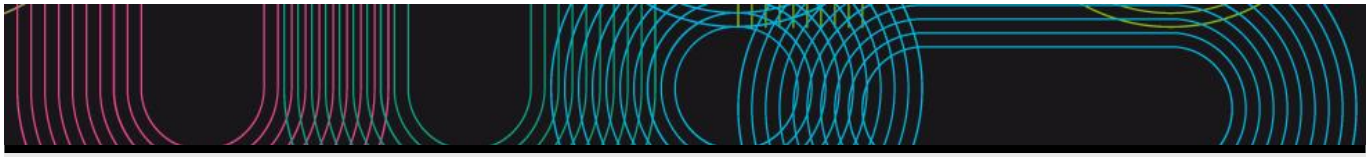

(*)Facultade de Ciencias do Mar

Máster Universitario en Oceanografía

Subjects

Year 1st

Code	Name	Quadmester	Total Cr.
V10M153V01101	Physical Processes in the Ocean	1st	5
V10M153V01102	Oceanography of Ecosystems	1st	5
V10M153V01103	Chemical Reactions in the Ocean	1st	5
V10M153V01104	Geological Processes in Continental Margins and Ocean Basins	1st	5
V10M153V01201	Large-scale and Small-scale Oceanography	2nd	5
V10M153V01202	Biological Processes and Global Change	2nd	5
V10M153V01203	CO2 and Ocean Acidification	2nd	5
V10M153V01204	Oceanography of Unique Regions: Polar, Equatorial and Upwelling Regions	2nd	5
V10M153V01205	Climate Models	2nd	5
V10M153V01206	Palaeoclimatology and Paleoceanography	2nd	5
V10M153V01207	Atmosphere-Ocean Interaction	2nd	5
V10M153V01208	Global Change and Marine Ecosystems	2nd	5
V10M153V01209	Modelling in Coastal Systems	2nd	5
V10M153V01210	Anthropogenic Impact on the Coast	2nd	5
V10M153V01211	Biogeochemistry of Coastal Systems	2nd	5
V10M153V01212	Coastal Ecosystems	2nd	5
V10M153V01301	Design and Carrying out of Oceanographic Campaigns	An	5
V10M153V01302	Master's Degree Dissertation	An	15
V10M153V01CF101	Physical Oceanography	1st	3
V10M153V01CF102	Chemical Oceanography	1st	3
V10M153V01CF103	Biological Oceanography	1st	3
V10M153V01CF104	Geological Oceanography	1st	3

IDENTIFYING DATA				
Physical Processes in the Ocean				
Subject	Physical Processes in the Ocean			
Code	V10M153V01101			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Mandatory	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Roson Porto, Gabriel			
Lecturers	Gil Coto, Miguel Roson Porto, Gabriel			
E-mail	groson@uvigo.es			
Web	http://masteroceanografia.com/			
General description	Study of the main physical processes, paying attention to their time and spatial scales.			

Training and Learning Results	
Code	
A2	Students who can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study
A4	Students who can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and nonspecialist audiences clearly and unambiguously
B1	The students will understand in a detailed and based form the theoretical and practical aspects and the work methodology of the oceanography
B4	The students will be able to analyse oceanographic databases and obtain skills for their treatment.
C1	The students will be able to obtain advanced and relevant knowledge, of skilled and multidisciplinary character, in the field of the oceanography and their application to the marine environment
C3	The students will analyse situations and specific oceanographic conditions related with the global change
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D3	The students will be able to communicate the obtained information and their conclusions in a effective way to the general public, to other scientists and to the competent authorities, listening and answering of effective form and, using an appropriate language to the audience and to the context

Expected results from this subject	Training and Learning Results
To deep understand of the physical processes that occur in the ocean	A2 A4 B1 B4 C1 C3 D1 D3
To adquire understanding about the effects of the coastal boundaries in those processes.	B1 C1
To achieve the skill of analyze experimental data by means of low level languages.	A2 C1 C3 D3

Contents	
Topic	
Theorists: Dynamics of the superficial and deep circulation.	Dynamics of surface circulation. Mesoscale processes. Coastal Upwelling: Time variability, from meteo to decadal. Deep circulation and climatic change. Estuarine Physics. Models of estuarine circulation.
Practical: Time series processing	Upwelling index time series processing Meridional ocean heat transport Atlantic Meridional Overturning Circulation: multiple equilibrium model.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	26	27	53
Seminars	24	23	47
Presentation	0	25	25

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

Methodologies	
	Description
Lecturing	Explanation of contents by the teacher. Analysis of competences, abilities and skills, in the classroom, using participatory master class session methodology. The purpose of the teacher is to explain the theoretical fundamentals of the matter.
Seminars	Group work session for problem resolution supervised by teacher. Activities that develop the knowledge through the interaction and the activity of the student.
Presentation	Explanation by student about a physical process

Personalized assistance	
Methodologies	**Description**
Lecturing	The tutorials will be carried out through the teacher's physical or virtual office by appointment by institutional email @alumnado.uvigo.gal
Seminars	The tutorials will be carried out through the teacher's physical or virtual office by appointment by institutional email @alumnado.uvigo.gal
Presentation	The tutorials will be carried out through the teacher's physical or virtual office by appointment by institutional email @alumnado.uvigo.gal

Assessment						
	Description	Qualification	Training and Learning Results			
Lecturing	Attendance required	40	A2	B1	C1	D1
			A4	B4	C3	D3
Seminars	Explanations of exercises, topics or projects. Attendance required	40	A2	B1	C1	D1
			A4	B4	C3	D3
Presentation	Oral individual presentations by students.	20	A2	B4	C1	D3

Other comments on the Evaluation

Non attendance to required activities make impossible submission to the second opportunity as well as to the global evaluation.

Students are strongly requested to fulfil a honest and responsible behaviour. It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary record

The dates of the evaluation tests can be seen in: http://masteroceanografia.com/horarios/

Sources of information

Basic Bibliography

POND, S., G.L.PICKARD, **Introductory Dynamical Oceanography**, Pergamon Press,

CUSHMAN-ROISIN, B., **Introduction to Geophysical Fluid Dynamics**, Ray Henderson & DeirdeÂ Cavanaugh,

Complementary Bibliography

Benoit Cushman-Roisin, Jean-Marie Beckers, **INTRODUCTION TO GEOPHYSICAL FLUID DYNAMICS. Physical and Numerical Aspects**, ACADEMIC PRESS,

Recommendations

Subjects that continue the syllabus

Atmosphere-Ocean Interaction/V10M153V01207
Climate Models/V10M153V01205

Subjects that it is recommended to have taken before

Physical Oceanography/V10M153V01CF101

Other comments

If any student did not come from Marine Science studies, the previous study of the matter "Physical Oceanography" is strongly recommended.

Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is requested to previously contact his/her teacher with reasonable anticipation. Students are strongly requested to fulfil honest and responsible behaviour. It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary record

IDENTIFYING DATA				
Oceanography of Ecosystems				
Subject	Oceanography of Ecosystems			
Code	V10M153V01102			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Mandatory	1st	1st
Teaching language	#EnglishFriendly			
Department				
Coordinator	Mouriño Carballido, Beatriz			
Lecturers	Marañón Sainz, Emilio Mouriño Carballido, Beatriz			
E-mail	bmourino@uvigo.es			
Web	http://masteroceanografia.com/			
General description	This course addresses the trophic organisation and ecological functioning of pelagic communities, paying special attention to physical-biological coupling at different scales. Control factors of primary production and the role of the pelagic ecosystem in global biogeochemical cycles are studied. The course includes local oceanography case studies of the NW Iberian peninsula.			

Training and Learning Results	
Code	
A1	Students who have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
A2	Students who can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study
B1	The students will understand in a detailed and based form the theoretical and practical aspects and the work methodology of the oceanography
B3	The students will be able to deepen in the main oceanographic processes and their spatiotemporal scales
C1	The students will be able to obtain advanced and relevant knowledge, of skilled and multidisciplinary character, in the field of the oceanography and their application to the marine environment
C3	The students will analyse situations and specific oceanographic conditions related with the global change
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D3	The students will be able to communicate the obtained information and their conclusions in a effective way to the general public, to other scientists and to the competent authorities, listening and answering of effective form and, using an appropriate language to the audience and to the context

Expected results from this subject	Training and Learning Results
Interpretation of distribution patterns of planktonic organisms as well as fundamental biological processes.	A1 B3 C1 C3
Familiarise with advanced methodological tools for the study of pelagic ecosystems	A2 B1 D1
Understanding the way in which different key processes (physical, chemical and biological) interact in the ocean, using exhaustive analysis of regional cases	C1 C3 D3

Contents	
Topic	
Introduction	Pelagic ecosystems and their interactions with hydrodynamics. Key functional groups in the plankton. Production and fate of organic matter.
Physical-biological coupling in pelagic ecosystems	Scales of variability in the interaction between physical and biological processes: mixing and stratification, internal waves, frontal systems, sub- and meso-scale structures.
Plankton size structure: ecological and biogeochemical implications	Size-dependence of phytoplankton abundance, biomass and metabolism. Plankton size spectra. Environmental and ecological control of size structure.

Trophic analysis of pelagic ecosystems	Pelagic food webs. Bacteria-phytoplankton coupling. Grazing and mixotrophy. Structure of planktonic communities and biogeochemical circulation.
The role of pelagic ecosystems in global biogeochemical cycles.	Controlling factors of primary production. Processes and patterns of ocean nutrient limitation. The spring bloom: underlying mechanisms. The biological pump and the global carbon cycle.
Regional oceanography: the upwelling system of NW Iberian peninsula	Ecological and biogeochemical impact of the Galician upwelling. Links between size structure and metabolic balance in Ría de Vigo. Irradiance and nutrients as controlling factors of phytoplankton growth. Responses of microbial plankton to global change processes.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	20	10	30
Seminars	8	7	15
Seminars	17	13	30
Mentored work	0	30	30
Presentation	5	15	20

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

Methodologies

	Description
Lecturing	Fundamental theoretical contents are explained, supported by visual material and key review articles.
Seminars	Using data from articles and/or databases, theoretical concepts are applied quantitatively, so that a deep understanding of the topics can be obtained (E. Marañón).
Seminars	Using data from articles and/or databases, theoretical concepts are applied quantitatively, so that a deep understanding of the topics can be obtained (B. Mouriño).
Mentored work	The students prepare a group project that consists in a bibliographic review or data analysis. The students work under the supervision of the professor. The oral presentation of the work is followed by a debate session.
Presentation	Oral presentation of mentored work

Personalized assistance

Methodologies	Description
Lecturing	The students are supervised by the instructor during the preparation of the seminar. Tutorial hours are also used to solve any difficulties related to the acquisition of knowledge and skills.
Mentored work	The students are supervised by the instructor during the preparation of the seminar. Tutorial hours are also used to solve any difficulties related to the acquisition of knowledge and skills.
Presentation	The students are supervised by the instructor during the preparation of the seminar. Tutorial hours are also used to solve any difficulties related to the acquisition of knowledge and skills.

Assessment

	Description	Qualification	Training and Learning Results
Seminars	Evaluation of the understanding of the different concepts and processes treated during the theoretical classes and the seminars (E. Marañón). The proof consists of short questions.	20	A1 B1 C1 A2 B3 C3
Seminars	Evaluation of the understanding of the different concepts and processes treated during the theoretical classes and the seminars (B. Mouriño). The proof consists of short questions.	30	A1 B1 C1 A2 B3 C3
Mentored work	Evaluation of the written presentation. It values the rigour in the understanding of the concepts used, and the utilisation of diverse bibliographic sources.	10	A1 B1 C1 D1 A2 B3 D3
Presentation	Evaluation of the oral presentation. It values the rigour in the understanding of the concepts used, the utilisation of diverse bibliographic sources, and the clarity and precision during the oral presentation.	40	A1 B1 C1 D1 A2 B3 D3

Other comments on the Evaluation

The oficial dates of evaluation tests will be available at: http://masteroceanografia.com/horarios/

All tests can be evaluated on the second chance.

