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	01/10/2018
If new, does this module replace another? If so, enter module code and title:	Yes ES2B7 System Engineering Principles
If revised/ discontinued, please outline the rationale for the changes:	
Confirmation that affected departments have been consulted:	Changes were made in consultations between the School of Engineering and WMG. Computer Science Department consulted via the Computer Systems Engineering Steering Group.

Module Summary	
1. Module Code (if known)	ES2D7
2. Module Title	Systems Engineering Principles
3a. Lead department:	School of Engineering
3b. Teaching Split (if known):	100% Engineering
4. Name of module leader	Dr. Claire Lucas
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

Module Summary	
6. Credit value(s) (CATS)	15
7. Principal Module Aims	Introduce students to the concept of systems engineering as a philosophy for management, operation and technical projects, especially to manage the interactions of complex systems. Guide students to expand their thinking about design to include the whole lifecycle. Give an overview of tools and methodologies used in industry delving more deeply into life cycle models and model based approaches to systems engineering. Ensure that students are able to consider functional and non-functional behaviour when creating requirements as well as predicting failure modes. Impress upon students the importance of correct specifications with traceable requirements on product success as well as on safety and the environment. Introduce a range of testing considerations and techniques which can be applied when designing a system alongside practical experience of design of experiment. Ensure students can write test procedures and produce a test report to prove a system design.
8. Principal Learning Outcomes	By the end of the module students should be able to • Demonstrate understanding of the overall concepts and need for a systems approach to engineering • Use a P-diagram to determine design considerations for a system. • Write requirements which cover functional and non-functional uses and behaviours including failure mode avoidance. • Describe the difference between verification and validation and specify suitable verification and validation criteria. • Specify a variety of tests and choose from different test techniques (including statistical) to ensure appropriate test coverage. • Write and critique a test report for acceptance of design.
9. Timetabled Teaching Activities (summary)	Lectures 15 x 1 hr Laboratory classes 3 x 2 hr Class/workshops 5 x 2 hr Timed Test 3 hr Revision Classes 2 x 1 hr **TOTAL 36 Hours**

Module Summary	
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year2/
11. Other essential notes	Advice and feedback hours are available for answering questions on the module.
12. Assessment methods (summary)	50% examination (2hr paper) 50% seen practical computer exercise (3hr) Both examination and exercise must be passed with a mark of ≥40%.

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 100%

14. Availability of module

Degree Code	Title	Study Year	C/OC/ A/B/C	Credits
H113	BEng Engineering	2	A	15
H114	MEng Engineering	2	A	15
H216	BEng Civil Engineering	2	A	15
H217	MEng Civil Engineering	2	A	15
H315	BEng Mechanical Engineering	2	C	15
H316	MEng Mechanical Engineering	2	C	15
HH35	BEng Systems Engineering	2	C	15
HH31	MEng Systems Engineering	2	C	15
HN11	BSc Engineering and Business Studies	2	A	15

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

1 (Core)

16. Pre- and Post-Requisite Modules

Module Content and Teaching

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

Module duration (weeks)	**10**
Lectures	**15 x 1 hr**
Seminars	
Tutorials	**0**
Project Supervision	**0**
Demonstration	
Practical Class/Workshops	**3 x 2 hour Computer laboratories** **5 x 2 hour Workshops (table space)**
Supervised time in studio/workshop	

Module Content and Teaching		
Fieldwork		
External visits		
Work based learning		
Placement		
Year abroad		
Other activity *(please describe): e.g. distance-learning, intensive weekend teaching etc.*	**2 x 1 hour revision classes** **3 hour seen timed computer test** **114 hours self-study**	
18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations	2 Hours	**50**
Practical Examinations		
Assessed essays/coursework	3 Hours Seen timed practical computer exercise	**50**
18a. Final chronological assessment *(please see guidance*)	Written Examination	
19. Methods for providing feedback on assessment.		
written exam: mark, assignment: mark and comments, evidence of practical exercises (including peer review of test report): mark and peer comments, cohort level feedback on examinations.		

20. Outline Syllabus

Introduction to concepts, stages of design (traditional vs. lifecycle), systems architecture, introduction to and comparison of lifecycle models (waterfall, iterative, v-model, spiral, agile), expected system behaviour, requirements (functional vs non-functional), failure mode prediction and avoidance (p diagram, fishbone, is/is not), design for customer, design for development, design for build, design to deploy, design for service, design for end of life, design for the environment, design for safety (HARA), specification writing, systems integration, testing (truth tables, design verification plan, verification vs validation), statistical test techniques, non-functional testing, design of experiment (test matrices, test report), application of systems engineering to people and project management,

21. Illustrative Bibliography

Blanchard, Benjamin S., and W. J. Fabrycky. *Systems Engineering and Analysis*. Harlow: Pearson Education Limited, 2014.. **ISBN-13** 978-1292025971

D. C. Purdy. A Guide for Writing Successful Engineering Specifications. New York:McGraw-Hill, 1991. **ISBN**-13: 978-0070509993

A. P. Sage, J. E. Armstrong. Introduction to Systems Engineering. Wiley Series in Systems Engineering. Wiley 2000 **ISBN-13:** 978-0471027669

A. Kossiakoff. “Systems Engineering Principles and Practice” Wiley Series in Systems Enigneering. Wiley 2002 **ISBN-13:** 978-0470405482

Wasson, C., "System Analysis, Design, and Development: Concepts, Principles, and Practices." Wiley Series in Systems Engineering and Management. Wiley 2005. **ISBN-13:** 978-0471393337

PYSTER, A., OLWELL, D. H. *The Guide to the Systems Engineering Body of Knowledge (SEBoK) – continuously updated WIKI*

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.
classes require whiteboards, laboratories require computer rooms, computers must have Mathworks products: Simulink and stateflow and Minitab Inc minitab installed

Approval	
24. Module leader's signature	Dr Claire Lucas
25. Date of approval	Teaching Policy Committee meeting 22 March2017 Minute 308-16/17
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**
50	**50 Practical computer exercise**	**2 hr** **3 hr**
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.		
A8. Stationery requirements		
No. of Answer books?	**1**	
Graph paper?	**Yes**	
Calculator?	**Yes (non-programmable)**	
Any other special stationery requirements (e.g. Data books, tables etc)?	**Engineering databook**	
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 15)**	**Which summative assessment method(s) will measure the achievement of this learning outcome? (reference activities in section 16)**
Demonstrate understanding of the overall concepts of and need for a systems approach to engineering	Lectures, tutorials and practical exercises	Written examination and practical examination
Use a P-diagram to determine design considerations for a system.	Lectures, tutorials, practical exercises	Written examination, evidence and practical examination
Write requirements which cover functional and non-functional uses and behaviours including failure mode avoidance.	Lectures, tutorials, practical exercises	Written examination, evidence and practical examination
Describe the difference between verification and validation and identify suitable verification and validation criteria	Lectures, tutorials and practical exercises	Written examination
Specify a variety of tests and choose from different test techniques (including statistical) to ensure appropriate test coverage	Lectures, tutorials and practical exercises	Written examination, evidence and practical examination
Write and critique a test report for acceptance of design	Lectures, tutorials and practical exercises	Written examination, evidence, practical examination