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	October 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:	Reviewed as part of the curriculum refresh.
Confirmation that affected departments have been consulted:	Changes were made in consultation with the School of Engineering and WMG.

Module Summary	
1. Module Code (if known)	ES439
2. Module Title	Simulation of Operations
3a. Lead department:	WMG
3b. Teaching Split (if known):	100% WMG
4. Name of module leader	Dr Neil Davis
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	To introduce Discrete Event simulation in the context of business operations and planning in areas such as manufacturing plant, healthcare and large-scale construction activities. To develop understanding of how to apply the technique to help solve complex engineering systems design problems and basic skills in using commercial software used by major firms. To prepare the student so that they can engage with this in a meaningful way after they graduate, in identifying suitable problems, supporting the execution of simulation projects and managing them effectively.
8. Principal Learning Outcomes	By the end of the module the student should be able to... • Demonstrate in depth knowledge and skills to allow a new or existing facility and its operation to be simulated using discrete event simulation. • Demonstrate an in-depth understanding of DES theory and make suitable simplifications of a problem to suit DES technologies. • Make appropriate modelling simplifications (choice of variable, level of detail, degree of abstraction) • Design and execute an appropriate set of experiments using a simulation model. • Analyse experimental results using appropriate structured and statistical methods to critically evaluate engineering proposals. • Demonstrate an advanced ability to present the results of a simulation study in written form, and make evidence-based recommendations based on this. • Develop and apply a simulation model using a commercial simulation software tool • Interpret the meaning of simulation results, and make evidence-based recommendations for the design and operation of a system of interest.
9. Timetabled Teaching Activities (summary)	Lectures : 30 hours Surgery sessions in PC lab: 2x 1 hours Revision examples: 2x 1 hours Total 34 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 lab exercises.
12. Assessment methods (summary)	Individual assignment based on a modelling problem 2,000 words: 30% Written examination: 70% Students must pass the examination and pass the 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.

100% WMG.

14. Availability of module

Degree Code	Title	Study Year	C/OC/ A/B/C	Credits
H107	MEng Engineering and variants	4	A/B	15 CATS
H109	MEng Engineering with Intercalated Year	5	A	15 CATS
H110	MEng Engineering with a Year in Research	5	A	15 CATS
H211	MEng Civil Engineering and variants	4	B/Core	15 CATS
H212	MEng Civil Engineering with Intercalated Year	5	B	15 CATS
H213	MEng Civil Engineering with a Year in Research	5	B	15 CATS
H311	MEng Mechanical Engineering and variants	4	B/Core	15 CATS
H312	MEng Mechanical Engineering with Intercalated Year	5	B	15 CATS
H313	MEng Mechanical Engineering with a Year in Research	5	B	15 CATS
H331	MEng Automotive Engineering	4	B/C	15 CATS
H332	MEng Automotive Engineering with Intercalated Year	5	B	15 CATS
H333	MEng Automotive Engineering with a Year in Research	5	B	15 CATS
H635	MEng Electronic Engineering and variants	4	A/Core	15 CATS
H636	MEng Electronic Engineering with Intercalated Year	5	A	15 CATS
H637	MEng Electronic Engineering with a Year in Research	5	A	15 CATS
HH63	MEng Systems Engineering and variants	4	B/Core	15 CATS
HH64	MEng Systems Engineering with Intercalated Year	5	A	15 CATS
HH65	MEng Systems Engineering with a Year in Research	5	A	15 CATS
HH37	MEng Manufacturing & Mechanical Engineering	4	B	15 CATS
HH38	MEng Manufacturing & Mechanical with Intercalated Year	4	B	15 CATS

Module Context				
HH39	**MEng Manufacturing & Mechanical with a Year in Research**	**4**	**A**	**15 CATS**
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	
Lectures	10 x 3 hours per week	
Seminars	-	
Tutorials	-	
Project Supervision	-	
Demonstration	-	
Practical Class/Workshops	Surgery session in PC lab 2 x 1hour	
Supervised time in studio/workshop	-	
Fieldwork	-	
External visits	-	
Work based learning	-	
Placement	**-**	
Year abroad	**-**	
Other activity: **Revision examples class**	Self-paced computer-based tutorials and exercises 2 x 1 hours revision examples classes Guided Independent Learning 116 hours	
18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations	3 Hours	**70%**
Practical Examinations		
Assessed essays/coursework	Individual assignment based on a modelling problem. 2,000 word limit.	**30%**
18a. Final chronological assessment *(please see guidance*)	Unseen examination (70%).	

19. Methods for providing feedback on assessment.

Written comments on submitted assignment and written group feedback
Support through advice and feedback hours.
Cohort level feedback on examinations

20. Outline Syllabus

1. Fundamental theory of discrete-event simulation.
2. Setting objectives for the simulation (formal planning, shop loading, optimisation).
3. Data collection and verification; data collection from existing plant operations;
4. Methods of estimating in the common case of incomplete data; synthetic data for a new simulation.
5. Choice of the system for simulation; criteria: technological aspects, simulation objectives.
6. Types of simulation software and their best areas of application.
7. Planning and executing a simulation; programming and cross-checking validity of the model; model running; sensitivity analysis; output format.

21. Illustrative Bibliography

Simulation Modeling & Analysis, Law A., McGraw-Hill. 5th edition 2014

Computer Simulation in Management Science, Pidd M., Wiley. 5th edition, 2004.

Simulation: The practice of model development and use. Robinson S., Palgrave Macmillan. 2nd edition 2014.

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.

Access to simulation software (School of Engineering has licenses for 30 concurrent users and maintains these, upgrading every few years)

Approval	
24. Module leader's signature	Dr Neil Davis
25. Date of approval	Teaching Policy Committee Chair's Action 5 April 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 Gill Cooke
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**
70	**30 Individual assignment based on a modelling problem 2,000 words**	**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?	**0**	
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
Restricted?	☐ Yes	☒ No

Commented [ER1]: Has to be summer!

Examination Information	
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)**
Demonstrate in depth knowledge and skills to allow a new or existing facility and its operation to be simulated using discrete event simulation.	Lectures, worksheets, self-paced lab exercises.	Individual assignment, Examination
Demonstrate an in-depth understanding of DES theory and make suitable simplifications of a problem to suit DES technologies.	Lectures, worksheets, self-paced lab exercises.	Individual assignment, Examination
Make appropriate modelling simplifications (choice of variable, level of detail, degree of abstraction)	Self-paced Lab exercises and modelling problems.	Individual assignment Unseen Exam
Design and execute an appropriate set of experiments using a simulation model.	Self-paced Lab exercises and surgery sessions Worksheets	Individual assignment Unseen Exam
Analyse experimental results using appropriate structured and statistical methods.	Self-paced Lab exercises and surgery sessions Worksheets	Individual assignment Unseen Exam
Demonstrate an advanced ability to present the results of a simulation study in written form, and make evidence-based recommendations based on this.	Lectures, worksheets, self-paced lab exercises.	Individual assignment, Examination
Develop and apply a simulation model using a commercial simulation software tool.	Self-paced Lab exercises and surgery sessions Worksheets	Individual assignment Unseen Exam
Interpret the meaning of simulation results, and make evidence-based recommendations for the design and operation of a system of interest.	Self-paced Lab exercises and modelling problems	Individual assignment Unseen Exam