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 2018
If new, does this module replace another? If so, enter module code and title:	
If revised/discontinued, please outline the rationale for the changes:	The module is revised to adjust contact hours, remove quiz assessment and increase laboratory-based coursework to 30% overall.
Confirmation that affected departments have been consulted:	Changes were made in consultations between the School of Engineering and WMG. Computer Science have been consulted via the CSE steering committee.

Module Summary	
1. Module Code (if known)	ES3C5
2. Module Title	Signal Processing
3a. Lead department:	School of Engineering
3b. Teaching Split (if known):	100% School of Engineering
4. Name of module leader	Dr Christos Mias
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 module aims to introduce signal processing to 3rd year students. It aims to develop the student's ability to:- Select and apply appropriate mathematical methods for modelling and analysing signals; Understand the scientific principles underlying the generation of signals; Use practical skills in a laboratory session in which the relevant test and measurement equipment is

Module Summary	
	available; Select and apply appropriate computer based methods for modelling signals and communication systems; Design simple signal processing systems.
8. Principal Learning Outcomes	By the end of the module the student should be able to: 1. Use mathematics to analyse deterministic and random signals and to analyse processing systems 2. Classify signals and extract information. 3. Critique practical issues behind signal processing and information retrieval 4. Design signal processing systems 5. Use computer packages to model signals, filters and processes 6. Use test and measurement equipment in the laboratory to evaluate signals
9. Timetabled Teaching Activities (summary)	22 x 1hr lectures 4 x 1hr example classes 2 x 1hr revision class 2 x 3hr laboratory sessions (plus extra time for special arrangements students) **TOTAL 34 Hours**
10. Departmental Web-link	http://www2.warwick.ac.uk/fac/sci/eng/eso/modules/year3
11. Other essential notes	Advice and feedback hours are available for answering questions on the module
12. Assessment methods (summary)	3 hour Written examination (70%) 30% coursework comprising: Digital Filters Laboratory Quiz Sheet (15%) Signals Laboratory Quiz Sheet (15%)

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% School of Engineering

14. Availability of module

Degree Code Entry up to 16-17	Title	Study Year	C/OC/ A/B/C	Credits
H106	BEng Engineering	3	O	15
New	BEng Engineering with Intercalated Year	4	O	
H107	MEng Engineering	3	O	
H109	MEng Engineering with Intercalated Year	3 or 4	O	
H110	MEng Engineering with a Year in Research	3 or 4	O	
H634	BEng Electronic Engineering	3	C	
H63U	BEng Electronic Engineering with Intercalated Year	4	C	
H635	MEng Electronic Engineering	3	C	
H636	MEng Electronic Engineering with Intercalated Year	3 or 4	C	
H637	MEng Electronic Engineering with a Year in Research	3 or 4	C	
HH36	BEng Systems Engineering	3	C	
New	BEng Systems Engineering with Intercalated Year	4	C	
HH63	MEng Systems Engineering	3	C	
HH64	MEng Systems Engineering with Intercalated Year	3 or 4	C	
HH65	MEng Systems Engineering with a Year in Research	3 or 4	C	

Degree Code Entry from 17-18	Title	Study Year	C/OC/ A/B/C	Credits
H113	BEng Engineering	3	A	15
H111	BEng Engineering with Intercalated Year	4	A	15
H114	MEng Engineering	3	A	15
H115	MEng Engineering with Intercalated Year	3 or 4	A	15
H161	BEng Biomedical Systems Engineering	3	C	15
H163	BEng Biomedical Systems Engineering with Intercalated Year	4	C	15
H163	MEng Biomedical Systems Engineering	3	C	15
H164	MEng Biomedical Systems Engineering with Intercalated Year	3 or 4	C	15
H605	BEng Electrical and Electronic Engineering	3	C	15
H608	BEng Electrical and Electronic Engineering with Intercalated Year	4	C	15
H606	MEng Electrical and Electronic Engineering	3	C	15

