

Course guide 250575 - INSTANDACM - Instrumentation and Data Analyses in Marine Sciences

Unit in charge: Teaching unit:	Barcelona School of Civil E 710 - EEL - Department of	ngineering ⁻ Electronic Engineering.	
Degree:	BACHELOR'S DEGREE IN M	MARINE SCIENCE AND TECHNOLOGY (Syllabus 2018). (Compulsory subject).	
Academic year: 2024	ECTS Credits: 6.0	Languages: English	

LECTURER

Coordinating lecturer:	JOAQUIN DEL RIO FERNANDEZ		
Others:	JOAQUIN DEL RIO FERNANDEZ, MARC NOGUERAS CERVERA, DANIEL MIHAI TOMA		

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

13388. To know and apply the lexicon and concepts of the Marine Sciences and Technologies and other related fields.

13390. Establish a good practice in the integration of common numerical, laboratory and field techniques in the analysis of any problem related to the marine environment.

13394. Address the most relevant processes and their interactions related to their physical / chemical / biological / geological components, applying technical and scientific knowledge and criteria.

13397. Carry out environmental impact, management and protection studies of the marine environment and adjacent coastal areas, including the corresponding infrastructures and their related impacts.

13403. Develop a conceptual framework to address the sustainability of the marine environment and the related socio-economic activities at different scales, explaining the effects of climate change.

13404. Set, plan and execute basic and applied research in the field of Marine Sciences and Technologies.

13405. Carry out calculations, assessments, surveys and inspections in coastal and marine environments, as well as the corresponding technical documents.

13406. Write technical reports and disseminate knowledge about the different components of the marine system, considering the applicable legal framework.

Generical:

13382. Apply state-of-the-art methods and techniques in oceanography and marine climate, jointly covering the physical, chemical, geological and biological aspects.

13383. Develop a conceptual framework that links the scientific-technological and management aspects for marine resources, explaining the interactions with marine infrastructures and management plans in coastal areas.

13384. Apply knowledge and academic experience to the control and monitoring of the marine environment and its coastal boundary, using the state-of-the-art tools in the Marine Sciences and Technologies.

13386. Encompass and teach studies in the different research lines that converge in Marine Sciences and Technologies.

13387. Combining preservation with economic activity within the framework of current legislation promoting the development of a social and environmental awareness.

Last modified: 22/05/2024



TEACHING METHODOLOGY

The course consists of 2 hours a week of classroom classes (large group) and 2 hours a week with half of the students (medium group). 2 hours are devoted to theoretical classes in a large group, in which the teacher presents the basic concepts and materials of the subject, presents examples, performs exercises and problems. 2 hours (medium group) are dedicated to laboratory practices with greater interaction with students. Support material is used in the format of a detailed teaching plan through the ATENEA virtual campus: contents, programming of assessment and directed learning activities and bibliography.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

In this subject students will be shown the different measurement devices that are used in measurement campaigns in Oceanography and Maritime Engineering to obtain data on meteo-oceanographic parameters such as conductivity, temperature, salinity, turbidity, dissolved oxygen, pH, pressure, speeds, etc. Subsequently, different filtering and data validation techniques will be studied at different levels (verification of ranges and outliers, temporal coherence, coherence between variables, temporal coherence of the series, and spatial coherence). Finally, different data analysis and representation techniques will be seen.

- 1.- Understand the methodologies of analysis and data collection in oceanography.
- 2.- Know the oceanographic measuring systems, their characteristics and applications.
- 3.- Understand the methodologies of time series analysis in the time and frequency domains.

This subject is focused on showing, familiarizing and training students with techniques of observation, monitoring, acquisition and treatment of marine data, as well as modeling techniques, physical and numerical, which allow to characterize practically all of the real problems that will have to address in the professional practice and that will allow the students to finish a generic training cycle but with advanced and transversal knowledge in Sciences and Technologies of the Sea.

STUDY LOAD

Туре	Hours	Percentage
Hours large group	40,0	26.67
Hours small group	20,0	13.33
Self study	90,0	60.00

Total learning time: 150 h



CONTENTS

Introduction to Marine Instrumentation Systems

Description:

Different types of observation platforms used to integrate the marine instrumentation that we will use to make measurements of oceanographic parameters are described. Different types of platforms will be described: fixed, mobile, autonomous, wired observatories, platforms for making measurements in-situ or remotely, surface, background, etc ... Observation platforms, depending on the characteristics, can offer different capabilities when integrating different types of measuring instruments. This session will describe the most important features in terms of autonomy, power systems, wired or

Specific objectives:

Know the types and characteristics of marine observation platforms.

wireless communication systems, flotation, anchoring, etc ...

Know and be able to describe the capabilities of a marine observation platform. Have criteria for deciding which type of platform is most suitable for carrying out different types of oceanographic measurements or experiments.

Full-or-part-time: 9h 36m

Theory classes: 4h Self study : 5h 36m

Characteristics of the Instrumentation used in measurement systems

Description:

The measurement procedure and method used by an instrument is associated with certain characteristics such as the resolution, uncertainty or accuracy of the measurement. This session will explain these concepts and how to use them for a correct interpretation of the measures.

In order to integrate an instrument into an observation platform it is necessary to take into account different aspects about communications, power supply, autonomy, as well as the weight, buoyancy or even hydrodynamic characteristics of the instrument. This session describes all these features and how the instrument manufacturer provides them.

Specific objectives:

To know the characteristics associated with a measurement procedure and its interpretation. Know the basic characteristics needed for an instrument to be integrated into an observation platform.

