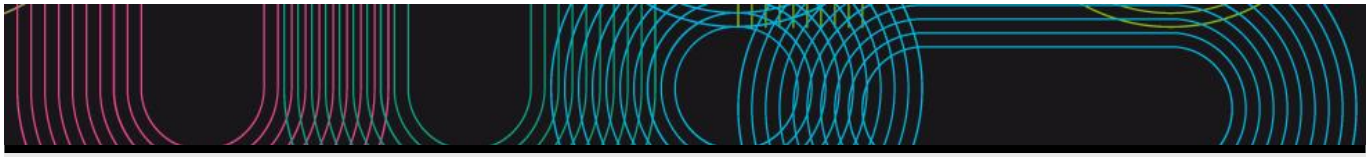

(*)Escola de Enxeñaría de Telecomunicación

(*)Páxina web

(*)

www.teleco.uvigo.es

(*)Presentación

The School of Telecommunication Engineering (EET) is a higher education school of the University of Vigo that offers Bachelor's degrees, Master's degrees and Doctoral programs in the fields of Telecommunications Engineering.

Bachelor's Degree in Telecommunication Technologies Engineering (EUR-ACE®).

The mail goal of the Bachelor's Degree in Telecommunication Technologies Engineering is to form professionals at the forefront of technological knowledge and professional competences in telecommunication engineering. This Bachelor has been recognized with the best quality seals, like the EUR-ACE's. **It has a bilingual option: up to 80% of the degree credits can be taken in English**.

http://teleco.uvigo.es/images/stories/documentos/gett/degree_telecom.pdf

www: http://teleco.uvigo.es/index.php/es/estudios/gett

Master in Telecommunication Engineering

The Master in Telecommunication Engineering is a Master's degree that qualifies to exercise the profession of Telecommunication Engineer, in virtue of the established in the Order CIN/355/2009 of 9 of February.

http://teleco.uvigo.es/images/stories/documentos/met/master_telecom_rev.pdf

www: http://teleco.uvigo.es/index.php/es/estudios/mit

Interuniversity Masters

The current academic offer includes interuniversity master's degrees that are closely related to the business sector:

Master in Cybersecurity: www: https://www.munics.es/

Master in Industrial Mathematics: www: http://m2i.es

International Master in Computer Vision: www: https://www.imcv.eu/

(*)Equipo directivo

MANAGEMENT TEAM

Director: Íñigo Cuíñas Gómez (teleco.direccion@uvigo.es)

Subdirección de Relaciones Internacionales: Enrique Costa Montenegro (teleco.subdir.internacional@uvigo.es)

Subdirección de Extensión: Francisco Javier Díaz Otero (teleco.subdir.extension@uvigo.es)

Subdirección de Organización Académica: Manuel Fernández Veiga (teleco.subdir.academica@uvigo.es)

Subdirección de Calidad: Loreto Rodríguez Pardo (teleco.subdir.calidade@uvigo.es)

Secretaría y Subdirección de Infraestruturas: Miguel Ángel Domínguez Gómez (teleco.subdir.infraestructuras@uvigo.es)

BACHELOR□S DEGREE IN TELECOMMUNICATION TECHNOLOGIES ENGINEERING

General coordinator: Rebeca Díaz Redondo (teleco.grao@uvigo.es)

http://teleco.uvigo.es/images/stories/documentos/comisions/membros_comisions_grao.pdf

MASTER IN TELECOMMUNICATION ENGINEERING

General coordinator: Manuel Fernández Iglésias (teleco.master@uvigo.es)

http://teleco.uvigo.es/images/stories/documentos/comisions/membros_comisions_master.pdf

MASTER IN CYBERSECURITY

General coordinator: Ana Fernández Vilas (camc@uvigo.es)

http://teleco.uvigo.es/images/stories/documentos/comisions/membros_comisions_master_ciberseguridade.pdf

MASTER IN INDUSTRIAL MATHEMATICS

General coordinator: Elena Vázquez Cendón (USC)

UVigo coordinator: José Durany Castrillo (durany@dma.uvigo.es)

http://www.m2i.es/?seccion=coordinacion

INTERNATIONAL MASTER IN COMPUTER VISION

General coordinator: Xose Manuel Pardo López (USC)

UVigo coordinator: José Luis Alba Castro (jalba@gts.uvigo.es)

https://www.imcv.eu/legal-notice/

(*)Máster Universitario en Ciberseguridade

Subjects			
Year 1st			
Code	Name	Quadmester	Total Cr.
V05M175V01101	Xestión da seguridade da información	1st	6
V05M175V01102	Seguridade da información	1st	6
V05M175V01103	Seguridade en comunicacións	2nd	6
V05M175V01104	Seguridade de aplicacións	1st	6
V05M175V01105	Redes Seguras	1st	6

Year 2nd			
Code	Name	Quadmester	Total Cr.

V05M175V01106	Prácticas en empresa	1st	15
V05M175V01107	Traballo Fin de Máster	1st	15

Year 1st			
Code	Name	Quadmester	Total Cr.
V05M175V01201	Conceptos e leis en ciberseguridade	2nd	3
V05M175V01202	Fortificación de sistemas operativos	1st	5
V05M175V01203	Tests de intrusión	2nd	5
V05M175V01204	Análise de malware	2nd	5
V05M175V01205	Seguridade como negocio	2nd	3
V05M175V01206	Seguridade en dispositivos móbiles	2nd	3
V05M175V01207	Análise forense de equipos	2nd	3
V05M175V01208	Seguridade ubicua	2nd	3
V05M175V01209	Ciberseguridade en contornas industriais	2nd	3
V05M175V01210	Xestión de incidentes	2nd	3

IDENTIFYING DATA				
Management of Information Security				
Subject	Management of Information Security			
Code	V05M175V01101			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	Spanish Galician			
Department				
Coordinator	Caeiro Rodríguez, Manuel			
Lecturers	Caeiro Rodríguez, Manuel Dafonte Vázquez, José Carlos Fernández Vilas, Ana			
E-mail	mcaeiro@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This subject introduces the fundamental concepts related to the management of information security (e.g. vulnerability, threat, risk). It is devoted to the study of the methodologies, tools and specifications that deal with risk analysis and the development of information security management systems.			

Competencies	
Code	
CB2	Students will be able to apply their knowledge and their problem-solving ability in new or less familiar situations, within a broader context (or in multi-discipline contexts) related to their field of specialization.
CB3	Students will be able to integrate diverse knowledge areas, and address the complexity of making statements on the basis of information which, notwithstanding incomplete or limited, may include thoughts about the ethical and social responsibilities entailed to the application of their professional capabilities and judgements.
CG1	To have skills for analysis and synthesis. To have ability to project, model, calculate and design solutions in the area of information, network or system security in every application area.
CG2	Ability for problem-solving. Ability to solve, using the acquired knowledge, specific problems in the technical field of information, network or system security.
CE5	To design, deploy and operate a security management information system based on a referenced methodology.
CE7	To demonstrate ability for doing the security audit of systems, equipment, the risk analysis related to security weaknesses, and for developing de procedures for certification of secure systems.
CE13	Ability for analysing, detecting and eliminating software vulnerabilities and malware capable to exploit those in systems or networks.
CT4	Ability to ponder the importance of information security in the economic progress of society.
CT5	Ability for oral and written communication in English.

Learning outcomes	
Learning outcomes	Competences
To know the fundamental concepts related to Information Security Management: vulnerability, threat, risk, countermeasure, security policy, security plan	CB2 CB3 CT4 CT5
To know the different Information Security Management methodologies, commonly accepted	CG1 CG2 CE5 CT5
To know the proper tools to carry out tasks related to risk analysis and security audit, as well as knowing which are the most appropriate for each environment	CG1 CG2 CE7 CE13 CT5

Contents	
Topic	
Foundations	Basic concepts: confidentiality, integrity, availability, threat, risk, etc. Legal framework of cybersecurity Standardization: standards and specifications Security operations centers

Risk analysis, management and certification	ISO 27005 and ISO 31000 Methodologies and risk analysis tools National Security Strategy
Information Security Management Systems	ISO27000, 27001 and 27002 National Scheme of Evaluation and Certification of Information Technologies Classification of information Training and awareness
Business impact	Cybersecurity roles Typical sequence of an attack Resilience Business continuity management Contingency plan
Security audit	Control objectives Frameworks and standards for the audit Audit of personal data security Delegate of data protection

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	19	29	48
Mentored work	0.5	10	10.5
Laboratory practical	18	57	75
Objective questions exam	1.5	3	4.5
Case studies	3	9	12

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Presentation by the faculty of the subject syllabus. This methodology will be used to work on competencies: CE5, CE7, CE13, CT4 and CT5.
Mentored work	Each student individually will carry out a work on one of the topics of the subject to be presented in group A. This methodology will be used to work on competences CG1, CG2, CT4 and CT5.
Laboratory practical	In the lab, guided practices will be developed and practical case studies will be presented. This methodology will be used to work on competencies CB2, CB3, CG1, CG2, CE5, CE7, CE13 and CT5.

Personalized assistance

Methodologies	Description
Lecturing	The teaching staff of the subject will provide individual and personalized attention to the students during the course, solving their doubts and questions. The doubts will be answered in person or online (during the master's own session, or during the schedule established for the tutorials). The tutoring schedule will be established at the beginning of the course and will be published on the webpage of the subject.
Laboratory practical	The teachers of the subject will provide individual and personalized attention to the students during the course, solving their doubts and questions. Likewise, the faculty will guide the students during the realization of the tasks assigned to them in the laboratory practices. The doubts will be answered in person (during the internships, or during the scheduled time for tutorials). The tutoring schedule will be established at the beginning of the course and will be published on the website of the subject.
Mentored work	The teachers of the subject will provide individual and personalized attention to the students during the course, solving their doubts and questions. Likewise, the faculty will guide the students during the realization of the tasks assigned to them in the laboratory practices. The doubts will be answered in person (during the internships, or during the scheduled time for tutorials). The tutoring schedule will be established at the beginning of the course and will be published on the website of the subject.

Assessment

	Description	Qualification	Evaluated Competencess		
Mentored work	Each student individually will carry out a work on one of the topics of the subject to be presented in group A.	10	CG1 CG2		CT4 CT5
Objective questions exam	Exam of theoretical knowledge and practical development	50	CG1 CG2	CE5 CE7 CE13	CT4 CT5

Case studies	Exercises of practical cases on the risk analysis and the realization of security plans	40	CB2 CB3	CE5 CE7 CE13	CT5

Other comments on the Evaluation

Students can decide to be evaluated according to a continuous evaluation model or a single evaluation model. All students who submit the report of the first case study are opting for continuous assessment. Once the students choose the continuous assessment model, their grade can never be "Not Submitted".
The grade will be the result of applying the weighted average between results: (i) written exam (50%) (ii) case studies (40%), and (iii) mentored work (10%).
Written exam: will take place on the dates published in the official calendar.
Practical part:
1- Continuous evaluation model. Reports of 2 case studies and 2 evaluations of the peer reports that will be delivered in the weeks indicated in the document that will be provided to students on the first day of class. One report will be on risk analysis and the other on the development of a security plan (ISMS). Each report will have a weight in the final grade of 15% and each evaluation of 5%. The reports will be developed in a group and all students in the same group will receive the same grade. The evaluations will be carried out individually. It is also necessary to carry out a supervised work on a subject of the subject to be presented in group A.
2- Single evaluation model. Individual delivery of the 2 reports of the two practical cases on the same date of the written exam published in the official calendar. In this case, the evaluation of peer reports will not be carried out and each report will have a weight in the final grade of 25%.
In the second-chance assessment, students will be evaluated using the single evaluation modality.
If plagiarism is detected in any of the assessment tests, the final grade of the subject will be "Suspenso (0)", a fact that will be communicated to the school's management to adopt the appropriate measures.

Sources of information

Basic Bibliography

Campbell, Tony, **Practical Information Security Management: A Complete Guide to Planning and Implementation**, Apress, 2016

UNE-EN ISO, **Protección y seguridad de los ciudadanos. Sistema de Gestión de la Continuidad del Negocio. Especificaciones. (ISO 22301:2012).**, AENOR, 2015

UNE-EN ISO, **Protección y seguridad de los ciudadanos. Sistema de Gestión de la Continuidad del Negocio. Directrices. (ISO 22313:2012).**, AENOR, 2015

UNE-EN ISO, **Tecnología de la información. Técnicas de seguridad. Sistemas de Gestión de la Seguridad de la Información. Requisitos. (ISO/IEC 27001:2013 incluyendo Cor 1:2014 y Cor 2:2015)**, AENOR, 2017

UNE-EN ISO, **Tecnología de la Información. Técnicas de seguridad. Código de prácticas para los controles de seguridad de la información. (ISO/IEC 27002:2013 incluyendo Cor 1:2014 y Cor 2:2015).**, AENOR, 2017

ISO/IEC, **Information technology -- Security techniques -- Information security management systems -- Overview and vocabulary (ISO/IEC 27000:2018)**, ISO/IEC, 2018

ISO/IEC, **Information technology -- Security techniques -- Information security management systems -- Guidance (ISO/IEC 27003:2017)**, ISO/IEC, 2017

ISO/IEC, **Information technology -- Security techniques -- Information security management -- Monitoring, measurement, analysis and evaluation (ISO/IEC 27004:2016)**, ISO/IEC, 2016

ISO/IEC, **Information technology -- Security techniques -- Information security risk management (ISO/IEC 27005:2011)**, ISO/IEC, 2011

Complementary Bibliography

Gómez Fernández, Luis y Fernández Rivero, Pedro Pablo, **Como implantar un SGSI según UNE-ISI/IEC 27001:2014 y su aplicación en el ENS**, AENOR, 2015

Fernández Sánchez, Carlos Manuel y Piatiini Velthuis, Mario, **Modelo para el gobierno de las TIC basado en las normas ISO**, AENOR, 2012

ISO, **Risk management -- Principles and guidelines (ISO/IEC 31000:2009)**, ISO, 2009

Alan Calder Steve Watkins, **IT Governance: An International Guide to Data Security and ISO27001/ISO27002**, 5, Kogan Page, 2012

Alan Calder, **Nine Steps to Success - North American edition: An ISO 27001:2013 Implementation Overview**, 1, IT Governance Publishing, 2017

Edward Humphreys, **Implementing the ISO / IEC 27001 ISMS Standard**, 2, Artech House, 2016

Recommendations

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===

Presentations for groups A will be provided through Faitic.

