MODULE TITLE

Oceanology

1.1. Module number

1.

1.2. Module type

Compulsory subject

1.3. Module level

Master

1.4. Semester

1st

1.5. Credit allotment

2 ECTS credits

1.6. Prerequisites

To direct access to the Master the candidate should have an academic background in:

- Engineering degree or Master's Degree in Naval, Civil, Industrial, Energy or Aeronautical Engineering.
- Graduated in Naval Architecture, Marine Engineering, Mechanic Engineering, Electrical Engineering or Civil Engineering.

Special cases will be analysed by the Academic Commission.

Students are expected to have an upper intermediate level of English (B2 or higher). All module documentation is in English. Lectures will be carried out in English whenever there is a non Spanish speaking student in the module; otherwise, the lecturer will decide the language to be used.

1.7. Minimum attendance requirement

Attendance is highly recommended. Minimum attendance requirement: 80% of the sessions. Up to 25% of the contact hours can be accomplished via the on-line platform.

1.8. Module objectives

TC1 Understanding the offshore environmental conditions.
TC2 To gain the ability of building the environmental load conditions in order to properly model and design the structures.
TC3 Energy resource, characterization: waves, currents, wind-waves joint probability, long term descriptions.

1.9. Module contents

Theme 1.0: General issues

1.0.1. Justification and objectives
1.0.2. Program and master details
1.0.3. Learning platform (moodle)
1.0.4. On-line platform (Webex)

Theme 1.1: Site Conditions

1.1.1. Wind condition assessment: wind theories and profiles, wind-wave correlation
1.1.2. Metocean condition assessment: wave theories (shallow and deep waters), current theories and profiles, tidal conditions
1.1.3. Discussion on Marine Growth and impact on design of structures
1.1.4. Discussion on ice and icing

Theme 1.2: Environmental Resources

1.2.1. Ocean energy resource: wind
1.2.2. Ocean energy resource: wave, tidal, thermal

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1.11. Module bibliography

- Shore Protection Manual. Coastal Engineering Research Center. Vicksburg. U.S.A. 1.984.

- Random Seas and design of maritime Structures. Yoshimi Goda. University of Yokohama. Tokio Press. 1.985.
- Water wave mechanics for engineers and scientists. Robert G. Dean and Robert A. Dalrymple. Advanced series on Ocean Engineering. 1.992.
- Nearshore dynamics and coastal processes. Theory, measurement and predictive Models. Horikawa, K. University of Tokyo Press. 1.988.
- Coastal Engineering Manual. Part II. Coastal Hydrodynamics. 2006

2. Teaching methodology

Theoretical sessions: Lectures on the topics in the programme.

Practical sessions: Oral and written assignments on subjects in the programme. Seminars. Work done on the module Moodle page.

Independent study time: Reading, preparation of oral and written assignments, and Moodle tasks.

3. Student workload

		Nº hours	Percentage
Lecture and online sessions	Theoretical lectures	16 h	36% = 22 h
	Practical lectures		
	Tutorials	6 h	
	Final Exam (included in module 2)	0 h	
Independent work/study time	Practical works	0 h	64% = 38 h
	Weekly study	38 h	
	Exam preparation	0 h	
Total load of working hours: 30 hours x 2 ECTS		**60 h**	

4. Evaluation procedures and relevance of components in the final assessment

This module will score a 3.3% of the final Master mark. Minimum mark to be obtained in this course will be 3 out of 10.

The final mark will be the average of all modules, and it must be above 5.0.

Final Module mark will be established:

- Exam/works: 70%
- Participation in class and on-line activities: 30%
- Module assignments: 0%

Students must hand in the assignments that make up the 30% of continuous assessment at the times set by the lecturer during the module period. On the contrary, who do not submit the continuous assessment activities during the module may sit for the final exam, receiving a maximum grade of 7.

Based on the proposal of the Module coordinator, the Academic Commission may propose and qualify a complementary exam or assignment in order to fulfil the necessary conditions to pass the Module.

5. Module calendar

A detailed and updated module calendar will be provided at the beginning of the module by the module coordinator.

Tutorial times will be announced at the beginning of the module.

MODULE TITLE

2. Structural design

1.1. Module number

2.