Sources of information

Basic Bibliography

Gasol, Josep M., 1962-, ed. lit.; Kirchman, David L., ed. lit., **Microbial Ecology of the Oceans**, SBN: 978-1-119-10718-7, 3a, Hoboken, NJ : John Wiley & Sons, 2018

Williams RG, Follows MJ, **Ocean dynamics and the carbon cycle: principles and mechanisms**, ISBN : 978-0-521-84369-0, 1a, Cambridge University Press, 2011

Complementary Bibliography

Fasham MJR, **Ocean biogeochemistry: the role of the ocean carbon cycle in global change**, SBN : 3-540-42398-2, 1a, Berlin etc. : Springer, 2003

Mann KH, Lazier JRN, **Dynamics of marine ecosystems: biological-physical interactions in the oceans**, ISBN : 1-4051-1118-6 ISBN : 978-1-4051-1118-8, 3a, Malden MA : Blackwell, 2006

Miller CB (2012), **Biological oceanography**, ISBN : 978-1-4443-3302-2, 2a, Hoboken, NJ : Wiley, 2012

Simpson JH, Sharples J, **Introduction to the Physical and Biological Oceanography of Shelf Seas**, ISBN : 9780521701488, 1a, Cambridge : Cambridge University Press, 2012

Steele JH, Turekian KK, Thorpe SA, **Encyclopedia of Ocean Sciences**, ISBN : 9781787853959, 2a (online), Boston, Massachusetts, 2019

Recommendations

Subjects that continue the syllabus

Global Change and Marine Ecosystems/V10M153V01208

Subjects that it is recommended to have taken before

Biological Oceanography/V10M153V01CF103

Other comments

Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is requested to previously contact his/her teacher with reasonable anticipation. Students are strongly requested to fulfil a honest and responsible behaviour. It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary record

IDENTIFYING DATA				
Chemical Reactions in the Ocean				
Subject	Chemical Reactions in the Ocean			
Code	V10M153V01103			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Mandatory	1st	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Nieto Palmeiro, Óscar			
Lecturers	Cobelo García, Antonio Morente Fontela, Marcos Nieto Cid, María del Mar Nieto Palmeiro, Óscar Santos Echeandía, Juan			
E-mail	palmeiro@uvigo.es			
Web	http://masteroceanografia.com/			
General description	In this matter tackle appearances advanced of the chemical oceanography and his relation with the biological processes, physicists and geological. It does emphasis in the thermodynamic and kinetical **appearances of the processes of exchange between compartments, establishing flows between them and standing out the importance in the generation of vertical flows.			

Training and Learning Results	
Code	
A1	Students who have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
A4	Students who can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and nonspecialist audiences clearly and unambiguously
B2	The students will interpret the behaviour of the global oceanic system and their controlling factors.
B5	The students will be able to develop the sufficient autonomy to participate in research projects and scientific collaborations, especially in interdiscipinary contexts
C1	The students will be able to obtain advanced and relevant knowledge, of skilled and multidisciplinary character, in the field of the oceanography and their application to the marine environment
C4	The students will be able to apply in the practice the obtained knowledge and issue resolutions and judgments in the different oceanography fields
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D4	The students will be able to understand the need and obligation to perform a continuous training, to a large extent autonomous, for the scientific development, updating the knowledges, skills and attitudes of the professional competences along the life.

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Understand and explain from a theoretical and practical point of view the chemical processes that take place in half marine and that are related with the biological processes, physicists and geological that produce in a multicomponent system as it is the ocean and his importance in the generation of vertical profiles.	A1 A4 B2 B5 C1 C4 D1 D4
Comprise the importance of the thermodynamic and kinetical aspects of the processes of exchange of compounds between the atmosphere, the ocean and the sediments, doing a special reference to the methodologies employed to establish flows between environmental compartments.	A1 A4 B2 B5 C1 C4 D1 D4

Understand the behaviour of the C, N, P and Si from a global perspective, basing in the approach of biogeochemical cycles that put of self-evident to importance of the processes of vertical transport in the ocean.	A1 A4 B2 B5 C1 C4 D1 D4
Understand the variables that affect to the biogeochemical cycle of the metals traces in the oceans and purchase the necessary methodology for the study.	A1 A4 B2 B5 C1 C4 D1 D4

Contents	
Topic	
Approximations used in the biogeochecmical models.	Environmental compartments. Main flows between the environmental compartments. Equilibrium and kinetical models.
Models and parametrizations used to characterise the exchange of gases through the interphase waters-atmosphere.	Dissolution of gases in the atmosphere. I exchange atmosphere ocean. Structural appearances of the solubility in gases.
Reactivity of the elements in the superficial waters, transport of the particulate material and segregation in the deep ocean.	Properties of the superficial waters. Introduction to the 1D models with advention + diffusion + reaction through the column of sediments.
Biogeochemical cyles in the ocean.	Training, dissolution and preservation of calcium carbonate and opal.
Vertical transport of organic matter and remineralization.	Dissolved and particulate organic matter in the ocean. Sources of organic matter. Importance of the cycles of the C, O, N and P.
Reactivity and biogeochemical cycles of metals in the ocean	Processes related with the complexation of metals. Chemical speciation under the influence of future changes.

Planning			
	Class hours	Hours outside the classroom	Total hours
Project based learning	15	20	35
Seminars	10	15	25
Practices through ICT	10	12	22
Laboratory practical	5	5	10
Mentored work	7	15	22
Presentation	1	2	3
Seminars	1	2	3
Problem and/or exercise solving	1	4	5
*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	It consists in the exhibition of contents by part of the professor, analysis of competitions, explanation and demonstration of capacities, skills and knowledges in the classroom, using like methodology to participatory masterclass and in which the function of the professor is to explain the theoretical foundations of the distinct matters.
Seminars	Sessions of groupal work oriented by the professor, whose purpose is the research of data or information in libraries, databases, internet, etc. The professor indicates the need of extension of knowledges and orients in the research. This methodology carries implicit a load of work no face-to-face significant that it will have to be quantified in the programming of each matter, matter or module.
Practices through ICT	Session of groupal work for the resolution of problems in the classroom of computing, supervised by the professor. Significant construction of the knowledge through the interaction and activity of the student.
Laboratory practical	Activities developed in spaces and with specialized equipments that improve the significant construction of the knowledge through the interaction and activity of the student. It is carried out at th laboratory and the function of the professor is to present the aims, orient the work and realise the follow-up of the student.

Mentored work	Realisation in group of a work on a subject of the matter with participation shared. The professor presents the aims, orients and tutorizes the work, with participation shared with the students.
Presentation	Exhibition in group of the tutored work.
Seminars	Significant construction of the knowledge through the interaction between tutor and student by means of sessions of tutorial activities personalised or in group very reduced, where the professor orients and resolves doubts.

Personalized assistance

Methodologies	Description
Project based learning	Any doubts that arise to the students, can consult it through the forums that are enabled for this on the platform Moovi, being able to be answered by both the faculty and the rest of the students. In addition, they can arrange a personal appointment with the faculty to attend to their questions in their respective office or in the virtual office (campusremotouvigo.gal).
Laboratory practical	Any doubts that arise to the students, can consult it through the forums that are enabled for this on the platform Moovi, being able to be answered by both the faculty and the rest of the students. In addition, they can arrange a personal appointment with the faculty to attend to their questions in their respective office or in the virtual office (campusremotouvigo.gal).
Practices through ICT	Any doubts that arise to the students, can consult it through the forums that are enabled for this on the platform Moovi, being able to be answered by both the faculty and the rest of the students. In addition, they can arrange a personal appointment with the faculty to attend to their questions in their respective office or in the virtual office (campusremotouvigo.gal).
Seminars	It does not have place
Seminars	Any doubts that arise to the students, can consult it through the forums that are enabled for this on the platform Moovi, being able to be answered by both the faculty and the rest of the students. In addition, they can arrange a personal appointment with the faculty to attend to their questions in their respective office or in the virtual office (campusremotouvigo.gal).
Mentored work	Any doubts that arise to the students, can consult it through the forums that are enabled for this on the platform Moovi, being able to be answered by both the faculty and the rest of the students. In addition, they can arrange a personal appointment with the faculty to attend to their questions in their respective office or in the virtual office (campusremotouvigo.gal).
Presentation	Any doubts that arise to the students, can consult it through the forums that are enabled for this on the platform Moovi, being able to be answered by both the faculty and the rest of the students. In addition, they can arrange a personal appointment with the faculty to attend to their questions in their respective office or in the virtual office (campusremotouvigo.gal).
Tests	**Description**
Problem and/or exercise solving	In the review of examinations

Assessment

	Description	Qualification	Training and Learning Results			
Laboratory practical	The learning attitude will be evaluated during visits to the IIM-CSIC research laboratories.	25	A1 A4	B5	C1 C4	D1 D4
Mentored work	Students will present a working report of the supervised project using ICT technologies.	25	A1 A4	B2 B5	C1 C4	D1 D4
Presentation	The students will exhibit the supervised work done using ICT technologies.	10	A4		C4	D1
Problem and/or exercise solving	The student will have to answer succinctly a series of questionnaires that will be carried out throughout the course. The ability to understand and relate the concepts learned during the course will be evaluated.	40	A1 A4	B2 B5	C1 C4	D1 D4

Other comments on the Evaluation

To pass the subject, each and every test conducted throughout the subject must be passed with a minimum rating of 5 points.

In the event that in any test the minimum grade is not reached, the questionnaire will be repeated or a new paper will be delivered with the relevant corrections in the July call.

The official dates of evaluation can be found in this link:

http://masteroceanografia.com/horarios/

Sources of information

Basic Bibliography

J.P. Riley y R. Chester, **Introducción a la química marina**, 1ª edición en castellano y ediciones en inglés, A.G.T., 1989

Susan M. Libes, **Introduction to marine biogeochemistry**, 2ª edición, Elsevier-Academic Press, cop., 2009

Robert A. Berner, **Early diagenesis : a theoretical approach**, Princeton University Press, cop., 1980

Patrick L. Brezonik, **Chemical kinetics and process dynamics in aquatic systems**, Lewis, cop., 1994

Antonio C. Lasaga, **Kinetic theory in the earth sciences**, Princeton University Press, cop., 1998

R. Chester y T.D. Jickells, **Marine Geochemistry**, 3ª edición, Willey Blackwell cop., 2012

Complementary Bibliography

Frank J. Millero, **Chemical oceanography**, 4ª edición, CRC Press, 2013

J. P. Riley, R. Chester (eds.), **Chemical oceanography**, Academic Press, 1989

C.A.J. Appelo, D. Postma, **Geochemistry, groundwater and pollution**, 2ª edición, CRC Press, 2005

Recommendations

Other comments

The student who wishes, can attend personalized tutorials to solve doubts. To optimize the time, it is necessary for the student to contact the teacher well in advance.

Students are required to teach this subject, responsible and honest conduct. Any form of fraud (e.g. copying and/or plagiarism) aimed at distorting the level of knowledge or skill achieved by students in any type of test, report or work designed for this purpose is inadmissible. Fraudulent conduct may be suspended during a full course. An internal register of these proceedings shall be kept in order to request the Rectorate to open disciplinary proceedings in the event of a repeat offence.

IDENTIFYING DATA				
Geological Processes in Continental Margins and Ocean Basins				
Subject	Geological Processes in Continental Margins and Ocean Basins			
Code	V10M153V01104			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Mandatory	1st	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Nombela Castaño, Miguel Angel			
Lecturers	Alejo Flores, Irene Francés Pedraz, Guillermo García Gil, María Soledad Mena Rodríguez, Ángel Nombela Castaño, Miguel Angel			
E-mail	mnombela@uvigo.es			
Web	http://masteroceanografia.com			
General description	This subject tackles the knowledge of the geological processes that take place in the marine field from the line of coast until the abyssal plain. They will analyse the processes of transport and sedimentation that control the movement of sediment and the sedimentary structures resultant in the different marine environments. Also it tackles the sismoestratigraphical interpretation, like tool for the interpretation of sequences and geological cycles in the differents sedimentary environments. The practical content of the subject will consist in a field trip of several days of length to see different ancient sedimentary environments. It proposes visit the neogen basins of Sorbas; Nijar and Tabernas in the province of Almería for the characterisation in situ of the lithology, the facies and the sedimentary architecture of a wide variety of environments (alluvial fans, beaches, deltas, reefs, carbonatic shelfs, evapories, slumps, debris flows, turbidites, pelagic), as well as the sedimentary processes and tectonic that have controlled his origin and space-temporary evolution .			

