ANX-PR/CL/001-01

LEARNING GUIDE

SUBJECT

93000927 - Secure Rf Communications

DEGREE PROGRAMME

09AT - Master Universitario En Teoria De La Señal Y Comunicaciones

ACADEMIC YEAR & SEMESTER

2019/20 - Semester 2

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Learning guide

1. Description

1.1. Subject details

Name of the subject	93000927 - Secure Rf Communications
No of credits	3 ECTS
Type	Optional
Academic year ot the programme	First year
Semester of tuition	Semester 2
Tuition period	February-June
Tuition languages	English
Degree programme	09AT - Master Universitario En Teoria De La SeÑal Y Comunicaciones
Centre	09 - Escuela Tecnica Superior de Ingenieros de Telecomunicacion
Academic year	2019-20

2. Faculty

2.1. Faculty members with subject teaching role

Name and surname	Office/Room	Email	Tutoring hours *
Fco. Javier Casajus Quiros (Subject coordinator)	C-328	javier.casajus@upm.es	Sin horario. Use e-mail for an appointment
Mariano Garcia Otero	C-327	mariano.garciao@upm.es	Sin horario. Use e-mail for an appointment

* The tutoring schedule is indicative and subject to possible changes. Please check tutoring times with the faculty member in charge.

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3. Prior knowledge recommended to take the subject

3.1. Recommended (passed) subjects

The subject - recommended (passed), are not defined.

3.2. Other recommended learning outcomes

- Radio Communications

- Digital Communication fundamentals

- Probability and Stochastic Processes for Engineers

- Working knowledge of a computation environment (MATLAB, Octave, Python,?)

4. Skills and learning outcomes *

4.1. Skills to be learned

CB06 - Poseer y comprender conocimientos que aporten una base u oportunidad de ser originales en el desarrollo y/o aplicación de ideas, a menudo en un contexto de investigación

CB07 - Que los estudiantes sepan aplicar los conocimientos adquiridos y su capacidad de resolución de problemas en entornos nuevos o poco conocidos dentro de contextos más amplios (o multidisciplinares) relacionados con su área de estudio

CB08 - Que los estudiantes sean capaces de integrar conocimientos y enfrentarse a la complejidad de formular juicios a partir de una información que, siendo incompleta o limitada, incluya reflexiones sobre las responsabilidades sociales y éticas vinculadas a la aplicación de sus conocimientos y juicios

CB09 - Que los estudiantes sepan comunicar sus conclusiones y los conocimientos y razones últimas que las sustentan a públicos especializados y no especializados de un modo claro y sin ambigüedades

CB10 - Que los estudiantes posean las habilidades de aprendizaje que les permitan continuar estudiando de un modo que habrá de ser en gran medida autodirigido o autónomo

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CE01 - Analizar y aplicar técnicas para el diseño y desarrollo avanzado de equipos y sistemas, basándose en la teoría de la señal y las comunicaciones, en un entorno internacional

CE02 - Evaluar y sintetizar los resultados de un trabajo en equipo en proyectos relacionados con la teoría de la señal y las comunicaciones, en un entorno internacional.

CE03 - Valorar y contrastar la utilización de las diferentes técnicas disponibles para la resolución de problemas reales dentro del área de teoría de la señal y comunicaciones.

CETFM - Capacidad de realizar un trabajo o proyecto integrando y relacionando las competencias adquiridas en las distintas asignaturas del máster, junto con la capacidad de defenderlo en público ante un grupo de personas expertas en el tema del trabajo

CT01 - Capacidad para comprender los contenidos de clases magistrales, conferencias y seminarios en lengua inglesa

CT03 - Capacidad para adoptar soluciones creativas que satisfagan adecuadamente las diferentes necesidades planteadas

CT04 - Capacidad para trabajar de forma efectiva como individuo, organizando y planificando su propio trabajo, de forma independiente o como miembro de un equipo

