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:	Reviewed as part of the curriculum refresh. Updates in assessment weightings, learning outcome wordings and reading list
Confirmation that affected departments have been consulted:	Engineering and WMG have been consulted.

Module Summary	
1. Module Code (if known)	ES4A1
2. Module Title	Advanced 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	Advanced Robotics will explore in great depth areas relevant to not only industrial robotics but service robots (i.e. robots outside a factory environment particularly mobile robots) and the application of this technology to real world environments e.g. driverless vehicles, unmanned aerial vehicles and tele-robots. Students will also master robot kinematics and dynamics.

Module Summary	
8. Principal Learning Outcomes	By the end of the module the student should be able to... • Solve complex kinematic and dynamic calculation problems applied to serial robots arms. • Independently program and set up: an industrial robot; a vision guided robot system; a safety controller simulation system; and PLC (programmable logic controller). • Undertake self-directed research and critically evaluate current and future non-industrial applications of robotic technology. • Appraise and evaluate mobile robot technology: locomotion, sensors and probabilistic techniques. • Design and critically evaluate: a safe system in a robot cell; a robot end-effector; fixturing and tools for robot cells.
9. Timetabled Teaching Activities (summary)	18 hours lectures, 10 hours tutorials, 9 hours laboratory (1 hour safety controller, 2 hours PLC, 6 hours vision guided robot), 1 revision class **Total contact hours = 38 hours**
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year4/es4a1/
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)	Examination (2 hours) 50% Coursework 50%: • 2000 word Written Essay worth 15% • On-line and Vision guided robot laboratory group performance 5% • 2500 word report (plus robot kinematic analysis) on vision guided robot laboratory 30% Students must pass the examination and pass the coursework overall.

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.

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
H311	MEng Mechanical Engineering and variants	4	B/C	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	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	15 CATS
HH64	MEng Systems Engineering with Intercalated Year	5	B	15 CATS
HH65	MEng Systems Engineering with a Year in Research	5	B	15 CATS
HH37	MEng Manufacturing & Mechanical Engineering	4	A/B	15 CATS
HH38	MEng Manufacturing & Mechanical with Intercalated Year	4	A	15 CATS
HH39	MEng Manufacturing & Mechanical with a Year in Research	4	A	15 CATS

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

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Module Context

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)	**13**
Lectures	**18 x 1**
Seminars	
Tutorials	**10 x 1**
Project Supervision	
Demonstration	
Practical Class/Workshops	1 x 1 hour Safety Controller Lab in IMC 2 x 1 hour PLC Programming Lab in IMC/IDL 1 x 3 hour on-line robot programming lab in IDL 1 x 3 hours (plus additional 3 hours if required) Vision Guided Robot programming lab in IDL
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 hr revision class** **112 hrs guided independent learning**

18. Assessment Method (Standard)

Type of assessment	**Length**	**% weighting**
Written Examinations	2 Hours	**50 %**
Practical Examinations	2 x 3 Hour robot labs (plus additional lab time if required) group mark	**5%**
Assessed essays/coursework	2000 Word written essay 2500 Word written lab based report	**15%** **30%**
18a. Final chronological assessment *(please see guidance*)	**Examination**	

19. Methods for providing feedback on assessment.

Verbal communication in the robot labs. Written comments and electronically marked-up assignments for the written essay and report.
Cohort level feedback on examinations

20. Outline Syllabus

Geometric, kinematic, and dynamic analysis of serial robots manipulators.
Robot, vision, PLC (programmable logic controller) and safety controller programming.
Robot motion control.
Robot tooling (particularly welding) /end-effector and fixture design.
Safety in a robot cell.
Current and future application of robotics in industry and outside industry, i.e. service robots.
Mobile robotics: locomotion, sensors, perception, SLAM (Simultaneous Localisation And Mapping) and probabilistic techniques.

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
“PLC Hardware and Programming”, Lamb, Frank, 2016, 978-1524648183,
“Introduction to autonomous mobile robots”, Siegwart, Roland, Nourbakhsh, Illah R., (2nd Edition), 2011, 978-0262015356, TJ 211.S4
“Probabilistic Robotics”, Thrun, Sebastian, Burgard, Wolfram, Fox, Dieter, 2005, 978-0262201629, TJ 211.T575

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.

PLC demonstrator units with PC’s and wide-screen monitors– available within WMG
Machine vision equipment with Industrial robots – available within WMG

Approval	
24. Module leader's signature	Emma Rushforth
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**
50	15 2000 word Written Essay worth 15% 5 On-line and Vision guided robot laboratory group performance 30 2500 word report (plus robot kinematic analysis) on vision guided robot laboratory	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)?	**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 (note that an additional datasheet is appended to exam question paper)**	
A9. Type of examination paper		

Examination Information		
Seen?	☐ Yes	☒ No
Open Book?	☐ Yes	☒ No
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)**
Solve complex kinematic and dynamic calculation problems applied to serial robots arms.	Lectures, private study, tutorials, problem sheets, assessed coursework	Coursework, unseen examination, self-marking against published answers.
Independently program and set up: an industrial robot; a vision guided robot system; a safety controller simulation system; and PLC (programmable logic controller).	Lectures, Laboratory work, assessed coursework	Laboratory performance assessment, coursework, unseen examination.
Undertake self-directed research and critically evaluate current and future non-industrial applications of robotic technology.	Lectures, private study, assessed coursework, short videos	Coursework, unseen examination
Appraise and evaluate mobile robot technology: locomotion, sensors and probabilistic techniques.	Lectures, private study, assessed coursework, short videos	Coursework, unseen examination
Design and critically evaluate: a safe system in a robot cell; a robot end-effector; fixturing and tools for robot cells.	Lectures, Laboratory work, private study, assessed coursework, short videos	Coursework, unseen examination