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230672 - EIS - Electronics Instrumentation Systems for Marine Applications

Coordinating unit: 230 - ETSETB - Barcelona School of Telecommunications Engineering

Teaching unit: 710 - EEL - Department of Electronic Engineering

Academic year: 2015

Degree: DEGREE IN ELECTRONIC ENGINEERING (Syllabus 1992). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN ELECTRONIC ENGINEERING (Syllabus 2013). (Teaching unit Optional)

ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: JOAQUÍN DEL RÍO FERNÁNDEZ

Others: SPARTACUS GOMARIZ CASTRO, ANTONI MÀNUEL LÀZARO

Degree competences to which the subject contributes

Transversal:

1. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.
2. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
3. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Teaching methodology

- Lectures
- Collaborative lecture
- Laboratory practical work
- Project based learning
- Autonomous work
- Tutoring
- Extended answer test (Final Exam)

Learning objectives of the subject

Learning objectives of the subject:

At the end of this matter is expected that the student be able to practically apply the knowledge and skills of the degree to electronic systems used in the marine environment. It is expected that the student is able to demonstrate knowledge of special methods of acquisition and transmission of information, and the design of the measuring instruments involved in the fields of research and technological development and fisheries oceanography. It will also be able to distinguish and differentiate the different types of underwater observation infrastructures as networks of sensors and undersea vehicles. In addition the student will demonstrate an understanding of the general concepts of the marine environment that affect climate change, sustainability of biological systems and the monitoring of natural hazards.

The aim of this course is to train students in methods of design, dimensioning and evaluation of data communications networks. First, we consider the parameters of interest for telematics network planning and mathematical tools we have. Then, using this knowledge, will study data routing mechanisms, network allocation capacity, congestion control and

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multiple access techniques.
- Ability to understand and interpret the functioning technical characteristics of the measuring equipment most commonly used in the marine environment (CTDs, hydrophones, etc..).
- Ability to understand the need of underwater robotics and interpret technical and operational characteristics of the different vehicles. ROV, AUV and Gliders.
- Ability to perform the specification, implementation, documentation and commissioning of equipment and systems, considering both the technical and corresponding regulatory standards.
- Ability to specify, design and use, electronic instrumentation and measurement systems applied to the marine environment, both in research and application through to the fishing fleet.
- Ability to perform the specification, implementation and commissioning of equipment and systems for autonomous underwater vehicle.
- Capacity to analyzes the needs of power consumption and power measuring equipment, for optimization and increase autonomy.
- Ability to understand the different environmental parameters involved in climate change.

Study load

Total learning time: 125h	Hours large group:	13h	10.40%
	Hours medium group:	0h	0.00%
	Hours small group:	26h	20.80%
	Guided activities:	0h	0.00%
	Self study:	86h	68.80%

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Content

1. Introduction to oceanographic measurement systems

Learning time: 10h

Theory classes: 3h
Self study : 7h

Description:
Characteristics, applications and technology challenges

2. The marine environment

Learning time: 16h

Theory classes: 2h
Laboratory classes: 2h
Self study : 12h

Description:
Specificity and protections. Basic standards in oceanographic and marine environment. Management and data acquisition. Infrastructure for observation. Buoys, boats, underwater observatories and autonomous vehicles. ROV (Remotely Operated Vehicle), AUV (Autonomous Underwater Vehicle), Underwater Gliders. Types of activities. Exploration, intervention, operating conditions. Depth Range, tools and sensors. Equipment and systems for environmental monitoring. Acidification of the sea. Terrestrial communication systems: Iridium, Wimax, 3G, etc.. Technological innovations in the development of new sensors and networked systems.

3. Underwater acoustic Communications

Learning time: 19h

Theory classes: 5h
Laboratory classes: 2h
Self study : 12h

Description:
Underwater transmission information. Principles of underwater acoustic communication. Sound propagation underwater. Transmission losses. Reverb. Properties of the probes and acoustic transducers. Directivity, Reciprocity. Calibration methods (ISO 17025).

