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	1/10/2018
If new, does this module replace another? If so, enter module code and title:	
If revised/discontinued, please outline the rationale for the changes:	Added laboratory session to provide practical experience with vibrations. Updated Reading List.
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)	ES386
2. Module Title	Dynamics of Vibrating Systems
3a. Lead department:	School of Engineering
3b. Teaching Split (if known):	School of Engineering 100%
4. Name of module leader	Dr P Brommer
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	Vibrations exert a significant influence on the performance of the majority of engineering systems. All engineers should understand the basic concepts and all mechanical engineers should be familiar with the analytical techniques for the modelling and quantitative prediction of behaviour. Thus, this module provides students with fundamental skills necessary for the analysis of the dynamics of

Module Summary	
	mechanical systems, as well as providing opportunities to apply these skills to the modelling and analysis of vibration. This third-year module is mandatory for students pursuing a degree in Mechanical Engineering, building upon competences acquired earlier in the course. This module introduces students to the use of Lagrange's equations (applied to 1D and 2D systems only for this module) and to techniques for modelling both lumped and continuous vibrating systems. It includes some coverage of approximate methods both as an aid to physical understanding of the principles and because of their continuing usefulness. The module assumes basic understanding of mechanics and linear algebra consistent with the level of Year 2 modules. At the end of the module students should have a sound understanding of the wide application of vibration theory and of the underlying physical principles. In particular, they should be able to use either Newtonian or Lagrangian mechanics to analyse 2D systems, and to determine the response of simple damped and undamped multi-degrees of freedom (DOF) systems to both periodic and aperiodic excitation. They should also be familiar with engineering solutions for measuring and influencing vibrational behaviour.
8. Principal Learning Outcomes	By the end of the module the student should be able to: 1. Model planar mechanical systems using Newton's or Lagrange's equations: Determine appropriate co-ordinate systems, analyse vibrations. 2. Abstract more complex engineering mechanisms: analyse using lumped system models or simple distributed mass and stiffness models. 3. Evaluate the natural frequencies and modes of vibration of a multi-degree of freedom damped or undamped linear system. 4. Use initiative to apply sensible approximations to develop practical models of complex vibrating systems, to find key parameters such as the natural frequency. 5. Evaluate complex (single- and multi-degree of freedom) systems and via a systematic approach show an understanding of the response of the system to periodic excitations. 6. Demonstrate a sound understanding of the application of vibration analysis to key engineering systems.
9. Timetabled Teaching Activities (summary)	30 1-hour lectures spread evenly over 1 term. 2-hour laboratory session (including preparation/evaluation). 2 x 1 hr revision classes.

Module Summary	
	Total 34 hours
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year3/
11. Other essential notes	Advice and feedback hours are available for answering questions on the lecture material (theory and examples).
12. Assessment methods (summary)	20% via a computational and lab exercise (Annotated figures plus computer code solution) 80% via 3-hour written 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 Pre17-18 entry	Title	Study Year	C/OC/ A/B/C	Credits
H106	BEng Engineering	3	O	
New	BEng Engineering with Intercalated Year	4	O	
H107	MEng Engineering (plus variants)	3	O	
H109	MEng Engineering with Intercalated Year	3 or 4	O	
H110	MEng Engineering with a Year in Research	3 or 4	O	
H310	BEng Mechanical Engineering	3	Core	
H319	BEng Mechanical Engineering with Intercalated Year	4	Core	
H311	MEng Mechanical Engineering (plus variants)	3	Core	
H312	MEng Mechanical Engineering with Intercalated Year	3 or 4	Core	15
H313	MEng Mechanical Engineering with a Year in Research	3 or 4	Core	
HH36	BEng Systems Engineering	3	Core	
New	BEng Systems Engineering with Intercalated Year	4	Core	
HH63	MEng Systems Engineering and variants	3	Core	
HH64	MEng Systems Engineering with Intercalated Year	3 or 4	Core	
HH65	MEng Systems Engineering with a Year in Research	3 or 4	Core	

Degree Code 17-18 entry on	Title	Study Year	C/OC/ A/B/C	Credits
H113	BEng Engineering	3	A	15
H111	BEng Engineering with Intercalated Year	4	A	15
H114	MEng Engineering	3	A	15
H115	MEng Engineering with Intercalated Year	3 or 4	A	15
H161	BEng Biomedical Systems Engineering	3	Core	15
H163	BEng Biomedical Systems Engineering with Intercalated Year	4	Core	15
H163	MEng Biomedical Systems Engineering	3	Core	15
H164	MEng Biomedical Systems Engineering with Intercalated Year	3 or 4	Core	15
H315	BEng Mechanical Engineering	3	Core	15
H314	BEng Mechanical Engineering with Intercalated Year	4	Core	15
H316	MEng Mechanical Engineering	3	Core	15

