UNIVERSITY OF WARWICK

Proposal Form for New or Revised Modules (MA1 - version 7 - April 2014)

Approval information	
Approval Type	☐ New module X Revised module ☐ Discontinue module
Date of Introduction/Change	01/10/2017
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 Curriculum Refresh
Confirmation that affected departments have been consulted:	Changes have been made in consultation between the School of Engineering and WMG. CS have been informed

Module Summary	
1. Module Code (if known)	ES434
2. Module Title	ASICS, MEMS and Smart Devices
3a. Lead department:	School of Engineering
3b. Teaching Split (if known):	N/A
4. Name of module leader	Professor J W Gardner
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 credits
7. Principal Module Aims	The course aims to present, mainly though substantial practical experience, the design methodology of Application Specific Integrated Circuits (ASICs) and Micro-electro-mechanical Systems (MEMS).

Module Summary	
8. Principal Learning Outcomes	• Critique the main principles of ASICs, smart systems and devices • Design ASICS and MEMS through practical experience using typical modern Computer Aided Design software for this task • Understand emerging techniques in ASICs, MEMS and smart sensor systems. • Evaluate the principles and processes involved in the implementation of complex VLSI circuits and MEMS devices
9. Timetabled Teaching Activities (summary)	20 lectures (1 hr each) 5 laboratory designs (3 hrs each) 1 revision class (1 hr) 114 hours of reading exercises and self-study
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year4/es434
11. Other essential notes	Advice and Feedback hours are arranged for answering questions on the lecture material (theory and examples) and past examination questions.
12. Assessment methods (summary)	50% coursework (25% Design Report plus Electronic Submission of Designs and 25% Laboratory Report) 50% 2 hour examination Students must pass the coursework overall and the examination.

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

14. Availability of module

Degree Code	Title	Study Year	C/OC/ A/B/C	Credits
H60C	MEng Electronic Engineering	4	C	15
H60D	MEng Electronic Engineering	4	C	15
H635	MEng Electronic Engineering	4	C	15
H636	MEng Electronic Engineering with Intercalated Year	5	C	15
H637	MEng Electronic Engineering with Year in Research	5	C	15
H107	MEng Engineering (and variants)	4	O	15
H109	MEng Engineering with Intercalated Year	5	O	15
H110	MEng Engineering with Year in Research	5	O	15
H641	MSc Communications and Information Engineering	1	O	15
H642	MSc in Energy and Power Engineering	1	O	15
G408	MEng Computer Systems Engineering	4	A	15

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

1 (core)

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 weeks
Lectures	20 lectures
Seminars	
Tutorials	
Project Supervision	
Demonstration	
Practical Class/Workshops	5 laboratory classes of 3 hours each
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.*	1 hr Revision class Self-study of 114 hours

18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations	2 Hours	50
Practical Examinations	Hours	
Assessed essays/coursework	2 assessed assignments. One laboratory based assessment One written design report of up to 2000 words, plus design files.	50 25 25
18a. Final chronological assessment *(please see guidance*)	**Examination**	

19. Methods for providing feedback on assessment.
Feedback during all 5 laboratory sessions of progress. Feedback on one written laboratory assignment. Feedback from design report. Cohort level feedback on examinations.
20. Outline Syllabus
Devices and silicon processing; ASIC (based on analogue/digital VLSI) and MEMS design; silicon micromachining and other emerging process technologies; system design methodology; device design styles: detailed optimisation (cost and power), principles and applications. Examples will include physical and chemical microsensors, MEMS and microsystems. Automotive, environmental, industrial and healthcare applications. Students are expected to solve problems taken from the recommended text-book. Written Design Project: ASIC chip, MEMS or smart device to be designed and simulated with students working individually.

21. Illustrative Bibliography

A "Microsensors, MEMS and Smart Devices", Gardner, J.W., 2001, 9780471861096, TK 7874.G2

B "CMOS Analog Circuit Design", Allen, P.E. , 2012, 978-0199765072,

B "CMOS VLSI design", Weste, N.H.E, 2011, 9780321547743, TK 7872.468.W3

B "Integrated Citcuit Design", Weste, N.H.E, 2011, 978-0321696946,

C "MEMS Mechanical Sensors", Beeby, S, 2004, 9781580535366, TK 7874.M3

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:

Please, see 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.

- Site licence for VLSI design software (e.g. Tanner Tools) running on all managed PCs.
- Site licence for MEMS software to design and simulate basic micro-mechanical structures

Approval

24. Module leader's signature	Professor Julian W Gardner
25. Date of approval	Teaching Policy Committee Chair's Action 24 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 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	25 Laboratory based assessment 25 Design report of up to 2000 words, plus design files	2 hr
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

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 15)**	**Which summative assessment method(s) will measure the achievement of this learning outcome? (reference activities in section 16)**
Critique the main principles of ASICs, smart systems and devices	Lecturing material and handouts	Examination
Design ASICS and MEMS through practical experience using typical modern Computer Aided Design software for this task	5 exercises - 15 hours of lab sessions	Laboratory assignment and Design report of 2,000 words and electronic design files
Understand emerging techniques in ASICs, MEMS and smart sensor systems.	Course textbook, and lecturing material.	Examination
Evaluate the principles and processes involved in the implementation of complex VLSI circuits and MEMS devices	Course material and lab sessions	Design report and Examination