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 2016
If new, does this module replace another? If so, enter module code and title:	N/A
If revised/discontinued, please outline the rationale for the changes:	The proposed change is to increase the length of the exam from 2 hours to 3. This will allow the learning outcomes to be tested in the greater depth expected of a Masters lever module.
Confirmation that affected departments have been consulted:	WMG and School of Engineering have been consulted.

Module Summary	
1. Module Code (if known)	ES4E5
2. Module Title	Lifecycle Engineering of Manufacturing Systems
3a. Lead department:	WMG
3b. Teaching Split (if known):	100% WMG
4. Name of module leader	Dr. Kobby Kodua
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 seeks to integrate and consolidate students' understanding of the full lifecycle behaviour of manufacturing systems. It provides systematic analysis of the models, integration mechanisms and performance indicators for the different life phases (from design and planning through to decommissioning or reuse) of a manufacturing system. The module assumes

Module Summary	
	fundamental knowledge in Maths (algebra, calculus, probability & statistics) and Engineering (modelling & simulation).
8. Principal Learning Outcomes	By the end of the module the student should be able to... • Analyse the changes and issues associated with the different life phases of a manufacturing system (MS) • Select a suitable modelling framework and represent the full lifecycle of a typical MS. • Identify different models, tools and data required for the different life phases of a manufacturing system. • Simulate and predict systems maintainability, reliability and end-of-life. • Model the knowledge life cycle of a typical MS and identify critical integration issues • Conduct a full Life Cycle Assessment (LCA) of a MS • Simulate and predict system's Life Cycle Cost (LCC) • Optimise the whole life cycle of a typical MS
9. Timetabled Teaching Activities (summary)	Lectures : 20 hours Seminars: 10 hours Laboratories : 6 hours Revision examples: 2 hours
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/...
11. Other essential notes	
12. Assessment methods (summary)	Group presentation (peer reviewed): 15% Individual assignment: 15% Written 3 hour examination: 70%

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**	**4**	**A**	**15 CATS**
H109	**MEng Engineering with Intercalated Year**	**5**	**A**	**15 CATS**
H10C	**MEng Engineering with Business Management**	**5**	**A**	**15 CATS**
H10D	**MEng Engineering with Sustainability**	**4**	**A**	**15 CATS**
H10G	**MEng Engineering with Communications**	**4**	**A**	**15 CATS**
H10K	**MEng Engineering with Robotics**	**4**	**A**	**15 CATS**
H10M	**MEng Engineering with Fluid Dynamics**	**4**	**A**	**15 CATS**
H110	**MEng Engineering with a Year in Research**	**4**	**A**	**15 CATS**
H331	**MEng Automotive Engineering**	**4**	**A**	**15 CATS**
H332	**MEng Automotive Engineering with Intercalated Year**	**5**	**A**	**15 CATS**
H333	**MEng Automotive Engineering with a Year in Research**	**5**	**A**	**15 CATS**
H33A	**MEng Automotive Engineering with Business Management**	**4**	**A**	**15 CATS**
H33B	**MEng Automotive Engineering with Sustainability**	**4**	**A**	**15 CATS**
H33C	**MEng Automotive Engineering with Robotics**	**4**	**A**	**15 CATS**
HH37	**MEng Manufacturing & Mechanical Engineering**	**4**	**A**	**15 CATS**
HH38	**MEng Manufacturing & Mechanical with Intercalated Year**	**5**	**A**	**15 CATS**
HH39	**MEng Manufacturing & Mechanical with a Year in Research**	**5**	**A**	**15 CATS**
H37A	**MEng Manufacturing & Mechanical with Business Management**	**4**	**A**	**15 CATS**
H37B	**MEng Manufacturing & Mechanical with Sustainability**	**4**	**A**	**15 CATS**
H37D	**MEng Manufacturing & Mechanical with Robotics**	**4**	**A**	**15 CATS**
15. Minimum number of registered students required for module to run				

Module Context
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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 2 hour	
Seminars	5 x 2 hour	
Tutorials	-	
Project Supervision	-	
Demonstration	-	
Practical Class/Workshops	3 x 2 hour laboratory sessions	
Supervised time in studio/workshop	-	
Fieldwork	-	
External visits	-	
Work based learning	-	
Placement	**-**	
Year abroad	**-**	
Other activity:	2 hours revision examples class 112 hours self-study	
18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations	3 Hours	**70%**
Practical Examinations	20 minutes group presentation	**15%**
	Peer Review of Group Work (factor)	**0%**
Assessed essays/coursework	Individual assignment (2,000 words excluding figures)	**15%**
18a. Final chronological assessment *(please see guidance*)	Unseen examination.	
19. Methods for providing feedback on assessment.		
Open feedback on group presentation		

Module Content and Teaching

Written comments on submitted assignment.
Support through office hours.

