UNIVERSITY OF WARWICK

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

Approval information	
Approval Type	☒ Revised
Date of Introduction/Change	October 2018
If new, does this module replace another? If so, enter module code and title:	
If revised/discontinued, please outline the rationale for the changes:	Minor revisions to reflect module development. Modify contact hours to reduce lectures and add a laboratory. Maximum number reduced to 25. Availability updated.
Confirmation that affected departments have been consulted:	Changes were made in consultations between the School of Engineering and WMG.

Module Summary	
1. Module Code (if known)	ES4F5
2. Module Title	Gas Turbine Equipment
3a. Lead department:	School of Engineering
3b. Teaching Split (if known):	100 % School of Engineering
4. Name of module leader	Dr Richard Lillington
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 a rigorous understanding of the design, construction, and use of gas turbine equipment (aka jet engines) and a sound understanding of the requirements of associated ancillary equipment required and how these are met on the wing.

Module Summary	
	To provide insights into applications of under-pinning engineering science learnt throughout their degree in a high-technology, highly-efficient, safety critical application.
8. Principal Learning Outcomes	On completion of this module a student will be able to : 1. Demonstrate how to employ Engineering Science in complex applications at the forefront of current technical possibilities. 2. Show a substantial understanding of the gas turbine technology: from a comprehensive understanding of the need for the innovation; by considering the original features of early designs; by evaluation of developing engines families across multiple generations of the technology; by critiquing these differing engine technologies; by understanding comprehensively the current capability; and by hypothesising future trends. 3. Interpret specifications related to high-technology applications. 4. Evaluate of compressor technologies; fuel system and combustion technologies; and turbine technologies. 5. Interpret engine operating regimes, physical engine controls, and engine control strategies. 6. Demonstrate informed opinions on the latest methods applied to engine control and maintenance (data-analytics, on-the-wing data), and to evaluate and hypothesise on future engine trends.
9. Timetabled Teaching Activities (summary)	• 20 x 1 hr lectures • 6 x 1 hr seminars (including guest speakers if available on topical subjects; discussing case studies). • 1 x 2hr Engine Familiarity lab • Museum visit(s) if available. • 3 x 1 hr revision workshops. Total 31 hours
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year4
11. Other essential notes	Advice and feedback hours are available for answering questions on the lecture material (theory and examples).
12. Assessment methods (summary)	2 hour examination 50% Coursework 50% (Engine development poster 10%; assignment 6000 words 40%) Students must achieve a pass mark both in the cumulative coursework and in the examination.

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 % School of Engineering

14. Availability of module

Degree Code	Title	Study Year	C/OC/ A/B/C	Credits
H107	MEng Engineering (and variants)	4	A	15
H109	MEng Engineering with Intercalated Year	5	A	
H110	MEng Engineering with a Year in Research	5	A	
H311	MEng Mechanical Engineering	4	B	
H312	MEng Mechanical Engineering with Intercalated Year	5	B	
H313	MEng Mechanical Engineering with a Year in Research	5	B	
NEW	MEng Engineering with Exchange Year	4	A	
H320	MEng Mechanical Engineering with Exchange Year	4	B	

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

Minimum 10 students Maximum 25 students**.**

16. Pre- and Post-Requisite Modules

- ES3B5 - Engines and Heat Pumps

Module Content and Teaching

17. Teaching and Learning Activities *(totals for module – please see guidance)*

Module duration (weeks)	**Two terms (nominally 20 weeks)**
Lectures	20 x 1 hr
Seminars	6 x 1 hr
Tutorials	-
Project Supervision	-
Demonstration	-
Practical Class/Workshops	1 x 2 hr (Engine Familiarity Laboratory)
Supervised time in studio/workshop	-
Fieldwork	-
External visits	If available, a visit to a suitable museum (*e.g.,* Midland Air Museum; or RAF Cosford).