Training and Learning Results	
Code	
A3	Students who have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments
A4	Students who can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and nonspecialist audiences clearly and unambiguously
B1	The students will understand in a detailed and based form the theoretical and practical aspects and the work methodology of the oceanography
B5	The students will be able to develop the sufficient autonomy to participate in research projects and scientific collaborations, especially in interdiscipinary contexts
C3	The students will analyse situations and specific oceanographic conditions related with the global change
C4	The students will be able to apply in the practice the obtained knowledge and issue resolutions and judgments in the different oceanography fields
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D3	The students will be able to communicate the obtained information and their conclusions in a effective way to the general public, to other scientists and to the competent authorities, listening and answering of effective form and, using an appropriate language to the audience and to the context

Expected results from this subject	
Expected results from this subject	Training and Learning Results
Capacity to interpret seismic profiles. Recognise inside the context of the sequential stratigraphy the courtships *sedimentarios and his relation with the stages *eustáticas.	A3 B1 B5 C3 C4 D1 D3

Capacity for the integration of data and interpretation of the physical and geological processes in oceanic environments.	A3 B1 B5 C3 C4 D1 D3
Capacity for the recognition and interpretation of sequences and cycles.	A3 B1 C3 C4 D1
Capacity to identify the means *sedimentarios, his processes associated and the factors that have controlled his evolution *espaciotemporal.	A3 B1 C3 C4 D1
Capacity to evaluate the economic potential of the oceanic basins with regard to diverse geological resources.	A3 A4 B1 C4 D1 D3

Contents	
Topic	
T1.Tectonic and geomorphological configuration of the oceanic bottom. Introduction to basin analysis. Types of basins. Tectonic and sedimentation.	The sub-topic coincides with the topic
T2. Geological processes in coastal environments	The sub-topic coincides with the topic
T3. Processes in of continental shelf environments	The sub-topic coincides with the topic
T4. Origin and distribution of marine sediments	The sub-topic coincides with the topic
T5. Processes of resedimentation associated to the continental slope: turbidites	The sub-topic coincides with the topic
T6. Processes in hemipelagic and pelagic environments	The sub-topic coincides with the topic
T7. Evolution of continental margins and oceanic basins. Interaction between the internal and external geological processes: the case of the Alboran Sea basin.	The sub-topic coincides with the topic
T8. Seismic-stratigrafical interpretation of marine sedimantary environments..	The sub-topic coincides with the topic
P1. Geological characterisation of coastal environments	Practical contents developed in the Field Trip of Almería
P2. Identification and characterisation of shelf environments	Practical contents developed in the Field Trip of Almería
P3. Characterisation of continental slope environments	Practical contents developed in the Field Trip of Almería
P4. Caracerización of pelagic environments	Practical contents developed in the Field Trip of Almería
P5. Space-temporary evolution of continental margins and oceanic basins. Filling of basins: budget-tectonic-sedimentation relations	Practical contents developed in the Field Trip of Almería

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	23	35	58
Introductory activities	2	0	2
Studies excursion	25	30	55
Problem solving	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	It consists in the exhibition of contents by part of the professor, analysis of competitions, explanation and demonstration of capacities, skills and knowledges in the classroom, using like methodology the participatory masterclass and in which the function of the professor is to explain the theoretical foundations of the matter.
Introductory activities	It will contextualise the subject inside the *master as well as the zone of exit of studies.
Studies excursion	Group work session during fieldwork, supervised by the lecturer, enabling meaningful knowledge construction through student interaction and activity, and through their engagement with the real-world context in which they must apply their knowledge. Attendance is compulsory. A tour will be conducted of the Neogene outcrops in various sedimentary basins of the south-east of the Iberian Peninsula, where there are magnificent examples of fossil marine sedimentary environments, including carbonate platforms, turbidites, evaporites, reefs, pelagic sedimentation, etc
Problem solving	

Personalized assistance

Methodologies	Description
Lecturing	The students will be attended of personal form by any one of the professors that give the matter, by means of concerted previous appointment by email. Likewise, they will be attended in front of any query during the development of the lessons *magistrales.
Studies excursion	The students will be attended of personal form by any one of the professors that give the matter, by means of concerted previous appointment by email. Likewise, they will be attended in front of any query during the development of the exits of studies.
Introductory activities	The students will be attended of personal form by any one of the professors that give the matter, by means of concerted previous appointment by email. Likewise, they will be attended in front of any query during the development of the introductory activities.
Problem solving	

Assessment

	Description	Qualification	Training and Learning Results			
Lecturing	They will evaluate the knowledges purchased by means of written/oral exams	40	A4	B1		
Studies excursion	The evaluation features of two parts: assistance to the fieldtrip and the elaboration of a written work including the most important aspects adquired in the field.	40	A3 A4	B5		D1 D3
Problem solving	The students will carry out several Tests related to the Theoretical classes.	20	A3 A4	B1	C3 C4	

Other comments on the Evaluation

The fieldtrip (Studies excursion) is of experimental character and therefore his assistance is MANDATORY. In case of no assistance without any justification, students will not be able to opt for a global assessment.
All tests can be evaluated on the second chance. Non attendance to mandatory activities precludes the possibility to be evaluated in the second chance.
The official dates for the proofs of evaluation can consult in: http://masteroceanografia.com/horarios/
Requires of the students that curse this matter a responsible and honest behaviour. It considers inadmissible any form of fraud (copy or plagiarism) directed to *falsear the level of knowledges and skills reached in all type of proof, report or work. The fraudulent behaviours will be able to suppose suspend the subject during a complete course. It will carry an internal register of these performances so that, in case of *reincidencia, request the opening to the rectorship of a disciplinary

Sources of information

Basic Bibliography

Arche, A. (ed.), **Sedimentología**,
Chiocci, F.L. y Chivas, A.R. (eds.), **Continental Shelves of the World**,
Huneke, H. y Mulder, T., **Deep-sea sediments**,

Complementary Bibliography

Rebesco, M. and Camerlenghi, A. (eds.), **Contourites**,
Nittrouer, C.; Austin, J.; Field, M.; Kravitz, J.; Syvitski, J.; Wiberg, P. (eds.), **Continental margin sedimentation: from sediment transport to sequence stratigraphy**,
Mather, A., **A Field guide to the neogene sedimentary basins of the Almería province, SE Spain**,
Braga, J.C. et al., **Geología del Entorno Árdido Almeriense. Guía Didáctica de Campo**,
CIESM Workshop, **The Messinian Salinity Crisis from mega-deposits to microbiology. A consensus report**,

Recommendations

Subjects that it is recommended to have taken before

Geological Oceanography/V10M153V01CF104

Other comments

For those students that have not graduated in Sciences of the Sea or in Geology is fundamental to have *cursado the subject of Geological Oceanography.

IDENTIFYING DATA				
Large-scale and Small-scale Oceanography				
Subject	Large-scale and Small-scale Oceanography			
Code	V10M153V01201			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Martínez García, Sandra			
Lecturers	Teira Gonzalez, Eva Maria			
E-mail	sandra@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The teaching guide of this subject is available in the following link: https://www2.ulpgc.es/index.php?pagina=plan_estudio&ver=wpe005&codTitulacion=5044&codPlan=50&tipotitulacion=M&codEspecialidad=11, and is imparted by the Universidad de Las Palmas de Gran Canaria.			

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				
Biological Processes and Global Change				
Subject	Biological Processes and Global Change			
Code	V10M153V01202			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Martínez García, Sandra			
Lecturers	Teira Gonzalez, Eva Maria			
E-mail	sandra@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The teaching guide of this subject is available in the following link: https://www2.ulpgc.es/index.php?pagina=plan_estudio&ver=wpe005&codTitulacion=5044&codPlan=50&tipotitulacion=M&codEspecialidad=11, and is imparted by the Universidad de Las Palmas de Gran Canaria.			

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				
CO2 and Ocean Acidification				
Subject	CO2 and Ocean Acidification			
Code	V10M153V01203			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Martínez García, Sandra			
Lecturers	Teira Gonzalez, Eva Maria			
E-mail	sandra@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The teaching guide of this subject is available in the following link: https://www2.ulpgc.es/index.php?pagina=plan_estudio&ver=wpe005&codTitulacion=5044&codPlan=50&tipotitulacion=M&codEspecialidad=11, and is imparted by the Universidad de Las Palmas de Gran Canaria.			

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				
Oceanography of Unique Regions: Polar, Equatorial and Upwelling Regions				
Subject	Oceanography of Unique Regions: Polar, Equatorial and Upwelling Regions			
Code	V10M153V01204			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Martínez García, Sandra			
Lecturers	Teira Gonzalez, Eva Maria			
E-mail	sandra@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The teaching guide of this subject is available in the following link: https://www2.ulpgc.es/index.php?pagina=plan_estudio&ver=wpe005&codTitulacion=5044&codPlan=50&tipotitulacion=M&codEspecialidad=11, and is imparted by the Universidad de Las Palmas de Gran Canaria.			

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				
Climate Models				
Subject	Climate Models			
Code	V10M153V01205			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Gómez Gesteira, Ramón			
Lecturers	Costoya Noguerol, Jorge Domínguez Alonso, José Manuel Fernández Nóvoa, Diego Gómez Gesteira, Ramón			
E-mail	mggesteira@uvigo.es			
Web	http://masteroceanografia.com/			
General description	Climate models course will deal about the different types of models that are used for the study of the climate as well as its evolution over the years. You will see different models and their output files in order to learn how to treat and analyze their results. Finally, we will know the climatic models, their function and their main characteristics.			

Training and Learning Results
Code

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

Contents	
Topic	
Numerical Models and Climatic System	Introduction to Numerical Models Introduction to the climatic system. Climatic data. Radiative Balance Continental distribution and topography Atmosphere Continents Ocean Cryosphere Variability Forcings
History and introduction to the climatic models	Introduction to the modelling. Types of models. History of the models for the study of the climate. Sensitivity of the climatic models. Parametrisation of the climatic processes.
Models of balance of energy	Energy Budget Structure of the models of balance of energy. Parametrisations. Models of Box. Models of balance of energy.
Radiative-convective models	Structure of the radiative-convective model. Calculation of the radiation and convective adjust . Development of the radiative-convective model
Two-dimensional models	Main characteristics of the two-dimensional models. Comparison between two-dimensional and three-dimensional models. Climatic models of intermediate Complexity
Climatic models of general circulation	Structure of the climatic models of general circulation. Climatic models of general circulation in cartesian grid. Spectral climatic models of general circulation. Parametrisations. Models joined up ocean-atmosphere.

Practical examples	Examples of simple models. Examples of models of intermediate complexity. Examples of models of general circulation.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	27	28	55
Problem solving	14	28	42
Presentation	4	12	16
Seminars	1	0	1
Problem and/or exercise solving	2	0	2
Essay	1	7	8
Objective questions exam	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	The teacher explains the theoretical concepts of the different subjects of the course using powerpoint.
Problem solving	Seminars in which the student solve practical cases supervised by the teacher. They are activities developed to improve the significant construction of the knowledge through the interaction between students. The aim of the teacher is to present the aims, to orient students and to realize the follow-up of the procedure to carry out the practical activity.
Presentation	Individual or group oral sesion of a subject from the course. The teacher presents the aims, orients and supervises the oral presentation.
Seminars	Significant construction of the knowledge through the interaction between the teacher and the student by means of sessions of personalized supervision or in group very reduced, where the teacher orients and resolves doubts.

Personalized assistance	
Methodologies	**Description**
Problem solving	The function of the professor is to present the aims, orient the work and realises the follow-up of the same.
Seminars	By means of sessions of tutoríals personalised or in groups very reduced, the professor will orient and will resolve the doubts.

Assessment			
	Description	Qualification	Training and Learning Results
Problem and/or exercise solving	It will value the work and the progress of the student during the kinds and the practical. It will evaluate the result of the learning AR2	40	
Essay	It will evaluate the realization and presentation of the memories and works that ask by part of the professors. It will evaluate the result of the learning AR3	40	
Objective questions exam	Short questionnaires about the content of the subject.	20	

Other comments on the Evaluation

The preferred assessment method is Continuous Evaluation. Students who wish to take the Global Evaluation (100% of the grade based on the official exam) must inform the course instructor, via email or through the Moovi platform, within one month from the start of the course.

Attendance to lectures, especially seminars, is mandatory.

Students who are unable to attend classes due to justified reasons must provide appropriate justification. Evaluation will be conducted through complementary assignments proposed by the professor, depending on the circumstances.

Online tutoring sessions will be available through the virtual office of each professor on Campus Remoto, by appointment.

All tests are evaluable on the second chance. Non-attendace to lectures and seminar precludes the possibility to be evaluated in the second chance.

Exam Dates:

The dates of the exams can be consulted at: http://masteroceanografía.com/horarios/

Any changes in the dates of officially approved exams will be published on the notice board and on

the Center's website.

Sources of information
Basic Bibliography
Hartman, D. L., **Global Physical Climatology**, 1999
Henderson-Sellers, A. and K. Mc Guffie, **ntroducción a los Modelos Climáticos**, Omega, 1990
Kendal McGuffie, Ann Henderson-Sellers, **A Climate Modelling Primer**, Wiley-Blackwell, 2014
Complementary Bibliography
Berger, A. L. and C. Nicolis, **New Perspectives in Climate Modeling. Developments in Atmospheric Science 16.**, Elsevier Science, 1984
Daley, R, **Atmospheric Data Analysis**, Cambridge Atmospheric and Space Science Series, 1993
Houghton, J. T., et al., **Climate Change 2001:**, The Scientific Basis. Cambridge University Press,,
Lozán, J. L., Grassl H., Hupfer P., **Climate of the 21st Centuty: Changes and Risks**, Scientific Facts. Wissenschaftliche Auswertungen,, 2001
Randall, D. A., **General Circulation Model Development. Past, Present and Future.**, Academic Press, 2001
Trenberth, Kevin, **Climate System Modeling**, Cambridge University Press, 1992

Recommendations

Subjects that are recommended to be taken simultaneously
Atmosphere-Ocean Interaction/V10M153V01207
Global Change and Marine Ecosystems/V10M153V01208

Subjects that it is recommended to have taken before
Physical Oceanography/V10M153V01CF101
Modelling in Coastal Systems/V10M153V01209

Other comments
Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is requested to previously contact his/her teacher with reasonable anticipation. Students are strongly requested to fulfil honest and responsible behaviour. It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary record

IDENTIFYING DATA				
Palaeoclimatology and Paleoceanography				
Subject	Palaeoclimatology and Paleoceanography			
Code	V10M153V01206			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language	Spanish			
Department				
Coordinator	Marino , Gianluca			
Lecturers	Marino , Gianluca Rey García, Daniel			
E-mail	gianluca.marino@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The course focuses on the study of the ocean and climate before the period covered by instrumental measurements (approximately 1850 to the present), which represents a very small fraction (<10^−7) of the history of our planet. Therefore, instrumental records offer an incomplete view of the time scales and patterns of change in the ocean and climate. Palaeoclimatology and palaeoceanography provide a comprehensive framework to understand temperature changes, precipitation patterns, ice-sheet evolution, and biosphere adaptation across a wide range of climate states and boundary conditions. This advances the debate on how the high levels of greenhouse gases predicted for the 21st century and beyond will affect key elements of the climate system. Paleoclimatology and paleoceanography are fields within Earth Sciences that have significantly expanded their scope in recent decades. This partly arises from the knowledge of the natural patterns of change and variability in Earth's climate system that these disciplines contribute, contextualising future changes influenced by human activity. Another key factor is tied to the rapid development of methodological and analytical approaches, which are largely diversified and become (more) quantitative. These advancements are the result of multidisciplinary efforts involving sedimentologists, geochemists, geophysicists, biologists, (micro)paleontologists, geostatisticians, and modelers. Palaeoclimatology and palaeoceanography provide essential information for the ocean and climate communities. This is exemplified by their contribution to the reports of the Intergovernmental Panel on Climate Change (IPCC), which in the last almost two decades include chapters specifically dedicated to palaeoclimate and palaeoceanography. In the most recent report, such information is integrated into the assessment report's findings as one of the "multiple lines of evidence" to define the state of Earth's climate. The course focuses on analyzing the pace, magnitude, and rates of changes in the ocean and climate through the geological timescale and from the instrumental record, with special emphasis on those changes taking place in the ocean. The following topics are explored, the: (i) different time scales (from 10^1 to 10^8 years) and patterns of climate change; (ii) research tools used to reconstruct the (paleo)ocean and (paleo)climate; and (iii) relationship between forcings, feedback processes, and the responses of the climate system, especially regarding temperature variations.			

