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	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:	Revised during the Curriculum Refresh
Confirmation that affected departments have been consulted:	Changes were made in consultations between the School of Engineering and WMG.

Module Summary	
1. Module Code (if known)	ES372
2. Module Title	Automation & Robotics
3a. Lead department:	WMG
3b. Teaching Split (if known):	100% WMG
4. Name of module leader	Dr Emma Rushforth
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	The module provides an understanding of the principles of operation of automated equipment with particular reference to industrial robots. It focuses on the knowledge needed to select and use such equipment effectively and safely. However, some design aspects will be presented. There is an emphasis on the use of sensors to make robots behave "intelligently".

Module Summary	
8. Principal Learning Outcomes	By the end of the module students will be able to: • Appraise the impact of automation, both economic and social, on modern industry and future applications in industry • Contrast the benefits and disadvantages of automating a task. • Evaluate the different mechanical configurations available for a modern industrial robot and argue if a task is appropriate for that configuration. • Program an industrial robot off-line using kinematic simulation software to perform a specified task. • Locate the sources of positional error and calculate the possible positional error in an application. • Analyse safety hazards and formulate a safety system for a given automation application. • Select appropriate sensors for a given automation application. • Apply machine vision to a given application and set up a machine vision system. • Analyse complex robot kinematic theory and devise kinematic calculations for a given case study.
9. Timetabled Teaching Activities (summary)	Lectures 25 x 1hr = 25 hours Surgeries in computer rooms to assist laboratory preparation = 12 hours Revision class 1 x 1hr = 1 hours Laboratory = 2.5 hours (up to 1 hour robot programming lab, 1.5 hours machine vision programming) **Total contact hours = 40.5 hours**
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year3/es372/
11. Other essential notes	Advice and feedback hours are available for answering questions on the lecture material (theory and examples) and past examination questions.
12. Assessment methods (summary)	Examination (2 hours) 70% Coursework 30%: • 2 Individual online tests based on Robot Programming lab and Machine vision lab each worth 10% • 2 lab performance marks based on Robot Programming lab and Machine vision lab each worth 5%

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
H106	BEng Engineering	3	O	15
H107	MEng Engineering	3	O	15
H109	MEng Engineering with Intercalated Year	3	O	15
H110	MEng Engineering with a Year in Research	3	O	15
H330	BEng Automotive Engineering	3	Core	15
H331	MEng Automotive Engineering	3	Core	15
H332	MEng Automotive Engineering with Intercalated Year	3	Core	15
H333	MEng Automotive Engineering with a Year in Research	3	Core	15
HH73	BEng Manufacturing and Mechanical Engineering	3	Core	15
HH37	MEng Manufacturing and Mechanical Engineering	3	Core	15
HH38	MEng Manufacturing and Mechanical Engineering with Intercalated Year	3	Core	15
HH39	MEng Manufacturing and Mechanical Engineering with a Year in Research	3	Core	15
HN12	BEng Engineering Business Management	3	B	15
HH36	BEng Systems Engineering	3	Core	15
HH63	MEng Systems Engineering	3	Core	15
HH64	MEng Systems Engineering with Intercalated Year	3	Core	15
HH65	MEng Systems Engineering with a Year in Research	3	Core	15

Module Content and Teaching

17. Teaching and Learning Activities *(totals for module – please see guidance)*		
Module duration (weeks)	**14**	
Lectures	**25**	
Seminars		
Tutorials		
Project Supervision		
Demonstration		
Practical Class/Workshops	5 hours Robot Programming Surgeries drop-in in a computer room 7 hours Machine Vision Surgeries drop-in in a computer room 1.5 hour Machine Vision Laboratory Up to 1 hour Robot Programming Laboratory (length dependant on how many attempts are needed to achieve successful program).	
Supervised time in studio/workshop		
Fieldwork		
External visits		
Work based learning		
Placement		
Year abroad		
Other activity *(please describe): e.g. distance-learning, intensive weekend teaching etc.*	1 x 1 hrs revision class 109.5 hrs guided independent learning	

18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations	2 Hours	70%
Practical Examinations		
Assessed essays/coursework	Online test: Robot Programming Laboratory Exercise Online test: Machine Vision Laboratory Exercise End-of-lab assessment – Robot Programming End-of-lab assessment – Machine Vision (group of 2)	10% 10% 5% 5%
18a. Final chronological assessment *(please see guidance*)	Examination	

19. Methods for providing feedback on assessment.

End-of-lab assessments are via verbal feedback at completion of lab. End-of-lab assessment for Robot programming is also emailed directly to individual students.
Feedback on online assessments is via individual emails giving written feedback for each response.
Cohort level feedback on examinations

20. Outline Syllabus

Introduction to automation and robotics: Fiction and history from Leonardo da Vinci onwards; Classification of robots; Fixed and flexible automation; High speed automation. Social and economic aspects; Safety issues and risk assessment; Future applications.
Machine design: Degrees of freedom; Actuators and power transmission; End effector design; Robot accuracy.
Machine control: Feedback control; Servomechanisms; PLC's and fieldbus; Robot Kinematic analysis.
Sensors and Machine vision: Transducers, tactile and proximity sensors; Vision - image analysis, cameras, optics, lighting and applications.
Robot programming and languages: Methods of programming; Teach mode, off line, and graphical simulation. Languages, e.g. ABB RAPID, ABB RobotStudio.

21. Illustrative Bibliography

"An Introduction to Robotics Analysis, Systems, Applications", Niku, S.B, 2010, 9780470604465, TJ 211.N4
"Implementation of Robotic Systems", Wilson, Mike, 2014, 9780124047334, EBOOK/ TS191.8.W55
"Introduction to robotics : mechanics and control", Craig, J. J, 2013, 9781292040042, TJ 211.C7
"Robotics: A Very Short Introduction", Winfield, Alan, 2012, 9780199695980, TJ211.W56
"Principles of Modern Manufacturing" Groover, Mikell P., 2013 9781118474204, TS183.G763

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.

Machine vision equipment – available within WMG
Industrial robots – available within WMG

Approval	
24. Module leader's signature	Dr Emma Rushforth
25. Date of approval	Teaching Policy Committee Chair's Action 30 March 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 Gillian 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% - 2 on-line tests (10% each) and 2 end-of-lab assessments (5% each)**	**2 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)?		
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**	
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
Restricted?	☐ Yes	☒ No

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 17)**	**Which summative assessment method(s) will measure the achievement of this learning outcome? (reference activities in section 18)**
Appraise the impact of automation, both economic and social, on modern industry and future applications in industry	Lectures, short online videos, case studies	Examination
Contrast the benefits and disadvantages of automating a task.	Lectures	Examination
Evaluate the different mechanical configurations available for a modern industrial robot and argue if a task is appropriate for that configuration.	Lectures	Examination
Program an industrial robot off-line using kinematic simulation software to perform a specified task.	Lectures, Laboratory, Practical Class/Workshops	On line test, end-of-lab assessment
Locate the sources of positional error and calculate the possible positional error in an application.	Lectures, short online videos	Examination
Analyse safety hazards and formulate a safety system for a given automation application.	Lectures, short online videos	Examination
Select appropriate sensors for a given automation application.	Lectures	Examination
Apply machine vision to a given application and set up a machine vision system.	Lectures, Laboratory, Practical Class/Workshops	Examination, On line test, end-of-lab assessment
Analyse complex robot kinematic theory and devise kinematic calculations for a given case study.	Lectures, short online videos	Examination