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:	N/A
If revised/discontinued, please outline the rationale for the changes:	The module is revised to simplify learning outcomes. The changes do not affect the ticked IET learning outcomes.
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)	ES4D2
2. Module Title	Antenna, Propagation and Wireless Communications Theory
3a. Lead department:	Engineering
3b. Teaching Split (if known):	100% Engineering
4. Name of module leader	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
7. Principal Module Aims	The module continues the development of concepts and techniques required for an understanding of fundamental aspects of telecommunications. This will enable students to carry out project work in antennas, propagation and wireless communications. The module's aim is to present fundamental theory and its

Module Summary	
	application in understanding the operation of the physical layer of a wireless communications system, such as antennas, propagation, shadowing and diversity.
8. Principal Learning Outcomes	By the end of the module the student should be able to: • Solve electromagnetic plane wave propagation problems in lossless or lossy media (e.g. plane wave reflection/transmission from planar material interfaces). • Apply fundamental theory to evaluate antenna parameters. Design antennas. • Derive basic radiowave propagation models and use them to design and evaluate the performance of a wireless link between two antennas. Be critical of the limitations of path loss models. • Interpret the basics of shadowing and fading • Advance knowledge of diversity and multiple-input-multiple-output techniques • Design linear equalisers and Rake receivers • Evaluate performances of digital modulation techniques • Comprehend cellular communications and organisation and spread spectrum basics
9. Timetabled Teaching Activities (summary)	Lectures 30 × 1 hour 2 Example Classes for Revision
10. Departmental Web-link	www2.warwick.ac.uk/fac/sci/eng/eso/modules/year4/es4d2/
11. Other essential notes	Office hours for answering questions on the lecture material (theory and examples) and past examination questions.
12. Assessment methods (summary)	2 Assignments (15% each) 30% 3 hours examination (70%)

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 100%

14. Availability of module

Degree Code	Title	Study Year	C/OC/ A/B/C	Credits
H107	MEng Engineering (and electives) Option	4	Option A/B depending on Elective	15
H109	MEng Engineering with Intercalated Year	5	Option A	15
H110	MEng Engineering with Year in Research	5	Option A	15
New	MEng Engineering with Exchange Year	4	Option A	15
H635	MEng Electronic Engineering	4	Option A	15
H60C	MEng Electronic Engineering with Business Management	4	Option A	15
H60D	MEng Electronic Engineering with Communications	4	Core	15
H636	MEng Electronic Engineering with Intercalated Year	5	Option A	15
H637	MEng Electronic Engineering with Year in Research	5	Option A	15
H64Z	MEng Electronic Engineering with Exchange Year	4	Option A	15
H641	MSc Computer and Information Engineering	M1	Core	15
H642	MSc Energy and Power Engineering	M1	Option	15
G5PA	MSc Data Analytics	M1	Option	15
G408	MEng Computer Systems Engineering	4	Option A	15

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

1 – core module

16. Pre- and Post-Requisite Modules

Pre-requisites: ES183 Engineering Mathematics and Systems Modelling or equivalent, 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**

Module Content and Teaching	
Lectures	**30 x 1 hour**
Seminars	
Tutorials	
Project Supervision	
Demonstration	
Practical Class/Workshops	
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.*	**Revision Classes 2 x 1 hour** **Self-study 118 hours**

18. Assessment Method (Standard)		
Type of assessment	**Length**	**% weighting**
Written Examinations	3 Hours	**70**
Practical Examinations		
Assessed essays/coursework	Assignment 1 Assignment 2	**15** **15**
18a. Final chronological assessment *(please see guidance*)	**Examination**	

19. Methods for providing feedback on assessment.
Marked assignments with comments.
20. Outline Syllabus
1. Electromagnetics/Propagation/Antenna Introduction: concept of a wireless channel, the electromagnetic spectrum, history, the cellular concept. Properties of electromagnetic waves. Propagation mechanisms. Antenna fundamentals Antenna Array Basics. Propagation models for wireless links.

2. Wireless Communication Techniques
Shadowing and fading basics.
Diversity techniques.
Multiple-input-multiple-output techniques.
Linear equalisers and Rake receivers.
Digital modulators and demodulators.
Spread spectrum and cellular communications.

21. Illustrative Bibliography

1. Fundamentals of Applied Electromagnetics, 7th ed. (global), F.W. Ulaby, E. Michielssen, and U. Ravaioli, Pearson, 2015.
2. Antennas and Propagation for Wireless Communication Systems, 2nd ed., S. Saunders and A. Aragon-Zavala, Wiley, 2007.
3. Antenna theory : analysis and design, 3rd ed., C.A. Balanis, Wiley, 2009.
4. Principles of Mobile Communications, 3rd ed., G.L. Stuber, Springer, Kluwer, 2011.
5. Wireless Communications: Principles and Practice, 2nd ed. T.S. Rappaport, Prentice Hall, 2001.

22. Learning outcomes
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.

None

Approval

24. Module leader's signature	Dr Christos Mias
25. Date of approval	20 March 2018
26. Name of Approving Committee (include minute reference if applicable)	School of Engineering and WMG Course and Module Approval Committee Minute 162-17/18
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	**Assignment 1 15%** **Assignment 2 15%**	**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?	**Yes**	
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)**
Solve electromagnetic plane wave propagation problems in lossless or lossy media (e.g. plane wave reflection/transmission from planar material interfaces).	Lectures	Unseen examination and/or assignments
Apply fundamental theory to evaluate antenna parameters. Design antennas.	Lectures	Unseen examination and/or assignments
Derive basic radiowave propagation models and use them to design and evaluate the performance of a wireless link between two antennas. Be critical of the limitations of path loss models.	Lectures	Unseen examination and/or assignments
Interpret the basics of shadowing and fading	Lectures	Unseen examination and/or assignments
Advance knowledge of diversity and multiple-input-multiple-output techniques	Lectures	Unseen examination and/or assignments
Design linear equalisers and Rake receivers	Lectures	Unseen examination and/or assignments
Evaluate performances of digital modulation techniques	Lectures	Unseen examination and/or assignments
Comprehend cellular communications and organisation and spread spectrum basics	Lectures	Unseen examination and/or assignments