Training and Learning Results	
Code	
A1	Students who have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
A2	Students who can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study
A4	Students who can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and nonspecialist audiences clearly and unambiguously
A5	Students who have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
B2	The students will interpret the behaviour of the global oceanic system and their controlling factors.
B3	The students will be able to deepen in the main oceanographic processes and their spatiotemporal scales
C1	The students will be able to obtain advanced and relevant knowledge, of skilled and multidisciplinary character, in the field of the oceanography and their application to the marine environment
C3	The students will analyse situations and specific oceanographic conditions related with the global change
C7	The students will obtain knowledge that will allow them reinforce and deepen in the physical mechanisms that control the atmosphere-ocean interactions, the climatic variability, as well as the validity and contrast of climatic models.
D2	The students will possess the handle skills in the laboratory that allow them to develop autonomous work.

D3 The students will be able to communicate the obtained information and their conclusions in a effective way to the general public, to other scientists and to the competent authorities, listening and answering of effective form and, using an appropriate language to the audience and to the context

Expected results from this subject	
Expected results from this subject	Training and Learning Results
To obtain information from the various palaeoceanographic and palaeoclimatic proxies and comprehend how they are used to reconstruct ocean and climate changes.	A1 A2 A4 A5 B2 B3 C3 C7 D2 D3
To integrate the information retrieved from regionally to globally distributed palaeoceanographic and palaeoclimatic records.	A1 A2 A4 A5 B2 B3 C1 C3 C7 D3
To understand the natural mechanisms of climatic change at the different temporal and spatial scales.	A1 A2 A4 A5 B2 B3 C1 C3 C7 D3
To exploit the continuous nature of the oceanic sedimentary record to reconstruct the history of Earth's climate.	A1 A2 A4 A5 B2 B3 C1 C3 C7 D3
To extract information from the palaeoclimate record and use it to better understand current climate change and improve predictions of future climate developments.	A1 A2 A4 A5 B2 B3 C1 C3 C7 D2 D3

Contents	
Topic	
Topic 0. Introduction to the subject	0.1. Aims and learning outcomes 0.2. Course structure and content overview 0.3. Laboratory practicals and seminars 0.4. Assessment and evaluation criteria

Topic 1. Basic concepts in (palaeo)climatology	1.1. Earth□s climate system 1.2. Climate change versus climate variability 1.3. Timescales of climate variability and change 1.4. Global temperature as an indicator of climate state 1.5. Earth□s energy balance 1.6. Climate forcing, feedbacks, and system response 1.7. Climate sensitivity and thresholds
Topic 2. Climate archives, proxies, and chronologies	2.1. Archives and proxies in palaeoclimatology and palaeoceanography 2.2. Types of natural archives (ice cores, marine and terrestrial sediments, corals, speleothems) 2.3. Micropalaeontological proxies and transfer functions 2.4. Geochemical proxies in foraminifera and other archives 2.5. Environmental magnetism as a palaeoenvironmental tool 2.6. Sedimentological proxies and facies indicators 2.7. Chronological tools and radiometric dating methods 2.8. Uncertainty and error propagation in palaeoclimate reconstructions
Topic 3. Climate change at the tectonic scale	3.1. Plate tectonics, silicate weathering, and long-term carbon cycling 3.2. Volcanism versus weathering: controls on atmospheric CO2 3.3. Icehouse and greenhouse climate states 3.4. Global glaciations: ice□albedo feedback mechanisms
Topic 4. Climate change at orbital scales	4.1. Orbital parameters, insolation, and orbital forcing of climate 4.2. Insolation control of ice sheets: glacial□interglacial cycles 4.3. Insolation control of low-latitude hydroclimate 4.4. Feedback mechanisms in Quaternary climate dynamics 4.5. Unresolved questions
Topic 5. Climate change at suborbital scales	5.1. Patterns and mechanisms of sub-orbital climate variability 5.2. Dansgaard□Oeschger and Heinrich events 5.3. Northern Hemisphere ice sheets, Atlantic Meridional Overturning Circulation (AMOC), and solar variability
Topic 6. The ocean and the short-term carbon cycle	6.1. Reservoirs of carbon in the Earth system 6.2. The role of the ocean in the global carbon cycle: size of the reservoir(s) and timescales 6.3. Ocean carbonate chemistry and the carbonate compensation feedback 6.4. The role of the ocean in glacial□interglacial variations in atmospheric CO2 6.5. Unresolved questions
Laboratory practicals	Quantitative exercises and/or practical, analytical examples related with the subjects developed during the course. The course involves 3 laboratory practicals: Laboratory practical 1 (foraminiferal proxies); Laboratory practical 2 (climate sensitivity); Laboratory practical 3 (magnetism applied to palaeoclimatology).
Seminars	The course includes 3 seminars that will deepen some of the main topics of the course (patterns of palaeoclimate change, palaeoclimate proxies, ocean-atmosphere interactions, palaeoclimate variability).

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	33	30	63
Laboratory practical	9	5	14
Presentation	2	22	24
Seminars	6	3	9
Presentation	2	5	7
Essay	0	5	5
Laboratory practice	0	3	3

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

Methodologies

	Description
Lecturing	Lectures on the 7 topics of the program. Coverage of the topics will be flexible to address questions and issues that may arise over the duration of the course. Some lectures will be given by (foreigner) guest lecturers and done by remote-connection.

Laboratory practical	They illustrate those methods and protocols that are commonly used to generate sedimentological, geophysical, and/or geochemical data from deep-sea sediment cores. Laboratory practicals will centre on: (1) foraminifera as proxies os past ocean conditions; (2) the topic climate sensitivity based on palaeoclimate data; and (3) on the methods of magnetism applied to palaeoclimate research. Attendance is mandatory.
Presentation	Oral presentations on topics that are related to those addressed during the lectures.
Seminars	Additional presentations centred on specific, timely topics within the wider fields of palaeoclimatology and paleoceanography (patterns of palaeoclimate change, palaeoclimate proxies, ocean-atmosphere interactions, palaeoclimate variability). Attendance is mandatory.

Personalized assistance

Methodologies	Description
Lecturing	Questions and doubts that may arise during lectures will be addressed during tutorials. In order to schedule a tutorial students and/or group of students should contact the professors well in advance in order to efficiently schedule the tutorial.
Laboratory practical	Questions and doubts that may arise during laboratory practicals will be addressed during tutorials. In order to schedule a tutorial students and/or group of students should contact the professor well in advance in order to efficiently schedule the tutorial.
Presentation	Prior to the final presentation the students can contact the professors in order to be advised about literature material that could be used to develop the presentation topic.
Seminars	Questions and doubts that may arise during seminars will be addressed during tutorials. In order to schedule a tutorial students and/or group of students should contact the professors well in advance in order to efficiently schedule the tutorial.

Assessment

	Description	Qualification	Training and Learning Results			
Presentation	Oral presentation on a topic related to those developed during the course.	40	A1 A4		C3	D3
Essay	Short, written reports on two topics related to those developed during the course.	40		B2 B3	C1 C7	
Laboratory practice	Exercises related to the laboratory practicals.	20	A2 A5	B3		D2

Other comments on the Evaluation

Attendance at seminars and laboratory practicals is mandatory and constitutes an essential requirement to obtain a passing evaluation. Students who cannot attend any of these activities are expected to provide an adequate justification. Otherwise, absence will result in the loss of the option for a second opportunity, which consists of an oral presentation on a topic related to the content covered during the course.

The oficial dates of evaluation tests will be available at: http://masteroceanografia.com/horarios/

All tests can be evaluated on the second chance.

Students are strongly requested to fulfil an honest and responsible behaviour. It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary record.

Sources of information

Basic Bibliography

Archer, D., **The global carbon cycle**, Princeton University Press, 2010

Barron, E.J., **Climatic variation in Earth history**, University Science Books, 1996

Berner, E.K., Berner, R.A., **Global environment: Water, air, and geochemical cycles (Second Edition)**, Princeton University Press, 2012

Broecker, W.S., **What drives the ice ages?**, Egidio Press, 2013

Cronin, T. M., **Paleoclimates: Understanding climate change past and present**, Columbia University Press, 2010

Gornitz, V., **Encyclopedia of paleoclimatology and ancient environments**, Springer Science & Business Media, 2009

Hemming, S., **Heinrich events: Massive late Pleistocene detritus layers of the North Atlantic and their global climate imprint**, 42, RG1005, Reviews in Geophysics, 2004
Pierrehumbert, R.T., **Principles of planetary climate**, Cambridge University Press, 2010
Rohling, E.J., **The Oceans: A Deep History**, Princeton University Press, 2017
Rohling, E.J., Marino, G., Foster, G.L., Goodwin, P.A., von der Heydt, A.S., Köhler, P., **Comparing climate sensitivity, past and present**, 10, Annual Reviews of Marine Science,
Ruddiman, W. F., **Earth□s climate. Past and future (Third Edition)**, W.H. Freeman and Company, 2014
Sarmiento, J.L., Gruber, N., **Ocean biogeochemical dynamics**, Princeton University Press, 2006
Trenberth, K.E., **The changing flow of energy through the climate system**, Cambridge University Press, 2022
Complementary Bibliography
Climate Reanalizer,
Masson-Delmotte, V., et al., **Climate Change 2021: The Physical science basis. Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change**, Cambridge University Press, 2021
National Oceanic and Atmospheric Administration (NOAA), Paleoclimatology,
Paleo-CO2,
Past Global Changes (PAGES),
RealClimate,
Snowball Earth,
United States Geological Survey (USGS), Paleoclimate,

Recommendations

Subjects that are recommended to be taken simultaneously

Design and Carrying out of Oceanographic Campaigns/V10M153V01301
Physical Oceanography/V10M153V01CF101
Geological Oceanography/V10M153V01CF104
Chemical Oceanography/V10M153V01CF102
Biological Oceanography/V10M153V01CF103

Subjects that it is recommended to have taken before

Geological Oceanography/V10M153V01CF104
Geological Processes in Continental Margins and Ocean Basins/V10M153V01104

Other comments

Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is requested to previously contact his/her teacher with reasonable anticipation. Students are strongly requested to fulfil a honest and responsible behaviour. It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary record.

IDENTIFYING DATA				
Atmosphere-Ocean Interaction				
Subject	Atmosphere-Ocean Interaction			
Code	V10M153V01207			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Castro Rodríguez, María Teresa de			
Lecturers	Castro Rodríguez, María Teresa de Des Villanueva, Marisela Eiras Barca, Jorge Gimeno Presa, Luís Nieto Muñiz, Raquel Olalla			
E-mail	mdecastro@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The atmosphere and the ocean are two physical systems that interact and are joined up. In this subject study all those processes that involve the interaction between the ocean and the atmosphere as well as his exchanges. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English. Matter of the program *English *Friendly: The/ace international students will be able to request to the *profesorado: to) material and bibliographic references for the follow-up of the matter in English, *b) attend the *tutorías in English, *c) proofs and evaluations in English.			

Training and Learning Results	
Code	
A1	Students who have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
A2	Students who can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study
A5	Students who have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
B3	The students will be able to deepen in the main oceanographic processes and their spatiotemporal scales
B4	The students will be able to analyse oceanographic databases and obtain skills for their treatment.
C2	The students will be able to schedule, design and execute original applied investigations from the stage of recognition until the evaluation of results and discoveries.
C7	The students will obtain knowledge that will allow them reinforce and deepen in the physical mechanisms that control the atmosphere-ocean interactions, the climatic variability, as well as the validity and contrast of climatic models.
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D2	The students will possess the handle skills in the laboratory that allow them to develop autonomous work.
D3	The students will be able to communicate the obtained information and their conclusions in a effective way to the general public, to other scientists and to the competent authorities, listening and answering of effective form and, using an appropriate language to the audience and to the context
D4	The students will be able to understand the need and obligation to perform a continuous training, to a large extent autonomous, for the scientific development, updating the knowledges, skills and attitudes of the professional competences along the life.