1.2. Module type

Compulsory subject

1.3. Module level

Master

1.4. Semester

1st

1.5. Credit allotment

8 ECTS credits

1.6. Prerequisites

To direct access to the Master the candidate should have an academic background in:

- Engineering degree or Master's Degree in Naval, Civil, Industrial, Energy or Aeronautical Engineering.
- Graduated in Naval Architecture, Marine Engineering, Mechanic Engineering, Electrical Engineering or Civil Engineering.

Special cases will be analyzed by the Academic Commission.

Students are expected to have an upper intermediate level of English (B2 or higher). All module documentation is in English. Lectures will be carried out in English whenever there is a non-Spanish speaking student in the module; otherwise, the lecturer will decide the language to be used.

1.7. Minimum attendance requirement

Attendance is highly recommended. Minimum attendance requirement: 80% of the sessions. Up to 25% of the contact hours can be accomplished via the on-line platform.

1.8. Module objectives

TC1 Understanding site assessment, including offshore dynamics and geotechnical engineering.
TC2 Understanding the design of foundations, mainly the fixed ones, including the comprehension of the structural design principles, integrated design, material technologies, cathodic protection principles and the Certification Process.
TC3 Gaining the knowledge about new technologies: floating support structures, and marine energy converters (TECs, WECs, and OTECs).
TC4 Identify the different renewable ocean converter technologies and discuss on the status and future road map.

1.9. Module contents

Theme 2.1: Site assessment
- 2.1.1. Offshore dynamics
- 2.1.2. Geotechnical engineering

Theme 2.2: Design
- 2.2.1 Foundations: fixed structures
- 2.2.2 Structural design principles
- 2.2.3 Integrated design
- 2.2.4 Material technologies
- 2.2.5 Cathodic protection systems
- 2.2.6 Certification process

Theme 2.3: Floating wind design
- 2.3.1. Floating wind turbines
- 2.3.2. Floating platforms design principles
- 2.3.3. Design methodologies for floating wind turbines
- 2.3.4. Mooring systems
- 2.3.5. Offshore concrete platforms
- 2.3.6. Design of offshore concrete platforms

Theme 2.4: New Technologies. The business ahead.

2.4.1. Marine energy converters: TECs, WECs, and OTECs

1.10. Academic Staff

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1.11. Module bibliography

Technical standards and recommendations:

- BSH, 2007. BSH Standard - Design of offshore wind turbines.
- BSH, 2014. BSH Standard - Ground investigation for offshore wind energy.

- BSH, 2015. BSH Standard - Minimum requirements concerning the constructive design of offshore structures within the Exclusive Economic Zone (EEZ).
- DNVGL, 2015. DNVGL-ST-0164 - Tidal turbines.
- DNVGL, 2020. DNVGL-SE-0190 - Project certification of wind power plants.
- DNVGL, 2018. DNVGL-ST-0126 - Support structures for wind turbines.
- DNVGL, 2020. DNVGL-ST-0145 - Offshore substations.
- DNVGL, 2016. DNVGL-ST-0262 - Lifetime extension of wind turbines.
- DNVGL, 2016. DNVGL-ST-0437 - Loads and site conditions for wind turbines.
- DNVGL, 2016. DNVGL-ST-0438 - Control and protection systems for wind turbines.
- DNVGL, 2016. DNVGL-RP-0416 - Corrosion protection for wind turbines.
- BSH, 2007. BSH Standard - Design of offshore wind turbines.
- BSH, 2014. BSH Standard - Ground investigation for offshore wind energy.
- BSH, 2015. BSH Standard - Minimum requirements concerning the constructive design of offshore structures within the Exclusive Economic Zone (EEZ).
- IEC, 2005. IEC 61400-1: 2005 - Design requirements.
- IEC, 2009. IEC 61400-3: 2009 - Design requirements for offshore wind turbines.
- Puertos del Estado, 1990. ROM 0.2-90 - Actions in the Design of Maritime & Harbour Works.
- Puertos del Estado, 1991. ROM 0.3-91 - Waves Recommendation & Annex: Climate on the Spanish Coastlines.
- Puertos del Estado, 1995. ROM 0.4-95 - Acciones climáticas para el Proyecto de las Obras Marítimas y Portuarias (II): Viento.
- Puertos del Estado, 2001. ROM 0.0-01 - General Procedure & Requirements for Design of Maritime & Harbour Structures.
- Puertos del Estado, 2005. ROM 0.5-05 - Geotechnical Recommendation for Design of Maritime & Harbor Works.

