Information about the subject

Degree: Bachelor of Degree in Marine Sciences

Faculty: Faculty of Veterinary Medicine and Experimental Sciences

Code: 273006 **Name:** Physical Oceanography

Credits: 6,00 **ECTS Year:** 3 **Semester:** 1

Module: Professional

Subject Matter: Oceanography **Type:** Compulsory

Department: Oceanography and Environment

Type of learning: Classroom-based learning

Languages in which it is taught: Spanish

Lecturer/-s:

273A	Amanda Sancho Garcia **(Responsible Lecturer)**	amanda.sancho@ucv.es

Module organization

Professional

Subject Matter	ECTS	Subject	ECTS	Year/semester
Oceanography	36,00	Chemical Oceanography	6,00	3/1
		Geological Oceanography	6,00	3/1
		Marine Biology and Biological Oceanography	6,00	3/1
		Methods in Oceanography I: Physical and Geological	6,00	3/2
		Methods in Oceanography II: Chemical and Biological	6,00	3/2
		Physical Oceanography	6,00	3/1
Marine living resources	12,00	Aquaculture	6,00	3/2
		Fisheries	6,00	3/2
Marine and Coastal Management	18,00	Coastal Planning and Management	6,00	4/1
		Legislation and Economy	6,00	4/1
		Marine Pollution	6,00	4/1

Recommended knowledge

Physics and Fluids Mechanics knowledge.

Learning outcomes

At the end of the course, the student must be able to prove that he/she has acquired the following learning outcomes:

R1	The student knows and applies in practical cases the fundamentals of physical oceanography.
R2	The student applies the general knowledge of physical oceanography.
R3	The student solves problems related to the temperature and salinity of seawater. TS Diagrams.
R4	The student knows the physical process and marine dynamics, waves, currents and tides.
R5	The student knows and applies the oceanographic data processing software.

Competencies

Depending on the learning outcomes, the competencies to which the subject contributes are (please score from 1 to 4, being 4 the highest score):

BASIC		Weighting			
		1	2	3	4
CB2	Students are able to apply knowledge to their work in a professional way and have the competences enabling them to state and defend views and opinions as well as perform problem-solving tasks in their field of study.				x
CB4	Command of a foreign language				x
CB5	Students develop the necessary learning skills to undertake further studies with a high level of autonomy.				x

GENERAL		Weighting			
		1	2	3	4
CG1	Capacity to analyze and synthesize			x	
CG2	Capacity to organize and plan			x	
CG3	Mastering Spanish oral and written communication				x
CG5	Knowing and applying Basic ITC skills related to marine science				x
CG6	Capacity to manage information (capacity to look for and analyze information coming from different types of sources)				x
CG7	Decision making		x		
CG8	Capacity to work in interdisciplinary and multidisciplinary team				x
CG9	Interpersonal skills	x			
CG10	Critical and self-critical capacity	x			

CG11	Capacity to learn				x
CG12	Capacity to adapt to new situations		x		
CG13	Capacity to produce new ideas (creativity)			x	
CG14	Leadership abilities.	x			
CG17	Research skills				x

SPECIFIC		Weighting			
		1	2	3	4
CE1	Knowing and understanding contents, principles and theories related to Oceanography				x
CE2	Knowing basic sampling techniques of water column, organisms, sediment and sea-bottoms as well as basic techniques of dynamic and structural variable measurement	x			
CE6	Applying marine instrument techniques			x	
CE7	Collecting, assessing, processing and interpreting oceanographic data, following the most recent theories				x
CE8	Identifying and analyzing new problems and proposing solution strategies				x
CE9	Knowing how to carry out experiments and measurements both in the laboratory and during sample collection				x
CE15	Identifying and proposing monitoring means for problems of marine pollution	x			
CE17	Developing training programs for marine and coastal areas	x			

Assessment system for the acquisition of competencies and grading system

Assessed learning outcomes	Granted percentage	Assessment method
R1, R2, R3, R4	40,00%	Written test with theoretical and practical questions
R1, R2, R3, R4, R5	40,00%	Delivery of guided assignments, whose objectives and contents will be proposed by the teacher
R1, R2, R3, R5	10,00%	Problem-solving and issues related to the use of specific software
R1, R2, R4	10,00%	Oral presentation

Observations

According to the general evaluation and qualification regulations, the preferred evaluation system will be by means of continuous evaluation. Specifically:
Continuous assessment will be applied to the item 'Problem solving and related questions using specific computer programmes', with the student having to hand in the exercise carried out at the end of each practice (it will be essential to hand in all the exercises requested). The final assessment of this item will consist of an exam with theoretical and practical questions using ODV software.
A minimum of 5 out of 10 in the written test and in the rest of the evaluation instruments is required to obtain an average. If a final mark of 5 points is not obtained in each section and only one of them has been passed, the course will be failed, even if the weighted average is equal to or higher than 5. The weighted average is also subject to the student having submitted all the required assignments. The mark obtained may suffer a penalty of up to 10% for late delivery of the work requested.
The delivery of supervised work will be both individual and group work. The evaluation percentage of this evaluation instrument is broken down into 20% for individual and/or pair work and 20% for group work (Calpe Report and Physical Oceanography Conference paper). The minimum mark for both types of directed work must be at least 5 points.