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

AIR1. Knowledge of processes related to the processes of interaction between the atmosphere and the ocean	A1 A2 A5 B3 B4 C2 C7 D1 D2 D4
AR2. Gain an in-depth understanding of oceanographic processes and develop proficiency in the analysis, management, and interpretation of oceanographic and atmospheric databases.	A2 B3 B4 C7
AR3. Develop the capacity for independent learning, as well as the ability to communicate effectively with a general audience.	D3

Contents	
Topic	
Previous concepts	Equation of movement of a geophysical fluid Latent Heat Specific Heat Transfer of Heat Density Comparison between atmospheric and oceanic properties
Introduction	Atmosphere influence on ocean Ocean influence on atmosphere Atmosphere and ocean as an integrated system
Hurricanes	Definition Physical structure Mechanics Process of training Places and main regions of training Movement and route
Current of the Gulf	Introduction The circulation of dump meridional The circulation of dump meridional of the Atlantic Common of the Gulf
ENSO	Introduction Definition History The south swing The climatic Variable Boy Index Projections
Oceanic evaporation and precipitation	Oceanic evaporation Global Distribution of water steam. Flow of water steam and his divergence Changes in sea water salinity. Transport of water steam to big distance, sources and sinks. Global of humidity Extreme Events: the oceans role on the jet modulation at low levels Atmospheric rivers, implications of climate change
Monsoons	Different warming in earth and ocean Geographic Distribution Diets of winds Extreme rains

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	28	25	53
Problem solving	14	28	42
Presentation	4	12	16
Seminars	1	0	1
Essay	1	7	8

Problem and/or exercise solving	2	0	2
Report of practices, practicum and external practices	0	3	3

*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 teacher explains the main theoretical aspects of the subject in class by means of Powerpoint or similar.
Problem solving	Seminars during which students solve practical activities supervised by the teacher. They are activities developed to improve the significant construction of the knowledge through the interaction between students. The function of the teacher is to present the aims, supervise and to realize the follow-up of the same.
Presentation	Individual or group oral session of a subject from the course.
Seminars	Significant construction of the knowledge through the interaction between the teacher and the student by means of tutorials to orient and solve doubts.

Personalized assistance

Methodologies	Description
Problem solving	During the resolution of practical cases and in the tutorial classes, the attention to the student will be customized with the aim to resolve any type of doubt so much theoretical like practice. Tutorial classes will be virtual through the Campus Remoto by appointment
Seminars	During the resolution of practical cases and tutorials the attention to the student will be able to be customized with the aim to resolve any type of doubt so much theoretical like practice. Tutorials: Monday from16:00 to 18:00 and Wednesday from 9:00 to 11:00

Assessment

	Description	Qualification	Training and Learning Results			
Essay	Individual or group oral sesion of a subject from the course. The AR3 learning outcome will be assessed.	30	A1 A2 A5		C2 C7	D1
Problem and/or exercise solving	Questions on the subject topics, practical reports, practical exercises. AR2, and AR3 learning outcomes will be assessed.	40	A1 A2	B3 B4	C7	D2
Report of practices, practicum and external practices	Report	30	A2 A5	B4	C2 C7	D2 D4

Other comments on the Evaluation

"The preferred assessment method is Continuous Evaluation. Students who wish to opt for Global Evaluation (100% of the grade based on the official exam) must inform the course instructor, via email or through the Moovi platform, within a period not exceeding one month from the start of the course.

Attendance to lectures, especially problem-solving seminars, is mandatory.

Students who are unable to attend the sessions due to justified reasons must provide appropriate justification. Evaluation will be conducted through other alternative tests chosen by the professor(s).

All tests can be evaluated on the secondchance. Nonattendance to compulsory activities precludes the possibility to beevaluated in the second chance.

Exam Dates:

The exam dates can be viewed at: http://masteroceanografia.com/horarios/

Any changes to the officially approved exam dates will be posted on the notice board and the Center's website."

Sources of information

Basic Bibliography

Pedlosky, J., **Geophysical Fluid Dynamics**, 1, Springer- Verlag, 1979

Gill, A.E., **Atmosphere- Ocean Dynamics**, 1, Academic Press, 1982

Complementary Bibliography

Recommendations

Subjects that are recommended to be taken simultaneously

Climate Models/V10M153V01205
Global Change and Marine Ecosystems/V10M153V01208
Physical Processes in the Ocean/V10M153V01101

Subjects that it is recommended to have taken before

Physical Oceanography/V10M153V01CF101

Other comments

Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is requested to previously contact his/her teacher with reasonable anticipation. Students are strongly requested to fulfil honest and responsible behaviour. It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary record

IDENTIFYING DATA				
Global Change and Marine Ecosystems				
Subject	Global Change and Marine Ecosystems			
Code	V10M153V01208			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Sobrino Garcia, Maria Cristina			
Lecturers	Martínez García, Sandra Nieto Cid, María del Mar Riveiro Alarcón, María Isabel Santos Echeandía, Juan Sobrino Garcia, Maria Cristina Teira Gonzalez, Eva Maria			
E-mail	sobrinoc@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The subject is focused to the study of the main processes of global change that affect to the biology of the ocean in different levels of organisation. For this *desglosa the results of observational and experimental studies directed to determine the effect of the global change on populations, communities and marine ecosystems, by means of masterclasses, practices of laboratory, resolution of practical cases and seminars.			

Training and Learning Results	
Code	
A1	Students who have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
A2	Students who can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study
A4	Students who can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and nonspecialist audiences clearly and unambiguously
A5	Students who have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
B1	The students will understand in a detailed and based form the theoretical and practical aspects and the work methodology of the oceanography
B2	The students will interpret the behaviour of the global oceanic system and their controlling factors.
B3	The students will be able to deepen in the main oceanographic processes and their spatiotemporal scales
B5	The students will be able to develop the sufficient autonomy to participate in research projects and scientific collaborations, especially in interdiscipinary contexts
C1	The students will be able to obtain advanced and relevant knowledge, of skilled and multidisciplinary character, in the field of the oceanography and their application to the marine environment
C3	The students will analyse situations and specific oceanographic conditions related with the global change
C4	The students will be able to apply in the practice the obtained knowledge and issue resolutions and judgments in the different oceanography fields
C7	The students will obtain knowledge that will allow them reinforce and deepen in the physical mechanisms that control the atmosphere-ocean interactions, the climatic variability, as well as the validity and contrast of climatic models.
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D2	The students will possess the handle skills in the laboratory that allow them to develop autonomous work.
D3	The students will be able to communicate the obtained information and their conclusions in a effective way to the general public, to other scientists and to the competent authorities, listening and answering of effective form and, using an appropriate language to the audience and to the context
D4	The students will be able to understand the need and obligation to perform a continuous training, to a large extent autonomous, for the scientific development, updating the knowledges, skills and attitudes of the professional competences along the life.

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

The students will learn the importance of the human effect on the biogeochemical processes to scale global and temporary scales, its repercussions for the marine environment and the sustainability of the ecosystems.	A1 A5 B3 B5 C7 D1 D4
The students will work their skills to express the ideas and knowledge about the topic by oral and written communications.	A2 A4 B2 B3 C3 C4 D3
The students will learn laboratory or field methodologies that will help them to interpret the results showed in the scientific publications related with the field of the Global Change	B1 C1 D2
New	A4 D3

Contents

Topic	
SUBJECT 1.	Introduction and reflections to start with a course of global change. Ecological footprint and index of human development. Concept and aims of sustainable development.
SUBJECT 2.	Scales of natural and anthropogenic variability: An approach across different temporal and spatial scales. Interdecadal trends in primary production
SUBJECT 3.	Multiple factors of stress: Temperature, stratification and nutrients. Interactive effects: experimental approximations and observations of field.
SUBJECT 4	Effects of ozone layer depletion and increased UV radiation on marine ecosystems. The ozone cycle. Penetration of UV radiation in aquatic environments. Photodegradation and photoinhibition. Direct and indirect effects of UV radiation on marine organisms.
SUBJECT 5.	Impacts of global change on the ocean carbon cycle. Ocean acidification and coastal acidification. Effects of increasing CO2; concentrations on marine organisms and ecosystems. Blue carbon: CO2; capture and sequestration in different marine ecosystems, including seagrass meadows, salt marshes, mangroves, and planktonic systems.
SUBJECT 6.	Impacts of global change on ocean biogeochemical cycles (O, N, P, Fe). Eutrophication: coastal and atmospheric inputs. Harmful algal blooms and massive proliferations of toxic phytoplankton.
SUBJECT 7.	Impacts of global change on planktonic communities. Community responses to global change. Changes in the diversity, distribution, and abundance of key functional groups: bacteria, phytoplankton, and zooplankton.
SUBJECT 8.	Impacts of global change on pelagic food webs. Changes in the biomass of primary producers and consumers. Changes in trophic transfer efficiency within food webs.
SUBJECT 9.	Fisheries overexploitation. Measures of sustainability. Global status of fishery resources. Effects of climate change on fisheries. Top-down effects in marine ecosystems.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	27	26	53
Seminars	4	22	26
Problem solving	1	6	7
Laboratory practical	9	9	18
Seminars	4	4	8
Presentation	4	8	12
Objective questions exam	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 lecturer of the main concepts and key topics of the course.
Seminars	The communication of scientific works in international congresses
Problem solving	Resolution of a practical case: Impact of the global change in the Estuary of Vigo.
Laboratory practical	Laboratory simulation exercises: Determination of metabolic rates: phytoplankton primary production. Estimation of photosynthesis□irradiance (P□I) curves. Multivariate statistical techniques: from data visualization to hypothesis testing.
Seminars	Group tutorials will be conducted to monitor the progress of the project to be presented at the end of the course as a scientific poster and oral communication. Students will be expected to present their progress, justify their methodological and scientific decisions, and participate in the critical discussion of their own work and that of their peers under the supervision of the lecturer.
Presentation	Students will deliver an oral presentation of a review project on a topic related to the course content, following the format commonly used at scientific conferences. The lecturer may, when appropriate, require the submission of a written report corresponding to the presented work.

Personalized assistance

Methodologies	Description
Lecturing	The student that wish to be attended in a one-to-one tutorial will be scheduled between 13:00 and 15:00 h. The student shall previously contact the corresponding professor by email.
Seminars	The student that wish to be attended in a one-to-one tutorial will be scheduled between 13:00 and 15:00 h. The student shall previously contact the corresponding professor by email.
Problem solving	The student that wish to be attended in a one-to-one tutorial will be scheduled between 13:00 and 15:00 h. The student shall previously contact the corresponding professor by email.
Laboratory practical	The student that wish to be attended in a one-to-one tutorial will be scheduled between 13:00 and 15:00 h. The student shall previously contact the corresponding professor by email.
Seminars	In group.

Assessment

	Description	Qualification	Training and Learning Results			
Lecturing	Students' knowledge will be assessed through a written examination.	30	A1 A5	B3	C1	D4
Seminars	Presentation of a scientific poster in a conference-style format.	25	A2 A4	B2 B3 B5	C1 C4	D1 D3
Problem solving	Submission of a report presenting the results of a practical case study.	15			C1 C3 C4 C7	
Laboratory practical	Students' knowledge will be assessed through a written examination.	5	A1		C1 C4	D2
Presentation	Presentation of a scientific project related to the course topics in the format of an oral presentation at a scientific conference. The project will be supervised through group tutorials, and assessment will be based on students□ participation and engagement during these tutorials, as well as on the quality of the written report and the oral presentation.	25	A5	B2 B3	C1 C3	D1 D3

Other comments on the Evaluation

Assessment of theoretical knowledge (lectures) and practical skills (laboratory sessions) may be carried out through a single examination. A minimum grade of 5/10 must be obtained in each assessment component in order to pass the course.

The examination dates will be published on the Master's website.

All assessment components may be retaken during the second examination period.

Students enrolled in this course are expected to demonstrate responsible and honest academic conduct. Any form of academic misconduct, including cheating or plagiarism, aimed at misrepresenting the level of knowledge or skills acquired in any examination, report, or assignment, is considered unacceptable. Such misconduct may result in failure of the course for the entire academic year. A record of these incidents will be maintained and, in cases of repeated misconduct, a formal disciplinary procedure may be requested through the Rector's Office.

Sources of information

Basic Bibliography

Intergovernmental Panel on Climate Change (IPCC), **Fifth assessment report (Climate Change 2014: Synthesis Report)**, 2014

Hilborn, R. and Hilborn, U., **Overfishing. What everyone needs to know**, Oxford University Press, 2012

Gattuso & Hansson, **Ocean acidification**, Oxford University Press, 2011

Bode et al., **Cambio climático y oceanográfico en el Atlántico del norte de España**, Instituto Español de Oceanografía, 2012

Complementary Bibliography

Barange et al., **Marine ecosystems and global change**, Oxford University Press, 2010

Zeebe & Wolf-Gladrow, **CO2 in seawater: equilibrium, kinetics, isotopes.**, Elsevier Oceanography Series, 2005

Robert P. Mason, **Trace Metals in Aquatic Systems**, Wiley-Blackwell, 2013

Recommendations

Subjects that are recommended to be taken simultaneously

Atmosphere-Ocean Interaction/V10M153V01207
Palaeoclimatology and Paleoceanography/V10M153V01206

Subjects that it is recommended to have taken before

Physical Oceanography/V10M153V01CF101
Chemical Oceanography/V10M153V01CF102
Biological Oceanography/V10M153V01CF103

IDENTIFYING DATA				
Modelling in Coastal Systems				
Subject	Modelling in Coastal Systems			
Code	V10M153V01209			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Martínez García, Sandra			
Lecturers	Teira Gonzalez, Eva Maria			
E-mail	sandra@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The teaching guide of this subject is available in the following link: https://asignaturas.uca.es/asig/2024-25/2368101/pdf/firmado/, and is imparted by the Universidad de Cádiz.			

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				
Anthropogenic Impact on the Coast				
Subject	Anthropogenic Impact on the Coast			
Code	V10M153V01210			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Martínez García, Sandra			
Lecturers	Teira Gonzalez, Eva Maria			
E-mail	sandra@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The teaching guide of this subject is available in the following link: https://ccmaryambientales.uca.es/asignaturas-master-en-oceanografia/, and is imparted by the Universidad de Cádiz.			

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				
Biogeochemistry of Coastal Systems				
Subject	Biogeochemistry of Coastal Systems			
Code	V10M153V01211			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Martínez García, Sandra			
Lecturers	Teira Gonzalez, Eva Maria			
E-mail	sandra@uvigo.es			
Web				
General description	The teaching guide of this subject is available in the following link: https://asignaturas.uca.es/asig/2024-25/2368103/pdf/firmado/, and is imparted by the Universidad de Cádiz.			

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				
Coastal Ecosystems				
Subject	Coastal Ecosystems			
Code	V10M153V01212			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	1st	2nd
Teaching language				
Department				
Coordinator	Martínez García, Sandra			
Lecturers	Teira Gonzalez, Eva Maria			
E-mail	sandra@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The teaching guide of this subject is available in the following link: https://asignaturas.uca.es/asig/2024-25/2368104/pdf/firmado/, and is imparted by the Universidad de Cádiz.			

Training and Learning Results
Code

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

Other comments on the Evaluation

Sources of information
Basic Bibliography
Complementary Bibliography

Recommendations

IDENTIFYING DATA				
Design and Carrying out of Oceanographic Campaigns				
Subject	Design and Carrying out of Oceanographic Campaigns			
Code	V10M153V01301			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Mandatory	1st	An
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Alejo Flores, Irene			
Lecturers	Alejo Flores, Irene Nombela Castaño, Miguel Angel Ramil Blanco, Francisco José Roson Porto, Gabriel Varela Benvenuto, Ramiro Alberto Vázquez Otero, María Elsa			
E-mail	ialejo@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The subject "Design and realisation of oceanographic campaigns" will give from the 4 areas of knowledge, where each one they contributes his own methodology. The high cost of the Oceanographic Research does that the oceanographic campaigns have to be necessarily interdisciplinaries, and his design and execution has to realise from the perspective of the optimisation of the available resources. The subject includes the realisation of an oceanographic campaign, whose length will depend on the budgetary availability and of oceanographic ships. It considers a minimum time of ship of 2 days by student to be able to assimilate the distinct methodologies of sampling, taking of data and usual instrumental techniques in Oceanography. This subject will give with annual character, so that it allow a flexible design in function of the availability of oceanographic vessels. Inside his planning considered the possibility that the students can ship in other campaigns of opportunity that realise researchers and that they can offer available squares for teaching.			

Training and Learning Results	
Code	
A3	Students who have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments
A5	Students who have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
B1	The students will understand in a detailed and based form the theoretical and practical aspects and the work methodology of the oceanography
B4	The students will be able to analyse oceanographic databases and obtain skills for their treatment.
C2	The students will be able to schedule, design and execute original applied investigations from the stage of recognition until the evaluation of results and discoveries.
C4	The students will be able to apply in the practice the obtained knowledge and issue resolutions and judgments in the different oceanography fields
D2	The students will possess the handle skills in the laboratory that allow them to develop autonomous work.
D4	The students will be able to understand the need and obligation to perform a continuous training, to a large extent autonomous, for the scientific development, updating the knowledges, skills and attitudes of the professional competences along the life.

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

Realise a complete route by the methodology of the oceanographic discipline, from the planning of the campaign, the obtaining of data in situ on board of the Oceanographic Vessel going through the learning of the treatment and presentation of the oceanographic results.	A3 A5 B1 B4 C2 C4 D2 D4

Contents	
Topic	
Design of the oceanographic campaign.	Adjusting the aims to the technical characteristic of the Oceanographic Vessel (O.V.) Configuration of the O.V. to reach the aims. Calculation of time in traffics and in stations.
Execution of the oceanographic campaign.	Management of the human resources. Management of the technical equipments. Management of the time.
Broadcast of reports of oceanographic campaigns.	Structure. Contents. Incidents.
Handling oceanographic equipment of data acquisition	Direct: samplings in the water column and in the bottom. Indirect: in the water column and in the bottom.
Treatment of oceanographic data.	Handling of acquisition software and of oceanographic data.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	5	7.5	12.5
Laboratory practical	15	18.75	33.75
Studies excursion	25	37.5	62.5
Presentation	3	10.75	13.75
Seminars	2	0.5	2.5
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	The basic concepts related to the design and realization of oceanographic campaigns will be presented by the professor.
Laboratory practical	The students will become familiar with the laboratory techniques for the preparation of the samples collected in the oceanographic campaign before their analysis, with the use of oceanographic data acquisition and treatment software. Attendance is compulsory.
Studies excursion	A campaign will be made on board an Oceanographic Vessel to become familiar with the use of the different data acquisition equipment both in the water column and in the substrate. Attendance is compulsory.
Presentation	With the information collected in the campaigne at a Oceanographic vessel, the students will have to make the report of the campaign and expose it in the class.
Seminars	There will be tutorials in small groups where students can ask questions and answer questions.

Personalized assistance	
Methodologies	**Description**
Lecturing	The students will be personally attended during the development of the master sessions as well as during the individual tutorials enabled for this purpose.
Laboratory practical	The students will be personally attended during the development of laboratory practices as well as during the individual tutorials enabled for this purpose.
Studies excursion	The students will be personally assisted during the development of field trips as well as during the individual tutorials enabled for this purpose.
Presentation	The students will be personally attended during the development of the presentations / exhibitions as well as during the individual tutorials enabled for that purpose.
Seminars	The students will be personally attended during the development of the group tutorials as well as during the individual tutorials enabled for that purpose.

Assessment

	Description	Qualification	Training and Learning Results			
Laboratory practical	Will be evaluated the attitude and the use of the activities realised in the laboratory and in the use of specific software.	20	A3	B1 B4	C2	D2
Studies excursion	Will be evaluated so much the quality of the report of campaign like the attitude during unroll it of the same.	40	A3 A5	B1 B4	C2 C4	D2 D4
Presentation	Will be evaluated the structure, content, clarity of the exhibition and organisation of the time during presentation.	40	A5	B4		D4

Other comments on the Evaluation

The date, time and place of the evaluation tests will be published on the master's official website.

https://masteroceanografia.com/horarios/

All tests can be evaluated on the second chance. Nonattendance to compulsory activities precludes the possibility to be
evaluated in the second chance, as well as the continuous evaluation.
Students who study this subject are responsible and honest behavior. Any form of fraud (copying,
or plagiarism) aimed at distorting the level of knowledge and skills reached in any type of test,
report or work will be considered inadmissible. Fraudulent behaviors may involve suspending the
subject during a full course. An internal record of these actions will be kept so that, in the case of
recidivism, request the opening of a disciplinary file to the Rectorate.

Sources of information

Basic Bibliography

Emery, W.J, and Thomson, R.E., **Data analysis methods in physical oceanography**, Elsevier,

Complementary Bibliography

Varios, **Manuales de los diferentes equipos empleados**, varias,
Varios, **Methods in oceanography**, Elsevier,
Varios, **Informes de diferentes campañas oceanográficas**, Non publicados,

Recommendations

IDENTIFYING DATA				
Master's Degree Dissertation				
Subject	Master's Degree Dissertation			
Code	V10M153V01302			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	15	Mandatory	1st	An
Teaching language	#EnglishFriendly Spanish Galician			
Department				
Coordinator	Nieto Palmeiro, Óscar			
Lecturers	Nieto Palmeiro, Óscar			
E-mail	palmeiro@uvigo.es			
Web	http://masteroceanografia.com/trabajo-fin-de-master/			
General description	It will consist in a work of investigation in the field of the Oceanography, in which sinteticen and integrate the competitions purchased in the educations.			

Training and Learning Results	
Code	
A1	Students who have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
A2	Students who can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study
A3	Students who have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments
A4	Students who can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and nonspecialist audiences clearly and unambiguously
A5	Students who have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
B1	The students will understand in a detailed and based form the theoretical and practical aspects and the work methodology of the oceanography
B2	The students will interpret the behaviour of the global oceanic system and their controlling factors.
B3	The students will be able to deepen in the main oceanographic processes and their spatiotemporal scales
B4	The students will be able to analyse oceanographic databases and obtain skills for their treatment.
B5	The students will be able to develop the sufficient autonomy to participate in research projects and scientific collaborations, especially in interdiscipinary contexts
C1	The students will be able to obtain advanced and relevant knowledge, of skilled and multidisciplinary character, in the field of the oceanography and their application to the marine environment
C2	The students will be able to schedule, design and execute original applied investigations from the stage of recognition until the evaluation of results and discoveries.
C3	The students will analyse situations and specific oceanographic conditions related with the global change
C4	The students will be able to apply in the practice the obtained knowledge and issue resolutions and judgments in the different oceanography fields
C5	The students will be able to draft scientific articles and present their results with clarity, using solid arguments in the development of their conclusions
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D2	The students will possess the handle skills in the laboratory that allow them to develop autonomous work.
D3	The students will be able to communicate the obtained information and their conclusions in a effective way to the general public, to other scientists and to the competent authorities, listening and answering of effective form and, using an appropriate language to the audience and to the context
D4	The students will be able to understand the need and obligation to perform a continuous training, to a large extent autonomous, for the scientific development, updating the knowledges, skills and attitudes of the professional competences along the life.

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

Endow to the students of the competences, knowledges, skills and tools, in order to qualify them, from a technical-scientific point of view, for the realisation, presentation and defence of a research work. This work will facilitate that the student have a taking of direct contact with the instrumentation, methodological techniques and methods for interpretation of data used in scientific-technical studies in the ocean. Likewise, it will give him the opportunity to work in a consolidated group of research. Hence, they are initiating their scientific work in an individual way and/or in a group.	A1 A2 A3 A4 A5 B1 B2 B3 B4 B5 C1 C2 C3 C4 C5 D1 D2 D3 D4

Contents

Topic	
The student will be able to make the Work End of Máster in the following big areas:	- Biological oceanography - Physical Oceanography - Chemical Oceanography - Geological Oceanography - Other disciplines related with the half marine and that are inside the contents given in the máster.
The lines of investigation or thematic fields offered are the following:	- Marine geology - Coastal Geology - Carbon dioxide, global Change and temporary series - chemical Processes of metals traces with ligandos organic. - Global changes in the oceanographic chemistry and biogeochemical cycles. - Ecology and physiology planctónica. - Oceanography Pesquera - Effects of global changes in the biological oceanography. - Global changes in the circulation to wide, meso- and sub-meso scale. - Fronts, twists and systems of afloramentos. - Hydrodynamic modelling. - Biology larvaria of marine invertebrates. - Effects of physical processes and chemists in the cycles bioxeoquímicos and answer of the biological communities. - Analysis sedimentario,micropaleontolóxico and isotopic of oceanic polls. - Ecology bentónica. - Analysis of oceanographic temporary series. - Resulted of oceanographic Campaigns. - Marine geochemistry. - Ways of climatic variability. - Interaction ocean-atmosphere. - Modelling of the ocean. - Climatic change in the ocean. - Energy in half marine (aeolian, maremotriz, currents). - Identification in analysis of registers paleoclimáticos. - Dynamic of gases invernadero in the coastal systems. - Diagénesis Of the organic matter and flows bentónicos. - Influence of the activity antrópica on the biogeochemical processes in the coastal systems. - Recent tectonic activity in coastal zones. - Stratigraphy of coastal zones and his relation with the changes of the level of the mar. - Geomorfología of continental margins. - Biological oceanography: Biology and Ecology of the Plankton. - Ecophysiology of macroalgas and ficología applied. - Microbial and biogeochemical ecology of the interfase waters-sediment. - Hydrodynamic modelling in coastal zones. - Operational oceanography in coastal zones. - Applications of the teledetection to the coastal oceanography.

Planning			
	Class hours	Hours outside the classroom	Total hours
Mentored work	0.25	354.5	354.75
Presentation	0.25	20	20.25

*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	Significant construction of knowledge through the interaction between the tutor and the student by means of tutorial sessions which can be personalised or carried out in very reducedin groups. In these season, the professor orients and resolves doubts.
Presentation	It consists in obtaining the keys for the preparation of the presentation of the work at the end of the master course.

Personalized assistance	
Methodologies	**Description**
Mentored work	The tutors and the works will be offered and assigned to beginning of the master course. The student will have to enter into appointments with his tutor when was required, in order to go advancing in the development of the work.

Assessment							
	Description	Qualification	Training and Learning Results				
Mentored work	The scientific content and written presentation of the Master's thesis will be assessed by a evaluating committee appointed for this purpose, in accordance with a rubric published on the Master's website.	60	A1 A2 A3 A4 A5	B1 B2 B3 B4 B5	C1 C2 C3 C4 C5	D1 D2 D3 D4	
Presentation	The presentation of a scientific paper and the answers, according to a rubric published on the Master's website, will be assessed by a evaluating committee appointed for this purpose.	40	A1 A2 A3 A4 A5	B1 B2 B3 B4 B5	C1 C2 C3 C4 C5	D1 D2 D3 D4	

Other comments on the Evaluation

There will be two ordinary announcements to proceed to the defense of the master's degree dissertation, one in June and another in July. In addition, there will be an extraordinary call in the month of December. The rules, the calendar of procedures, the evaluation guidelines, and another relevante information will be published in the virtual teaching platform *Moovi*, as well as in the following links:
http://masteroceanografia.com/trabajo-fin-de-master/https://mar.uvigo.es/docencia/trabajo-fin-de-master/
Students are strongly requested to fulfil a honest and responsible behaviour.
It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary recor. To control this aspect, students will personally submit their work to the Turnitin anti-plagiarism application, which will be enabled on the Moovi platform.

Sources of information

Basic Bibliography

Complementary Bibliography

Recommendations

IDENTIFYING DATA				
Physical Oceanography				
Subject	Physical Oceanography			
Code	V10M153V01CF101			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	1st
Teaching language	Spanish			
Department				
Coordinator	Varela Benvenuto, Ramiro Alberto			
Lecturers	Costoya Noguerol, Jorge Des Villanueva, Marisela Varela Benvenuto, Ramiro Alberto			
E-mail	rvarela@uvigo.es			
Web	http://masteroceanografia.com/			
General description	Acquisition of basic knowledges for the understanding of the main physical processes that occur in the oceans, attending especially to the different scales space-temporary in which they operate said physical processes in the field of the physical oceanography.			

Training and Learning Results	
Code	
A1	Students who have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
A5	Students who have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
B1	The students will understand in a detailed and based form the theoretical and practical aspects and the work methodology of the oceanography
C6	The students will be able to understand the controlling processes of the water masses, species and organisms distribution in the open ocean and in regions of special interest that capacite them for a oceanographic competitive research
C7	The students will obtain knowledge that will allow them reinforce and deepen in the physical mechanisms that control the atmosphere-ocean interactions, the climatic variability, as well as the validity and contrast of climatic models.
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D4	The students will be able to understand the need and obligation to perform a continuous training, to a large extent autonomous, for the scientific development, updating the knowledges, skills and attitudes of the professional competences along the life.

Expected results from this subject	Training and Learning Results
Capacity to understand the different scales space-temporary in which they operate the physical processes in the field of the physical oceanography.	A1 A5 B1 C6 C7 D1 D4
Matlab initiation level procedures	A5

Contents	
Topic	
Equation of state of seawater Continuity equation Navier-Stokes equations Ocean vorticity Waves in the ocean	Seawater physical properties. EOS-80 and TEOS-10 conventions. Boussinesq approximation, geostrophic balance, Ekman balance and transport. Understanding potential and total vorticity. Effects Main concept of wind waves. Classification of the oceanic waves. Tide origin. Tidal harmonic components Gravity waves in fluids. Deep and shallow water waves
CLIMATOLOGY	Electromagnetic radiation Simple heat balance in a water reservoir

HYDROGRAPHY	Surface distribution of salt and temperature Thermal and salt profiles in the water column Water masses. TS diagrams. Static and dynamic stability. The Richardson number
CURRENTS	Surface currents and the wind system. systems of winds. Western intensification. Geostrophic flow. Barotropic and baroclinic regimes. Dynamic topography. Ekman pumping. Convergences and divergences. Upwelling and downwelling.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	13	21	34
Seminars	16	20	36
Objective questions exam	0	1	1
Problem and/or exercise solving	4	0	4

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

Methodologies

	Description
Lecturing	Classical theoretical explanation/lecture.
Seminars	Real world examples questions and exercises to be solved with the teacher's help and by group discussion.

Personalized assistance

Methodologies	**Description**
Lecturing	Teacher's lecture on the corresponding subject, with a continuous interaction of the students to solve doubts about subjects of interest that can arise in this regard Students willing so could attend personal tutorials to solve doubts and/or uncertainties, which will mainly take place during the timetables indicated. To better optimise the procedure, the student is requested to previously contact his/her teacher with reasonable anticipation
Seminars	Resolution of exercises and problems (all they extracted from real situations)
Tests	**Description**
Problem and/or exercise solving	

Assessment

	Description	Qualification	Training and Learning Results			
Lecturing	We will value the assistance to class as well as the interventions and discussions that the student generates	20	A1 A5	B1		D1 D4
Objective questions exam	The student will be requested to do a multiple examination option (non eliminatory) in Moovi	40	A1 A5	B1	C7	
Problem and/or exercise solving	The student will be required to do a report (minimum qualification 5/10) with problems and exercises of the subjects treated during the course	40	A1 A5		C6 C7	D1 D4

Other comments on the Evaluation

In case of global evaluation is requested, the percentage of the problem and/or exercise solving exam will be increased from 40% to 60%

The oficial dates of evaluation tests will be available at: http://masteroceanografia.com/horarios/

Students are strongly requested to fulfil a honest and responsible behaviour. It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary record

Sources of information

Basic Bibliography

VARELA R.A. y ROSÓN, G, **Métodos en Oceanografía Física**, Editorial Anthias,

PICKARD, G.L. y W. EMERY, **Descriptive Physical Oceanography**, Pergamon Press,

Periáñez, Raúl, **Fundamentos de Oceanografía Dinámica**, Univ. de Sevilla,

Malek-Madani, Reza, **Physical Oceanography: A Mathematical Introduction with MATLAB**, Chapman and Hall/CRC,

Complementary Bibliography

TOMCZCAK, M. y J. STUART GODFREY, **Regional Oceanography: an introduction**, Pergamon,

BROWN, J.,, **Ocean circulation. Open University course Team**, Pergamon press,

Stewart, Robert., **Introduction to Physical Oceanography**, Texas A&M University,

Recommendations

Subjects that continue the syllabus

Atmosphere-Ocean Interaction/V10M153V01207
Physical Processes in the Ocean/V10M153V01101

Other comments

PREVIOUS REQUIREMENTS: The Educational Commission of the Master will evaluate, for each student that do not proceed from the degree in Marine Science, the particular need of receiving this complementary course in view of his/her previous knowledge and experience.

IDENTIFYING DATA				
Chemical Oceanography				
Subject	Chemical Oceanography			
Code	V10M153V01CF102			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Nieto Palmeiro, Óscar			
Lecturers	Nieto Palmeiro, Óscar			
E-mail	palmeiro@uvigo.es			
Web	http://masteroceanografia.com/			
General description	This subject is an introduction for those students that do not have previously studied chemical oceanography during the graduate and that will be used as a background for the following subjects in this master.			

Training and Learning Results	
Code	
A1	Students who have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
A5	Students who have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
B1	The students will understand in a detailed and based form the theoretical and practical aspects and the work methodology of the oceanography
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D4	The students will be able to understand the need and obligation to perform a continuous training, to a large extent autonomous, for the scientific development, updating the knowledges, skills and attitudes of the professional competences along the life.

Expected results from this subject	Training and Learning Results
Establish the chemical composition of the water of sea, determining the mechanisms and factors that compose it.	A1 A5 B1 D1
Describe the balances of the chemical species and gases dissolved in oceanic waters, including climatic and thermodynamic considerations.	A1 A5 B1 D1 D4
Study the mechanisms of transfer between the interphases.	A1 A5 B1 D1 D4
Establish the global cycles of the elements	A1 A5 B1 D1 D4

Contents	
Topic	
Composition and stoichiometry of seawater. Concept of salinity.	Major components of the water of mar. Salinity: chlorinity and chlorosity.
Reactivity of the minor elements in seawater: vertical profiles and time of residence.	Classification of elements. Vertical profiles. Time of residence.
Chemical speciation.	States of oxidation. Natural complexes in seawater.

Solubility of the gases in seawater.	Composition of the atmosphere. Dissolved gases in the water column. Dissolved oxygen in seawater.
Chemistry of interstitial water	The diagenetic sequence and redox reactions in sediments. Inputs of chemical elements from the interstitial water to the oceans.
Biogeochemical cycles of the C and of the elements nutrients	Cycle of C

Planning			
	Class hours	Hours outside the classroom	Total hours
Introductory activities	0.5	0	0.5
Lecturing	17.5	25	42.5
Laboratory practical	6	0	6
Seminars	4	0	4
Essay questions exam	2	0	2
Report of practices, practicum and external practices	0	10	10
Essay	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
Introductory activities	Brief presentation of the educational guide and of the development of the subject.
Lecturing	Exhibition of contents by part of the professor, analysis of competitions, explanation and demonstration of capacities, skills and knowledges in the classroom, using like methodology the participatory masterclass and in which the function of the professor is to explain the theoretical foundations of the matter.
Laboratory practical	Significant construction of the knowledge through the interaction the activity of the student. They are activities developed in spaces and with skilled equipment that improve the significant construction of the knowledge through the interaction and activity of the student. They realise in the laboratory and the function of the professor is to present the aims, orient the work and realise the follow-up of the same.
Seminars	Significant construction of the knowledge through a skilled meeting, of technical or academic nature, that tries to develop a deep study on the matter in question. The significant construction of the knowledge is active, since the students have to look for and elaborate the information in the frame of a reciprocal collaboration between himself and from the interaction with the professor.

Personalized assistance	
Methodologies	**Description**
Introductory activities	The student who wishes it will be able to attend personalized tutorials to solve doubts, mainly in the schedules indicated. To optimize the time, it is necessary for the student to contact the teacher well in advance. These tutorials can be done in person in the offices of the teachers or through the virtual offices that the teachers have in campusremotouvigo.gal. Likewise, any doubts that arise to the student can be formulated through the forums that are enabled for this on the Moovi platform.
Lecturing	The student who wishes it will be able to attend personalized tutorials to solve doubts, mainly in the schedules indicated. To optimize the time, it is necessary for the student to contact the teacher well in advance. These tutorials can be done in person in the offices of the teachers or through the virtual offices that the teachers have in campusremotouvigo.gal. Likewise, any doubts that arise to the student can be formulated through the forums that are enabled for this on the Moovi platform.
Laboratory practical	The student who wishes it will be able to attend personalized tutorials to solve doubts, mainly in the schedules indicated. To optimize the time, it is necessary for the student to contact the teacher well in advance. These tutorials can be done in person in the offices of the teachers or through the virtual offices that the teachers have in campusremotouvigo.gal. Likewise, any doubts that arise to the student can be formulated through the forums that are enabled for this on the Moovi platform.
Seminars	The student who wishes it will be able to attend personalized tutorials to solve doubts, mainly in the schedules indicated. To optimize the time, it is necessary for the student to contact the teacher well in advance. These tutorials can be done in person in the offices of the teachers or through the virtual offices that the teachers have in campusremotouvigo.gal. Likewise, any doubts that arise to the student can be formulated through the forums that are enabled for this on the Moovi platform.
Tests	**Description**

Essay questions exam	The student who wishes it will be able to attend personalized tutorials to solve doubts, mainly in the schedules indicated. To optimize the time, it is necessary for the student to contact the teacher well in advance. These tutorials can be done in person in the offices of the teachers or through the virtual offices that the teachers have in campusremotouvigo.gal. Likewise, any doubts that arise to the student can be formulated through the forums that are enabled for this on the Moovi platform.

Assessment

	Description	Qualification	Training and Learning Results		
Essay questions exam	The student will have to answer in a succinct way to some questions in which it will evaluate the capacity to comprise and relate the concepts learnt during the subject.	40	A1 A5	B1	D1 D4
Report of practices, practicum and external practices	The students in group will present a memory of the work of practices realised in the laboratory and will be evaluated of agreement to some criteria that will be published as a rubric in the platform Moovi.	30	A1 A5	B1	
Essay	The students in group will present a memory of the work realised in the sessions of seminars and will be evaluated of agreement to some criteria that will be published as a rubric in the platform Moovi.	30	A1 A5	B1	D1 D4

Other comments on the Evaluation

The official dates for the evaluation tests can be found at the following links:

http://masteroceanografia.com/horarios/

Exámenes - Facultade de Ciencias do Mar (uvigo.es)

In order to surpass the whole subject, all and each one of the parts that compose the subject have to be surpassed with a minimum qualification of 5 points.

In case that any of the proofs of short answer and the resolution and of problems and/or exercises do not reach the minimum note, will repeat the examination in the second announcement.
In the case that it do not reach the minimum note in "Reports/memories of practice" and/or the "Jobs and projects", it will present again the work in the term that the professor estimate timely.