In the case of groups B, the teaching staff will be able to establish communication channels with the students through the Remote Campus, Faitic or other tools.

The tutoring sessions will be provided by telematic means (email, Remote Campus, Faitic forums, etc.) by prior appointment.

=== ADAPTATION OF THE TESTS ===

In case of activation of non-face-to-face teaching, no changes will be made in the evaluation model.

IDENTIFYING DATA				
Information Security				
Subject	Information Security			
Code	V05M175V01102			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	English			
Department				
Coordinator	Fernández Veiga, Manuel			
Lecturers	Fernández Veiga, Manuel Gestal Pose, Marcos Pérez González, Fernando			
E-mail	mveiga@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course covers the fields of cryptography and cryptanalysis, generation of pseudorandom numbers and functions, message integrity, authenticated encryption, public key cryptography, privacy and anonymity in information systems, secure computations, steganography and watermarking.			

Competencies	
Code	
CB2	Students will be able to apply their knowledge and their problem-solving ability in new or less familiar situations, within a broader context (or in multi-discipline contexts) related to their field of specialization.
CB5	Students will apprehend the learning skills enabling them to study in a style that will be self-driven and autonomous to a large extent.
CE1	To know, to understand and to apply the tools of cryptography and cryptanalysis, the tools of integrity, digital identity and the protocols for secure communications.
CE4	To understand and to apply the methods and tools of cybersecurity to protect data and computers, communication networks, databases, computer programs and information services.
CE10	Knowledge of the mathematical foundations of cryptography. Ability to understand their evolution and future developments.

Learning outcomes	
Learning outcomes	Competences
Understand the theoretical basis of encryption: Shannon ciphers, perfect security, semantic security, information-theoretic security	CE1 CE10
To know and be able to use stream ciphers	CE1 CE4 CE10
To know and be able to apply block ciphering tools, pseudorandom functions and the DES and AES ciphering standards	CE1 CE4 CE10
Knowledge about the construction, use and properties of hash functions, universal hashing and collision resistant hashing. Knowledge about message authentication codes. Case studies	CE1 CE4 CE10
Knowledge about public key cryptography and PK cryptographic schemes: RSA, ElGamal, Diffie-Hellman. Knowledge about digital signatures. Semantic security of public key cryptography	CE1 CE4 CE10
To know the basics of advanced cryptography: cryptography on elliptic curves. Lattice-based cryptography	CB2 CB5 CE1 CE4 CE10
To know and be able to use identification protocols, key interchange protocols and interactive communication protocols	CB5 CE1 CE4 CE10
To understand and have the ability to apply the basic techniques for steganography, watermarking and digital forensics	CB5 CE1 CE4 CE10

To know, understand and be able to use techniques for data anonymization	CB2 CB5 CE1 CE4 CE10
To know and understand the basic principles of distributed secure computation	CB2 CB5 CE1 CE4 CE10

Contents	
Topic	
1. Encryption	Shannon ciphers. Perfect security. Semantic security. Information-theoretic security: the wiretap channel
2. Stream ciphers	Pseudorandom generators. Composition of PRGs. Security. Attacks. Case studies
3. Block ciphers	Block ciphers. Security. DES & AES. Pseudorandom functions. Construction of PRFs and block ciphers
4. Message integrity	Authentication codes. Message integrity. Definition of security. Keyed MACs. PRFs and MAC. Hashing, hash functions. Universal hashing. Collision resistant hashing. Case studies
5. Authenticated encryption	Definition. Composition. Attacks, examples and case studies
6. Public key cryptography	Definition. Semantic security. One-way trapdoor functions. RSA, ElGamal, McEliece crypto systems. Diffie-Hellman key agreement. Digital signatures. Case studies
7. Advanced cryptography	Elliptic curve cryptography. Lattice-based cryptography. RLWE. Quantum-resistant cryptography. Homomorphic encryption
8. Identification protocols	Definitions. Passwords. Challenge-response. sigma-protocols. Okamoto and Schnorr protocols
9. Anonymization	Definitions. t-integrity and anonymity. Divergence. Analysis
10. Data hiding and steganography	Definitions. Spread-spectrum watermarking. Dirty paper coding. Digital forensics.
11. Secure computation	Computable functions. Fundamental limits. Two-way secure computation. Multiparty secure computation. Interactive communications. Homomorphic computations. Applications

Planning			
	Class hours	Hours outside the classroom	Total hours
Problem solving	0	24	24
Laboratory practical	18	36	54
Lecturing	17	51	68
Essay questions exam	2	0	2
Problem and/or exercise solving	1	0	1
Project	1	0	1
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Problem solving	Students are supposed to solve problems and exercises about the curse contents. Written homework, with review and grading. This methodology develops the competences CB2, CB4, CB5, CE1, CE44, CE10 and CT5.
Laboratory practical	Students are expected to work in the computer laboratory doing small programs on ciphering, and a programming assignment on ciphering, authentication, anonymity or digital forensics. The programming assignment will be supervised by the instructors. This methodology develops the competences CB2, CB4, CB5, CE1, CE44, CE10 and CT4.
Lecturing	Lectures on the topics included in the course: definitions, concepts, main results, properties and applications. This methodology develops the competences CB2, CB4, CB5, CE1, CE44, CE10 and CT5.

Personalized assistance

Methodologies	Description
Lecturing	Individual office hours will be offered to the students who need guidance in the study, or further explanations on the course contents, clarification on the solutions to problems, etc.
Problem solving	Individual office hours will be offered to answer the questions about problems and exercises assigned to the students
Laboratory practical	Individual assistance will be given to the students who request guidance on the programming assignments or computer lab practice

Assessment

	Description	Qualification	Evaluated Competencess	
Essay questions exam	Written exam. Questions, problems or exercises about the contents covered in the course	50	CB2 CB5	CE1 CE4 CE10
Problem and/or exercise solving	2-3 homework problem sets, to be worked out individually. Written submission	20	CB2 CB5	CE1 CE4 CE10
Project	Design and development of a programming assignment. Functional and performance tests will be run	30	CB2 CB5	CE1 CE4 CE10

Other comments on the Evaluation

The student must choose between two alternative, mutually exclusive assessment method: continuous assessment or eventual assessment.

The continuous evaluation option consists in a final written exam (50% of the qualification), the completion of programming assignments (30% of the qualification) and homework (20%). These assignments will be due the last working day preceding the start of the examination period. The eventual assessment option consists in a final written exam (60% of the qualification) and in the completion of assignments (40% of the qualification). The assignments will be due the last working day preceding the start of the examination period. The examinations of the continuous and the eventual assessment options may not be equal.

The students can declare their preferred assessment type until the date of the written examination.

The students who fail the course will be given a second opportunity at the end of the academic year to do so. Their academic achievements will be re-evaluated, both with a written exam (theoretical knowledge) and a review of their engineering project looking for improvement or changes. The weights are the same they were committed to, according to their choice.

Any assigned grade will only be valid during the academic year where it is awarded.

Sources of information

Basic Bibliography

D. Boneh, V. Shoup, **A graduate course in applied cryptography**, http://toc.cryptobook.us, 2018

Complementary Bibliography

O. Goldreich, **Foundation of cryptography, vol. I**, Cambridge University Press, 2007

O. Goldreich, **Foundation of cryptography, vol. ii**, Cambridge University Press, 2009

J. Katz, Y. Lindell, **Introduction to modern cryptography**, 2, CRC Press, 2015

A. Menezes, P. van Oorschot, S. Vanstone., **Handbook of applied cryptography**, CRC Press, 2001

C. Dwork, A. Roth, **The algorithmic foundations of differential privacy**, NOW Publishers, 2014

W. Mazurczyk, S. Wenzel, S. Zander, A. Houmansadr, K. Szczypiorski, **Information hiding in communications networks: Fundamentals, mechanisms, applications, and countermeasures**, Wiley, 2016

I. Cox, M. Miller, J. Bloom, J. Fridrich, T. Kolker, **Digital watermarking and steganography**, 2, Morgan Kaufmann, 2008

A. El-Gamal, Y. Kim, **Network Information Theory**, Cambridge University Press, 2011

Recommendations

Other comments

The course is given in English. Ability for mathematical reasoning is highly recommended.

Contingency plan

Description

In the event that the teaching activities ought to be canceled or interrupted due to public health situations, all the activities in this course will be carried out online (lectures, exams, assignments), and will retain the sane weighs as those listed in other parts of this teaching guide.

IDENTIFYING DATA				
Secure Communications				
Subject	Secure Communications			
Code	V05M175V01103			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Rodríguez Rubio, Raúl Fernando			
Lecturers	Fernández Iglesias, Diego Rodríguez Pérez, Miguel Rodríguez Rubio, Raúl Fernando			
E-mail	rrubio@det.uvigo.es			
Web				
General description	This subject reviews the layers of the Internet communications architecture, showing its main weaknesses from a security point of view and providing the necessary techniques and tools to mitigate them. Students will acquire a detailed understanding of the network protocols that provide security for the transmission of information, and the implications derived from the place they occupy within the networking architecture.			

Competencies	
Code	
CB2	Students will be able to apply their knowledge and their problem-solving ability in new or less familiar situations, within a broader context (or in multi-discipline contexts) related to their field of specialization.
CB4	Students will learn to communicate their conclusions ---and the hypotheses and ultimate reasoning in their support--- to expert and non-expert audiences in a clear and unambiguous way.
CB5	Students will apprehend the learning skills enabling them to study in a style that will be self-driven and autonomous to a large extent.
CG1	To have skills for analysis and synthesis. To have ability to project, model, calculate and design solutions in the area of information, network or system security in every application area.
CG3	Capacity for critical thinking and critical evaluation of any system designed for protecting information, any information security system, any system for network security or system for secure communications.
CG5	Students will have ability to apply theoretical knowledge to practical situations, within the scope of infrastructures, equipment or specific application domains, and designed for precise operating requirements
CE1	To know, to understand and to apply the tools of cryptography and cryptanalysis, the tools of integrity, digital identity and the protocols for secure communications.
CE2	Deep knowledge of cyberattack and cyberdefense techniques.
CE4	To understand and to apply the methods and tools of cybersecurity to protect data and computers, communication networks, databases, computer programs and information services.
CE8	Skills for conceive, design, deploy and operate cybersecurity systems.
CT4	Ability to ponder the importance of information security in the economic progress of society.
CT5	Ability for oral and written communication in English.

Learning outcomes	
Learning outcomes	Competences
To understand that other protocols, being auxiliary (not related to the world of security), present exploitable vulnerabilities; and will be able to describe the most common attacks that try to take advantage of them, and some possible countermeasures	CB5 CE4 CT4 CT5
Knowing which solution / protocol is appropriate to ensure a specific scene	CB5 CG1 CG3 CG5 CE1 CE2 CE4 CT4 CT5

To know the solutions providing security to certain network services and/or universally used applications	CB5 CE2 CE8 CT4 CT5
To be able to configure the tools (software packages) that the different operating systems / platforms provide to secure communications.	CB2 CB5 CG5 CT4 CT5
To acquire the ability to write technical reports justifying the suitability of a cybersecurity solution for a given problem or scene	CB4 CG1 CG3

Contents	
Topic	
Internet architecture and protocols	Fundamental concepts
Link level security	Wired security/Ethernet networks: Access control and port-based authentication Confidentiality in Ethernet networks Wireless Security/WiFi networks: WPA/2/3: Personal & Enterprise security
Network level security	IPsec security protocols IPsec dynamic key management IPsec authentication mechanisms
Securing Internet infrastructure	Routing protocols security DNS security TCP security
Data transmission security	The TLS protocol Cryptographic suites WebPKI infrastructure Certificate validation
Mobile networks security	System architecture Association and authentication of the user/terminal Privacy

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	21	21	42
Laboratory practical	19	19	38
Practices through ICT	0	58	58
Essay questions exam	2	0	2
Report of practices, practicum and external practices	0	10	10
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	Master sessions follow the usual scheme for this type of teaching. In these sessions the CG3, CE1, CE2, CE4, CE8 competences are worked out
Laboratory practical	There will be several practical sessions guided by the teachers where the concepts learned in the theoretical classes will get entrenched. Such practices, will use network devices (routers and switches) and / or virtualization software that will allow students to learn and practice at home. The practices to be considered will be sized to be approachable during their respective classroom sessions; although any student that needs so will be able to reproduce them at home with free virtualization software that will allow them to virtualize the behaviour of the network hardware used in the laboratory. Students will acquire competencies CB2, CB4, CG1, CG3, CG5, CE1, CE4, CE8
Practices through ICT	Beyond the guided practices, the student will have to deploy / configure / implement some specific solutions, for certain scenarios, in an autonomous way. In these activities CB2, CB4, CB5, CG1, CG3, CG5, CE1, CE4, CE8 are worked out.

Personalized assistance	
Methodologies	**Description**

Lecturing	During the office hours teachers will provide personalized attention to strengthen or guide students in the understanding of the theoretical concepts explained in the lectures or practical demonstration sessions; and to correct or reorient the small optional practical works derived from said laboratory classes.
Laboratory practical	This activity is interactive by definition, so it is expected that questions will flow naturally between teachers and students, and may involve other students in the answers.
Practices through ICT	Although the autonomous work is targeted to make students solve situations / challenges to be found in real systems on their own, during office hours, teachers will guide them by questioning the chosen solutions or suggesting alternative paths.