CT05 - Capacidad para gestionar la información, identificando las fuentes necesarias, los principales tipos de documentos técnicos y científicos, de una manera adecuada y eficiente

CT06 - Capacidad para emitir juicios sobre implicaciones económicas, administrativas, sociales, éticas y medioambientales ligadas a la aplicación de sus conocimientos

4.2. Learning outcomes

RA40 - Evaluate the performance of secure RF communication systems at the signal and tactical level

RA39 - Capability to implement RF secure communication systems

* The Learning Guides should reflect the Skills and Learning Outcomes in the same way as indicated in the Degree Verification Memory. For this reason, they have not been translated into English and appear in Spanish.

5. Brief description of the subject and syllabus

5.1. Brief description of the subject

This course is focused on those elements and techniques, which are susceptible to attack in RF communications systems.

It covers those techniques that can be used in electronic warfare areas such as: electronic measures and countermeasures (ECM and ECCM) in communication systems, signal intelligence (SIGINT) and communication intelligence (COMINT). Topics such as intentional interference-resistant transmission methods and low probability of interception schemes are presented as a basis for subsequent studies.

The latter include the analysis and application of communication techniques that are robust when confronted to smart attacks taking advantage of signal structure: synchronism attack and follower jammer.

Additional topics present methodologies for information extraction from secure signals, namely basic transmission parameters o even the message itself. These methodologies are based on artificial intelligence concepts, so they can be used in fully automatic systems. Finally there is a in-depth description of the theory and use of communication protection for tactical, hostile environment and secure communications.

Theoretical topics will be supplemented by practical exercises and analysis of realistic cases involving numerical evaluations.

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5.2. Syllabus

1. Communication electronic warfare

    1.1. Electronic support, attack and protection

    1.2. System configuration

2. Electronic attack and support

    2.1. Electronic attack

        2.1.1. Jamming

        2.1.2. Synchronization

        2.1.3. Follower jammer

    2.2. Support

        2.2.1. Low probability of detection, interception, exploitation

        2.2.2. Location and identification

3. Communication intelligence

    3.1. COMINT architectures

    3.2. COMINT technology

        3.2.1. Detection

        3.2.2. Signal classification

4. Communication protection

    4.1. Steganography

    4.2. Emission protection

5. Design project

6. Schedule

6.1. Subject schedule*

Week	Face-to-face classroom activities	Face-to-face laboratory activities	Other face-to-face activities	Assessment activities
1	**Section 1.1** Duration: 02:00 Lecture			
2	**Section 1.2** Duration: 02:00 Lecture			
3	**Section 2.1.1** Duration: 02:00 Lecture			
4	**Section 2.1.2** Duration: 02:00 Lecture			
5	**Section 2.1.3** Duration: 02:00 Lecture			
6	**Section 2.2.1** Duration: 02:00 Lecture			
7	**Section 2.2.2** Duration: 02:00 Lecture			
8	**Section 3.1** Duration: 02:00 Lecture			
9	**Section 3.2.1** Duration: 02:00 Lecture			
10	**Section 3.2.2** Duration: 02:00 Lecture			
11	**Section 4.1** Duration: 02:00 Lecture			
12	**Section 4.2** Duration: 02:00 Lecture			
13		**Analysis Project** Duration: 02:00 Laboratory assignments		
14		**Analysis Project** Duration: 02:00 Laboratory assignments		**Analysis project report** Group work Continuous assessment and final examination Duration: 02:00 **Test exercises** Individual work Continuous assessment and final

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				examination
				Duration: 03:00
15				
16				
17				**Test of sections 1 to 4**
				Written test
				Continuous assessment and final examination
				Duration: 02:00

The independent study hours are training activities during which students should spend time on individual study or individual assignments.

Depending on the programme study plan, total values will be calculated according to the ECTS credit unit as 26/27 hours of student face-to-face contact and independent study time.

* The subject schedule is based on a previous theorical planning of the subject plan and might go to through experience some unexpected changes along throughout the academic year.