Overall evaluation option. The application for this evaluation option will have to be submitted in the time and form determined by the Center, which will be published before the beginning of the academic year. Given the experimental nature of the practices, attendance is mandatory to qualify for this evaluation option. **Failure to attend the internship, without justified cause, invalidates thispossibility, as well as the opportunity for extraordinary evaluation (2nd opportunity).**

Sources of information

Basic Bibliography

Millero F.J. y Sohn M.L., **Chemical Oceanography**, 4ª edición, CRC Press, cop., 2013

Chester R. y Jickells T.D., **Marine geochemistry**, 3ª edición, Wiley-Blackwell, cop., 2012

Complementary Bibliography

Open University course team, **Seawater : its composition, properties and behaviour**, 1ª edición, Pergamon Press, 1991

Libes S.M, **Introduction to Marine Biogeochemistry**, 2ª edición, Academic Press, 2009

Riley J.P. y Chester R., **Introducción a la Química Marina**, 1º edición en castellano y ediciones en inglés, A.G.T., 1989

Recommendations

Subjects that continue the syllabus

Chemical Reactions in the Ocean/V10M153V01103

Other comments

Students are required to teach this subject, responsible and honest conduct. Any form of fraud (e.g. copying and/or plagiarism) aimed at distorting the level of knowledge or skill achieved by students in any type of test, report or work designed for this purpose is inadmissible. Fraudulent conduct may be suspended during a full course. An internal register of these proceedings shall be kept in order to request the Rectorate to open disciplinary proceedings in the event of a repeat offence.

IDENTIFYING DATA				
Biological Oceanography				
Subject	Biological Oceanography			
Code	V10M153V01CF103			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Teira Gonzalez, Eva Maria			
Lecturers	Martínez García, Sandra Teira Gonzalez, Eva Maria			
E-mail	teira@uvigo.es			
Web	http://masteroceanografia.com/			
General description	The subject tackles the study of communities, food webs and the main oceanographic processes that take place in the ocean. We will present basic notions on the cycle of the organic matter in the marine environment. We will do special emphasis on microbial plankton communities, as they play a predominant role in marine biogeochemical cycles. The fundamental aim is to acquire basic knowledge on the communities of organisms, their interactions and the oceanographic processes in order to understand the role of the biology of the ocean in the Earth system functioning.			

Training and Learning Results	
Code	
A1	Students who have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
A5	Students who have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
B1	The students will understand in a detailed and based form the theoretical and practical aspects and the work methodology of the oceanography
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D2	The students will possess the handle skills in the laboratory that allow them to develop autonomous work.

Expected results from this subject	Training and Learning Results
Students will be able to use the terminology and concepts related with the biological oceanography scientific field	A1 B1
Students will be able to apply the scientific methodology and the basic technics related with the biological oceanography research field	A1 A5 B1 D1 D2
Students will be able to analyse and explain the relationship between the organisms and the environmental factors	A1 B1
Students will recognize the diversity and function of the main planktonic and benthonic marine groups	A1 B1
Students will be able to comprehensively describe the processes of circulation of the organic matter in the marine environment	A1 B1
Students will be able to evaluate, formulate, and resolve problems related with the oceanography	B1 D1
Students will be able to demonstrate advanced oral and written communication skills	D1

Contents	
Topic	
Lesson 1. The marine environment.	Classification of marine environments and organisms. Abiotic conditions: solar radiation, temperature, salinity, density, pressure. Oceanic circulation.
Lesson 2. Phytoplankton and primary production.	Main groups of phytoplankton. Photosynthesis and primary production. Factors that control primary production. Spatial and temporal variability.

Lesson 3. Microbial plankton: decomposition of organic matter.	Bacteria, archea, virus and heterotrophic protists. Biomass, production and bacterial growth efficiency. Factors that control the bacterial growth: resources versus predation.
Lesson 4. Zooplankton and pelagic food webs.	Main groups of zooplankton. Transfer of energy and trophic chains. Types of pelagic food webs.
Lesson 5. Benthonic Organisms.	Main groups of benthonic plants and animals. Factors that determine the structure of benthonic communities.
Lesson 6. Benthonic communities.	Benthonic communities of shallow rocky and sandy environments. Benthonic communities of deep systems.
Lesson 7. Human impact on the marine environment.	Overexploitation. Invasive species. Destruction and alteration of habitats. Climate change.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	18	30	48
Studies excursion	5	4	9
Laboratory practical	4	7	11
Presentation	2	4	6
Seminars	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	In-person presentation of subject contents supported with graphic material.
Studies excursion	Application of methodologies for field sampling in biological oceanography. Attendance is compulsory.
Laboratory practical	Study of the effect of nutrients on the microbial plankton metabolic rates. Attendance is compulsory.
Presentation	Oral presentation of the results obtained by the students in the field and laboratory practices.
Seminars	Analysis of the results obtained in the laboratory.

Personalized assistance

Methodologies	Description
Lecturing	Doubts about theoretical and practical contents will be resolved trough on-line or in-person tutorials.
Studies excursion	Doubts about theoretical and practical contents will be resolved trough on-line or in-person tutorials.
Laboratory practical	Doubts about theoretical and practical contents will be resolved trough on-line or in-person tutorials.
Presentation	Doubts about theoretical and practical contents will be resolved trough on-line or in-person tutorials.
Seminars	

Assessment

	Description	Qualification	Training and Learning Results		
Lecturing	Contents will be evaluated trough a written exam.	40	A1 A5	B1	
Studies excursion	Field work will be evaluated trough attendance and participation. Attendance is compulsory.	10	A1	B1	
Laboratory practical	Contents will be evaluated trough a written exam. Attendance is compulsory.	20		B1	D1 D2
Presentation	Oral presentation about the practical lab work. The quality of the presentation as well as the clarity of the exposition and the capacity to communicate of the student will be specifically valued.	30	A5		D1

Other comments on the Evaluation

The oficial dates of evaluation tests will be available at: https://mar.uvigo.es/docencia/asignaturas-y-horarios/

All testscan be evaluated on the second chance exam. Nonattendance to studies excursionand laboratory practical precludes the possibility to be evaluated in thesecond chance exam and to chose the global evaluation option.

Sources of information

Basic Bibliography

Lalli CM, **Biological oceanography. An introduction**, Elsevier,
Miller, CB, **Biological oceanography**, Wiley-Blackwell,

Complementary Bibliography

Kaiser, MJ, **Marine ecology. Processes, systems, and impacts**, Oxford University press, New York,
Kirchman DL, **Microbial ecology of the oceans**, Wiley-Liss, New York,
Reynolds C, **Ecology of Phytoplankton**, Cambridge University,
Castellani, C & Edwards, M, **Marine Plankton**, OxfordOxfrod University press, New York,

Recommendations

Subjects that continue the syllabus

Global Change and Marine Ecosystems/V10M153V01208
Coastal Ecosystems/V10M153V01212
Oceanography of Unique Regions: Polar, Equatorial and Upwelling Regions/V10M153V01204
Biogeochemistry of Coastal Systems/V10M153V01211

Subjects that are recommended to be taken simultaneously

Design and Carrying out of Oceanographic Campaigns/V10M153V01301
Oceanography of Ecosystems/V10M153V01102

Other comments

Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is requested to previously contact his/her teacher with reasonable anticipation.

Students are strongly requested to fulfil a honest and responsible behaviour. It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary record

IDENTIFYING DATA				
Geological Oceanography				
Subject	Geological Oceanography			
Code	V10M153V01CF104			
Study programme	Máster Universitario en Oceanografía			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	3	Optional	1st	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Alejo Flores, Irene			
Lecturers	Alejo Flores, Irene García Gil, María Soledad Nombela Castaño, Miguel Angel			
E-mail	ialejo@uvigo.es			
Web	http://masteroceanografia.com/			
General description	It is a complement formative that they will have to follow the students that do not proceed of the degree in Marine Sciences. The Educational Commission of the Master will study for each case, in sight of the training and previous experience of each student, the need of follow this subject. English Friendly subject: International students may request from the teachers: a) resources and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
A1	Students who have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within a research context
A5	Students who have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.
B1	The students will understand in a detailed and based form the theoretical and practical aspects and the work methodology of the oceanography
D1	The students will know and will be able to apply the scientific method in the academic and research fields.
D4	The students will be able to understand the need and obligation to perform a continuous training, to a large extent autonomous, for the scientific development, updating the knowledges, skills and attitudes of the professional competences along the life.

Expected results from this subject	Training and Learning Results
Purchase basic knowledges to understand the internal and external geological cycles in the frame of the Plate Tectonic.	A1 B1 D1
Capacity to take consciousness of the different scales space-temporary in which the geological processes operate in the field of the geological oceanography.	A1 A5 B1 D4
Understand the importance for the human being of the geological processes and products in the field of the marine geology.	A5 B1 D1 D4

Contents	
Topic	
The System Tierra	The Earth like dynamic system. Fundamental principles of the geology and concept of geological time. The geological cycle. Sources of energy of the internal system and of the external system. Scale space-temporary of the terrestrial processes.

Introduction to the Tectonics of Plates.	It derives it continental and the oceanic expansion. Active continental margins and passive. Edges of plate: convergent, divergent and *transcurrentes. The cycle of Wilson. Tectonics and climate: *ciclicidad of the processes in the geological register
Basic concepts of sedimentology	Fundamental principles. Structures *sedimentarias. *Facies And analysis of *facies
Coastal and marine sedimentary environments	Processes and products. Sedimentary Environments.
Seismic surveys at sea	- The seismic method - Seismic interpretation
Practical subjects	1. Introduction to the map and geological cut 2. Basic technicians in sedimentology

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	18	31.5	49.5
Laboratory practical	9	11.25	20.25
Seminars	3	2.25	5.25

*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 main concepts of each topic will be explained by the teacher and the students will be involved by asking questions. Attendance and active participation in the sessions will be valued.
Laboratory practical	Resolution of maps and simple geological sections. Use of basic techniques in sedimentology. Recognition of visu of the main groups of rocks. Given their experimental nature, attendance at them is MANDATORY.
Seminars	The students will present in small groups doubts that will be solved by the teacher and the rest of the students of the group.

Personalized assistance

Methodologies	Description
Lecturing	The students can be personally assisted both in the development of the lectures and in the hours of individual tutoring reserved for that purpose.
Laboratory practical	The students can be personally attended both in the development of laboratory practices and in the hours of individual tutoring reserved for that purpose.
Seminars	Students can be personally attended both in the development of group tutoring and in the individual tutoring hours reserved for this purpose.

Assessment

	Description	Qualification	Training and Learning Results		
Lecturing	It will be evaluated in 2 blocks: 20%, attendance at the sessions and active participation in them. 40%, evaluation of the knowledge acquired through a written test.	60	A1 A5	B1	D1 D4
Laboratory practical	For each one of the practices the students will have to present a memory that will be evaluated. Attendance is mandatory, given its experimental nature.	40	A5	B1	D4

Other comments on the Evaluation

Global assessment option

The application for this evaluation option must be submitted in the time and manner determined by the Center,

which will be published prior to the academic start.

Given the experimental nature of the internships, attendance at them is mandatory to be eligible for this evaluation option.

Failure to attend the practices, without just cause invalidates this possibility, as well as the opportunity for extraordinary evaluation (2nd opportunity).

Extraordinary evaluation (2nd chance)

Global exam in which 60% will correspond to the theoretical contents and 40% of the practical ones.

Other considerations

The oficial dates of evaluation tests will be available at:
http://masteroceanografia.com/horarios/

Students who study this subject are responsible and honest behavior. Any form of fraud (copy or plagiarism) aimed at distorting the level of knowledge and skills reached in any type of test, report or work will be considered inadmissible. Fraudulent behaviors may involve suspending the subject during a full course. An internal record of these proceedings will be kept so that, in case of recidivism, request the opening of a disciplinary file to the Rectorate.

Sources of information

Basic Bibliography

Leeder, M.R., Pérez Arlucea, M., **Physical processes in Earth and Environmental Sciences**, Blackwell Publishing, 321 pp.,

Tarbuck, E.J., Lutgens, F.K., **Ciencias de la Tierra. Una introducción a la Geología Física**, 10th Edition. Prentice Hall. Madrid. 710 pp.,

McQuillin, R., Bacon, M., Barclay, W., **An Introduction to seismic interpretation**, Grahan & Trotman, 287 pp.,

Davidson-Arnott, R., **Introduction to Coastal Processes and Geomorephology**, Cambridge University Press. 422.,

Complementary Bibliography

Reolid, M., **La Tierra un lugar privilegiado para la vida**, Aula Magna Magrav Gil, 298 pp.,

Recommendations

Other comments

Students willing so could attend personal tutorials to solve doubts and/or uncertainties. To better optimise the procedure, the student is requested to previously contact his/her teacher with reasonable anticipation. Students are strongly requested to fulfil a honest and responsible behaviour. It is considered completely unacceptable any alteration or fraud (i.e., copy or plagiarism) contributing to modify the level of knowledge and abilities acquired in exams, evaluations, reports or any kind of teacher□s proposed work. Fraudulent behaviour may cause failing the course for a whole academic year. An internal dossier of these activities will be built and, when reoffending, the university rectorate will be asked to open a disciplinary record.