Assessment

	Description	Qualification	Evaluated Competencess			
Laboratory practical	They will be qualified as apt / unfit. Students will pass them if they attend all sessions of this type. If for some reason they miss any, they must do some complementary practical that teachers will establish. In some of the sessions / activities the student may be asked for an additional autonomous work (and its associated report) that will be quantitatively evaluated within the more general element called "Autonomous practices through ICT".	0	CB2 CB4 CB5	CG5	CE4 CE8	CT4 CT5
Practices through ICT	Students must perform, in presence of the teachers, a practical demonstration showing the resolution of the different technical challenges posed, and face questions about the adopted solutions and their degree of completeness. This defense/interview will take place, in a general way, after the delivery deadline of the last ordered task, and before the beginning of the official exams period in the corresponding call, and its definite date will be agreed on time between students and teachers. Every challenge or autonomous activity will require a written report, whose structure, composition and readability will affect final mark.	40	CB2 CB4 CB5	CG5	CE1 CE4 CE8	CT4 CT5
Essay questions exam	A written exam will be carried out at the end of the semester, where the theoretical concepts taught in the lectures are evaluated, as well as the practical foundations derived from the classes / practical work carried out.	60	CB4		CE1 CE2 CE4	CT4
Report of practices, practicum and external practices	The student's autonomous work should be reported appropriately with pertinent docs whose evaluation will be part of the more general evaluation of the documented task.	0	CB4	CG1 CG3		CT4 CT5

Other comments on the Evaluation

The evaluation of the subject can either follow a continuous assessment strategy (EC) or a single assessment one (EU). The students choose EC if they deliver the solution to the first challenge or autonomous work that they must attend during the course. The percentages expressed in the previous section only reflect the maximum mark obtainable in each type of test in the EC modality; and they are only indicative. The detailed evaluation form is expressed below:

For EC (first call), the final grade will be the weighted geometric mean between the autonomous work grade (TA, 40%) and the corresponding grade for the essay questions exam (E, 60%). The grade of TA will be the arithmetic mean of the marks obtained in each of the challenges / autonomous practical that students have to solve during the semester.

FINAL GRADE (EC) = (TA ^ 0.4) × (E ^ 0.6)

If the laboratory practices assessment is unfit, the grade will be the minimum between the written test score (E) and 3.

Students who choose EU must take a final exam consisting of three parts: a written test analogous to the continuous assessment test (E), a proficiency test in the laboratory and one or more practical tasks (T). The final grade, in this case, is the weighted geometric mean between the theory grade (E, 80%) and practical work (T, 20%), with the condition that the aptitude test is passed. For any student that fails the aptitude test, the final grade will be the minimum between E and 3.

FINAL GRADE (EU) = (T ^ 0.2) × (E ^ 0.8)

Finally, for the second call (June / July), students will be able to continue with the evaluation mode that they had already chosen (keeping the mark of the part -E or TA / T- that they had passed), facing only the failed part - though with possible modifications in the specifications of the practical works; or they may choose to follow EU doing just a final exam as the one just described. The aptitude test will only be necessary if they did not attend all laboratory sessions.

Sources of information

Basic Bibliography

I. Ristic, **Bulletproff SSL and TLS, ser. Computers/Security**, London: Fesity Duck, 2015

A. Liska and G. Stowe, **DNS Security: Defending the Domain Name System**, Boston: Syngress, 2016

Yago Fernández Hansen, Antonio Angel Ramos Varón, Jean Paul García-Moran Maglaya, **RADIUS / AAA / 802.1x**, RA-MA Editorial, 2008
Graham Bartlett, Amjad Inamdar, **IKEv2 IPsec Virtual Private Networks: Understanding and Deploying IKEv2, IPsec VPNs, and FlexVPN in Cisco IOS**, CISCO PRESS, 2016

Complementary Bibliography

D. J. D. Touch, **Defending TCP Against Spoofing Attacks**, IETF, 2007
R. R. Stewart, M. Dalal, and A. Ramaiah, **Improving TCP□s Robustness to Blind In-Window Attacks**, IETF, 2010
D. J. Bernstein, **SYN cookies**,
P. McManus, **Improving syncookies**, 2008
C. Pignataro, P. Savola, D. Meyer, V. Gill, and J. Heasley, **The Generalized TTL Security Mechanism (GTSM)**, IETF, 2007
D. J. D. Touch, R. Bonica, and A. J. Mankin, **The TCP Authentication Option**, IETF, 2010
S. Rose, M. Larson, D. Massey, R. Austein, and R. Arends, **DNS Security Introduction and Requirements**, IETF, 2005
R. Arends, R. Austin, M. Larson, D. Massey, S. Rose, **Resource Records for the DNS Security Extensions**, IETF, 2005
R. Arends, R. Austein, M. Larson, D. Massey, S. Rose, **Protocol Modifications for the DNS Security Extensions**, IETF, 2005
Cloudflare Inc., **How DNSSEC works**,
P. E. Hoffman and P. McManus, **DNS Queries over HTTPS (DOH)**, IETF, 2018
E. Jones and O. L. Moigne, **OSPF security vulnerabilities analysis**, IETF, 2006
M. Khandelwal and R. Desetti, **OSPF security: Attacks and defenses**, 2016
J. Durand, I. Pepelnjak, and G. Doering, **BGP operations and security**, IETF, 2015
R. Kuhn, K. Sriram, and D. Montgomery, **Border gateway protocol security**, NIST, 2007
C. Pelsser, R. Bush, K. Patel, P. Mohapatra, and O. Maennel, **Making route flap damping usable**, IETF, 2014
Y. Rekhter, J. Scudder, S. S. Ramachandra, E. Chen, and R. Fernando, **Graceful restart mechanism for BGP**, IETF, 2007
IEEE 802.1 Working Group, **IEEE Std 802.1X - 2010. Port-Based Network Access Control**, IEEE Computer Society, 2010
Security Task group of IEEE 802.1, **IEEE Std 802.1AE. Medium Access Control Security**, IEEE Computer Society, 2018
S. Kent, K. Seo, **Security Architecture for the Internet Protocol**, IETF, 2005
S. Kent, **IP Authentication Header**, IETF, 2005
S. Kent, **IP Encapsulating Security Payload**, IETF, 2005
C. Kaufman, P. Hoffman, Y. Nir, P. Eronen, T. Kivinen, **Internet Key Exchange Protocol Version 2 (IKEv2)**, IETF, 2014
J. Cichonski, J. M. Franklin, M. Bartock, **Guide to LTE Security**, NIST Special Publication 800-187,

Recommendations

Subjects that it is recommended to have taken before

Secure Networks/V05M175V01105
Information Security/V05M175V01102

Contingency plan

Description

It is not foreseen that it will be necessary to make any change in the teaching planning of the subject. All the planned tasks can be carried out remotely with the equipment that the students normally have.

IDENTIFYING DATA

Applications Security

Subject	Applications Security			
Code	V05M175V01104			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	Spanish			
Department				
Coordinator	López Nores, Martín			
Lecturers	Bellas Permuy, Fernando López Nores, Martín Losada Pérez, José			
E-mail	mlnores@det.uvigo.es			
Web	http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614530&assignatura=614530005&any_academic=2018_19&idioma_assig=cast			
General description	Developing secure applications is not an easy task. Knowledge of the vulnerabilities that usually affect applications, the techniques of authentication, authorization and access control, as well as the incorporation of security into the development life cycle, is essential to be able to build and maintain applications successfully. In this course, all these aspects are studied in a practical way, with special emphasis on the development of web applications and services.			

Competencies

Code

Learning outcomes

Learning outcomes	Competences

Contents

Topic

Planning

	Class hours	Hours outside the classroom	Total hours

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description

Personalized assistance

Assessment

Description	Qualification	Evaluated Competencess

Other comments on the Evaluation

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained

* Teaching methodologies modified

* Non-attendance mechanisms for student attention (tutoring)

* Modifications (if applicable) of the contents

* Additional bibliography to facilitate self-learning

* Other modifications

=== ADAPTATION OF THE TESTS ===
* Tests already carried out
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Pending tests that are maintained
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Tests that are modified
[Previous test] => [New test]

* New tests

* Additional Information

IDENTIFYING DATA

Secure Networks

Subject	Secure Networks			
Code	V05M175V01105			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Rodríguez Pérez, Miguel			
Lecturers	Nóvoa de Manuel, Francisco Javier Rodríguez Pérez, Miguel Rodríguez Rubio, Raúl Fernando			
E-mail	miguel@det.uvigo.gal			
Web	http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614530&assignatura=614530006&any_academic=2018_19&idioma_assig=cast			
General description	(*)A materia Redes Seguras ten como obxectivo principal que os estudantes aprendan a deseñar e implementar infraestruturas de rede capaces de proporciona-los servizos de seguridade precisos nun contorno corporativo moderno. Deberán coñecer as arquitecturas de seguridad de referencia e seren quen de configuralas en mantelas, utilizando para iso tecnoloxías como VPN, IDS/IPS e Firewalls entre outros. A materia esta concebida para que as prácticas de laboratorio, con equipos físicos e virtuáis teñan unha importancia capital no proceso de aprendizaxe			

Competencies

Code

Learning outcomes

Learning outcomes	Competences

Contents

Topic

Planning

	Class hours	Hours outside the classroom	Total hours

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description

Personalized assistance

Assessment

Description	Qualification	Evaluated Competencess

Other comments on the Evaluation

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained

* Teaching methodologies modified

* Non-attendance mechanisms for student attention (tutoring)

* Modifications (if applicable) of the contents

* Additional bibliography to facilitate self-learning

* Other modifications

=== ADAPTATION OF THE TESTS ===
* Tests already carried out
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Pending tests that are maintained
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Tests that are modified
[Previous test] => [New test]

* New tests

* Additional Information

IDENTIFYING DATA				
Internship practice				
Subject	Internship practice			
Code	V05M175V01106			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	15	Mandatory	2nd	1st
Teaching language	Spanish			
Department				
Coordinator	Marcos Acevedo, Jorge			
Lecturers	Marcos Acevedo, Jorge			
E-mail	acevedo@uvigo.es			
Web	http://www.munics.es/			
General description	(*)La misión del máster es formar profesionales de alta cualificación en todos los procesos técnicos, organizativos, operativos y forenses relativos a la seguridad digital. El profesorado pertenece a las áreas de Ingeniería Telemática, Teoría de la Señal y Comunicaciones, Ciencias de la Computación e Inteligencia Artificial, Ingeniería de Sistemas y Derecho Penal de las dos universidades, y se complementa con la contribución de destacados profesionales de empresas del sector en Galicia y el compromiso de éstas en apoyar las prácticas de los estudiantes.			

Competencies	
Code	
CB1	To possess and understand the knowledge that provides the foundations and the opportunity to be original in the development and application of ideas, frequently in a research context.
CB2	Students will be able to apply their knowledge and their problem-solving ability in new or less familiar situations, within a broader context (or in multi-discipline contexts) related to their field of specialization.
CB3	Students will be able to integrate diverse knowledge areas, and address the complexity of making statements on the basis of information which, notwithstanding incomplete or limited, may include thoughts about the ethical and social responsibilities entailed to the application of their professional capabilities and judgements.
CB4	Students will learn to communicate their conclusions ---and the hypotheses and ultimate reasoning in their support--- to expert and non-expert audiences in a clear and unambiguous way.
CB5	Students will apprehend the learning skills enabling them to study in a style that will be self-driven and autonomous to a large extent.
CG1	To have skills for analysis and synthesis. To have ability to project, model, calculate and design solutions in the area of information, network or system security in every application area.
CG2	Ability for problem-solving. Ability to solve, using the acquired knowledge, specific problems in the technical field of information, network or system security.
CG3	Capacity for critical thinking and critical evaluation of any system designed for protecting information, any information security system, any system for network security or system for secure communications.
CG4	Ethical commitment. Ability to design and deploy engineering systems and management systems with ethical and responsible criteria, based on deontological behaviour, in the field of information, network or communications security
CG5	Students will have ability to apply theoretical knowledge to practical situations, within the scope of infrastructures, equipment or specific application domains, and designed for precise operating requirements
CG6	Ability to do research. Ability to innovate and contribute to the advance of the principles, the techniques and the processes within their professional domain, designing new algorithms, devices, techniques or models which are useful for the protection public, private or commercial of digital assets.
CE1	To know, to understand and to apply the tools of cryptography and cryptanalysis, the tools of integrity, digital identity and the protocols for secure communications.
CE2	Deep knowledge of cyberattack and cyberdefense techniques.
CE3	Knowledge of the legal and technical standards used in cybersecurity, their implications in systems design, in the use of security tools and in the protection of information.
CE4	To understand and to apply the methods and tools of cybersecurity to protect data and computers, communication networks, databases, computer programs and information services.
CE5	To design, deploy and operate a security management information system based on a referenced methodology.
CE6	To develop and apply forensic research techniques for analysing incidents or cybersecurity threats.
CE7	To demonstrate ability for doing the security audit of systems, equipment, the risk analysis related to security weaknesses, and for developing de procedures for certification of secure systems.
CE8	Skills for conceive, design, deploy and operate cybersecurity systems.
CE9	Ability to write clear, concise and motivated projects and work plans in the field of cybersecurity.
CE10	Knowledge of the mathematical foundations of cryptography. Ability to understand their evolution and future developments.
CE11	Ability to collect and interpret relevant data in the field of computer and communications security.

CE12	Knowledge of the role of cybersecurity in the design of new industrial processes, as well as of the singularities and restrictions to be addressed in order to build a secure industrial infrastructure.
CE13	Ability for analysing, detecting and eliminating software vulnerabilities and malware capable to exploit those in systems or networks.
CE14	Ability to develop a continuity business plan on the guidelines of commonly accepted norms and standards.
CE15	Ability to identify the value of information for an institution, economic or of other sort; ability to identify the critical procedures in an institution, and the impact due to their disruption; ability to identify the internal and external requirements that guarantee readiness upon security attacks.
CE16	Ability for envisioning and driving the business operations in areas related to cybersecurity, with feasible monetization.
CE17	Ability to plan a time schedule containing the detection periods of incidents or disasters, and their recovery.
CE18	Ability to correctly interpret the information sources in the discipline of criminal law (laws, doctrine, jurisprudence) both at the national and international levels.
CE19	To learn how to identify the best professional profiles for an institution as a functions of its features and activity sector.
CE20	Knowledge about the firms specialized in cybersecurity in the region.
CT1	Ability to apprehend the meaning and implications of the gender perspective in the different areas of knowledge and in the professional exercise, with the aim of attaining a fairer and more egalitarian society.
CT2	Ability for oral and written communication in Galician language.
CT3	Ability to include sustainability principles and environmental concerns in the professional practice. To integrate into projects the principle of efficient, responsible and equitable use of resources.
CT4	Ability to ponder the importance of information security in the economic progress of society.
CT5	Ability for oral and written communication in English.