Technical books:

- Burton, T., Sharpe, D., Jenkins, N., Bossanyi, E., 2001. Wind energy handbook. Technical book. Ed. Wiley.
- Cruz, J., 2008. Ocean wave energy, current status and future perspectives. Technical book. Ed. Springer.
- Kaiser, M.J., Snyder, B.F., 2012. Offshore wind energy cost modeling, Installation and decommissioning. Technical book. Ed. Springer.
- Negro, V., López-Gutiérrez, J.S., Esteban, M.D., 2014. Problemas resueltos de obras marítimas. Technical book. Ed. Garceta.
- OTEO, 2014. Offshore Renewable Energy current status-future perspectives for Portugal. Technical book. Ed. INEGI.
- Sumer, B.M., Fredsoe, J., 2002. The mechanics of scour in the marine environment. Technical book. Advanced Series on Ocean Engineering-Volume 17. World Scientific.
- USACE. Coastal Engineering Manual.
- USACE. Shore Protection Manual.

Technical papers:

- Chella, M.A., Tørum, A., Myrhaug, D., 2012. An Overview of Wave Impact Forces on Offshore Wind Turbine Substructures. Energy Procedia 20, 217-226.
- Escobar, A., Negro, V., López-Gutiérrez, J.S., Esteban, M.D., 2016. Influence of temperature and salinity on hydrodynamic forces. Journal of Ocean Engineering and Science, 1-4, 325-336.
- Esteban, M.D., Couñago, B., López-Gutiérrez, J.S., Negro, V., Vellisco, F., 2015. Gravity based support structures for offshore wind turbine generators: Review of the installation process. Ocean Engineering, 110-A, 281-291.
- Negro, V., López-Gutiérrez, J.S., Esteban, M.D., Alberdi, P., Imaz, M., Serraclara, J.M., 2017. Monopiles in offshore wind: preliminary estimate of main dimensions. Ocean Engineering, 133, 253-261

- Matutano, C., Negro, V., López-Gutiérrez, J.S., Esteban, M.D., 2013. Scour prediction and scour protections in offshore wind farms. Renewable Energy, 57, 358-365.

PhD Dissertations:

- Carswell, W., 2015. Soil-Structure Modeling and Design Considerations for Offshore Wind Turbine Monopile Foundations. PhD dissertation.
- Escobar, A., 2017. Modelos de predicción de esfuerzos hidrodinámicos y socavación aplicados a ingeniería offshore. PhD Dissertation.
- Esteban, M.D., 2009. Propuesta de una metodología para la implantación de parques eólicos offshore. PhD Dissertation.
- LeBlanc, C., 2004. Design of offshore wind turbine support structures. PhD Dissertation.
- Matutano, C., 2013. Caracterización de los sistemas de protección basados en materiales naturales destinados al control de la socavación en obras marítimas presentes en instalaciones eólicas marinas. PhD Dissertation.
- Petersen, T.U., 2014. Scour around offshore wind turbine foundations. PhD Dissertation.

Masters Dissertations:

- de Valk, P., 2013. Accuracy of calculation procedures for offshore wind turbine support structures. Master Thesis.
- Faruk Halici, Ö., Mutungi, H., 2016. Assessment of simulation codes for offshore wind turbine foundations. Master Thesis.
- Rausa Heredia, I.E., 2014. Characterization of wave slamming forces for a truss structure within the framework of the WaveSlam project. Master dissertation.

Technical reports:

- Carbon Trust, 2015. Floating offshore wind: market and technology review. Technical report.
- Heefe, A., Bonnet, P., Bastard, L, Horcas, S.G, Sánchez, J.L, Cucchini, P., Gaull, A., 2011. Numerical simulation of offshore wind turbines by a coupled aerodynamic and structural dynamic approach. DEWI magazine 39, 6-15
- IRENA, 2014. Ocean Energy. Technology readiness, patents, deployment status and outlook. Technical report.
- JRC, 2015. 2014 JRC Ocean Energy Status Report. Technology, market and economic aspects of ocean energy in Europe. Technical report.
- Matha, D., Schlipf, M., Cordle, A., Pereira, R, Jonkman, J., 2011. Challenges in simulation of aerodynamics, hydrodynamics, and mooring-line dynamics of floating offshore wind turbines. Technical report.

2. Teaching methodology

Theoretical sessions: Lectures on the topics in the programme.