20. Outline Syllabus

1. Fundamentals of Lifecycle Engineering of MS: Requirement specification, design & planning, ramp up, operation, decommissioning/reuse/end-of-life of a MS.
2. Modelling frameworks & architecture for Lifecycle Engineering of MS: Capabilities, limitations and application of key LC modelling frameworks- TOGAF, GERAM, CIMOSA, PERA, etc., case application of one example framework
3. Lifecycle management tools and their applications: PLMs and their applications
4. Detailed models for different MS life phases: conceptual, analytical and heuristic models: process modelling, operational performance analysis, quality improvement models, energy consumption, systems maintenance & reliability models, degradation & end-of-life models
5. Lifecycle knowledge management & integration: Knowledge modelling, Data requirement for different life phases, systems integration and interoperability issues.
6. Fundamentals of MS' LCC modelling: LCC economic models; types of LCC models and input data; general lifecycle cost model; specific lifecycle cost model; cost estimation methods; reliability, quality, safety, usability, maintenance, warranty and decommissioning cost.
7. Software based LCC for MS': Practical demo of system level LCC analysis using ReliaSoft
8. Fundamentals of LCA of MS': Introduction to LCA & frameworks, benefits & limitations of LCA, LC inventory analysis, LC impact assessment, Interpretation of LC results, LCA software tools and their capabilities.
9. Optimisation of whole lifecycle of MS': Optimisation strategies & models for MS lifecycle

21. Illustrative Bibliography

1. Enrico Zio, The Monte Carlo Simulation Method for System Reliability and Risk Analysis, Springer-Verlag London 2013
2. Farr, John V, Systems life cycle costing: economic analysis, estimation, and management, Boca Raton, FL : CRC Press, c2011,
3. Dhillon, B.S Life Cycle Costing for Engineers, CRC Press, Taylor & Franics Group, 2009
4. Chorafas, Dimitris N, Quality control applications, London ; New York : Springer, c2013.
5. Bernard, Alain and Tichkiewitch, S, Methods and tools for effective knowledge life-cycle-management, Berlin : Springer, c2008
6. Williams, Aida Sefic, Life Cycle Analysis: A Step by Step Approach, ISTC's 7HFKQLFDO Report Series, 2009. Available on-line at: http://www.istc.illinois.edu/info/library_docs/TR/TR040.pdf

22. Learning outcomes

See table at end of form.

Resources

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

Approval	
24. Module leader's signature	Dr Kobby Kodua
25. Date of approval	21 April 2016
26. Name of Approving Committee (include minute reference if applicable)	School of Engineering Teaching Policy Committee Chair's Action
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**
70	**30**	**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?	**No**	
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
If restricted, please provide a list of permitted texts:		

Commented [ER1]: Has to be summer!

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)**
Subject Knowledge and Understanding • Analyse the changes and issues associated with the different life phases of a manufacturing system (MS) • Select a suitable modelling framework and represent the full lifecycle of a typical MS. • Identify different models, tools and data required for the different life phases of a manufacturing system. • Simulate and predict systems maintainability, reliability and end-of-life. • Model the knowledge life cycle of a typical MS and identify critical integration issues • Conduct a full Life Cycle Assessment (LCA) of a MS • Simulate and predict system's Life Cycle Cost (LCC) • Optimise the whole life cycle of a typical MS.	Lectures, reading, seminars, worksheets, laboratory exercises.	Group presentation, Individual assignment, Unseen Examination
Key Skills • Use modern Systems' Life Cycle Engineering tools to develop models to estimate and optimise the performance of manufacturing systems throughout their life time.	Laboratory exercises Seminars Worksheets	Group presentation Individual assignment

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)**
• Manage a full MS life cycle engineering task, making reference to lifecycle modelling and management frameworks, capabilities and limitations of current analytical and numerical models.	Lectures Reading Seminar	Unseen Examination Group presentation
Cognitive Skills • Make judgements on life cycle results of MS • Select suitable models for life cycle analysis of MS	Seminar Laboratory exercises	Individual assignment Unseen Examination