

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 2018
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:	Slight revision on learning outcomes to reflect more what is needed currently within industry (i.e. an ability to conduct and understand life cycle assessments) and altering the assessment balance to reflect the amount of hours work required more accurately.
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 Stuart Coles
5. Level	UG: <input type="checkbox"/> Level 4 (Certificate) <input type="checkbox"/> Level 5 (Intermediate) <input type="checkbox"/> Level 6 (Honours) PG: <input checked="" type="checkbox"/> Level 7 (Masters) <input type="checkbox"/> Level 8 (Doctoral) See Guidance Notes for relationship to years of study
6. Credit value(s) (CATS)	15

Module Summary	
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 fundamental knowledge in Maths (algebra, calculus, probability & statistics) and Engineering (modelling & simulation).
8. Principal Learning Outcomes	<p>By the end of the module the student should be able to...</p> <ul style="list-style-type: none"> • 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 • Use modern Systems' Life Cycle Engineering tools to develop models to estimate and optimise the performance of manufacturing systems throughout their life time. • 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. • Make judgements on life cycle results of MS • Select suitable models for life cycle analysis of MS.
9. Timetabled Teaching Activities (summary)	<p>Lectures : 10 hours Seminars: 20 hours Laboratories : 6 hours Revision examples: 2 hours Total 38 hours</p>
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/...
11. Other essential notes	Advice and feedback hours are available for answering questions on the lecture material (theory and examples) and past examination questions. This module will need to be scheduled with ES3E4 Lifecycle Engineering of Manufacturing Systems when both modules run in 2019-20.

Module Summary	
12. Assessment methods (summary)	20 minute group presentation including peer assessment: 20% Individual assignment (10 page maximum): 20% Written 2 hour examination: 60%

For use by Strategic Planning and Analytics Office only – Do not fill in this section

Level	JACS3 Code	Teaching Split
		<i>If not provided in 3b above</i>

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
New	MEng Engineering with Exchange Year	4	A	15 CATS
H109	MEng Engineering with Intercalated Year	5	A	15 CATS
H10C	MEng Engineering with Business Management	4	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	5	A	15 CATS
H331	MEng Automotive Engineering	4	A	15 CATS
New	MEng Automotive Engineering with Exchange Year	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
HH79	MEng Manufacturing & Mechanical Engineering with Exchange Year	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

Module Context				
H37D	MEng Manufacturing & Mechanical with Robotics	4	A	15 CATS
15. Minimum number of registered students required for module to run				
1				
16. Pre- and Post-Requisite Modules				
None				

Module Content and Teaching		
17. Teaching and Learning Activities (<i>totals for module – please see guidance</i>)		
Module duration (weeks)	10	
Lectures	10 x 1 hour	
Seminars	20 x 1 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	2 Hours	60%
Practical Examinations	20 minute group presentation including peer assessment	20%
Assessed essays/coursework	Individual assignment (10 page limit)	20%
18a. Final chronological assessment (<i>please see guidance</i>)	Unseen examination.	

Module Content and Teaching

19. Methods for providing feedback on assessment.

Open feedback on group presentation
 Written comments on submitted assignment.
 Cohort level feedback on examinations
 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
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
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 & Francis Group, 2009
4. Yang, G., Life Cycle Reliability Engineering, Wiley, 2007
5. Hitomi, K., Manufacturing Systems Engineering, Taylor & Francis, 1996

22. Learning outcomes

See table at end of form.

Resources

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

Approval	
24. Module leader's signature	Dr Stuart Coles
25. Date of approval	Chair's Action 2 May 2018
26. Name of Approving Committee (include minute reference if applicable)	School of Engineering and WMG Course and Module Approval Committee (CMAC).
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
60	20 - group presentation including peer assessment (20 minute) 20 - Individual assignment (10 page maximum)	2 hours
A3. Will this module be examined together with any other module (sectioned paper)? If so, please give details below.		
Will need to be timetabled at the same time as ES3E4 in Summer of the 2019/2020 year		
A4. How many papers will the module be examined by?	<input checked="" type="checkbox"/> 1 paper <input type="checkbox"/> 2 papers	
A5. When would you wish the exam take place (e.g. Jan, April, Summer)?	Summer	
A6. Is reading time required?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	
Open Book?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	

Examination Information	
Restricted?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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)
<p>Subject Knowledge and Understanding</p> <ul style="list-style-type: none"> 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
<p>Key Skills</p> <ul style="list-style-type: none"> 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)
<ul style="list-style-type: none"> • 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 <ul style="list-style-type: none"> • Make judgements on life cycle results of MS • Select suitable models for life cycle analysis of MS 	Seminar Laboratory exercises	Individual assignment Unseen Examination