4. Marine technology for scientific studies and environmental management

Learning time: 18h

Theory classes: 3h
Laboratory classes: 2h
Self study : 13h

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5. Infrastructure for observation	Learning time: 20h Theory classes: 5h Laboratory classes: 2h Self study : 13h

Description:
Marine sensor networks. Smart sensors (IEEE 1451) for the measurement of physical and / or chemical compatible with cabled observatories connection (OBSEA). Presentation of current standards promoted by OGC (Open Geosptial Consortium) or GEOSS as SensorML. Synchronization in sensor network. NTP (Network Time Protocol). Or IEEE 1588 PTP (Precision Time Protocol).

6. Underwater vehicles	Learning time: 20h Laboratory classes: 2h Self study : 13h Self study : 5h

Description:
Underwater vehicle subsystems. Platform and materials. Propulsion systems and immersion. Rudders. Energy Management. Communications systems. Security systems .. Location underwater. Control Unit.

7. Navigation sensors and payload	Learning time: 22h Theory classes: 6h Laboratory classes: 3h Self study : 13h

Description:
Inertial Navigation System (INS). Accelerometers. Gyroscopes. Global Navigation Satellite System (GNSS). GPS. DGPS. Augmentation systems. (SBAS), GNSS and INS Integration. Acoustic navigation system. Doppler Velocity Log (DVL). Acoustic Doppler Current Profiler (ADCP). Submarine acoustic positioning. USBL (Ultra Short Base Line). Gentlemen CTD (conductivity, temperature, depth). Sonar. Side Scan. Multibeam. Optical imaging. Video and ESC (Electronic Still Camera)

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Planning of activities

LABORATORY 1

Description:
Equipment for measuring the water column. Measurement of conductivity and depth. Calibration of the CTD (conductivity, temperature, depth). Use and handling. Oceanographic Instrumentation in Biology.

LABORATORY 2

Description:
Seabed equipment. Vibration measurements. Commissioning and calibration of a marine seismometer. Identification of different sensors (hydrophone, geophone, etc.), correct wiring and adjustment. Assembly and handling. Oceanographic Instrumentation Geology.

LABORATORY 3

Description:
Introduction to communication systems. Transducers and acoustic modems. Release systems. Acoustic systems employed in the fisheries sector. Sounders.

LABORATORY 4

Description:
Surface observing systems. Moored and drifting buoys. Basic equipment. Feeding systems. Measurement of wave and current velocity. Using satellite communications for data transmission. Remote Sensing. Physical Oceanographic Instrumentation.

LABORATORY 5

Description:
Presentation Guanay II AUV. Identification of different subsystems. Commissioning and connection of control systems, propulsion and investment, communication, security, use of the graphical interface to mission control.

LABORATORY 6

Description:
Introduction to navigation systems. Calibration and communication of the various navigation sensors. INS, compass and inclinometer. Assembly and handling from the control unit.

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Qualification system

Final examination: 20%
Exercises: 10%
Individual assessments: 15%
Group assessments: 15%
Laboratory assessments: 40%

Bibliography

Basic:

Watson, J.; Zielinski, O. Subsea optics and imaging [on line]. Sawston, Cambridge: Woodhead Publishing, 2013 [Consultation: 18/01/2016]. Available on: <http://site.ebrary.com/lib/upcatalunya/detail.action?docID=10815547>. ISBN 9780857093417.

Urick, R.J. Sound propagation in the sea. Los Altos, California: Peninsula Pub, 1982. ISBN 978-0932146083.

Fossen, T.I. Marine control systems: guidance, navigation and control of ships, rigs and underwater vehicles. Trondheim: Marine Cybernetics, 2002. ISBN 82-92356-00-2.

Roberts, G.N.; Sutton, R. Advances in unmanned marine vehicles [on line]. The Institution of Engineering and Technology, 2006 [Consultation: 28/09/2015]. Available on: <http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10315943>. ISBN 9781849190534.

Others resources:

Scientific papers from Journal of Oceanic Engineering Society http://www.oceanicengineering.org