Module Content and Teaching	
Work based learning	-
Placement	-
Year abroad	-
Other activity *(please describe): e.g. distance-learning, intensive weekend teaching etc.*	3 x 1 hr revision workshops Guided Independent Learning 119 hrs

18. Assessment Method (Standard)

Type of assessment	Length	% weighting
Written Examinations	2 Hours	**50 %**
Practical Examinations	n/a	**-**
Assessed essays/coursework	1. Engine Development Poster. 2. Assignment – 6000 words / 30 page (or equivalent as includes tabulated data and plots).	10% 40%
18a. Final chronological assessment *(please see guidance*)	Written examination.	

19. Methods for providing feedback on assessment.

- Class summary of typical strengths/weaknesses;
- Discussion in seminar sessions;
- Feedback report including detailed annotations on submitted coursework script;
- Nominal mark *via* Tabula and feedback (or link to feedback on returned script);
- Student support through advertised Advice and Feedback Hours
- Cohort level feedback on examinations.

20. Outline Syllabus

The course will include the following:

- Origins – early jet engine concepts, designs, and limitations.
  - Whittle's vision / early engines / operation / limitations
- Timeline of engine developments across the last 80 years, showing significant advances in the context of the technology limitations of the time.
  - Gas turbine specification and selection / Engine architectures / thrust
- Gas turbine engine function and use.
  - Engine overview / PVT diagrams / control / material constraints
- Gas turbine technology
  - Compressors / Combustion and fuelling / Turbines
- Future trends
  - Current state-of-the-art / future options

21. Illustrative Bibliography

1. The Jet Engine, 5th Ed. RR / Wiley Publishing, 2015. ISBN: 978-1-119-06599-9.
2. Pegasus, the heart of the Harrier. Andrew Dow. E-book. 2009. 9781783837823 (e-book).
3. Innovation in Aeronautics / edited by Trevor M. Young and Mike Hirst. E-Book. Woodhead Publishing. 2012. ISBN: 978-1-84569-550-7.
4. Jet Propulsion, Cumpsty, A. 3rd Ed. Cambridge Publishing, 2005. ISBN: 1107511224.
5. The Simple Science of Flight, Tennekes, H. The MIT Press, 2009. ISBN : 978-0-262-51313-5

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	Dr Richard Lillington
25. Date of approval	25 April 2018
26. Name of Approving Committee (include minute reference if applicable)	School of Engineering and WMG Course and Module Approval Committee (CMAC), Minute 259-17/18
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)		
A2. Indicate all available methods of assessment in the table below		
% Examined	**% Assessed by other methods**	**Length of examination paper**
50 %	10 % Engine Development Poster 40 % Assignment 6000 words	2 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.		
None.		
A8. Stationery requirements		
No. of Answer books?	1	
Graph paper?	No	
Calculator?	Y	
Any other special stationery requirements (e.g. Data books, tables etc)?	School of Engineering Data book.	
A9. Type of examination paper		
Seen?	☐ Yes	☒ No
Open Book?	☐ Yes	☒ No
Restricted?	☐ Yes	☒ No
If restricted, please provide a list of permitted texts:	N/a	

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 17)**	**Which summative assessment method(s) will measure the achievement of this learning outcome? (reference activities in section 18)**
Demonstrate how to employ Engineering Science in complex applications at the forefront of current technical possibilities.	• Lectures	Assignment
Show a substantial understanding of the gas turbine technology: from a comprehensive understanding of the need for the innovation; by considering the original features of early designs; by evaluation of developing engines families across multiple generations of the technology; by critiquing these differing engine technologies; by understanding comprehensively the current capability; and by hypothesising future trends.	• Lectures • Seminar sessions.	Examination and Assignment (Supported by formative laboratory exercise).
Interpret specifications related to high-technology applications.	• Lectures	Examination and Assignment
Evaluate compressor technologies; fuel system and combustion technologies; and turbine technologies.	• Lectures	Examination
Interpret engine operating regimes, physical engine controls, and engine control strategies.	• Lectures	Examination and Poster
Demonstrate informed opinions on the latest methods applied to engine control and maintenance (data-analytics, on-the-wing data), and to evaluate and hypothesise on future engine trends.	• Lectures	Examination and Poster