Learning outcomes

Learning outcomes	Competences
Experience in the practice of the cybersecurity profession and its usual functions in some real company environment	CB1 CB2 CB3 CB4 CB5 CG1 CG2 CG3 CG4 CG5 CG6 CE1 CE2 CE3 CE4 CE5 CE6 CE7 CE8 CE9 CE10 CE11 CE12 CE13 CE14 CE15 CE16 CE17 CE18 CE19 CE20 CT1 CT2 CT3 CT4 CT5

Contents

Topic
The student will make a stay in the company developing own functions of a Master in Ciberseguridad

Planning

	Class hours	Hours outside the classroom	Total hours
Practicum, External practices and clinical practices	375	0	375

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Practicum, External practices and clinical practices	Stay in companies developing own functions of a Master in Ciberseguridad

Personalized assistance

Methodologies	Description
Practicum, External practices and clinical practices	The students will have a tutor in the company and a tutor in the University, to those who the students will be able to consult doubts on the activity to develop and to those who will have to present the results of the work made.

Assessment

	Description	Qualification	Evaluated Competencess
Practicum, External practices and clinical practices	The evaluation will make it the tutor in the University in function of the memory of the work made in the company and of the evaluation of the student by part of the tutor in the company.	100	

Other comments on the Evaluation

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Contingency plan

Description

=== ADAPTATION OF THE METHODOLOGIES ===
* Educational Methodologies that keep
Any because the subject consists of the permanence in a company developing activities adapted to the degree

* Educational Methodologies that modify
All. The subject sewed in the stay in the company of the student during a time. In the case that the teaching was exclusively no face-to-face, the practice in the company only will be able to make if it does in the remote.

* Modifications (if they proceed) of the contents to give
There are no changes

* Additional Bibliography to facilitate the self-learning
There are not

* Other modifications
There are not more modifications

=== ADAPTATION OF THE EVALUATION ===
Unchanged

IDENTIFYING DATA				
Master´s Thesis				
Subject	Master´s Thesis			
Code	V05M175V01107			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	15	Mandatory	2nd	1st
Teaching language	Spanish Galician English			
Department				
Coordinator	Gil Castiñeira, Felipe José			
Lecturers	Gil Castiñeira, Felipe José			
E-mail	felipe@uvigo.es			
Web	http://munics.es			
General description	The Master Thesis (TFM) is an academic work, personal and original that is presented in public and that is evaluated by a panel. It is a project where the student has to show the knowledge acquired during the master studies. It must conclude with a written dissertation including explanations, theories, ideas, reasonings, description of developments or designs, etc. It should address a topic chosen by the student, and supervised by a director or directors, that will care for its progression and its quality. Nonetheless, the Master Thesis is the responsibility of the aspirant to the title of Master.			

Competencies	
Code	
CB1	To possess and understand the knowledge that provides the foundations and the opportunity to be original in the development and application of ideas, frequently in a research context.
CB2	Students will be able to apply their knowledge and their problem-solving ability in new or less familiar situations, within a broader context (or in multi-discipline contexts) related to their field of specialization.
CB3	Students will be able to integrate diverse knowledge areas, and address the complexity of making statements on the basis of information which, notwithstanding incomplete or limited, may include thoughts about the ethical and social responsibilities entailed to the application of their professional capabilities and judgements.
CB4	Students will learn to communicate their conclusions ---and the hypotheses and ultimate reasoning in their support--- to expert and non-expert audiences in a clear and unambiguous way.
CB5	Students will apprehend the learning skills enabling them to study in a style that will be self-driven and autonomous to a large extent.
CG1	To have skills for analysis and synthesis. To have ability to project, model, calculate and design solutions in the area of information, network or system security in every application area.
CG2	Ability for problem-solving. Ability to solve, using the acquired knowledge, specific problems in the technical field of information, network or system security.
CG3	Capacity for critical thinking and critical evaluation of any system designed for protecting information, any information security system, any system for network security or system for secure communications.
CG4	Ethical commitment. Ability to design and deploy engineering systems and management systems with ethical and responsible criteria, based on deontological behaviour, in the field of information, network or communications security
CG5	Students will have ability to apply theoretical knowledge to practical situations, within the scope of infrastructures, equipment or specific application domains, and designed for precise operating requirements
CG6	Ability to do research. Ability to innovate and contribute to the advance of the principles, the techniques and the processes within their professional domain, designing new algorithms, devices, techniques or models which are useful for the protection public, private or commercial of digital assets.
CE1	To know, to understand and to apply the tools of cryptography and cryptanalysis, the tools of integrity, digital identity and the protocols for secure communications.
CE2	Deep knowledge of cyberattack and cyberdefense techniques.
CE3	Knowledge of the legal and technical standards used in cybersecurity, their implications in systems design, in the use of security tools and in the protection of information.
CE4	To understand and to apply the methods and tools of cybersecurity to protect data and computers, communication networks, databases, computer programs and information services.
CE5	To design, deploy and operate a security management information system based on a referenced methodology.
CE6	To develop and apply forensic research techniques for analysing incidents or cybersecurity threats.
CE7	To demonstrate ability for doing the security audit of systems, equipment, the risk analysis related to security weaknesses, and for developing de procedures for certification of secure systems.
CE8	Skills for conceive, design, deploy and operate cybersecurity systems.
CE9	Ability to write clear, concise and motivated projects and work plans in the field of cybersecurity.

CE10	Knowledge of the mathematical foundations of cryptography. Ability to understand their evolution and future developments.
CE11	Ability to collect and interpret relevant data in the field of computer and communications security.
CE12	Knowledge of the role of cybersecurity in the design of new industrial processes, as well as of the singularities and restrictions to be addressed in order to build a secure industrial infrastructure.
CE13	Ability for analysing, detecting and eliminating software vulnerabilities and malware capable to exploit those in systems or networks.
CE14	Ability to develop a continuity business plan on the guidelines of commonly accepted norms and standards.
CE15	Ability to identify the value of information for an institution, economic or of other sort; ability to identify the critical procedures in an institution, and the impact due to their disruption; ability to identify the internal and external requirements that guarantee readiness upon security attacks.
CE16	Ability for envisioning and driving the business operations in areas related to cybersecurity, with feasible monetization.
CE17	Ability to plan a time schedule containing the detection periods of incidents or disasters, and their recovery.
CE18	Ability to correctly interpret the information sources in the discipline of criminal law (laws, doctrine, jurisprudence) both at the national and international levels.
CE19	To learn how to identify the best professional profiles for an institution as a functions of its features and activity sector.
CE20	Knowledge about the firms specialized in cybersecurity in the region.
CT1	Ability to apprehend the meaning and implications of the gender perspective in the different areas of knowledge and in the professional exercise, with the aim of attaining a fairer and more egalitarian society.
CT3	Ability to include sustainability principles and environmental concerns in the professional practice. To integrate into projects the principle of efficient, responsible and equitable use of resources.
CT4	Ability to ponder the importance of information security in the economic progress of society.
CT5	Ability for oral and written communication in English.

Learning outcomes

Learning outcomes	Competences
Capacity for planning and executing an original work in the cybersecurity field.	CB1 CB2 CB3 CB4 CB5
Capacity for finding relevant information in the cybersecurity field, for its study and analysis, and the retrieval of relevant results.	CG1 CG3 CG5 CG6 CT1 CT3 CT4 CT5

Resolution of original problems with real implications in the cybersecurity field.	CB1 CB2 CB3 CG1 CG2 CG3 CG4 CG5 CG6 CE1 CE2 CE3 CE4 CE5 CE6 CE7 CE8 CE9 CE10 CE11 CE12 CE13 CE14 CE15 CE16 CE17 CE18 CE19 CE20 CT1 CT3 CT4 CT5
Elaboration of a project report that summarizes the state of the art, the analyzed problematic, the objectives, the completed work, the conclusions and the future lines.	CB1 CB3 CB4 CG1 CG2 CG6
Presentation of a summary of the main results in front of a public jury.	CB4 CT1 CT4

Contents

Topic
he Master's Thesis is an academic, personal and original work in which the student has to show the knowledge obtained during the master. Therefore, the content of each work must be unique. Nevertheless, it must show the ability of the student to analyze a problem in a systematic way, propose solutions, analyze the results obtained and expose them clearly.

Planning

	Class hours	Hours outside the classroom	Total hours
Mentored work	0	350	350
Presentation	1	24	25

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description

Mentored work	The student will complete an academic, personal and original work in which he will have to show the knowledge obtained during the master. It must conclude with a set of written explanations, theories, ideas, reasoning, description of developments or designs, etc. on a subject chosen by the student, and supervised by a tutor or tutors, who will ensure the correct progression and the quality level.

Personalized assistance

Methodologies	Description
Mentored work	During the Master's Thesis there will be periodic meetings between the student and the tutors to define, orient, supervise and delimit the work, as well as to orient the writing of the dissertation.

Tests	Description
Presentation	The directors of the work will guide the student in the preparation of the presentation of the work at the end of the master's degree.

Assessment

	Description	Qualification	Evaluated Competencess
Mentored work	The work will be evaluated by a panel. The student will provide a written dissertation, and will make a public presentation. The panel will use a rubric that will be publicly available.	100	

Other comments on the Evaluation

Sources of information

Basic Bibliography

Complementary Bibliography

Manuel Ruiz-de-Luzuriaga-Peña, **Guía para citar y referenciar. Estilo IEEE**, Universidad Pública de Navarra, 2016

Recommendations

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
To public presentation will be performed using videoconferencing tools.

There are no other changes in the subject.

IDENTIFYING DATA				
Principles and Law in Cybersecurity				
Subject	Principles and Law in Cybersecurity			
Code	V05M175V01201			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	3	Mandatory	1st	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	Rodríguez Vázquez, Virgilio			
Lecturers	Faraldo Cabana, Patricia Rodríguez Vázquez, Virgilio			
E-mail	virxilio@uvigo.es			
Web				
General description	This subject will address the rules relating to cybersecurity. A criminological study of the main computing crimes will be carried out. The central block consists of a systematic review of the regulation of the computing crimes contained in the Spanish Criminal Code. Analysis will also be made of the case law existing in this subject.			

Competencies	
Code	
CB3	Students will be able to integrate diverse knowledge areas, and address the complexity of making statements on the basis of information which, notwithstanding incomplete or limited, may include thoughts about the ethical and social responsibilities entailed to the application of their professional capabilities and judgements.
CE3	Knowledge of the legal and technical standards used in cybersecurity, their implications in systems design, in the use of security tools and in the protection of information.
CE8	Skills for conceive, design, deploy and operate cybersecurity systems.
CT1	Ability to apprehend the meaning and implications of the gender perspective in the different areas of knowledge and in the professional exercise, with the aim of attaining a fairer and more egalitarian society.
CT5	Ability for oral and written communication in English.

Learning outcomes	
Learning outcomes	Competences
Students will be able to integrate diverse knowledge areas, and address the complexity of making statements on the basis of information which, notwithstanding incomplete or limited, may include thoughts about the ethical and social responsibilities entailed to the application of their professional capabilities and judgements.	CB3
Knowledge of the legal and technical standards used in cybersecurity, their implications in systems design, in the use of security tools and in the protection of information.	CE3
Skills for conceive, design, deploy and operate cybersecurity systems.	CE8
Ability to apprehend the meaning and implications of the gender perspective in the different areas of knowledge and in the professional exercise, with the aim of attaining a fairer and more egalitarian society.	CT1
Ability for oral and written communication in English.	CT5

Contents	
Topic	
1. Introduction to the law on cybersecurity. Review of the rules on computer and risk management.	1.1. EU regulations. 1.2. The Law of National Security: the strategy of national security and the diagram of national security. 1.3. Regulation (EU) 2016/679 of 27 April 2016, General Data Protection Regulation. The Organic Law of Data Protection and the developmental Regulation. 1.4. Computing crimes in the Criminal Code.
2. Criminological approach to computing.	2.1. Statistical sources: main national and international organisms, crimes. 2.2. Analysis of the main reports on cybersecurity. 2.3. Identification of the main technological resources used.

3. Cybersecurity breaches through criminal conduct.	3.1. Definition: computing crimes and cybercrime. 3.2. The use of ICT to commit crimes and when ICT is the goal of the crime. 3.3. The Spanish Criminal Code, LO 10/1995, of 23 November, European Directive 2013/40/UE of the European Parliament and of the Council, of 12 August 2013, on attacks against information systems, Agreement on cybersecurity or Agreement of Budapest, of the Council of Europe, of 23 November 2001.
4. The main crimes that affect cybersecurity.	4.1. Crimes of discovering and disclosing secrets (I). Frequent risks: ransomware and the theft of information. 4.2. Crimes of discovering and disclosing secrets (II). Access and interception. The access to files or computer, electronic or telematic media. Special attention to the manager of the files or media. The interception of transmissions of computing data. The use of malware (virus, spyware...). 4.3. Crimes of discovering and disclosing of secrets (III). Producing, purchasing, importing or facilitating programs to commit the crimes listed above, or computer passwords or access codes. 4.4. Crimes against privacy and an individual□s right to their own image: the undue use of cookies. 4.5. Crimes against property (I). Scams committed via computer. Producing, possessing or facilitating computer programs used for this purpose. 4.6. Crimes against property (II). Fraud using a third-party telecommunication signal. Use of telecommunication terminal without the owner□s consent. 4.7. Crimes against property (III). Damages to computing data, computing programs or electronic documents. Damages to computing systems. Damages to computing systems of a critical infrastructure (brief reference to the operators of critical infrastructure, to the operator□s security plans and to the of specific protection plans). Hindering or interrupting the functioning of a third-party computing system. Manufacturing, possessing or facilitating to third parties computing programs to be used for this purpose. Special reference to the criminal liability of legal persons. 4.8. Crimes against intellectual and industrial property. Through the provision of information society services or through an Internet access portal. 4.9. Crimes relating to the market and to consumers. Discovering company secrets through the use of ICT. Intelligible access to a radio or television broadcast, to remote interactive services via electronic channels. 4.10. Crimes against public faith: electronic lies.
5. Crimes committed against persons using communication techniques.	5.1. Crimes against freedom. Threats using social networks or other ICT. Cyber stalking. 5.2. Crimes against the sexual freedom and indemnity. Child grooming and child pornography. 5.3. Crimes against intimacy and privacy. 5.4. Crimes against honour. Harming a person□s digital reputation.
6. Cyberterrorism.	6.1. Concept. 6.2. Computing crimes carried out with the specific purpose of art. 573 of the Criminal Code. 6.3. Crime of collaborating with a terrorist group or organisation through the provision of technological services.
7. Crimes relating to national Defence and others.	Brief approximation.
8. Analysis of Spanish caselaw in relation to computing crimes.	8.1. Special attention to the caselaw of the Supreme court. 8.2. Agreements of the non-jurisdictional plenary of the Second Chamber of the Supreme Court relating to computing crimes. 8.3. The Prosecution Service and the Prosecutor□s Office specialising in computer criminality.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	13	32	45
Laboratory practical	5	22	27
Objective questions exam	2	0	2
Problem and/or exercise solving	1	0	1

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies	
	Description
Lecturing	Presentation by the teacher of the contents of the subject under study, theoretical and / or guidelines for the work, exercise or project to be developed by the student.
Laboratory practical	Activities to apply knowledge to specific situations and basic skills acquisition and procedures related to the matter to be studied. Special areas are developed with specialized equipment (scientific and technical laboratories, computer rooms, etc.).

Personalized assistance	
Methodologies	**Description**
Lecturing	The students will have lectures as shown on the timetable published on the website for the Master□s Degree. It will be able to attended, previous appointment -by email-, or well through email or well through virtual dispatch in the remote campus-integrates of the University of Vigo.
Laboratory practical	The students will have lectures as shown on the timetable published on the website for the Master□s Degree. It will be able to attended, previous appointment -by email-, or well through email or well through virtual dispatch in the remote campus-integrates of the University of Vigo.

Assessment					
	Description	Qualification	Evaluated Competencess		
Objective questions exam	The continuous assessment system will consist of three written examinations first two will focus on partial objective tests(objective questions exam, multiple choice, referred to in this part of the Guide), and the third, will focus on "problem solving" (referred to in the following part of the guide). The multiple choice □objective questions□ exam: - will be held throughout the course, during the lecture timetable.. The timetable for the different intermediate assessment tests will be approved by the Comisión Académica de Máster Interuniversitario (CAMI) and will be available at the beginning of each academic term. - each examination will comprise the part of the program that is indicated at the start of the term by the subject coordinator. - they will consist of a multiple choice test, with 0 to 2.5 points for each of them. Correct answers will be worth 0.1 and 0.05 will be deducted for each incorrect answer. Answers left blank will not score anything. - Both exams together will be worth 50% of the final mark, with the remaining 50% corresponding to the □problem solving□ (described in the following section). To pass the subject under the continuous assessment system the mark from the three exams, based on the weighting above, needs to be equal to or greater than 5. Those who attend the first partial test (the first multiple choice objective questions exam), thereby expressing their interest in being included in the continuous assessment system, will be assessed according to the criteria stated above and will not be entitled to be assessed by the final exam system that corresponds to 100% of the marks for the subject. Therefore, if a student takes the first partial exam, it is not possible to abandon the continuous assessment system. If a student takes the first partial exam and then does not take the next partial exam(s), they will score 0 points for this/these exam(s).	50	CB3	CE3 CE8	CT1

Problem and/or exercise solving	The continuous assessment system will consist of three written examinations: the first two will focus on partial objective tests (objective questions exam, multiple choice, referred to in the previous part of the guide exercise, and the third will focus on "problem solving" (referred to in this part of the guide). The examination corresponds to "problem solving": - it will be held on the official date of the ordinary announcement of the final exam: first opportunity, according to the official schedule approved by the Academic Commission of the Master's Degree for the 2019-2020 academic year - It will consist of solving one or several practical cases and will be marked with a score of 0 to 5 points - The problems posed by the practical cases may affect the issues covered in the course syllabus. - It will be worth 50% of the final mark, with the remaining 50% corresponding to the two multiple choice objective questions exams. To pass the subject under the continuous assessment system, the mark from the three exams, based on the weighting above, needs to be equal to or greater than 5. Those who attend the first partial test (the first multiple choice objective questions exam), thereby expressing their interest in being included in the continuous assessment system, will be assessed according to the criteria stated above and will not be entitled to be assessed by the final exam system that corresponds to 100% of the marks for the subject. Therefore, if a student takes the first partial exam, it is not possible to abandon the continuous assessment system. If a student takes the first partial exam and then does not take the next partial exam(s), they will score 0 points for this/these exam(s).	50	CB3 CE3 CE8	CT1 CT5

Other comments on the Evaluation

1. FIRST OPPORTUNITY

a) CONTINUOUS ASSESSMENT SYSTEM described in the sections above.

b) FINAL EXAM SYSTEM

For those who do not choose the continuous assessment system, the subject assessment will consist of a single final exam, on the date established in the official schedule approved by the Academic Commission of the Master's Degree for the 2019-2020 academic year.

The exam will cover the whole syllabus and will be worth 100% of the mark for the subject. It will consist of two parts, a theory part and a practical part, which will both be worth 0 to 5 points each. The theory part will consist of a multiple choice test, in which correct answers will be worth twice as much as the points deduced for incorrect answers. Any answers left blank will not score anything. The practical part will consist of solving one or several practical cases. The final mark for the exam will be obtained by adding together the marks obtained in each of the parts. To pass the subject students must obtain a minimum of 5 points after adding the marks from both parts together.

2. SECOND OPPORTUNITY AND EXTRAORDINARY EXAM

The subject assessment will consist of a single final exam, on the date established in the official schedule approved by the Academic Commission of the Master's Degree for the 2019-2020 academic year.

The exam will cover the whole syllabus and will be worth 100% of the mark for the subject. It will consist of two parts, a theory part and a practical part, which will both be worth 0 to 5 points each. The theory part will consist of a multiple choice test, in which correct answers will be worth twice as much as the points deduced for incorrect answers. Any answers left blank will not score anything. The practical part will consist of solving one or several practical cases. The final mark for the exam will be obtained by adding together the marks obtained in each of the parts. To pass the subject students must obtain a minimum of 5 points after adding the marks from both parts together.

Sources of information

Basic Bibliography

DE LA CUESTA ARZAMANDI, José Luis (dir.), **Derecho penal informático**, 1.ª, Civitas, 2010

LUZÓN PEÑA, Diego-Manuel (dir.), **Código Penal**, 5.ª, Reus, 2017

Complementary Bibliography

BARONA VILAR, Silvia, **Justicia civil y penal en la era global**, 1.ª, Tirant lo Blanch, 2017

BARRIO ANDRÉS, Moisés, **Ciberdelitos : amenazas criminales del ciberespacio : adaptado reforma Código Penal 2015**, 1.ª, Reus, 2017

CRESPO SANCHÍS, Carolina (coord.), **Fraude electrónico : panorámica actual y medios jurídicos para combatirlo**, 1.ª, Civitas, 2013

CRUZ DE PABLO, José Antonio, **Derecho penal y nuevas tecnologías : aspectos sustantivos : adaptado a la reforma operada en el Código penal por la Ley orgánica 15-2003 de 25 de noviembre, especial referencia al arículo 286 CP**, 1.ª, Difusión Jurídica y Temas de actualidad, 2006

CUERDA ARNAU, María Luisa (coord.), **Menores y redes sociales : ciberbullying, ciberstalking, cibergrooming, pornografía, sexting, radicalización y otras formas de violencia en la red**, 1.ª, Tirant lo Blanch, 2016

DAVARA RODRÍGUEZ, Miguel Ángel, **Manual de derecho informático**, 11.ª, Thomson-Aranzadi, 2015

DE NOVA LABIÁN, Alberto José, **Delitos contra la propiedad intelectual en el ámbito de Internet : especial referencia a los sistemas de intercambio de archivos**, 1.ª, Dykinson, 2010

DE URBANO CASTRILLO, Eduardo et al., **Delincuencia informática : tiempos de cautela y amparo**, 1.ª, Aranzadi, 2012

FARALDO CABANA, Patricia, **Las Nuevas tecnologías en los delitos contra el patrimonio y el orden socioeconómico**, 1.ª, Tirant lo Blanch, 2009

FERNÁNDEZ TERUELO, Javier Gustavo, **Cibercrimen, los delitos cometidos a través de Internet : estafas, distribución de pornografía infantil, atentados contra la propiedad intelectual, daños informáticos, delitos contra la intimidad y ot**, 1.ª, Constitutio Criminalis Carolina, 2017

FLORES PRADA, Ignacio, **Criminalidad informática : (aspectos sustantivos y procesales)**, 1.ª, Tirant lo Blanch, 2012

GALÁN MUÑOZ, Alfonso, **El Fraude y la estafa mediante sistemas informáticos : análisis del artículo 248.2 C.P**, 1.ª, Tirant lo Blanch, 2005

GIANT, Nikki, **Ciberseguridad para la i-generación : usos y riesgos de las redes sociales y sus aplicaciones**, 1.ª, Narcea, 2016

GÓMEZ RIVERO, M.ª del Carmen (dir.), **Nociones fundamentales de Derecho penal. Parte especial. Volumen I**, 2.ª, Tecnos, 2015

GÓMEZ RIVERO, M.ª del Carmen (dir.), **Nociones fundamentales de Derecho penal. Parte especial. Volumen II**, 2.ª, Tecnos, 2015

GÓMEZ TOMILLO, Manuel, **Responsabilidad penal y civil por delitos cometidos a través de Internet : especial consideración del caso de los proveedores de contenidos, servicios, acceso y enlaces**, 2.ª, Thomson-Aranzadi, 2006

GONZÁLEZ CUSSAC, José Luis (coord.), **Derecho penal. Parte especial**, 5.ª, Tirant lo Blanch, 2016

GONZÁLEZ CUSSAC, José Luis/CUERDA ARNAU, M.ª Luisa (dirs.), **Nuevas amenazas a la seguridad nacional : terrorismo, criminalidad organizada y tecnologías de la información y la comunicación**, 1.ª, Tirant lo Blanch, 2013

GOODMAN, Marc, **Future crimes : inside the digital underground and the battle for our connected world**, 1.ª, Pegasus Books, 2016

HILGENDORF, Eric, **Computer- und Internetstrafrecht : ein Grundriss**, 1.ª, Springer, 2005

Instituto Español de Estudios Estratégicos, Grupo de Trabajo número 03/10, **Ciberseguridad : retos y amenazas a la seguridad nacional en el ciberespacio**, 1.ª, Ministerio de Defensa, Dirección General de Relaci, 2011

LUZÓN PEÑA, Diego-Manuel, **Lecciones de Derecho penal. Parte general**, 3.ª, Tirant lo Blanch, 2016

MARZILLI, Alan, **The Internet and crime**, 1.ª, Chelsea House, 2010

MATA Y MARTÍN, Ricardo M., **Estafa convencional, estafa informática y robo en el ámbito de los medios electrónicos de pago : el uso fraudulento de tarjetas y otros instrumentos de pago**, 1.ª, Thomson-Aranzadi, 2007

MORÓN LERMA, Esther, **Internet y derecho penal : "hacking" y otras conductas ilícitas en la red**, 2.ª, Aranzadi, 2002

MUÑOZ CONDE, Francisco/GARCÍA ARÁN, Mercedes, **Derecho penal. Parte general**, 9.ª, Tirant lo Blanch, 2015

ORENES, Eduardo, **Ciberseguridad familiar : cyberbullying, hacking y otros peligros en Internet**, 1.ª, Círculo Rojo, 2013

ORTS BERENGUER, Enrique/ROIG TORRES, Margarita, **Delitos informáticos y delitos comunes cometidos a través de la informática**, 1.ª, Tirant lo Blanch, 2001

QUERALT JIMÉNEZ, Joan Josep, **Derecho penal español. Parte especial**, 7.ª, Tirant lo Blanch, 2015

QUINTERO OLIVARES, Gonzalo (dir.), **Comentarios a la Parte especial del Derecho penal**, 10.ª, Aranzadi, 2016

RALLO LOMBARTE, Artemi, **El derecho al olvido en Internet : Google**, 1.ª, Centro de Estudios Políticos y Constitucionales, 2014

RODRÍGUEZ MESA, M.ª José, **Los delitos de daños**, 1.ª, Tirant lo Blanch, 2017

ROMEO CASABONA, Carlos M.ª (coord.), **El Cibercrimen : nuevos retos jurídico-penales, nuevas respuestas político-criminales**, 1.ª, Comares, 2006

RUEDA MARTÍN, M.ª Ángeles, **Protección penal de la intimidad personal e informática : (los delitos de descubrimiento y revelación de secretos de los artículos 197 y 198 del Código penal)**, 1.ª, Atelier, 2004

SAIN, Gustavo, **Delitos informáticos : investigación criminal, marco legal y peritaje**, 1.ª, B de f, 2017

SÁINZ PEÑA, Rosa M.ª (coord.), **Ciberseguridad, la protección de la información en un mundo digital**, 1.ª, Fundación Telefónica, Ariel, 2016

SEGURA SERRANO, Antonio/GORDO GARCÍA, Fernando (coords.), **Ciberseguridad global : oportunidades y compromisos en el uso del ciberespacio**, 1.ª, Universidad de Granada, 2013

SILVA SÁNCHEZ, Jesús María (dir.)/RAGUÉS I VALLÉS, Ramón (coord.), **Lecciones de Derecho penal: Parte especial**, 5.ª, Atelier, 2018

SINGER, Peter Warren, **Cybersecurity and cyberwar : what everyone needs to know**, 1.ª, Oxford University Press, 2014

TOURIÑO, Alejandro, **El derecho al olvido y a la intimidad en Internet**, 1.ª, Los Libros de la Catarata, 2014

VALLS PRIETO, Javier, **Problemas jurídico penales asociados a las nuevas técnicas de prevención y persecución del crimen mediante inteligencia artificial**, 1.ª, Dykinson, 2017

VELASCO NÚÑEZ, Eloy (dir.), **Delitos contra y a través de las nuevas tecnologías : ¿cómo reducir su impunidad?**, 1.ª, Consejo General del Poder Judicial,Centro de Docu, 2006

VELASCOS SAN MARTÍN, Cristos, **La jurisdicción y competencia sobre delitos cometidos a través de sistemas de cómputo e internet**, 1.ª, Tirant lo Blanch, 2012

WALDEN, Ian, **Computer crimes and digital investigations**, 1.ª, Oxford University Press, 2007

Recommendations

Subjects that it is recommended to have taken before

Management of Information Security/V05M175V01101

Contingency plan

Description

=== EXCEPTIONAL MEASURES SCHEDULED ===
In front of it uncertain and unpredictable evolution of the sanitary alert caused by the COVID- 19, the University establishes join extraordinary planning that will actuate in the moment in that the administrations and the institution determine it attending to criteria of security, health and responsibility, and guaranteeing the course in a scenario non presential or no totally presential. These already scheduled measures guarantee, in the moment that was prescriptive, the development of the course of a way but effective when being known beforehand (or with a wide advance) pole students and the teaching staff through the tool normalized and institutionalized of the teaching guides DOCNET.

=== ADAPTATION OF The METHODOLOGIES ===
There are not changes. Telematic platform of and virtual classroom and office.

=== ADAPTATION OF The EVALUATION ===
There are not changes. Telematic platform of and virtual classroom and office.

IDENTIFYING DATA				
Hardening of Operating Systems				
Subject	Hardening of Operating Systems			
Code	V05M175V01202			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	5	Mandatory	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Lorenzo Veiga, Beatriz			
Lecturers	Lorenzo Veiga, Beatriz Yáñez Izquierdo, Antonio Fermín			
E-mail	blorenzo@gti.uvigo.es			
Web	http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614530&assignatura=614530007&any_academic=2018_19&idioma_assig=eng			
General description	A newly installed Operating system is inherently insecure. It has a certain number of vulnerabilities, depending on such things such as the age of the O.S., the amount of services it provides, the existence of initial backdoors not already patched, and the use of default policies designed without security in mind By Hardening Operating Systems we refer to the act of configuring an operating system with the aim of making it as secure as possible, so thet we minimize the risk of getting it compromised. This usually implies applying patches, changing default O.S. policies, and removing (or disabling) non-essential aplications and/or services. In this course we'll try to identify common O.S. vulnerabilities and how to defend the O.S. against them. Both UNIX (linux) and Windows type O.S. will be considered.			

Competencies
Code

Learning outcomes	
Learning outcomes	Competences

Contents
Topic

Planning			
	Class hours	Hours outside the classroom	Total hours

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies
Description

Personalized assistance

Assessment		
Description	Qualification	Evaluated Competencess

Other comments on the Evaluation

Sources of information
Basic Bibliography
Complementary Bibliography

Recommendations

Contingency plan
Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained

* Teaching methodologies modified

* Non-attendance mechanisms for student attention (tutoring)

* Modifications (if applicable) of the contents

* Additional bibliography to facilitate self-learning

* Other modifications

=== ADAPTATION OF THE TESTS ===
* Tests already carried out
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Pending tests that are maintained
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Tests that are modified
[Previous test] => [New test]

* New tests

* Additional Information

IDENTIFYING DATA				
Intrusion tests				
Subject	Intrusion tests			
Code	V05M175V01203			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	5	Mandatory	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Costa Montenegro, Enrique			
Lecturers	Carballal Mato, Adrián Costa Montenegro, Enrique			
E-mail	kike@gti.uvigo.es			
Web	http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614530&assignatura=614530008&any_academic=2018_19&idioma_assig=cast			
General description	No hay una mejor forma de probar la fortaleza de un sistema que atacarlo. Los Test de Intrusión sirven para reproducir intentos de acceso de un atacante valiéndose de las vulnerabilidades que puedan existir en una determinada infraestructura. En este curso se cubrirán los temas fundamentales orientados a los test de intrusión (pentesting) cubriendo las distintas fases de un ataque y explotación (desde el reconocimiento y el control de acceso hasta el borrado de huellas)			

Competencies
Code

Learning outcomes	
Learning outcomes	Competences

Contents
Topic

Planning			
	Class hours	Hours outside the classroom	Total hours

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies
Description

Personalized assistance

Assessment		
Description	Qualification	Evaluated Competencess

Other comments on the Evaluation

Sources of information
Basic Bibliography
Complementary Bibliography

Recommendations

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes

an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained

* Teaching methodologies modified

* Non-attendance mechanisms for student attention (tutoring)

* Modifications (if applicable) of the contents

* Additional bibliography to facilitate self-learning

* Other modifications

=== ADAPTATION OF THE TESTS ===
* Tests already carried out
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Pending tests that are maintained
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Tests that are modified
[Previous test] => [New test]

* New tests

* Additional Information

IDENTIFYING DATA				
Malware Analysis				
Subject	Malware Analysis			
Code	V05M175V01204			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	5	Mandatory	1st	2nd
Teaching language	English			
Department				
Coordinator	Burguillo Rial, Juan Carlos			
Lecturers	Burguillo Rial, Juan Carlos Rivas López, Jose Luis			
E-mail	jrial@uvigo.es			
Web	http://http://faitic.uvigo.es			
General description	Malware uses the systems and the communication networks to disseminate virus, hijack devices or steal confidential data. The aim of this subject is to provide the student the capability to analyze, detect and erase malware. To achieve that, we will explore and evaluate, practically and with case studies, the techniques used nowadays to hide malware, together with the new tendencies to detect it and eliminate it. This subject will be taught in English.			

Competencies	
Code	
CB1	To possess and understand the knowledge that provides the foundations and the opportunity to be original in the development and application of ideas, frequently in a research context.
CG1	To have skills for analysis and synthesis. To have ability to project, model, calculate and design solutions in the area of information, network or system security in every application area.
CE8	Skills for conceive, design, deploy and operate cybersecurity systems.
CE11	Ability to collect and interpret relevant data in the field of computer and communications security.
CE13	Ability for analysing, detecting and eliminating software vulnerabilities and malware capable to exploit those in systems or networks.
CT4	Ability to ponder the importance of information security in the economic progress of society.
CT5	Ability for oral and written communication in English.

Learning outcomes	
Learning outcomes	Competences
The student will learn to analyze, detect and erase malware in systems and networks.	CG1 CE11 CE13 CT5
The student will learn to detect and fight against techniques used to hide and to provide persistence to malware in systems and networks.	CB1 CG1 CE8 CE11 CE13 CT5
The student will analyze systems and networks to detect and correct vulnerabilities that can be used by malware.	CG1 CE8 CE11 CE13 CT5
The student will learn the malware nowadays trends and the experience obtained from relevant case studies.	CB1 CG1 CT4 CT5

Contents	
Topic	
Introduction to malware analysis and engineering.	a) What is malware? b) How to detect and erase it? c) What is malware engineering?

Malware types and definitions.	a) Estructure. b) Components. c) Infection vectors.
Malware Engineering.	a) Propagation techniques. b) Infection processes. c) Malware persistence. d) Hiding techniques.
Reverse malware engineering.	a) How to analyze and infer malware behavior? b) Understanding how new malware types work.
Tools for malware analysis.	a) Tools for malware detection. b) Tools for malware erasing.

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	2	2	4
Lecturing	10	30	40
Laboratory practical	15	40	55
Discussion Forum	0	2	2
Case studies	5	4	9
Objective questions exam	2	4	6
Problem and/or exercise solving	3	6	9
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Introductory activities	We start doing a general introduction to the aims, the global contents of the subject and the expected outcomes. This activity will be performed individually.
Lecturing	We describe the different subject topics, giving the teaching material needed to follow them. Through this methodology the competencies CB1, CG1, CE8, CE11, CE13, CT4 and CT5 are developed. This activity will be performed individually.
Laboratory practical	Students must perform a set of practices in the lab to better understand the contents explained along the master lessons. Through this methodology the competencies CG1, CE8, CE11, CE13 and CT5 are developed. Some practices will be performed individually and others in groups (depending on the number of students).
Discussion Forum	Students must participate in the subject forum within TEMA at FAITIC. Through this methodology the competencies CE8, CE11, CE13 and CT5 are developed. This activity will be performed individually.
Case studies	Along master lessons students will present case studies about threads, security problems already known and nowadays technologies. Through this methodology the competencies CG1, CE11, CE13 and CT5 are developed. This activity can be performed individually or in groups of two people.

Personalized assistance	
Methodologies	**Description**
Introductory activities	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Lecturing	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.

Case studies	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Laboratory practical	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.
Discussion Forum	In the practical formative activities and tutoring, the professors of the subject will offer personal guidance to each student in the tasks to be performed, with the aim to orient the approach and the methodology. Also they will offer coordination information with other contents and subjects of the study program. It is recommended to consult the doubts with the teachers along the course in order to improve the understanding of the basic concepts, and for performing the tasks and activities to be evaluated.

Assessment

	Description	Qualification	Evaluated		Competencess	
Laboratory practical	Students will perform a set of practices at the lab, where they work with the concepts studied along the master lessons.	45	CB1	CG1	CE8 CE11 CE13	CT5
Discussion Forum	Students must participate in the subject forum available at TEMA in FAITIC.	5	CB1	CG1	CE11 CE13	CT4 CT5
Case studies	Students will provide presentations about case studies, selected by them, in order to analyze nowadays threads.	15		CG1	CE11 CE13	CT5
Objective questions exam	Two evaluation tests will be performed along the subject for the partial contents provided in the subject. Tests will be filled individually and time limited	30	CB1	CG1	CE11 CE13	CT5
Problem and/or exercise solving	Along master lessons, the teacher will ask questions to the students to test their knowledge level in the discussed topics.	5	CB1		CE11 CE13	CT5

Other comments on the Evaluation

The elements that are part of the evaluation of the subject are the following:

- **Questionnaires**: along the course the student will fill two questionnaires that will contribute 15% to the final mark (each one).

- **Presentation of case studies**: each student has to provide an original presentation, which contributes with a 15% to the final mark.

- **Laboratory practice**: each student will have to perform a set of practical tasks/quizzes in the laboratory that will contribute 45% to the final mark.

- **Class participation**: students will discuss in class about expositions done by the professor, and this contributes up to a 5% to the final mark.

- **Forum participation**: students should interact individually in the forum of the subject to achieve up to a 5% to the final mark. To achieve such percentage the student should provide at least two relevant contributions.

Therefore, we have:

Final Mark = Questionnaires (2*x15% = 30%) + Case Study Presentation (15%) + Lab. Tasks (45%) + Class participation (5%) + Forum (5%) = 100%.

The students need to pass the questionnaires and the practical task with at least 4 points over 10 to calculate the average final mark. If any of the marks is below 4, then the final mark will never be higher than 4 points over 10.

The schedule of the midterm/intermediate exams will be approved in the Comisión Académica de Grado (CAG) and will be available at the beginning of each academic semester.

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Following the degree guidelines, the students that will follow this subject can choose between two possibilities: continuous or final assessment (at the end of the semester).

Continuous assessment: the student follows the continuous assessment since the moment he/she fulfills the two questionnaires. From that moment we assume that he/she will participate in the subject, independently of the assistance to the first call.

First Call: if the continuous assessment is not performed, then the student will have to perform a final exam that substitutes the questionnaires done along the course, in addition to provide the practical tasks and the equivalent work to be done as part of the continuous assessment.

Second Call: the student will have to perform the part not passed previously.

The questionnaires and tasks, proposed and performed along the module, are only valid for the current course.

Sources of information

Basic Bibliography

Michael Hale Ligh, Andrew Case, Jamie Levy, Aaron Walters, **The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory**, 1, John Wiley & Sons Inc, 2014

Michael Sikorski / Andrew Honig, **Practical Malware Analysis**, 1, William Pollock, 2012

Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously

Forensic Analysis/V05M175V01207
Hardening of Operating Systems/V05M175V01202
Security in Mobile Devices/V05M175V01206

Subjects that it is recommended to have taken before

Applications Security/V05M175V01104

Contingency plan

Description

In the case that the teaching is exclusively remote, the classes of the subject will be developed in a similar way, but using the platforms provided by the University.

Virtual classes will be taught weekly through the Remote Campus, both in the theoretical sessions (groups A) and in the practical sessions (groups B). In this second case, the students will perform the practices using their personal computers or the virtual infrastructure of the laboratory.

The means enabled for the resolution of the doubts raised by the students will include online consultation forums and tutorials in the teacher's virtual office.

The remote assessment of the subject will be governed by the conditions described in the teaching guide for the face-to-face teaching modality, including the same number of tests, identical weighting and minimum grades. The theoretical and practical exams will be carried out virtually, using the platforms provided by the University.