MENTION OF DISTINCTION:
In accordance with the regulations governing the assessment and grading of subjects in force at UCV, the distinction of "Matrícula de Honor" (Honours with Distinction) may be awarded to students who have achieved a grade of 9.0 or higher. The number of "Matrículas de Honor" (Honours with Distinction) may not exceed five percent of the students enrolled in the group for the corresponding academic year, unless the number of enrolled students is fewer than 20, in which case a single "Matrícula de Honor" (Honours with 9 Distinction) may be awarded. Exceptionally, these distinctions may be assigned globally across different groups of the same subject. Nevertheless, the total number of distinctions awarded will be the same as if they were assigned by group, but they may be distributed among all students based on a common criterion, regardless of the group to which they belong. The criteria for awarding "Matrícula de Honor" (Honours with Distinction) will be determined according to the guidelines stipulated by the professor responsible for the course, as detailed in the "Observations" section of the evaluation system in the course guide.

Learning activities

The following methodologies will be used so that the students can achieve the learning outcomes of the subject:

M1	Teacher presentation of contents, analysis of competences, explanation and in-class display of skills, abilities and knowledge.
M2	Group work sessions supervised by the professor. Case studies, diagnostic tests, problems, field work, computer room, visits, data search, libraries, on-line, Internet, etc. Meaningful construction of knowledge through interaction and student activity.
M3	Activities carried out in spaces with specialized equipment.
M4	Supervised monographic sessions with shared participation.
M5	Application of multidisciplinary knowledge.
M6	Personalized and small group attention. Period of instruction and/or guidance carried out by a tutor to review and discuss materials and topics presented in classes, seminars, readings, papers, etc.
M8	Set of oral and/or written tests used in initial, formative or additive assessment of the student.
M9	Group preparation of readings, essays, problem-solving, seminars, papers, reports, etc. to be presented or submitted in theoretical , practical and/or small-group tutoring sessions. Work done on the university e-learning platform (www.plataforma.ucv.es)

M10 Student's study: Individual preparation of readings, essays, problem-solving, seminars, papers, reports, etc. to be presented or submitted in theoretical, practical and/or small-group tutoring sessions. Work done on the university e-learning platform (www.plataforma.ucv.es).

IN-CLASS LEARNING ACTIVITIES

	LEARNING OUTCOMES	HOURS	ECTS
ON-CAMPUS CLASS M1	R1, R2, R3, R4	34,00	1,36
PRACTICAL CLASSES M2	R1, R2, R3, R4, R5	17,00	0,68
SEMINAR M4	R1, R2, R4	2,00	0,08
GROUP PRESENTATION OF ASSIGNMENTS M5	R1, R2, R4	2,00	0,08
TUTORIAL M6	R1, R2, R3, R4, R5	2,00	0,08
ASSESSMENT M8	R1, R2, R3, R4, R5	3,00	0,12
TOTAL		**60,00**	**2,40**

LEARNING ACTIVITIES OF AUTONOMOUS WORK

	LEARNING OUTCOMES	HOURS	ECTS
GROUP WORK M9	R1, R2, R3, R4, R5	40,00	1,60
INDEPENDENT WORK M10	R1, R2, R3, R4, R5	50,00	2,00
TOTAL		**90,00**	**3,60**

Description of the contents

Description of the necessary contents to acquire the learning outcomes.

Theoretical contents:

Content block	Contents
UNIT 1. PHYSICAL PROPERTIES OF SEAWATER	**Lesson 1.Temperature** 1.1 Heat balance 1.2 Definitions, units and magnitudes 1.3 Spatial distribution and in the water column of the temperature 1.4 Mixed layer formation processes **Lesson 2.Salinity** 2.1 Definitions, units and magnitudes 2.2 Spatial distribution and in the water column of the temperature 2.3 Salinity variations due to local conditions **Lesson 3.Density** 3.1 Definitions, units and magnitudes 3.2 Spatial distribution and in the water column of the density. 3.3 Equation of state (TEOS-10) 3.4 Effect of the temperature and salinity on the seawater density. **Lesson 4.Sound and sea ice** 4.1 Sound in the sea 4.2 Seawater freezing point 4.3 Freezing processes 4.4 Density and thermodynamics of sea ice 4.5 Brine rejection 4.6 Polynyas
UNIT 2. WATER MASSES	**Lesson 5. Water masses** 5.1 Types of water masses and their characteristics 5.2 TS-diagrams 5.3 Caballing 5.4 Vertical stability of water masses