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H317	MEng Mechanical Engineering with Intercalated Year	3 or 4	Core	15
HH35	BEng Systems Engineering	3	Core	15
HH34	BEng Systems Engineering with Intercalated Year	4	Core	15
HH31	MEng Systems Engineering	3	Core	15
HH33	MEng Systems Engineering with Intercalated Year	3 or 4	Core	15

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

1 - Core module

16. Pre- and Post-Requisite Modules

Pre-
ES2B0 Mechanics and Thermofluids (or equivalent)
ES2A9 Engineering Mathematics and Technical Computing (or equivalent)

Module Content and Teaching

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

Module duration (weeks)	10
Lectures	30 hours
Seminars	2 hours (2x1 hr revision classes)
Tutorials	-
Project Supervision	-
Demonstration	-
Practical Class/Workshops	2-hour lab session on Free and Forced Vibrations
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 116 hours.

18. Assessment Method (Standard)

Type of assessment	**Length**	**% weighting**
Written Examinations	3 hours	80 %

Module Content and Teaching		
Practical Examinations	--	--
Assessed essays/coursework	Computational and Lab exercise (Annotated figures plus computer code solution)	20 %
18a. Final chronological assessment *(please see guidance)*	Written Examination (80 %)	

19. Methods for providing feedback on assessment.

- Feedback on assignment.
- Model solutions to exam type questions.
- Support through advice and feedback hours.
- Cohort level feedback on examinations

20. Outline Syllabus

- Generalised co-ordinates, Lagrange's equation (including preliminary study of other classical methods)
- General application of the Lagrange equation to vibrating systems
- Multi-degree of freedom systems: lumped system models, continuous system models; geared and branched systems; reduction of an n-DOF system to a set of n single-DOF systems; principal co-ordinates
- Matrix methods of analysis: conservative and non-conservative (damped) systems; determination of principal co-ordinates
- Modelling of damping: hysteretic, Coulomb, viscous; measurement of damping factor
- Forced vibration: harmonic excitation of multi-DOF systems; shaft whirling; transmissibility; vibration isolation; non-harmonic and arbitrary excitation (convolution integral)
- Approximate methods e.g. Rayleigh's method, Dunkerley's method

21. Illustrative Bibliography

1. Theory of Vibration with Applications, by W. T. Thomson and M. D. Dahleh. Publisher: Pearson. Fifth edition, 1998. ISBN-10: 013651068X, ISBN-13: 9780136510680.
2. Principles of Vibration, by B. H. Tongue. Publisher: Oxford University Press. Second edition, 2002. ISBN-10: 0195142462.
3. Engineering Vibrations, by D. J. Inman. Publisher: Pearson. Fourth international edition, 2013. ISBN-10: 0273768441, ISBN-13: 9780273768449.
4. Mechanical vibrations, by S. S. Rao, Fook Fah Yap. Publisher: Prentice Hall. Fifth edition in SI units, 2011. ISBN-10: 9810687125, ISBN-13: 9789810687120
5. Vibrations, by B. Balachandran, E. B. Magrab. Publisher: Cengage. Second international SI edition, 2009. ISBN10: 0495411256, ISBN-13: 9780495411253.

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:

Module Content and Teaching

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

Approval	
24. Module leader's signature	Dr Peter Brommer
25. Date of approval	14 March 2018
26. Name of Approving Committee (include minute reference if applicable)	School of Engineering and WMG Course and Module Approval Committee Minute 132-17/18
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**
80	20 computational and lab exercise	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?	**N**	
Calculator?	**Y**	
Any other special stationery requirements (e.g. Data books, tables etc)?	**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:		

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)**
1. Model planar mechanical systems using Newton's or Lagrange's equations: Determine appropriate co-ordinate systems, analyse vibrations.	Lectures, directed reading, private study	Computational and lab exercise Unseen examination
2. Abstract more complex engineering mechanisms: analyse using lumped system models or simple distributed mass and stiffness models.	Lectures, directed reading, private study	Computational and lab exercise Unseen examination
3. Evaluate the natural frequencies and modes of vibration of a multi-degree of freedom damped or undamped linear system.	Lectures, directed reading, private study	Computational and lab exercise Unseen examination
4. Use initiative to apply sensible approximations to develop practical models of complex vibrating systems, to find key parameters such as the natural frequency..	Lectures, directed reading, private study	Computational and lab exercise Unseen examination
5. Evaluate complex (single- and multi-degree of freedom) systems and via a systematic approach	Lectures, directed reading, private study	Computational and lab exercise Unseen examination

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)**
show an understanding of the response of the system to periodic excitations.		
6. Demonstrate a sound understanding of the application of vibration analysis to key engineering systems.	Lectures, directed reading, private study	Computational and lab exercise Unseen examination