination.