



(*)Escola de Enxeñaría de Telecomunicación

(*)Páxina web

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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 main 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

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Secretaría e Subdirección de Novas Titulacións: Pedro Rodríguez Hernández

(teleco.subdir.secretaria@uvigo.gal;teleco.subdir.novastitulacions@uvigo.gal)

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Subdirección de Calidade: Ana María Cao Paz(teleco.subdir.calidade@uvigo.gal)

BACHELOR'S DEGREE IN TELECOMMUNICATION TECHNOLOGIES ENGINEERING

Generalcoordinator: Lucía Costas Pérez (teleco.grao@uvigo.gal)

<https://teleco.uvigo.es/es/documentos/acordos-es/comisions-academicas-es/miembros-de-la-comision-academica-del-gett/>

MASTER IN TELECOMMUNICATION ENGINEERING

Generalcoordinator: Manuel García Sánchez (teleco.master@uvigo.gal)

<https://teleco.uvigo.es/es/documentos/acordos-es/comisions-academicas-es/miembros-de-la-comision-academica-del-met/>

MASTER IN CYBERSECURITY

General coordinator: Ana Fernández Vilas (teleco.munics@uvigo.gal)

<https://teleco.uvigo.es/es/documentos/acordos-es/comisions-academicas-es/miembros-de-la-comision-academica-del-munics/>

MASTER IN INDUSTRIAL MATHEMATICS

Generalcoordinator: 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/>

MASTER'S DEGREE IN QUANTUM INFORMATION SCIENCE AND TECHNOLOGIES (MQIST)

General coordinator: Javier Mas (USC)

Coordinador UVIGO: Manuel Fernández Veiga(teleco.mqist@uvigo.es)

<https://quantummastergalicia.es/info>

Máster Universitario en Visión por Computador

Subjects

Year 1st

Code	Name	Quadmester	Total Cr.
V05M185V01101	Fundamentals of image analysis and processing	1st	6
V05M185V01102	Image description and modeling	1st	6
V05M185V01103	Fundamentals of machine learning for computer vision	1st	6

V05M185V01104	Instrumentation and processing for machine vision	1st	6
V05M185V01105	Instrumentation and processing for biomedical applications	1st	6
V05M185V01201	Advanced image processing and analysis	2nd	6
V05M185V01202	Three-dimensional modeling and recognition	2nd	3
V05M185V01203	Visual recognition	2nd	6
V05M185V01204	Human action recognition	2nd	3
V05M185V01205	Advanced machine learning for computer vision	2nd	6
V05M185V01206	Photogrametrics and robot vision	2nd	6
V05M185V01207	Real time machine vision	2nd	3
V05M185V01208	Biomedical image analysis	2nd	6
V05M185V01209	Biometrics	2nd	3
V05M185V01210	External practices	2nd	3

Year 2nd

Code	Name	Quadmester	Total Cr.
V05M185V01301	Master dissertation	1st	30

IDENTIFYING DATA				
Fundamentals of image analysis and processing				
Subject	Fundamentals of image analysis and processing			
Code	V05M185V01101			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/fipa/			
General description	This subject covers the fundamental topics of image processing and analysis and is presented as the first part of another subject that introduces more advanced topics. In addition to the study and application of fundamental techniques, practical applications of these techniques will be studied to solve real problems. This course provides the necessary tools to apply the algorithms used in practical cases, as well as the bases to develop new algorithms and continue studying more advanced methods. Learning outcomes: * Understand the basic concepts and techniques of digital image processing * Understand the basic concepts and techniques of digital image analysis * Ability to apply different basic techniques to computer vision problems * Knowing how to assess the adequacy of methodologies applied to specific problems			
Training and Learning Results				
Code				
Expected results from this subject				
Expected results from this subject				Training and Learning Results
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	Training and Learning Results		
Other comments on the Evaluation				
Sources of information				
Basic Bibliography				
Complementary Bibliography				
Recommendations				

IDENTIFYING DATA				
Image description and modeling				
Subject	Image description and modeling			
Code	V05M185V01102			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	English			
Department				
Coordinator	Fernández Álvarez, Antonio			
Lecturers	Fernández Álvarez, Antonio			
E-mail	antfdez@uvigo.gal			
Web	http://https://www.imcv.eu/guide/2026-2027/idm/			
General description	The aim of this course is to become familiar with the fundamental characteristics of the digital image and its forms of representation, the description of visual content through local features of colour, shape and texture, and the practical application of these concepts to problems of image processing and analysis.			

Training and Learning Results	
Code	
A1	CB6 Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	CB7 Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study
B1	Capacity for analysis and synthesis of knowledge
B3	Ability to develop computer vision systems depending on the existent needs and apply the most suitable technological tools
C1	To know and apply the concepts, methodologies and technologies of image processing
D1	To practice the profession with a clear awareness of its human, economic, legal and ethical dimensions and with a clear commitment to quality and continuous improvement
D2	Capacity for teamwork, organization and planning

Expected results from this subject	
Expected results from this subject	Training and Learning Results
To know the fundamental characteristics of digital image and its forms of representation	A1 A2 B1 B3 C1 D1 D2
Description of visual content through local characteristics of colour, shape and texture	A1 A2 B1 B3 C1 D1 D2
To apply image modelling and representation techniques to image processing and analysis problems	A1 A2 B1 B3 C1 D1 D2

Contents	
Topic	
Image representation and modeling	Space-frequency, orientation and phase, space-scale

Wavelets and filter banks	- Wavelets - Filter banks
Image coding and reconstruction	- Coding - Reconstruction
Image descriptors	- Colour - Shape - Texture
Applications	- Image modelling applications - Image description applications

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	10	20	30
Case studies	4	16	20
Laboratory practical	16	32	48
Project based learning	10	40	50
Objective questions exam	2	0	2

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

Methodologies

	Description
Lecturing	Participatory lessons with the aim of learning the theoretical content of the subject
Case studies	Elaboration and presentation of selected state-of-the-art methodologies related to the subject
Laboratory practical	Analysis and resolution of practical cases with the aim of strengthening the practical application of the theoretical content. Practice in computer classrooms, learning based on the resolution of practical cases, autonomous work and independent study of the students, and group work and cooperative learning.
Project based learning	Learning based on the resolution of practical cases, autonomous work and independent study of the students, and group work and cooperative learning.

Personalized assistance

Methodologies	Description
Case studies	Individualized advice during case studies
Laboratory practical	Resolution of doubts during laboratory practices
Project based learning	Individualized advice during research projects

Assessment

	Description	Qualification	Training and Learning Results			
Case studies	Elaboration and presentation of works on selected state-of-the-art methodologies	15	A1 A2	B1 B3	C1	D1 D2
Laboratory practical	Analysis and resolution of practical cases with the aim of strengthening the practical application of theoretical content	40	A1 A2	B1 B3	C1	D1 D2
Project based learning	Resolution of practical cases of application of the subject through autonomous work of the student, and using the techniques learned during the course	20	A1 A2	B1 B3	C1	D1 D2
Objective questions exam	Continuous self-evaluation tests during the course. Evaluation by examination at the end of the course as an alternative.	25	A1 A2	B1 B3	C1	D1 D2

Other comments on the Evaluation

The evaluation corresponding to the objective test may be passed by means of the tests scheduled during the course or by means of the final exam.

Sources of information

Basic Bibliography

- Bovik, Alan, **The essential guide to image processing**, 1, Elsevier, 2009
- Bovik, Alan, **Handbook of image and video processing**, 2, Elsevier, 2005
- Mallat, Stephane, **A wavelet tour of signal processing: The sparse way**, 3, Elsevier, 2009
- Nixon, Mark S.; Aguado, Alberto S., **Feature extraction and image processing for computer vision**, 3, Elsevier, 2012
- Sonka, M.; Hlavac, V.; Boyle, R., **Image Processing, Analysis, and Machine Vision**, 3, Thomson Learning, 2009

Forsyth, David A.; Ponce, Jean, **Computer Vision: A Modern Approach**, 2, Pearson, 2012

Szeliski, Richard, **Computer Vision: Algorithms and Applications**, 1, Springer, 2010

Petrou, Maria; García-Sevilla, Pedro, **Image processing: Dealing with texture**, 1, Wiley, 2006

9. Mirmehdi, M.; Xie, X.; Suri, J., **Handbook of texture analysis**, 1, Imperial College Press, 2008

Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously

Fundamentals of machine learning for computer vision/V05M185V01103

Fundamentals of image analysis and processing/V05M185V01101

IDENTIFYING DATA				
Fundamentals of machine learning for computer vision				
Subject	Fundamentals of machine learning for computer vision			
Code	V05M185V01103			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/fmlcv/			
General description	The aim of the course is to present some of the topics which are at the core of modern Machine Learning, from fundamentals to state-of-the-art methods. Emphasis will be put both on the essential theory and on practical examples and lab projects. Each exercise has been carefully chosen to reinforce concepts explained in the lectures or to develop and generalize them in significant ways.			
Training and Learning Results				
Code				
Expected results from this subject				
Expected results from this subject	Training and Learning Results			
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	Training and Learning Results		
Other comments on the Evaluation				
Sources of information				
Basic Bibliography				
Complementary Bibliography				
Recommendations				

IDENTIFYING DATA				
Instrumentation and processing for machine vision				
Subject	Instrumentation and processing for machine vision			
Code	V05M185V01104			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/ipmv/			
General description	To understand the basics and fundamentals of a computer vision system for different types of sensors and their corresponding applications.			

Training and Learning Results

Code	
Expected results from this subject	
Expected results from this subject	Training and Learning Results

Contents

Topic	
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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	
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Personalized assistance

Assessment

Description	Qualification	Training and Learning Results
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Other comments on the Evaluation

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

IDENTIFYING DATA				
Instrumentation and processing for biomedical applications				
Subject	Instrumentation and processing for biomedical applications			
Code	V05M185V01105			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/ipbma/			
General description	General objectives: To introduce the student to the basic aspects of computer applications related to medical imaging.			
	Learning outcomes: Each student will demonstrate his or her ability to			
	☐ Understand the basic concepts related to the different biomedical imaging modalities and the physical factors that influence their properties.			
	☐ Know the statistical techniques currently used for the validation of biomedical applications.			
	☐ Apply different processing and analysis techniques in biomedical imaging applications.			
	☐ To learn about image recording techniques and their applications in biomedical imaging.			
Training and Learning Results				
Code				
Expected results from this subject				
Expected results from this subject	Training and Learning Results			
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	Training and Learning Results		
Other comments on the Evaluation				
Sources of information				
Basic Bibliography				
Complementary Bibliography				

Recommendations

IDENTIFYING DATA				
Advanced image processing and analysis				
Subject	Advanced image processing and analysis			
Code	V05M185V01201			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/aipa/			
General description	-Study and application of advanced digital image processing techniques.			
	-Study and application of advanced techniques of digital image analysis.			
	-Analysis of real problems, and design and development of solutions based on advanced image processing and analysis technologies.			
	-Evaluation of the adequacy of the methodologies applied in specific problems.			
	This curricular unit addresses the most advanced topics in image processing and analysis and presents itself as a sequence of a curricular unit where the fundamental topics are presented. It is designed to provide the essential foundation for students wishing to pursue research in this area. In addition to the study and application of advanced techniques of image processing and analysis, applications in this area are studied that aim to solve real problems. This approach gives students the necessary tools to apply the algorithms studied in practical cases, as well as the basis for developing new algorithms.			

Training and Learning Results	
Code	

Expected results from this subject	
Expected results from this subject	Training and Learning Results

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	
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Assessment		
Description	Qualification	Training and Learning Results

Other comments on the Evaluation	
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Sources of information	
Basic Bibliography	
Complementary Bibliography	

Recommendations	
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IDENTIFYING DATA				
Three-dimensional modeling and recognition				
Subject	Three-dimensional modeling and recognition			
Code	V05M185V01202			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/tdmr/			
General description	At the end of the course the student must understand the development of interactive graphic applications focused on polygonal modeling, volumetric image representation and ray-marching.			
Training and Learning Results				
Code				
Expected results from this subject				
Expected results from this subject				Training and Learning Results
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		Training and Learning Results	
Other comments on the Evaluation				
Sources of information				
Basic Bibliography				
Complementary Bibliography				
Recommendations				

IDENTIFYING DATA				
Visual recognition				
Subject	Visual recognition			
Code	V05M185V01203			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/vr/			
General description	Visual recognition tasks range from object detection in images and videos, object classification, and instance recognition, to human action recognition. In the course we will undertake a study of the first tasks, as action recognition is the main topic of Human Action Recogniton subject.			
	The objective is for students to acquire knowledge and skills that allow them to design systems for video motion detection, motion-based segmentation and tracking, classification and detection of objects in images and video, as well as visual tracking of objects. O obxectivo é que o alumnado adquira coñecementos e habilidades que lles permitan deseñar sistemas de detección de movemento de vídeo, segmentación e rastreamento baseados en movementos, clasificación e detección de obxectos en imaxes e vídeo, así como rastrexo visual de obxectos.			
Training and Learning Results				
Code				
Expected results from this subject				
Expected results from this subject				Training and Learning Results
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	Training and Learning Results		
Other comments on the Evaluation				
Sources of information				
Basic Bibliography				
Complementary Bibliography				
Recommendations				

IDENTIFYING DATA				
Human action recognition				
Subject	Human action recognition			
Code	V05M185V01204			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/har/			
General description	-Knowledge of recognition techniques applied to the recognition of people, and body parts. -Analysis and evaluation of human action recognition applications -Development of tools based on advanced technologies for recognition of human actions -Análisis y evaluación de aplicaciones de reconocimiento de acciones humanas -Desarrollo de herramientas basadas en tecnologías avanzadas de reconocimiento de acciones humanas			
Training and Learning Results				
Code				
Expected results from this subject				
Expected results from this subject				Training and Learning Results
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	Training and Learning Results		
Other comments on the Evaluation				
Sources of information				
Basic Bibliography				
Complementary Bibliography				
Recommendations				

IDENTIFYING DATA				
Advanced machine learning for computer vision				
Subject	Advanced machine learning for computer vision			
Code	V05M185V01205			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	2nd
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/amlcv/			
General description	The objective of this subject is to know and apply advanced neural models, to know the techniques of the state of the art of deep learning, with end-to-end training approaches, and minimizing the use of tagged data, to solve computer vision applications using the methodologies covered in the subject.			

Training and Learning Results	
Code	
A1	CB6 Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	CB7 Students should be able to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study
A5	CB10 Students should possess the learning skills to enable them to continue studying in a largely self-directed or autonomous manner.
B1	Capacity for analysis and synthesis of knowledge
B3	Ability to develop computer vision systems depending on the existent needs and apply the most suitable technological tools
B5	Ability to identify unsolved problems and provide innovative solutions
B6	Ability to identify theoretical results or new technologies with innovative potential and turn them into products and services useful to society
C2	To know and apply automatic learning and pattern recognition techniques applied to computer vision
D1	To practice the profession with a clear awareness of its human, economic, legal and ethical dimensions and with a clear commitment to quality and continuous improvement
D2	Capacity for teamwork, organization and planning

Expected results from this subject	
Expected results from this subject	Training and Learning Results
To know, apply and evaluate advanced neural models.	A1
	A2
	A5
	B1
	B3
	B5
	B6
	C2
	D1
	D2
To know deep learning techniques with end-to-end training approaches, and minimizing the use of labelled data.	A1
	A2
	A5
	B1
	B3
	B5
	B6
	C2
	D1

To solve computer vision applications using advanced machine learning methods

A1
A2
A5
B1
B3
B5
B6
C2
D1
D2

Contents

Topic

Multilayer perceptron and backpropagation
Convolutional neural networks and recurrent networks
Principles of deep learning
Self-supervised learning and autoencoders.
Advanced Neural models for computer vision.
Advanced paradigms of supervision
Selected subjects in machine learning for computer vision.
Advanced Applications in computer vision.

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practical	16	32	48
Case studies	4	16	20
Project based learning	10	40	50
Lecturing	10	20	30
Objective questions exam	2	0	2

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

Methodologies

	Description
Laboratory practical	Analysis and resolution of practical cases with the objective of reinforce the practical application of the theoretical contents. Practices in computing labs, learning based in the resolution of practical cases, autonomous work and independent study of the students, and work in group and cooperative learning.
Case studies	Elaboration and presentation of works on selected and related state of the art methodologies.
Project based learning	Learning based on the resolution of practical cases, autonomous work and independent study of the students, and group work and cooperative learning.
Lecturing	Participatory lessons aimed at learning the theoretical contents of the subject

Personalized assistance

Methodologies	Description
Laboratory practical	Resolution of doubts during laboratory practices.
Case studies	Individualized advice during the case study.
Project based learning	Individualized advice during the realization of the projects

Assessment

	Description	Qualification	Training and Learning Results			
Laboratory practical	Analysis and resolution of practical cases with the objective of affirming the practical application of theoretical contents	40	A1 A2 A5 B6	B1 B3 B5 B6	C2	D1 D2
Case studies	Elaboration and presentation of works on selected state-of-the-art methodologies	15	A1 A2 A5	B1 B3 B5 B6	C2	D1 D2

Project based learning	Resolution of practical cases of application of the subject by means of autonomous work of the student, and using the techniques learned during the course	20	A1 A2 A5	B1 B3 B5 B6	C2	D1 D2
Objective questions exam	Tests for continuous assessment during the course. Evaluation by means of a final examination of the course as an alternative	25	A1 A2 A5	B1 B3 B5 B6	C2	D1 D2

Other comments on the Evaluation

The evaluation corresponding to the objective test can be passed by means of the programmed tests during the course or by means of a final exam.

Sources of information

Basic Bibliography

Complementary Bibliography

Ian Goodfellow, Yoshua Bengio, Aaron Courville., **Deep Learning.**, MIT Press., 2017

Artigos recentes en revistas e conferencias científicas relevantes: NIPS, ICML, IJCAI, AAAI, ECML, C,

Recommendations

Subjects that are recommended to be taken simultaneously

Visual recognition/V05M185V01203

Subjects that it is recommended to have taken before

Fundamentals of machine learning for computer vision/V05M185V01103

Image description and modeling/V05M185V01102

IDENTIFYING DATA				
Photogrametrics and robot vision				
Subject	Photogrametrics and robot vision			
Code	V05M185V01206			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	Martínez Sánchez, Joaquín			
Lecturers	Balado Frías, Jesús Martínez Sánchez, Joaquín			
E-mail	joaquin.martinez@uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/prv/			
General description	In this subject students will learn to: * accurately model an image acquisition system from a geometric point of view; * apply appropriate acquisition and processing methodologies to relate multiple images to each other; * use orientation tools to obtain a three-dimensional model; * implement mapping and navigation techniques through sensor integration and the generation of multimodal vision-laser information.			

Training and Learning Results	
Code	
A1	CB6 Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A4	CB9 Students should be able to communicate their findings - and the ultimate knowledge and reasons behind them - to specialist and non-specialist audiences in a clear and unambiguous manner
A5	CB10 Students should possess the learning skills to enable them to continue studying in a largely self-directed or autonomous manner.
C1	To know and apply the concepts, methodologies and technologies of image processing
C3	To know and apply the concepts, methodologies and technologies of image and video analysis
C5	To analyze and apply state-of-the-art methods in computer vision
C6	To know and apply the fundamentals of image acquisition and machine vision systems
C9	To know and apply the concepts, methodologies and technologies for the recognition of visual patterns in real scenes
D2	Capacity for teamwork, organization and planning

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Know howto precisely modelling image acquisition systems from a geometrical point of view	A1 A4 A5 C6 C9 D2
Understand and apply the methodologies for image acquisition and processing oriented to obtain their relative orientation	A1 A4 A5 C1 C3 C5 C9 D2
Understand and apply orientation techniques aimed at obtaining local and georeferenced 3D models	A1 A4 A5 C1 C6 C9 D2

Understand and apply mapping and navigation techniques based on sensor fusion in a multimodal vision-laser system	A1 A4 A5 C1 C3 C6 C9 D2
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Contents

Topic

Photogrammetric Computer Vision. Calibration of cameras and Geometrical transformations.

Interior, Relative, Absolute orientation

Bundle Adjustment, Spatial Transformations

GeoRectification

3D Point Cloud Data Calculation and Acquisition Calculation of Point Cloud data from oriented images

Point Cloud data collection with laser scanners

Point Cloud structure and conversion

Sensor fusion of Laser Scanning and images

3D Data Analysis and processing

Geometric and radiometric analysis

Visualization

Machine Learning applied to 3D data

Advanced Techniques in Spatial Computing

Simulated Point Clouds

Visual Odometry and SLAM

Real Applications and Case Studies.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	10	20	30
Practices through ICT	25	40	65
Mentored work	0.5	20	20.5
Seminars	4	6	10
Objective questions exam	0.5	5	5.5
Problem and/or exercise solving	1	7.5	8.5
Report of practices, practicum and external practices 1		9.5	10.5

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

Methodologies

	Description
Lecturing	It will consist of the collaborative discussion of contents of the course of way.
Practices through ICT	This includes discussion and solving problems and practical case studies in the classroom. Methodology oriented to solving cases of study related with the thematic of the course using software of reference.
Mentored work	Practices and exercises focused on the implementation of the algorithms explained in the participatory classes. Specific hardware will be used in the laboratory in sessions of mandatory face-toface attendance Taking into account proposed practical case studies, this method is oriented to solving and documenting a complete photogrammetric project, including the definition of:3D data acquisition methodologies in the field, supporting data processing for modeling the main products obtained through the photogrammetric process.
Seminars	The description of a concrete practical case related with the professional practice of photogrammetry.

Personalized assistance

Methodologies	Description
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Lecturing	For all the modalities of teaching, tutorial session meetings could be held by telematic means (email, videoconference, forums in FAITIC, ...) Under the modality of previous agreement.
Practices through ICT	In the mandatory lab sessions there will be a continuous assesment of the student performance. For all the modalities of teaching, tutorial session meetings could be held by telematic means (email, videoconference, forums in FAITIC, ...) Under the modality of previous agreement.
Mentored work	For all the modalities of teaching, tutorial session meetings could be held by telematic means (email, videoconference, forums in FAITIC, ...) Under the modality of previous agreement.

Assessment						
	Description	Qualification	Training and Learning Results			
Mentored work	The students will have to complete a case of study by means of the design of a methodology that include the steps seen in the course: 1.- Objectives, Requirements and Products analysis 2.- Definition of the image acquisition networks in the case study 3.- Image processing and analysis 4.- Obtaining key photogrammetric products	40	A1 A4 A5	C1 C3 C5 C6 C9	D2	
Objective questions exam	The students will have to answer individually a test with questions about the contents of the course and the activities carried out during the semester. The exam will include an assessment that will be carried out in an oral format.	30	A1 A4 A5	C1 C3 C5 C6 C9		
Problem and/or exercise solving	The students will have to resolve of individual form and in small groups a group of cases and concrete practical exercises.	20	A1 A4 A5	C1 C3 C5 C6 C9	D2	
Report of practices, practicum and external practices	The students will have to do a presentation of the main findings from the face-to-face activities followed by a discussion and defense of the report.	10				

Other comments on the Evaluation

For more information about the tests dates and schedule please visit the webpage of the programm: <https://www.imcv.eu/>

Sources of information

Basic Bibliography

Richard Hartley, **Multiple view geometry in Computer Vision**, 2, Cambridge : Cambridge University Press, 2003

Wolfgang FörstnerBernhard P. Wrobel, **Photogrammetric Computer Vision**, Springer, 2016

Complementary Bibliography

Thomas Luhmann, **Close Range Photogrammetry**, Whittles Publishing, 2006

Karl Kraus, **Photogrammetry : geometry from images and laser scans**, 2, Berlin ; New York : Walter De Gruyter, cop., 2007

Recommendations

Subjects that are recommended to be taken simultaneously

Real time machine vision/V05M185V01207

Instrumentation and processing for machine vision/V05M185V01104

Subjects that it is recommended to have taken before

Fundamentals of image analysis and processing/V05M185V01101

Image description and modeling/V05M185V01102

IDENTIFYING DATA				
Real time machine vision				
Subject	Real time machine vision			
Code	V05M185V01207			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	Martín Herrero, Julio			
Lecturers	Martín Herrero, Julio			
E-mail	julio@uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/rtmv/			
General description	Workshop for getting acquainted with machine vision cameras and hardware, their configuration, fine tuning and how to work with them in real time.			

Training and Learning Results

Code	
A5	CB10 Students should possess the learning skills to enable them to continue studying in a largely self-directed or autonomous manner.
B3	Ability to develop computer vision systems depending on the existent needs and apply the most suitable technological tools
C6	To know and apply the fundamentals of image acquisition and machine vision systems

Expected results from this subject

Expected results from this subject	Training and Learning Results
The students will learn how to efficiently program real time acquisition and processing of images proper of machine vision applications.	A5 B3 C6

Contents

Topic	
Real time programming for machine vision	.
PC-frame-grabber communication	.
Memory management	.
Structure and usage of a typical machine vision SDK	.
Low-level programming for high speed industrial processes	.

Planning

	Class hours	Hours outside the classroom	Total hours
Workshops	75	0	75
Systematic observation	0.1	0	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
Workshops	Hands-on workshop working in pairs in the lab with a computer and machine vision hardware, using C and C++. On-site attendance is compulsory, except when any extraordinary circumstances may concur.

Personalized assistance

Methodologies	Description
Workshops	Direct access to the teacher during the work at the lab.

Assessment					
	Description	Qualification	Training and Learning Results		
Systematic observation	The teacher will follow closely the performance and progress of the students during the workshop, with timely individual feedback.	100	A5	B3	C6

Other comments on the Evaluation

This is an optional experimental subject that requires in situ attendance of the students at the lab. Attendance to each of the four in situ sessions is compulsory. The classes' schedule is published before the enrolment period. Make sure that you will be able to attend the four sessions at UVigo before you enrol in this subject. If you are working, make sure that you get a commitment in writing from your employers allowing you to attend the four scheduled sessions at UVigo before you enrol. Otherwise, DO NOT ENROL, choose another optional subject that does not require in situ attendance. Job commitments are not a recognised cause for leave of absence. Porto students please note: UPorto's general 25% leave of absence DOES NOT APPLY at UVigo. The only recognised causes for leave of absence at UVigo are the usual force majeure causes: death, serious illness, law enforcement, and acts of God, and they must be officially sanctioned by UVigo's administrative services by means of suitable documentary proof. If a leave of absence is officially sanctioned by UVigo, the evaluation of the missed session will be arranged on a case-per-case basis with consideration of the particular circumstances of the case.

Sources of information

Basic Bibliography

Davies, **Machine Vision**, 3, Elsevier, 2005

Complementary Bibliography

Several, **Webinar series**, Basler, 2020

Recommendations

Other comments

Good working knowledge of C/C++ is essential. Note that this subject requires on-site attendance at the University of Vigo in the programmed dates and times.

IDENTIFYING DATA				
Biomedical image analysis				
Subject	Biomedical image analysis			
Code	V05M185V01208			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/bmia/			
General description	-Knowledge of specific advanced techniques for biomedical image processing and analysis. -Analysis of current biomedical imaging applications, and ability to evaluate existing solutions, as well as the development of new specific solutions ☐ Evaluation of the adequacy of applied methodologies in a multidisciplinary context for biomedical environments. -Ability to write documentation and reports on scientific and technical results.			
Training and Learning Results				
Code				
Expected results from this subject				
Expected results from this subject				Training and Learning Results
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	Training and Learning Results		
Other comments on the Evaluation				
Sources of information				
Basic Bibliography				
Complementary Bibliography				
Recommendations				

IDENTIFYING DATA				
Biometrics				
Subject	Biometrics			
Code	V05M185V01209			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	2nd
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://https://www.imcv.eu/guide/2026-2027/bm/			
General description	This subject offers a general view of the biometric identification techniques based on image and video. It delves into the most common ones: face, fingerprint and iris recognition.			

Training and Learning Results	
Code	
A3	CB8 Students should be able to integrate knowledge and deal with the complexity of making judgements based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with applying their knowledge and judgements
B4	Capacity for critical analysis and rigorous evaluation of technologies and methodology
B7	Autonomous learning ability for specialization in one or more fields of study
C2	To know and apply automatic learning and pattern recognition techniques applied to computer vision
C4	To conceive, develop and evaluate complex computer vision systems
D1	To practice the profession with a clear awareness of its human, economic, legal and ethical dimensions and with a clear commitment to quality and continuous improvement
D4	Ability to understand the meaning and application of the gender perspective in the different areas of knowledge and in professional practice with the aim of achieving a more just and egalitarian society

Expected results from this subject	
Expected results from this subject	Training and Learning Results
The students will have comprised the common characteristics of the technicians of biometric identification, the evaluation metrics, the problems of practical implementation, the peculiarities of each biometric modality and the best way to combine them. Besides, they will have developed a critical analysis on the best working point for a concrete application, as well as an understanding of the peculiarities been due to demographic factors (sex, age, race, culture) in the design, development, evaluation and deployment of a solution of biometric identification.	A3 B4 B7 C2 C4 D1 D4

Contents	
Topic	
Basic principles of biometric identification	Identity versus biometric traits: Types of traits and biometric signatures. Variance intra-class and *nter-class of the biometric signatures. Influence of the sensors in the different signatures. Mathematical modelling of the biometric data: Extraction of characteristics. Compression. Representation versus Discrimination. Recognition, Identification, Verification and Authentication. Types of errors: TER, ERR, FAR, FRR.
Current biometric technologies	Physiological characteristics: fingerprints, iris, face, palm, retina, voice. Behavioural characteristics: signature (static and dynamic), keystrokes. Detection of alive sample. Pros and cons in the use of each biométric trait.
Facial recognition	Global technics (eigenfaces, fisherfaces) versus local technics (template matching, NCC, Elastic Bunch Graph Matching). The problem of the variation of illumination and pose. The problem of the detection and normalisation. Technicians of deep learning. Pros and cons.
Fingerprint recognition	Representation of minucias. Hausdorff distance. Gabor. filters. Tolerance to deformations. Types of sensors.

Iris recognition	Representation of the iris. Algorithm of Daugman. Algorithm of Wildes. Recognition at a distance. Pros and cons of iris recognition.
Multimodal recognition. Multibiometrics.	Combination of classifiers. Independent or correlated sources. Fusion of classifiers: intramodal, intermodal, algorithmic and scores-based. State of the art Systems using multimodal recognition and/or multibiometrics.

Planning

	Class hours	Hours outside the classroom	Total hours
Laboratory practical	12	0	12
Lecturing	7	20	27
Objective questions exam	1	0	1
Problem and/or exercise solving	1	0	1
Laboratory practice	0	40	40

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

Methodologies

	Description
Laboratory practical	Practices of the concepts showed in the masterclasses. They will be made with software accessible to all the students. Learning based in the resolution of practical cases and in small projects. The work will be in general autonomous and with independent study of the students. Some practices will be done in group and by means of cooperative learning. Intensive use of the virtual classroom will be implemented.
Lecturing	Participatory master classes where the contents are exposed and the pros and cons that different options would have to solve practical cases will be advanced, leaving some open questions so that the students work them and arrive to their own conclusions.

Personalized assistance

Methodologies	Description
Lecturing	During the master class the debate between the students will be forced and open questions will hang in the air.
Laboratory practical	During the face-to-face part of the practices of laboratory there will be a personalized attention to solve doubts and to help in the advances. During the asynchronous part an extensive use of the Learning Management Systems and the forums of debate will be implemented

Assessment

	Description	Qualification	Training and Learning Results
Objective questions exam	Test of short questions about the concepts studied with individual evaluation	15	A3 B4 C2 D1 D4
Problem and/or exercise solving	Examination of short problems on the concepts and practices carried out, with individual evaluation	15	A3 B4 C4
Laboratory practice	The laboratory practices will have a part that can be evaluated individually or in groups depending on the type of practice.	70	A3 B4 C2 D4 B7 C4

Other comments on the Evaluation

Sources of information

Basic Bibliography

Complementary Bibliography

Wayman, J.L., Jain, A.K., Maltoni, D., Maio, D. (Eds.), **Biometric systems. Technology, Design and Performance Evaluation**, 1, Springer, 2005

Anil Jain, Ruud Bolle y Sarta Pankanti (Eds.), **Biometrics. Personal Identification in Networked Society**, 1, Kluwer Academic Publishers, 2006

John Daugman, **How iris recognition works**, IEEE Transactions on Circuits and Systems for Vide, 2004

Recommendations

Subjects that are recommended to be taken simultaneously

Advanced machine learning for computer vision/V05M185V01205

Advanced image processing and analysis/V05M185V01201

Subjects that it is recommended to have taken before

Fundamentals of machine learning for computer vision/V05M185V01103

Fundamentals of image analysis and processing/V05M185V01101

Image description and modeling/V05M185V01102

Other comments

Big part of the material of study is based in scientific articles that will be left to student's disposal in the LMS.

IDENTIFYING DATA				
External practices				
Subject	External practices			
Code	V05M185V01210			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Mandatory	1st	2nd
Teaching language	Spanish Galician English Portuguese			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://imcv.eu			
General description	External internships should provide students with direct contact with the reality of work. Although credits are limited, students will be integrated in ongoing projects, not only to learn the flows and dynamics of teamwork in the field of computer vision, but also to try to contribute in some part of the project the knowledge acquired in the Master to date. This work should lead students to deepen in a topic related to the Master in Computer Vision, to internalize concepts, methods and techniques in the perspective of learning by doing, allowing them to develop reflection and synthesis, and to perform an applied work in the context of the area of specialization of computer vision.			

Training and Learning Results

Code

Expected results from this subject

Expected results from this subject	Training and Learning Results
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Contents

Topic

The practices will be agreed with the offering companies and with the centres of investigation (that they already have signed an agreement of collaboration), in such a way that it fulfil the requirement that the projects in which they integrate help to complete his training in some of the compulsory or elective subjects and that allow them have a direct contact with the reality of the market

- Review of the state of the art;
- Analysis of possible solutions;
- Proposed / Development of a solution;
- critical Analysis of the solution proposed / developed;

Each student will have a program of individual work in the field of the educational, defined by the tutor in the host institution and validated by the academic tutor. The main steps can include a subset of the following, in accordance with the specific needs of the project.

At the end, the student will do a written report of the work developed.

Planning

	Class hours	Hours outside the classroom	Total hours
Practicum, External practices and clinical practices	0	70	70
Report of practices, practicum and external practices	0	5	5

*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	A working plan will be agreed with the offering entities that will have to be approved by the CAM. Each student will have an academic tutor and a tutor in the company/centre of investigation that will look after the correct development of the practice. The main tasks of the work include the understanding of the problem, the formalisation of the problem, the study of appropriate methodologies, the development and design of a proposed / solution to the problem, an evaluation and a critical analysis of the results obtained, and conclusions. The External Practices will serve as adaptation of the students to the new surrounding work, or as a preamble for the realisation of the Master's thesis. In this case, more than providing solutions would look for doing proposals to develop in the Master's thesis. Plan of Contingency for alternative stages: Remote realisation of the practices could be a possibility

Personalized assistance

Methodologies	Description
Practicum, External practices and clinical practices	Each student will have an academic tutor and a tutor in the company/centre of investigation that will look after the correct development of the practice.

Assessment

	Description	Qualification	Training and Learning Results
Report of practices, practicum and external practices	System of evaluation Inform of the tutor in the external entity (60%) Report of the academic tutor (40%)	100	

Other comments on the Evaluation

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

IDENTIFYING DATA				
Master dissertation				
Subject	Master dissertation			
Code	V05M185V01301			
Study programme	Máster Universitario en Visión por Computador			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	30	Mandatory	2nd	1st
Teaching language	English			
Department				
Coordinator	Alba Castro, José Luis			
Lecturers	Alba Castro, José Luis			
E-mail	jalba@gts.uvigo.es			
Web	http://imcv.eu			
General description	The main objective of the TFM is the analysis, design, implementation and validation of a project, carried out individually, related to computer vision. It can be developed in a company or entity with proven experience in R & D & i projects, being tutored by a professional in the field. The project must provide innovation components that go beyond the simple development of an application, service or standard line of business. The TFM must promote the contribution of added value by the student in innovative projects and their direct relationship with the labor market or with some cutting-edge research aspect.			

Training and Learning Results	
Code	
A4	CB9 Students should be able to communicate their findings - and the ultimate knowledge and reasons behind them - to specialist and non-specialist audiences in a clear and unambiguous manner
B2	Ability to analyse the needs of a company in the computer vision field and determine the best technical solution for it
B3	Ability to develop computer vision systems depending on the existent needs and apply the most suitable technological tools
B4	Capacity for critical analysis and rigorous evaluation of technologies and methodology
B5	Ability to identify unsolved problems and provide innovative solutions
B6	Ability to identify theoretical results or new technologies with innovative potential and turn them into products and services useful to society
C4	To conceive, develop and evaluate complex computer vision systems
C8	To communicate and disseminate research results and conclusions
D1	To practice the profession with a clear awareness of its human, economic, legal and ethical dimensions and with a clear commitment to quality and continuous improvement
D2	Capacity for teamwork, organization and planning
D3	Development of the innovative and entrepreneurial spirit

Expected results from this subject	
Expected results from this subject	Training and Learning Results
New	A4
	B2
	B3
	B4
	B5
	B6
	C4
	C8
	D1
	D2
	D3

Contents	
Topic	

The Master's Thesis will consist of an original exercise carried out individually, consisting of a research or innovation project related to computer vision. The project may be carried out at the proposal of a company, public organization, university, research center or technology center that has signed a collaboration agreement with some of the universities participating in the master's degree or in a research group of the USC, UDC, UVigo or UPorto. In all cases, the TFM will be tutored by professors from the departments involved in the teaching of the Master, or by doctoral professors from the participating universities who have the authorization of the Interuniversity Academic Committee.

Planning

	Class hours	Hours outside the classroom	Total hours
Mentored work	29	720	749
Essay	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
Mentored work	The tutors will guide the work with face-to-face or on-line meetings.

Personalized assistance

Methodologies	Description
Mentored work	

Assessment

	Description	Qualification	Training and Learning Results			
Essay	Written work 70%	100	A4	B2	C4	D1
				B3	C8	D2
	Presentation and defense 30%			B4		D3
				B5		
				B6		

Other comments on the Evaluation

Plan of Contingency for alternative stages:

On-line meetings and final assessment can be done on-line due to exceptional causes

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

Other comments

Before the defense of the MT all the matters have to be surpassed