H607	MEng Electrical and Electronic Engineering with Intercalated Year	3 or 4	C	15
H63W	BEng Electronic Engineering	3	C	15
H63V	BEng Electronic Engineering with Intercalated Year	4	C	15
H63X	MEng Electronic Engineering	3	C	15
H63Y	MEng Electronic Engineering with Intercalated Year	3 or 4	C	15
HH35	BEng Systems Engineering	3	C	15
HH34	BEng Systems Engineering with Intercalated Year	4	C	15
HH31	MEng Systems Engineering	3	C	15
HH33	MEng Systems Engineering with Intercalated Year	3 or 4	C	15
G406	BSc/BEng Computer Systems Engineering	3	B	15
G408	MEng Computer Systems Engineering	3	B	15
15. Minimum number of registered students required for module to run				
1 (Core)				
16. Pre- and Post-Requisite Modules				
ES2A9 Engineering Mathematics and Technical Computing or equivalent				

Module Content and Teaching

17. Teaching and Learning Activities *(totals for module – please see guidance)*

Module duration (weeks)	**10**
Lectures	**22 x 1 hr**
Seminars	
Tutorials	**0**
Project Supervision	0
Demonstration	0
Practical Class/Workshops	2 x 3 hour laboratory sessions (plus extra time for special arrangements students)
Supervised time in studio/workshop	0
Fieldwork	0
External visits	0
Work based learning	0
Placement	**0**
Year abroad	**0**

Module Content and Teaching

Other activity *(please describe): e.g. distance-learning, intensive weekend teaching etc.*	**4 x 1hr examples class** **2 x 1hr revision class** **116 hours Guided independent learning**

18. Assessment Method (Standard)

Type of assessment	Length	% weighting
Written Examinations	3 Hours	**70**
Practical Examinations		
Assessed essays/coursework	20% coursework comprising Digital Filters Laboratory Quiz Sheet Signals Laboratory Quiz Sheet	 15% 15%
18a. Final chronological assessment *(please see guidance*)	**Examination**	

19. Methods for providing feedback on assessment.

- Model solutions to past papers.
- Support through advice and feedback hours.
- Cohort-level feedback on final exam.

20. Outline Syllabus

Signals: Time domain and frequency domain representation of continuous and discrete signals; Laplace transform and transfer functions; Z-transform and transfer functions; Relation between time domain and frequency domain; Fourier Transform; Discrete Time Fourier Transform; Practical use of Fast Fourier Transform; Convolution.
Filter Design: Specification in terms of frequency response; time domain and frequency responses; filter design filter design - FIR and IIR; Linear phase filters; Non-recursive designs using windowing; Quantisation and rounding in both recursive and non-recursive designs
Random Signal Analysis: Revision of some fundamental concepts of probability:- probability density, expected values, correlation; Time domain analysis:- correlation functions for continuous and discrete signals, analogue and digital measurement of correlation; Frequency domain analysis:- spectral densities and their relation to correlation functions, analogue and digital measurement.

21. Illustrative Bibliography

"Digital Signal Processing with Matlab Examples" (Vol. 1 only), J. Giron-Sierra, Springer, 2016
"Signals and Systems", Hweu Hsu, McGraw-Hill Education; 3 edition, 2013 Schaum's Outlines

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.

Approval

24. Module leader's signature	Dr Christos Mias
25. Date of approval	25 April 2018
26. Name of Approving Committee (include minute reference if applicable)	School of Engineering and WMG Course and Module Approval Committee (CMAC) Minute 252-17/18
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**
70	**30% coursework comprising** **15% Digital Filters Lab Quiz** **15% Signals Lab Quiz**	**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?	**2**	
Graph paper?	**Y**	
Calculator?	**Y**	
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 17)**	**Which summative assessment method(s) will measure the achievement of this learning outcome? (reference activities in section 18)**
Use mathematics to analyse deterministic and random signals and to analyse processing systems	Lectures, examples sheets, examples classes and laboratories	Examination
Classify signals and extract information.	Lectures, examples sheets, examples classes and laboratories	Examination
Critique practical issues behind signal processing and information retrieval	Lectures, examples sheets, examples classes and laboratories	Examination
Design signal processing systems	Lectures, examples sheets, examples classes and laboratories	Examination and coursework
Use computer packages to model signals, filters and processes.	Lectures, examples sheets, examples classes and laboratories	Coursework
Use test and measurement equipment in the laboratory to evaluate signals	Lectures, examples sheets, examples classes and laboratories	Coursework