7. Activities and assessment criteria

7.1. Assessment activities

7.1.1. Continuous assessment

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
14	Analysis project report	Group work	No Presential	02:00	30%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CETFM CE02 CT04 CE01 CT06 CE03 CB10
14	Test exercises	Individual work	Face-to-face	03:00	10%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CETFM CE02 CT04 CE01 CT06 CE03 CT05 CB10
17	Test of sections 1 to 4	Written test	Face-to-face	02:00	60%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CE02 CT04 CE01 CT06 CE03 CT05 CB10

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7.1.2. Final examination

Week	Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
14	Analysis project report	Group work	No Presential	02:00	30%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CETFM CE02 CT04 CE01 CT06 CE03 CB10
14	Test exercises	Individual work	Face-to-face	03:00	10%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CETFM CE02 CT04 CE01 CT06 CE03 CT05 CB10
17	Test of sections 1 to 4	Written test	Face-to-face	02:00	60%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CE02 CT04 CE01 CT06 CE03 CT05 CB10

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7.1.3. Referred (re-sit) examination

Description	Modality	Type	Duration	Weight	Minimum grade	Evaluated skills
Test of section 1 to 4	Written test	Face-to-face	02:00	60%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CE02 CT04 CE01 CT06 CE03 CT05 CB10
Test exercises or extra Test	Individual work	Face-to-face	02:00	10%	5 / 10	CB08 CB09 CT01 CB07 CT03 CB06 CETFM CE02 CT04 CE01 CT06 CE03 CT05 CB10
Analysis project report or oral exam on the project	Individual work	Face-to-face	02:00	30%	5 / 10	CB06 CETFM CE02 CT04 CE01 CT06 CE03 CB10 CB08 CB09 CT01 CB07 CT03

7.2. Assessment criteria

Students will be qualified through continuous evaluation by default. According to the Normativa de Evaluación del Aprendizaje de la Universidad Politécnica de Madrid, students willing to renounce to continuous evaluation must complete the Moodle task entitled "Renounce to continuous evaluation" before the end of the third week of the semester (deadline will be announced in Moodle).

Evaluation will assess if students have acquired all the competences of the subject. Thus, evaluation through final assessment will be carried out considering all the evaluation techniques used in continuous evaluation (EX, ET, TG, etc.), and will be celebrated in the exam period approved by Junta de Escuela for the current academic semester and year. Evaluation activities that assess learning outcomes that cannot be evaluated through a single exam can be carried out along the semester.

The analysis project is an additional assignment involving the in-depth analysis of a realistic system from different points of view: performance, robustness, feasibility; involving computational developments

A report about the design must be delivered and a practical exam of it will follow.

Classroom exercises will be proposed, solved and marked in classroom time.

A minimum of 3.5 points, out of 10, must be attained in every test so as to contribute to the final mark.

For evaluation by final examination only, students must deliver a report on the design project, exercises solved in the classroom and attend a test on the theoretical matters as expounded on sections 1 through 4.

For the extraordinary examination, students will be allowed to choose between delivery of test exercises plus a report on the analysis project and solving an extra test plus an oral exam on the analysis project, thus assessing the level they have attained in the practical matters of the course.

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8. Teaching resources

8.1. Teaching resources for the subject

Name	Type	Notes
Introduction to communication electronic warfare systems, Richard A. Poisel, Artech House 2008	Bibliography	Text book
Communications, Radar and Electronic Warfare, A. Graham, Wiley 2011	Bibliography	Reference book
Tactical Battlefield Communications Electronic Warfare, David L. Adamy, Artech House 2009	Bibliography	Reference book
Automatic Modulation Classification: Principles, Algorithms and Applications, 3. Zhechen Zhu and Asoke K. Nandi, Wiley 2015	Bibliography	Reference book
Security Engineering: A Guide to Building Dependable Distributed Systems, Ross J. Anderson, Wiley 2008	Bibliography	Reference book
Computer	Equipment	The use of a laptop in class is strongly advised