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	01/10/16
If new, does this module replace another? If so, enter module code and title:	
If revised/discontinued, please outline the rationale for the changes:	MSc Biomedical Engineering students have a range of backgrounds. This module will be recommended as 'core' for students with a biological or other life sciences background but optional for other students. The MA1 form has also been updated slightly to reflect current content and related degrees.
Confirmation that affected departments have been consulted:	Only taken by Engineering

Module Summary	
1. Module Code (if known)	ES93Q
2. Module Title	Systems Modelling and Simulation
3a. Lead department:	School of Engineering
3b. Teaching Split (if known):	100% School of Engineering
4. Name of module leader	Dr Natasha Khovanova
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	This module aims to provide students with an introduction to techniques in systems analysis and mathematical modelling for application to physical processes across a range of engineering disciplines. It will be illustrated how the techniques for the analysis

Module Summary	
	of systems, and the general systems approach, are highly relevant to processes of a multi-disciplinary engineering nature. The module will focus on a broad and generic systems approach to understanding physical systems. Techniques for systems analysis, approaches to systems modelling and the techniques for the simulation of systems models will be considered. In particular, a rigorous approach to the application of physical laws to formulate appropriate dynamical systems representations, and their subsequent analysis using linear and nonlinear methods, will be taught. The application of appropriate computational tools for systems analysis and simulation will naturally be included. The development of data-driven models and system identification approaches will also be considered with importance placed on the role of model validation. The examples presented will be drawn from a range of different engineering disciplines to illustrate the advantages of a systems approach. This module aims to: • focus on the application of a systems and modelling approach to the analysis of physical processes across a range of engineering disciplines. • introduce the engineering techniques and foundation material needed to perform such analysis • illustrate how these approaches can be used for analysing problems and processes of a multi-disciplinary nature.
8. Principal Learning Outcomes	At completion, students will be able to: • formulate mathematical models of physical processes using appropriate physical laws • understand, and be able to apply, techniques for analysing both linear and nonlinear systems • apply appropriate computational tools, in an appropriate way, for systems analysis and simulation • understand the techniques available for the development of data-driven models and performing system identification/parameter estimation • understand the importance of model validation
9. Timetabled Teaching Activities (summary)	Eight x two hour lectures Eight x two hour seminars Two x three hour laboratory sessions 2 hour test

Module Summary	
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year4/es93q/
11. Other essential notes	This module will be strongly recommended to students without an appropriate mathematical background in order to provide a foundation for the rest of the MSc. Both elements must be passed >40% overall module mark >50
12. Assessment methods (summary)	50% Written Test (organised by department) 50% Coursework

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.

School of Engineering

14. Availability of module

Degree Code	Title	Study Year	C/OC/ A/B/C	Credits
H800	**MSc Biomedical Engineering**	**1**	**O**	**15**
H341	**MSc Advanced Mechanical Engineering**	**1**	**C**	**15**
H642	**MSc Energy and Power Engineering**	**1**	**O**	**15**

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

1

16. Pre- and Post-Requisite Modules

The module is core for students with certain degrees which do not contain equivalent mathematical content. Students will be advised by the Course Director if they must take the module.

Module Content and Teaching

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

Module duration (weeks)	**10 weeks**
Lectures	**8 x 2 Hours**
Seminars	**8 x 2 Hours**
Tutorials	**None**
Project Supervision	**None**
Demonstration	None
Practical Class/Workshops	2 x 3 Hours
Supervised time in studio/workshop	None
Fieldwork	None
External visits	None
Work based learning	None
Placement	**None**
Year abroad	**None**
Other activity *(please describe): e.g.*	**2 hour test** **110 hours of independent study.**

Module Content and Teaching		
distance-learning, intensive weekend teaching etc.		
18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations		
Practical Examinations		
Assessed essays/coursework	Assignment Written test	**50%** **50%**
18a. Final chronological assessment *(please see guidance*)	**Written test**	

19. Methods for providing feedback on assessment.
Generic feedback uploaded to module page and via tabula
20. Outline Syllabus
The module will focus on a broad and generic systems approach to understanding physical systems. Techniques for systems analysis, approaches to systems modelling and the techniques for the simulation of systems models will be considered. In particular, a rigorous approach to the application of physical laws to formulate appropriate dynamical systems representations, and their subsequent analysis using linear and nonlinear methods, will be taught. The application of appropriate computational tools for systems analysis and simulation will naturally be included. The development of data-driven models and system identification approaches will also be considered with importance placed on the role of model validation. The examples presented will be drawn from a range of different engineering disciplines to illustrate the advantages of a systems approach.
21. Illustrative Bibliography
Matlab for control engineers Ogata, K. Prentice Hall (2007) ISBN 9780136150770 Advanced engineering mathematics Kreyszig, E. Wiley (2006) ISBN 9780471728979 Modelling and Analysis of Dynamic Systems Close, Charles M John Wiley and Sons Ltd (1995) ISBN 9780395661581 Applied non linear dynamics a primer on stability chaos & friends Kaplan, Daniel Springer-Vlg. (1997) ISBN 9780387944401
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:*

At completion, students will be able to:

- formulate mathematical models of physical processes using appropriate physical laws
- understand, and be able to apply, techniques for analysing both linear and nonlinear systems
- apply appropriate computational tools, in an appropriate way, for systems analysis and simulation
- understand the techniques available for the development of data-driven models and performing system identification/parameter estimation
- understand the importance of model validation

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

Approval	
24. Module leader's signature	Dr Natasha Khovanova
25. Date of approval	14 April 2016
26. Name of Approving Committee (include minute reference if applicable)	School of Engineering Teaching Policy Committee Meeting of 14 April 2016
27. Chair of Committee's signature	Dr David Dyer
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**
	50% Assignment **50% Written Test**	**2 hours**
A3. Will this module be examined together with any other module (sectioned paper)? If so, please give details below.		
No		
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)?		
A6. Is reading time required?	☐ Yes	☐ No
A7. Please specify any special exam timetable arrangements.		
Organised by department, no requirement for examination office		
A8. Stationery requirements		
No. of Answer books?		
Graph paper?		
Calculator?		
Any other special stationery requirements (e.g. Data books, tables etc)?		
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)**
Formulate mathematical models of physical processes using appropriate physical laws	Lectures and seminars, use of appropriate computational tools, self-study.	Exercises, written test, modelling and simulation assignment
Understand, and be able to apply, techniques for analysing both linear and nonlinear systems	Lectures and seminars, use of appropriate computational tools, self-study.	Exercises, written test, modelling and simulation assignment
Apply appropriate computational tools, in an appropriate way, for systems analysis and simulation	Lectures and seminars, hands-on use of computational tools in computer laboratory, self-study.	Computer-based laboratory, computational exercises, written test, modelling and simulation assignment
Understand the techniques available for the development of data-driven models and performing system identification/parameter estimation	Lectures and seminars, use of appropriate computational tools, self-study.	Computational exercises, written test, modelling and simulation assignment
Understand the importance of model validation.	Lectures and seminars, use of appropriate computational tools, self-study.	Computational exercises, written test, modelling and simulation assignment