UNIT 3. OCEAN CIRCULATION	**Lesson 6. Thermohaline circulation and wind response circulation** 6.1 Thermohaline circulation 6.2 Wind response circulation 6.2.1 Forces 6.2.2 Atmospheric circulation 6.2.3 Main oceanic currents 6.2.4 Western intensification. Inertial currents. 6.2.5 Langmuir circulation. 6.2.6 Ekman surface and bottom layer 6.2.7 Vertical circulation 6.2.6.1 Upwelling 6.2.8 Geostrophic flow
UNIDAD 4. WAVES, TIDES AND COASTAL OCEANOGRAPHY	**Lesson 7.Waves** 7.1 Airy theory 7.2 Wave formation 7.3 Wind 7.4 Sea and swell 7.5 Wave approximation 7.6 Storm surge. 7.7 Tsunamis. 7.8 Data base and measuring instruments **Lesson 8. Internal waves** 8.1. Characteristics 8.2. Layer model **Lesson 9. Tides** 9.1 Generation forces 9.2 Datum or reference level 9.3 Tide prediction 9.4 Form factor **Lesson 10. Estuaries** 10.1 Definition 10.2 Classifications 10.3 Estuarine circulation 10.4 Removal time

Organization of the practical activities:

	Content	Place	Hours
PR1.	Representation and interpretation of temperature, salinity and density profiles and sections using Ocean Data View software (ODV).	Computer	4,00
PR2.	Physical parameters sampling.	Boat	1,00
PR3.	Physical parameters sampling.	Marine station	2,00
PR4.	Representation and interpretation of TS diagrams using ODV and identification of water masses.	Computer	2,00
PR5.	Representation of the Ekman layer.	Lecture room	2,00
PR6.	Representation and interpretation of geostrophic currents (ODV).	Computer	2,00
PR7.	Form factor (F) exercises.	Lecture room	1,00
PR8.	Estuarine circulation exercises.	Lecture room	2,00

Temporary organization of learning:

Block of content	Number of sessions	Hours
UNIT 1. PHYSICAL PROPERTIES OF SEAWATER	9,00	18,00
UNIT 2. WATER MASSES	6,00	12,00
UNIT 3. OCEAN CIRCULATION	11,00	22,00
UNIDAD 4. WAVES, TIDES AND COASTAL OCEANOGRAPHY	4,00	8,00

References

BASIC:

Dijkstra, H.A. (2010). Dynamical oceanography. Utrech: Springer. 407 pp.

Karnauskas, K. (2020). Physical Oceanography and Climate. Cambridge: Cambridge University Press. 247 pp.

Knauss, J.A., (2000). Introduction to Physical Oceanography. Estados Unidos: Pearson Educación. 309 pp.

Pond, S. and Pickard, GL., (2003). Introductory Dynamical Oceanography. 2ª Edición, Reino Unido: Butterworth. 329 pp.

Siedler, G., Griffies, S.M., Gould, J., and Church, J.A. (2013). Ocean circulation and climate: A 21st Century perspective. Amsterdam: Academic Press. 868 pp.

Stewart, R. H., (2004). Introduction to Physical Oceanography. Texas: Texas University

Talley, L.D., Pickard, G.L., Emery, W.J. and Swift, J.H., (2011). Descriptive Physical Oceanography: An Introduction, 6ª edición. Londres: Elsevier. 555 pp.

COMPLEMENTARY:

Brown, E., Colling, A., Park, D., Phillips, J., Rothery, D. and Wright, J., (2002). Waves, tides and shallow-water processes. Reino Unido: The Open University. 227 pp.

Brown, E., Colling, A., Park, D., Phillips, J., Rothery, D. and Wright, J., (2002). Ocean Circulation. Reino Unido: The Open University. 286 pp.

Brown, E., Colling, A., Park, D., Phillips, J., Rothery, D. and Wright, J., (2002). Seawater: its composition, properties and behaviour. Reino Unido: The Open University. 168 pp.

Castelló, M., (2007). Escribir y comunicarse en contextos científicos y académicos. Barcelona: Graó. 224 pp.

Garrison, T., (2009). Essentials of Oceanography. Belmont, CA: Brooks/Cole Cengage Learning, 434 pp.

Grasshoff, K., Krembling, K., and Ehrhardt, M., (2002). Methods of Seawater Analysis.Tercera edición. Koln (Colonia): Wiley. 600pp.

Rosón Porto, G. and Varela, R. A., (2008). Métodos en Oceanografía Física. Barcelona: Anthias. 126 pp.

Sendiña, I., and Pérez, V., (2006). Fundamentos de meteorología. Santiago de Compostela: Servizio de Publicacións da Universidade de Santiago de Compostela. 194 pp.

Tomczak, M. and Godfrey, J.F., (2003). Regional Oceanography: an Introduction, 2ª edición, Delhi: Daya Publishing House.

Trujillo, A.P., and Thurman, H.V., (2010). Essentials of Oceanography. Boston: Pearson Prentice Hall, 551pp.

WEBSITES

LIBROS ELECTRÓNICOS: http://ww2.icm.csic.es/oce/es/content/electronic-books

HERRAMIENTAS PARA REPRESENTAR: http://www.physocean.icm.csic.es

ECUACIÓN DE ESTADO, TEOS-10: http://www.teos-10.org/

OCEAN DATA VIEW: http://odv.awi.de/