IDENTIFYING DATA				
Security as a Business				
Subject	Security as a Business			
Code	V05M175V01205			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	3	Mandatory	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Fernández Vilas, Ana			
Lecturers	Carneiro Díaz, Victor Manuel Fernández Vilas, Ana			
E-mail	avilas@det.uvigo.es			
Web	http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614530&assignatura=614530010&any_academic=2020_21&idioma_assig=cast			
General description	Security Business addresses the necessary competencies to understand the operation of a Security Operation Center (SOC), from a technological, operational and intelligence point of view. The infrastructure, organization, operation and metrics mechanisms necessary for the business exploitation of the services associated with a SOC will be deepened. Different specialization environments will be studied, such as the banking sector, public administration or the military sector.			

Competencies	
Code	

Learning outcomes	
Learning outcomes	Competences

Contents	
Topic	

Planning			
	Class hours	Hours outside the classroom	Total hours

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies	
	Description

Personalized assistance

Assessment		
Description	Qualification	Evaluated Competencess

Other comments on the Evaluation

Sources of information
Basic Bibliography
Complementary Bibliography

Recommendations

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained

* Teaching methodologies modified

* Non-attendance mechanisms for student attention (tutoring)

* Modifications (if applicable) of the contents

* Additional bibliography to facilitate self-learning

* Other modifications

=== ADAPTATION OF THE TESTS ===
* Tests already carried out
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Pending tests that are maintained
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Tests that are modified
[Previous test] => [New test]

* New tests

* Additional Information

IDENTIFYING DATA				
Security in Mobile Devices				
Subject	Security in Mobile Devices			
Code	V05M175V01206			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	Spanish Galician English			
Department				
Coordinator	López Bravo, Cristina			
Lecturers	Fernández Caramés, Tiago Manuel López Bravo, Cristina Rivas López, Jose Luis			
E-mail	clbravo@det.uvigo.es			
Web	http://faitic.uvigo.es			
General description	This course presents a general view of security in mobile devices with different characteristics. Based on the study of the architecture of these devices, we will discover their internal operation and which are the main security tools that they include, along with the risks and threats they suffer. We will study how to find, analyze and mitigate the vulnerabilities that affect mobile devices, using forensic analysis tools, secure application development and device management in business environments. The documentation of this course will be in English.			

Competencies	
Code	
CB2	Students will be able to apply their knowledge and their problem-solving ability in new or less familiar situations, within a broader context (or in multi-discipline contexts) related to their field of specialization.
CB3	Students will be able to integrate diverse knowledge areas, and address the complexity of making statements on the basis of information which, notwithstanding incomplete or limited, may include thoughts about the ethical and social responsibilities entailed to the application of their professional capabilities and judgements.
CB4	Students will learn to communicate their conclusions ---and the hypotheses and ultimate reasoning in their support--- to expert and non-expert audiences in a clear and unambiguous way.
CG1	To have skills for analysis and synthesis. To have ability to project, model, calculate and design solutions in the area of information, network or system security in every application area.
CG2	Ability for problem-solving. Ability to solve, using the acquired knowledge, specific problems in the technical field of information, network or system security.
CG5	Students will have ability to apply theoretical knowledge to practical situations, within the scope of infrastructures, equipment or specific application domains, and designed for precise operating requirements
CE4	To understand and to apply the methods and tools of cybersecurity to protect data and computers, communication networks, databases, computer programs and information services.
CE6	To develop and apply forensic research techniques for analysing incidents or cybersecurity threats.
CE9	Ability to write clear, concise and motivated projects and work plans in the field of cybersecurity.
CE15	Ability to identify the value of information for an institution, economic or of other sort; ability to identify the critical procedures in an institution, and the impact due to their disruption; ability to identify the internal and external requirements that guarantee readiness upon security attacks.
CT4	Ability to ponder the importance of information security in the economic progress of society.
CT5	Ability for oral and written communication in English.

Learning outcomes	
Learning outcomes	Competences
Knowing the fundamental concepts associated with security in mobile operating systems and the development of secure apps.	CB2 CG1 CE4 CE15 CT4 CT5
Identifying an app with malicious behavior and vulnerabilities in operating systems and apps	CB4 CG2 CE4 CT4 CT5

Being able to perform a forensic analysis of a mobile device	CB3 CG2 CE6 CT5
Knowing the fundamentals of mobile device management systems	CB2 CG1 CG2 CG5 CE9 CT5

Contents	
Topic	
Introduction: Threats and vulnerabilities that affect mobile devices	
Mobile devices architectures	
Security models in mobile devices	
Writing secure Applications	Permissions Packages management Users management APIs
Data assurance	
Devices assurance	
Network assurance	
Vulnerabilities, exploits and malicious applications	
Forensic analysis of mobile operating systems	
Enterprise Mobile Management Systems (EMM)	

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	9	9	18
Practices through ICT	10	10	20
Objective questions exam	2	14	16
Problem and/or exercise solving	0	11	11
Report of practices, practicum and external practices	0	10	10
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies

	Description
Lecturing	The professors of the course present the main theoretical contents related to security in mobile devices. Through this methodology competencies CB3, CG1, CE4, CE15, and CT4 get developed.
Practices through ICT	Students will complete guided and supervised practices. Through this methodology the competencies CG2, CG5, CB2, CB4, CE4, CE6, and CE9 get developed.

Personalized assistance

Methodologies	**Description**
Practices through ICT	The professors of the course will provide individual attention to the students during the course, solving their questions. Questions will be answered during the lab sessions or during tutorial sessions. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the course website. The tutorial sessions could also be agreed with the teacher by appointment.
Lecturing	The professors of the course will provide individual attention to the students during the course, solving their questions. Questions will be answered during the master sessions or during tutorial sessions (also virtually). Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the course website. The tutorial sessions could also be agreed with the teacher by appointment.

Assessment

	Description	Qualification	Evaluated Competencess

Objective questions exam	Short-questions exam on the theoretical and practical contents reviewed throughout the course, both in the lectures and in the laboratory practices. This exam will be done at the end of the bimester.	50	CB3 CB4		CE4	
Problem and/or exercise solving	Problem-solving tests where students make use of the acquired knowledge, in both theoretical and practical sessions. This test will be carried out throughout the bimester, with partial deliveries on the dates indicated by teachers.	20	CB2 CB4	CG1 CG2	CE4	
Report of practices, practicum and external practices	Students will individually fill questionnaires and/or write practice reports, where the right development and understanding of the practice get probed.	30	CB4	CG5	CE4 CE6 CE9 CE15	CT4

Other comments on the Evaluation

FIRST CALL

Following the guidelines of the degree, two evaluation systems will be offered to students attending this course: continuous assessment and eventual assessment.

Before the end of the second week of the course, students must declare if they opt for the continuous assessment or the eventual assessment. Those who opt for the continuous assessment system may not be listed as "not presented" if they make a delivery or an assessment test after the communication of their decision.

Continuous assessment system

The final grade of the course will be equal to the weighted arithmetic average of the tests previously indicated. To pass the course the final grade must be greater or equal to five.

Eventual assessment system

The final grade of the course will be equal to the weighted arithmetic average of the tests previously indicated. In this case, the problem-solving test (troubleshooting) will be done in a single test at the end of the bimester. To pass the course the final grade must be greater or equal to five.

SECOND CALL

The assessment will consist in an objective questions exam, a problem-solving exam and delivering the practice reports of all the practices carried out throughout the course.

OTHER COMMENTS

The obtained grades are only valid for the current academic year.

The use of any material during the tests will have to be explicitly authorized.

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution.

Sources of information

Basic Bibliography

Dominic Chell, **The mobile application hacker´s handbook**, 1, Jonh Wiley & Sons, 2015

Complementary Bibliography

Joshua Drake, **Android hacker's handbook**, 1, John Wiley & Sons, 2014

Charles Miller, **iOS hacker's handbook**, 1, John Wiley & Sons, 2012

Abhishek Dubey, Anmol Misra, **Android security: attacks and defenses**, 1, CRC Press, 2013

David Thiel, **iOS application security: the definitive guide for hackers and developers**, 1, No Starch Press, 2016

Nikolay Elenkov, **Android security internals: an in-depth guide to Android's security architecture**, 1, No Starch Press, 2015

Andrew Hoog, **iPhone and iOS forensics: investigation, analysis, and mobile security for Apple iPhone, iPad, and iOS devices**, 1, Syngress/Elsevier, 2011

Andrew Hoog, **iPhone and iOS forensics: investigation, analysis, and mobile security for Apple iPhone, iPad, and iOS devices**, 1, Syngress/Elsevier, 2011

Recommendations

Other comments

It is recommended to have Linux OS and Java programming skills. It is also recommended, but not indispensable, to have Android programming skills.

Contingency plan

Description

In case of online tuition, the methodologies used and the tests performed will be the same as in the case of in-person tuition. The only expected modification is that they will be carried out via Remote Camnpus and Faitic, instead of the School classrooms and laboratories.

In case of online assessment, the weight of the different evaluation proofs would be the following:

- Objective questions exam: 30 %
- Problem and/or exercise solving: 30 %
- Report of practices: 40 %

COMPLEMENTARY REFERENCES
- Platform Architecture - Android Developers: https://developer.android.com/guide/platform/ - Android Secure: https://source.android.com/security
- Android Enterprise: https://www.android.com/enterprise/
- Mobile Threat Catalogue - NIST: https://pages.nist.gov/mobile-threat-catalogue/
- OWASP Mobile Security Project: https://www.owasp.org/index.php/OWASP_Mobile_Security_Project
- ENISA: Smartphone Secure Development Guidelines: https://www.enisa.europa.eu/publications/smartphone-secure-development-guidelines-2016
- Guía de Seguridad de las TIC CCN-STIC 453E. SEGURIDAD DE DISPOSITIVOS MÓVILES: ANDROID 9.x. Centro Criptográfico Nacional. NIPO: 083-19-015-2: https://www.ccn-cert.cni.es/pdf/guias/series-ccn-stic/400-guias-generales/3588-ccnstic-453g-guia-practica-de-seguridad-en-dispositvos-moviles-android-9/file.html
- Guía de seguridad de las TIC (CCN-STIC-457): Gestión de dispositivos móviles: https://www.ccn-cert.cni.es/series-ccn-stic/guias-de-accesopublico-ccn-stic/14-ccn-stic-457-herramienta-de-gestion-dedispositivos-moviles-mdm/file.html

IDENTIFYING DATA				
Forensic Analysis				
Subject	Forensic Analysis			
Code	V05M175V01207			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Suárez González, Andrés			
Lecturers	Suárez González, Andrés Vázquez Naya, José Manuel			
E-mail	asuarez@det.uvigo.es			
Web	http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614530&assignatura=614530012&any_academic=2020_21&any_academic=2020_21			
General description	El análisis forense de equipos consiste en la aplicación de técnicas científicas y analíticas para identificar, preservar, analizar y presentar datos que sean válidos dentro de un proceso legal. La materia "Análisis Forense de Equipos" tiene una fuerte componente práctica. Se comenzará con una introducción a este campo, explicando conceptos clave. A continuación, se estudiarán fundamentos y metodologías de análisis forense desde un punto de vista genérico y aplicable a nuevos casos, pero también se estudiarán ejemplos concretos basados en casos reales. Paralelamente, en las prácticas de laboratorio el/la alumno/a aprenderá a manejar diferentes herramientas de análisis forense y realizará prácticas simulando problemas reales.			

Competencies
Code

Learning outcomes	
Learning outcomes	Competences
New	

Contents
Topic

Planning			
	Class hours	Hours outside the classroom	Total hours

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies
Description

Personalized assistance

Assessment		
Description	Qualification	Evaluated Competencess

Other comments on the Evaluation

Sources of information
Basic Bibliography
Complementary Bibliography

Recommendations

Contingency plan
Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained

* Teaching methodologies modified

* Non-attendance mechanisms for student attention (tutoring)

* Modifications (if applicable) of the contents

* Additional bibliography to facilitate self-learning

* Other modifications

=== ADAPTATION OF THE TESTS ===
* Tests already carried out
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Pending tests that are maintained
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Tests that are modified
[Previous test] => [New test]

* New tests

* Additional Information

IDENTIFYING DATA				
Ubiquituous Security				
Subject	Ubiquituous Security			
Code	V05M175V01208			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	Spanish Galician			
Department				
Coordinator	Gil Castiñeira, Felipe José			
Lecturers	Gil Castiñeira, Felipe José Rabuñal Dopico, Juan Ramón			
E-mail	felipe@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Intelligent devices are providing new services and we are almost unaware of their presence: our car is not anymore a mechanical machine, as it became a connected device where electronics suppose an important part; in hotels, we no longer use a key as we can open our room with a card or with our mobile phone; our home thermostats can be connected to a weather forecasting service to take advantage of the temperature of the environment. Those are all examples of the applications that allow embedded technologies, wireless communication networks, and in summary, the "Internet of Things" (IoT). This subject analyzes the problems and the best practices to make this kind of systems secure.			

Competencies	
Code	
CB2	Students will be able to apply their knowledge and their problem-solving ability in new or less familiar situations, within a broader context (or in multi-discipline contexts) related to their field of specialization.
CB3	Students will be able to integrate diverse knowledge areas, and address the complexity of making statements on the basis of information which, notwithstanding incomplete or limited, may include thoughts about the ethical and social responsibilities entailed to the application of their professional capabilities and judgements.
CB4	Students will learn to communicate their conclusions ---and the hypotheses and ultimate reasoning in their support--- to expert and non-expert audiences in a clear and unambiguous way.
CG1	To have skills for analysis and synthesis. To have ability to project, model, calculate and design solutions in the area of information, network or system security in every application area.
CG2	Ability for problem-solving. Ability to solve, using the acquired knowledge, specific problems in the technical field of information, network or system security.
CG5	Students will have ability to apply theoretical knowledge to practical situations, within the scope of infrastructures, equipment or specific application domains, and designed for precise operating requirements
CE4	To understand and to apply the methods and tools of cybersecurity to protect data and computers, communication networks, databases, computer programs and information services.
CE9	Ability to write clear, concise and motivated projects and work plans in the field of cybersecurity.
CT4	Ability to ponder the importance of information security in the economic progress of society.
CT5	Ability for oral and written communication in English.