Full-or-part-time: 9h 36m Theory classes: 4h Self study : 5h 36m



Instruments for measuring meteoceanographic parameters

Description:

In this session there will be a detailed description of the different instruments most commonly used to make measurements at sea such as conductivity, temperature, salinity, turbidity, dissolved oxygen, pH, pressure, currents, waves, underwater noise. Examples of commercial instrumentation are described in this session, and the state of the art in the measurement of different types of variables since physical variables such as temperature or depth follow well-established and traceable procedures, but other biological variables or chemicals still require sampling and in-situ measurement is not yet feasible.

In this lab session, knowledge about serial communications with an instrument such as the CTD, its configuration, and data reading is put into practice.

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In this laboratory session, knowledge about serial communications with an instrument such as the hydrophone, its configuration, and data reading is put into practice, in order to finally be able to generate standard data files.

Specific objectives:

Know the instruments that are usually used to make measurements at sea. Interpret correctly how they work, their capabilities and limitations.

Know the commercial instrumentation and its characteristics.

Be able to set up and implement a CTD and perform real-time measurements or data download.

Be able to set up and operate a weather station and perform real-time measurements or data downloads.

Be able to set up and run a current meter and perform real-time measurements or data download.

Be able to set up and operate a hydrophone and perform real-time measurements or data download.

Full-or-part-time: 86h 24m

Theory classes: 12h Laboratory classes: 24h Self study : 50h 24m

Electronic systems associated with instrumentation

Description:

This session describes the different protocols, mechanisms and devices used in marine instrumentation: From the most common wired communication systems such as serial or ethernet communication buses, to describing how wireless acoustic communications are implemented underwater. , or wireless communications capabilities out of the water using satellites or mobile phone protocols.

This session describes the different options for energizing an observation platform and how it provides energy to the instrumentation used. The characteristics of wired or stand-alone power systems that can use renewable batteries or energy sources are described.

Specific objectives:

Know the characteristics and capabilities of communication systems. Be able to choose which communication system may be most appropriate depending on the measurement requirements and the location of the instrumentation. Know the characteristics and limitations of the energy systems used in observation platforms.

Full-or-part-time: 9h 36m Theory classes: 4h Self study : 5h 36m



Data time series processing

Description:

Once the measuring instruments transmit the information, it will be stored digitally to be processed: This section describes the most common formats with which to store datasets such as CSV, NetCDF, O & M, etc ...

This session describes some of the computer tools used such as Ocean Data View among others.

Statistical methods for the detection of errors that allow a correct filtering and visualization of the data generated by the measuring instruments are presented in this session.

Quality control methods based on range and outliers verification, temporal coherence, coherence between variables, temporal coherence of series, and spatial coherence are described.

In this session, algorithms will be implemented to perform quality control of different types of variables and based on the verification of ranges and outliers, temporal coherence, coherence between variables, temporal coherence of the series, and spatial coherence.

Specific objectives:

Know the di

Know the basic operation of some computer applications for data representation. Know basic techniques for the detection and filtering of aberrant measures, offset or drifts. Know the methods applied by the scientific community for data quality control. Learn to program data quality control algorithms.

Full-or-part-time: 28h 47m Theory classes: 6h Laboratory classes: 6h Self study : 16h 47m

GRADING SYSTEM

The qualification of the subject is obtained from the qualifications of the tests of partial and final evaluation, of the qualifications of follow-up and of continuous evaluation and of the qualifications corresponding to the activities in the laboratory and field.

The continuous assessment consists of doing different activities, both individual and group, of an additive and formative, carried out during the course (inside the classroom and outside).

The qualification of teaching in the laboratory is the average of such activities.

The assessment tests consist of a part with questions about concepts associated with the learning objectives of the subject in terms of knowledge or comprehension, and a set of application exercises.

NF = 50% Theory Note + 10% Monitoring Notes + 40% Laboratory Note

Theory note: evaluation tests

Follow-up notes: exercises and works presented during the course Laboratory note: previous studies and reports on the lab and field practices.

Criteria of qualification and of admission to the re-evaluation: The students failed on the ordinary evaluation that have presented regularly in the proofs of evaluation and have attended and approved the 50% of the course corresponding to field, laboratory and monitoring activities will have the option of taking a re-assessment test in the period set in the academic calendar. Students who have already passed it or students who have been classified as not presented, or those who have not passed the laboratory / field activities, will not be able to take the re-assessment test for a subject. The maximum grade in the case of taking the re-assessment exam will be five (5.0). The non-attendance of a student summoned to the re-evaluation test, held in the set period may not lead to the performance of another test with a later date. Extraordinary assessments will be carried out for those students who, due to accredited force majeure, have not been able to take any of the continuous assessment tests.

These tests must be authorized by the corresponding head of studies, at the request of the teacher responsible for the subject, and will be carried out within the corresponding teaching period.



BIBLIOGRAPHY

Basic:

- Delory, E.; Pearlman, J. (eds.). Challenges and innovations in ocean in situ sensors : measuring inner ocean processes and health in the digital age [on line]. Amsterdam: Elsevier, 2019 [Consultation: 19/02/2021]. Available on: https://www.sciencedirect.com/science/book/9780128098868. ISBN 9780128098868.

- Kim, Y.C. Handbook of coastal and ocean engineering. Hackensack ; London: World Scientifc, 2010. ISBN 9789812819291.

- Knauss, J.A.; Garfield, N. Introduction to physical oceanography. 3rd ed. Long Grove, Illinois: Waveland Press, Inc., 2017. ISBN 9781478632504.