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	02/10/2018
If new, does this module replace another? If so, enter module code and title:	
If revised/discontinued, please outline the rationale for the changes:	Revisions after the first run through. Increased lectures, remove tutorials, add in split class examples classes, independent working associated with the project.
Confirmation that affected departments have been consulted:	Changes were made in consultations between the School of Engineering and WMG. Computer Science have been consulted via the CSE Steering Group.

Module Summary	
1. Module Code (if known)	ES197
2. Module Title	Systems Modelling, Simulation and Computation
3a. Lead department:	School of Engineering
3b. Teaching Split (if known):	100% Engineering
4. Name of module leader	Dr Thomas Popham
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

Module Summary	
7. Principal Module Aims	Systems modelling is an essential skill which underpins all Engineering disciplines allowing the Engineer to model a variety of problems. The use of models aims to provide information necessary to make decisions in the design and development of Engineering solutions or to investigate systems which are too costly, difficult or unethical to investigate physically. Vast numbers of bespoke software solutions are available to Engineers working in industry but this module will focus on designing and programming models from first principles showing the application of mathematical techniques and avoidance of modelling errors. There are design principles associated with models which ensure robust development and these will also be covered along with verification and validation techniques and applications to data modelling. These methods are inherited from software design processes and the synthesis will be exploited.
8. Principal Learning Outcomes	By the end of the module students should be able to: • Simplify real engineering problems and approximate via a mathematical model. • Represent multi-domain systems in a graphical programming environment. • Derive simple models and relationships from data. • Construct a model to predict system response to inputs using simulation methods. • Demonstrate understanding that models are a tool developed with a user and purpose in mind. • Describe the role of modelling and simulation in Engineering design and development. • Apply computational thinking to create software for solving modelling and simulation problems.
9. Timetabled Teaching Activities (summary)	18 x 1 hr Lectures 2 x 1 hr revision lectures 3 x 1 hr examples classes (split class) 5 Computer based exercises (2 hours) 6 Laboratory exercises (2 hours) 1 Group project (18 hours lab time) **Total of 63 hours**
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year1
11. Other essential notes	Advice and feedback hours are available for answering questions on the module.
12. Assessment methods (summary)	40% written examination (1 hr); 30% continuous assessment of laboratory exercises; 30% group project, including peer assessment.

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
H113	BEng Engineering	1	C	15
H114	MEng Engineering	1	C	15
H161	BEng Biomedical Systems Engineering	1	C	15
H163	MEng Biomedical Systems Engineering	1	C	15
H216	BEng Civil Engineering	1	C	15
H217	MEng Civil Engineering	1	C	15
H315	BEng Mechanical Engineering	1	C	15
H316	MEng Mechanical Engineering	1	C	15
H335	BEng Automotive Engineering	1	C	15
H336	MEng Automotive Engineering	1	C	15
H605	BEng Electrical and Electronic Engineering	1	C	15
H606	MEng Electrical and Electronic Engineering	1	C	15
H63W	BEng Electronic Engineering	1	C	15
H63X	MEng Electronic Engineering	1	C	15
HH35	BEng Systems Engineering	1	C	15
HH31	MEng Systems Engineering	1	C	15
HH75	BEng Manufacturing and Mechanical Engineering	1	C	15
HH76	MEng Manufacturing and Mechanical Engineering	1	C	15
HN11	BSc Engineering and Business Studies	1	C	15
HN15	BEng Engineering Business Management	1	C	15
G406	BSc/BEng Computer Systems Engineering	1	C	15
G408	MEng Computer Systems Engineering	1	C	15

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

1 (core module)

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)	18
Lectures	18 x 1 hrs
Seminars	3 x 1 hr examples classes (split class)
Tutorials	None
Project Supervision	18 hrs
Demonstration	None
Practical Class/Workshops	5 x 2 hrs computer exercises, 6 x 2 hrs laboratories
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. distance-learning, intensive weekend teaching etc.*	2 x 1 hr revision lectures 27 hours independent working on projects (27+18=45) 60 hours of guided independent learning

18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations	1 Hour	**40%**
Practical Examinations	None	
Assessed essays/coursework	Continuous assessment of Laboratory Exercises Group Project, including peer assessment	**30%** **30%**
18a. Final chronological assessment *(please see guidance*)	Examination **or Group project (depending on timetable constraints)**	

19. Methods for providing feedback on assessment.
• Cohort level written feedback on group project • Cohort-level written feedback on laboratory exercises

- Support through advice and feedback hours
- Cohort-level feedback on final exams

20. Outline Syllabus

Lecture Topics

Context: What is modelling and how is it used?

- Model types, models as a tool, model design process akin to physical design process

Systems Modelling: how are mathematical models developed, simulated and validated? Model in the loop

- First/second order, block diagrams, Simulink, boundary conditions
- Modelling of mechanical translational, Rotational, mechanical, electrical, thermal systems
- First order systems, input-output and transfer function representation, step and frequency response
- Second order systems, input-output and transfer function representation, step and frequency response
- Deriving relationships from data: linear, quadratic, polynomial, exponential, logical, logarithmic, logistic

Programming and implementation of models, verification of code representation and testing, software in the loop

- Data representation
- Computational thinking
- Arduino programming
- Code architecture, verification, testing and implementation

21. Illustrative Bibliography

Close, C.M., Newell, J.C. and Frederick, D.K., 2002. *Modeling and analysis of dynamic systems*. Wiley.

Ceder, V., 2010. *The quick python book*. Manning Publications Co.

Karris, Steven T. *Introduction to Simulink with engineering applications*. Orchard Publications, 2006.

Margolis, Michael. *Arduino cookbook*. " O'Reilly Media, Inc.", 2011.

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 Thomas Popham	
25. Date of approval	20 March 2018	
26. Name of Approving Committee (include minute reference if applicable)	School of Engineering and WMG Course and Module Approval Committee Minute 153-17/18	
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**
40	30% Group Project, including peer assessment 30% Continuous assessment of Laboratory Exercises	1 hour
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.		
15 minutes reading time		
A8. Stationery requirements		
No. of Answer books?	1	
Graph paper?	**Yes**	
Calculator?	Yes	
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

Examination Information		
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 17)**	**Which summative assessment method(s) will measure the achievement of this learning outcome? (reference activities in section 18)**
Simplify real engineering problems and approximate via a mathematical model.	Lectures, laboratories, example sheets	Written Examination
Represent multi-domain systems in graphical programming environment.	Lectures, laboratories	Laboratories
Derive simple models and relationships from data.	Lectures, laboratories	Written Examination, Laboratories
Construct a model to predict system response to inputs using simulation methods.	Lectures, laboratories	Written Examination, Laboratories
Demonstrate understanding that models are a tool developed with a user and purpose in mind.	Lectures, laboratories	Group project
Describe the role of modelling and simulation in Engineering design and development.	Lectures	Written Examination, Group project
Apply computational thinking to create software for solving modelling and simulation problems.	Lectures, laboratories	Laboratories