Learning outcomes	
Learning outcomes	Competences
Gain knowledge of the security in the different layers of an ubiquitous system and the used technologies.	CB2 CB3 CB4 CG1 CG2 CG5 CE4 CE9 CT4 CT5

Understand the security problems related to the ubiquitous field.	CB2 CB3 CB4 CG1 CG2 CG5 CE4 CE9 CT4 CT5
To know real cases of attacks to ubiquitous systems.	CB2 CB3 CB4 CG5 CE4 CT4 CT5

Contents	
Topic	
Physical security	Hardware components. - Communication buses. - Interfaces. - Cryptographyc hardware. Attacks.
Middleware security	Security during the startup process. Security in the operating system. Access control. Cyphering. Firmware updates.
Communication security	Wireless communications. Risks and threats for communications.
Security in the perception of the environment	Attacks in the positioning system. Attacks to sensor measurements. Privacy.

Planning			
	Class hours	Hours outside the classroom	Total hours
Project based learning	10	35	45
Lecturing	10	20	30
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Project based learning	Work in groups in the design, implementation and validation of an IoT system, with a special emphasis in the security. Perform attacks to the security of the systems implemented by the other groups or implemented by third parties. This methodology will contribute to acquire competences CB2, CB3, CB4, CG1, CG2, CG5, CE4, CE9, CT4 and CT5.
Lecturing	Professors will present the main theoretical contents related to the security for ubiquitous systems (security for embedded systems, communications and backends). This methodology will contribute to the acquisition of competences CB2, CB3, CB4, CG1, CG2, CE4 and CE9.

Personalized assistance	
Methodologies	**Description**
Lecturing	The professors of the course will provide individual attention to the students during the course, solving their doubts and questions. Questions will be answered during the master sessions or during tutorial sessions. Professors will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.

Project based learning	The professors of the course will provide individual attention to the students during the course, solving their doubts and questions. The professors will guide and help the students to complete the assigned project. Questions will be answered during the supervising sessions, group supervising sessions, or during tutorial sessions. Teachers will establish timetables for this purpose at the beginning of the course. This schedule will be published on the subject website.

Assessment

	Description	Qualification	Evaluated Competencess
Project based learning	The students will work in groups in the design, implementation and proof of an IoT, with a special emphasis in security. The same group of students will perform attacks to the security of the systems implemented by other groups or by third parties. The results (project and reports containing the outcomes of the attacks) will be evaluated after the delivery, having into account key aspects such as the correction, the quality, the performance and the functionalities. It will be mandatory to deliver the code, prototypes and documentation. It will be also necessary make a public presentation of the results. In addition, during the implementation of the project, the design and the evolution of the development will be evaluated. If the intermediate results are not satisfactory, a penalization of the 20% of the grade could be applied. The evaluation will be by group and by person: each one of the members of a team must document his/her tasks and answer the questions related to them.	80	CB2 CG1 CE4 CT4 CB3 CG2 CE9 CT5 CB4 CG5
Lecturing	Students will complete one or several exams to asses what they have learned in master lessons. In case there is more than one exam, the result will be the arithmetic mean of the different tests.	20	CB2 CG1 CE4 CB3 CG2 CE9 CB4

Other comments on the Evaluation

In order to pass the course it is necessary to complete the different parts of the subject (exam or exams about the master sessions and project). The final grade will be the **weighted geometric mean** of the grades of the different parts. For example, If "NT" is the grade obtained for the master sessions and "NP" for the project, the final grade will be:

Grade = NT^0.2 × NP^0.8

During the first month, students must provide a written declaration to opt for single evaluation. In other case, it will be considered that they opt for continuous evaluation. Students who select continuous evaluation and submit the first task or questionnaire may not be listed as "Absent".

Students who opt for the final assessment procedure have to submit also a dossier that must be defended in-person in front of the professors, with detailed information about the events and issues that arose during the execution of the different tasks, and especially the project. In addition, during the first month of the course, professors will notify students who opted for final assessment if they have to do the tutored work individually.

Second call to pass the course

Students can opt to the second call only if they didn't pass the first call (at the end of the semester).

The evaluation procedure is the presented in the previous sections, but t will be necessary to submit an additional dossier that must be defended in-person in front of the professors, with detailed information about the events and issues that arose during the execution of the different tasks, and especially the project.

Students that have opted by the continuous evaluation procedure, can decide to maintain the grades of the different parts of the subject obtained in the first call or discard them.

Other comments

Although the project will be completed (if possible) in groups, each student should keep a record of his or her activities. In the case in which the performance of a member of the group wouldn't be adequate compared with the performance of his or her team mates, he or she could be excluded from the group and/or qualified individually.

The use of any material during the tests will have to be explicitly authorized.

In case of detection of plagiarism or unethical behavior in any of the tasks/tests done, the final grade will be "failed (0)" and the professors will communicate the incident to the academic authorities to take the appropriate measures.

Sources of information

Basic Bibliography

Brian Russell, Drew Van Duren, **Practical Internet of Things Security**, 1, Packt Publishing, 2016

Complementary Bibliography

Houbing Song, Glenn A. Fink, Sabina Jeschke, **Security and Privacy in Cyber-Physical Systems. Foundations, Principles, and Applications.**, 1, Wiley, 2018

Bruce Schneider, **Applied Cryptography: Protocols, Algorithms and Source Code in C**, 2, Wiley, 2015

Adam Shostack, **Threat Modeling. Designing for Security.**, 1, Wiley, 2014

Recommendations

Subjects that it is recommended to have taken before

Hardening of Operating Systems/V05M175V01202
Secure Networks/V05M175V01105
Applications Security/V05M175V01104
Information Security/V05M175V01102
Secure Communications/V05M175V01103
Intrusion tests/V05M175V01203

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===
Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
The project learning methodology will be modified in case group work is not possible. If the group project was already started, the IoT system designed by each of the groups will be made accessible through the Internet so that the project can be completed remotely. If it has not been started, students will be offered an alternative project related to IoT security that they can complete individually (e.g. threat modelling and attack of a commercial system). If enough devices are available, they will be sent to the students. Otherwise a project will be completed using simulators or it will be limited to a theoretical analysis.

IDENTIFYING DATA				
Cybersecurity in Industrial Enviromments				
Subject	Cybersecurity in Industrial Enviromments			
Code	V05M175V01209			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Diaz-Cacho Medina, Miguel Ramón			
Lecturers	Diaz-Cacho Medina, Miguel Ramón Fernández Caramés, Tiago Manuel			
E-mail	mcacho@uvigo.es			
Web	http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614530&assignatura=614530014&any_academic=2020_21			
General description	The Industry 4.0 paradigm derived into the proliferation of industrial devices connected to networks and physical processes. This subject, besides reviewing traditional industrial systems (i.e., industrial control systems, access controls, communication and information management systems) is focused on the security of the Industry 4.0 technologies: IoT/IIoT, robotics, cloud/edge computing, augmented reality, blockchain or AGVs.			

Competencies
Code

Learning outcomes	
Learning outcomes	Competences

Contents	
Topic	
Introduction	Politics of industrial security Implications of the *ciberseguridad industrial and of critical infrastructures practical Cases
Systems of control of physical access to industrial dependencies	Systems of vicinity Systems of remote access Systems *biométricos
Systems of industrial control	Architectures of communications traditional Systems Systems *ciberfísicos
Systems of the Industry 4.0	Introduction to the Industry 4.0 Systems *IoT/*IIoT *Seguridade in other technologies 4.0 (and.G., reality increased, *cloud/*edge *computing, *blockchain, *AGVs)
Systems of management of information in industrial surroundings	Traditional databases *ERPs *PLMs Systems MONTH
Systems of industrial communications	Architecture of communications Technologies of communication wired up Technologies of wireless communication

Planning

	Class hours	Hours outside the classroom	Total hours
ICT suppoted practices (Repeated, Dont Use)	10	10	20
Mentored work	0	20	20
Lecturing	9	9	18
Objective questions exam	1	15	16

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
ICT suppoted practices (Repeated, Dont Use)	Realisation by part of the students of practices guided and supervised.
Mentored work	Realisation by part of the students of works of component so much theorist like practice.
Lecturing	Exhibition by part of the *profesorado of the main theoretical contents related with the *ciberseguridad in industrial outlines.

Personalized assistance

Methodologies	Description
ICT suppoted practices (Repeated, Dont Use)	The professors of the subject will provide individual attention and customized to the students during it study, solving his doubts and questions. Likewise, the professors will guide and will guide to the students during the realization of the tasks that have assigned, in the practical tasks and in the guided works. The doubts generated would be attended during the lessons or even during the personalized time.

Assessment

	Description	Qualification	Evaluated Competencess
ICT suppoted practices (Repeated, Dont Use)	Evaluation of the reports of realization of practices	30	
Mentored work	Evaluation Of the memory and execution of one guided work agreed with the student.	30	
Objective questions exam	Evaluation of the resulted of an examination with the contained theoretical and practical of the subject	40	

Other comments on the Evaluation

FIRST OPPORTUNITY

Two posibilities: continuous evaluation and only one evaluation.

The continuous evaluation will imply to do the laboratory practices (30%), a guided work (30%) and a mixed exam (40%). The final score has to be least 5/10. A student that delivers at least one practice will be considered that attends the continuous evaluation.

In the case of only one evaluation, the evaluation will be performed by an unique exam with theoretic and practical contents. The final score has to be at least 5/10 to pas.

The student has to choose between both alternatives before the end of the second week of lessons.

SECOND OPPORTUNITY And EXTRAORDINARY ANNOUNCEMENTS
The students that chooses the continuous evaluation have the option to hold the score of practices and guided work. The students have to pass a theoretical and practical exam. The weight of the practices, guided works and exam are the same as in the first opportunity (30,30,40).
The other students will be considered as only one evaluation and will have to realize an unique exam containing theoretical and practical parts.

OTHER COMMENTS

The scores of previous courses will not be hold.

Plagiarism at the work reports will be considered as a score of 0. The Master header will be informed.

Sources of information

Basic Bibliography

Eric Knapp, Joel Thomas Langill, **Industrial Network Security.**, Elsevier, 2014

Junaid Ahmed Zubairi, **Cyber Security Standards, Practices and Industrial Applications: Systems and Methodologies.**, IGI Global, 2012

Tyson Macaulay, **Cybersecurity for Industrial Control Systems: SCADA, DCS, PLC, HMI, and SIS.**, Auerbach Publications, 2012

Josiah Dykstra, **Essential Cybersecurity Science: Build, Test, and Evaluate Secure Systems.**, O'Reilly, 2015

Pascal Ackerman, **Industrial Cybersecurity**, Packt, 2017

Complementary Bibliography

Peng Cheng, Heng Zhang, Jiming Chen, **Cyber Security for Industrial Control Systems: From the Viewpoint of Close-Loop.**, CRC Press, 2016

Recommendations

Contingency plan

Description

=== EXCEPTIONAL MEASURES SCHEDULED ===

STAGE 1: MIXED TEACHING

Because of the exceptional situation, due the impossibility to teach in person, the teaching will be performed in an online way.

For the online teaching, we will use the tools provided by the University, at present the "Remote Campus" and FAITIC tools. Nevertheless it will be able to be complemented by using other means.

STAGE 2: TEACHING COMPLETELY ONLINE.

Because of the exceptional situation, due the impossibility to teach in person, the teaching will be perform in an online way.

All the teaching will use the tools provided by the University, at present the "Remote Campus" and FAITIC tools. Nevertheless it will be able to be complemented by using other means.

=== ADAPTATION OF THE METHODOLOGIES ===

For the laboratory practices, we will substitute the practices that require specific equipment by virtualized practices or simulated ones. Eventually, other similar practices will be proposed that are able to be performed online or at home. The practices will be able to have an autonomous format to prevent conciliation problems and/or connectivity problems..

Tutoring sessions (attention to the students) will be done using telematic tools (Email, FAITIC forums, Remote Campus), that will be complemented by using other means. In some cases an appointment will be necessary.

=== ADAPTATION OF THE EVALUATION ===

The evaluation in the case of no-presence will be done by using of on-line proofs using Remote Campus and FAITIC.

Practical works will be evaluated with a report provided by the students.

IDENTIFYING DATA

Cybersecurity Incident Management

Subject	Cybersecurity Incident Management			
Code	V05M175V01210			
Study programme	(*)Máster Universitario en Ciberseguridade			
Descriptors	ECTS Credits	Type	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Álvarez Sabucedo, Luis Modesto			
Lecturers	Álvarez Sabucedo, Luis Modesto Dafonte Vázquez, José Carlos Gómez García, Ángel			
E-mail	lsabucedo@det.uvigo.es			
Web	http://guiadocente.udc.es/guia_docent/index.php?centre=614&ensenyament=614530&assignatura=614530015&any_academic=2018_19&idioma_assig=cast&idioma_assig=cast			
General description	La gestión de incidentes de ciberseguridad se centra en manejar la proactividad para prevenir y atenuar posibles consecuencias. Se obtendrá el conocimiento necesario sobre herramientas que pueden facilitar la gestión de los incidentes y las recuperaciones, la justificación de los planes propuestos para recuperación y resiliencia, la identificación y clasificación de los posibles incidentes y la definición de los cauces para su gestión y resolución.			

Competencies

Code

Learning outcomes

Learning outcomes	Competences

Contents

Topic

Planning

	Class hours	Hours outside the classroom	Total hours

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description

Personalized assistance

Assessment

Description	Qualification	Evaluated Competencess

Other comments on the Evaluation

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Contingency plan

Description

=== EXCEPTIONAL PLANNING ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===
* Teaching methodologies maintained

* Teaching methodologies modified

* Non-attendance mechanisms for student attention (tutoring)

* Modifications (if applicable) of the contents

* Additional bibliography to facilitate self-learning

* Other modifications

=== ADAPTATION OF THE TESTS ===
* Tests already carried out
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Pending tests that are maintained
Test XX: [Previous Weight 00%] [Proposed Weight 00%]
...

* Tests that are modified
[Previous test] => [New test]

* New tests

* Additional Information