Practical sessions: Oral and written assignments on subjects in the programme. Seminars. Work done on the module Moodle page.

Independent study time: Reading, preparation of oral and written assignments, and Moodle tasks.

3. Student workload

		Nº hours	Percentage
Lecture and online sessions	Theoretical lectures	83 h	35% = 83 h
	Practical lectures		
	Tutorials	0 h	
	Final Exam (included in module 2)	2 h	
Independent work/study time	Practical works	0 h	65% = 157 h
	Weekly study	127 h	
	Exam preparation	30 h	

	Nº hours	Percentage
Total load of working hours: 30 hours x 8 ECTS	**240 h**	

4. Evaluation procedures and relevance of components in the final assessment

This module will score a 13.3% of the final Master mark. Minimum mark to be obtained in this module will be 3 out of 10.

The final mark will be the average of all modules, and it must be above 5.0.

Final Module mark will be established:

- Exam/works: 70%
- Participation in class and on-line activities: 15%
- Module assignments: 15%

Based on the proposal of the Module coordinator, the Academic Commission may propose and qualify a complementary exam or assignment in order to fulfil the necessary conditions to pass the Module.

5. Module calendar

A more detailed and updated module calendar will be provided at the beginning of the module by the module coordinator.

Tutorial times will be announced at the beginning of the module.

MODULE TITLE

Generation and Export Technologies

1.1. Module number

3

1.2. Module type

Compulsory subject

1.3. Module level

Master

1.4. Semester

1st

1.5. Credit allotment

5.5 ECTS credits

1.6. Prerequisites

Engineering degree or Master degree in Naval, Civil, Industrial, Energy or Aeronautical Engineering.

Graduated in Naval Arquitecture, Marine Engineering, Mechanic Engineering, Electrical Engineering or Civil Engineering.

Special cases will be analyzed by the Academic Commission.

Students are expected to have an upper intermediate level of English (B2 or higher). All module documentation is in English. Lectures will be carried out in English whenever there is a non Spanish speaking student in the module; otherwise, the lecturer will decide the language to be used.

1.7. Minimum attendance requirement

Attendance is highly recommended. Minimum attendance requirement: 80% of the sessions. Up to 25% of the contact hours can be accomplished via the on-line platform.

1.8. Module objectives

To have a global vision of different PTOs types
To identify the basic model for blades power conversion
To understand the complete WTG's desing process. This part will cover from the aero-servo-hidroelastic calculations for obtaining the load assessment to the dimensioning parameters for the main WTG components
To identify the general models of energy conversion
To descry their main characteristics an their relationship
To introduce their effect on power absorbed
To present a general model of annual energy estimation
To understand the operation and behavior of different types of generators and their conection to grid
To understand of operation aspects related to active and reactive power control
Knowledge about typologies and technologies of array cables
Knowledge about typologies and technologies of export cables
To acquire knowledge about the state-of-the-art and future possibilities of hydrogen production from marine renewable energies
To analyse the diverse possibilities of using the hydrogen produced from marine renewables

1.9. Module contents

Theme 3.1: Offshore energy converters

3.1.1 Status of development, technologies, trends.
3.1.2 Fluid Mechanics of Blades. Design methodologies.
3.1.3 Structural aspects of Blades. Analysis models.
3.1.4 Gear Box, Brakes and Supports.
3.1.5 Generators (mechanical aspects)
3.1.6 Control Actuators (mechanical)
3.1.7 Wave Converters PTO's
3.1.8 Wind and TEC PTO's
3.1.9 Control and Dynamic Behaviour
3.1.10 Produced Energy

Theme 3.2: Grid Technology

3.2.1 PTO electrical components and Elements
3.2.2 Offshore substations
3.2.3 Offshore Converters
3.2.4 Operation aspects
3.2.5 Array Cables
3.2.6 Export Cables
3.2.7 Grid connection to Shore

Theme 3.3: Next storage offshore and photovoltaic technologies

3.3.1 Hydrogen generation offshore
3.3.2 Uses of stored hydrogen
3.3.3. Floating Photovoltaic Systems

1.10. Academic Staff

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1.11. Module bibliography

Lectures: 3.1.1, 3.1.2, 3.1.7, 3.1.8, 3.1.9, 3.1.10

Electricity from Wave and Tide. Paul A. Lynn. Wiley (2014)

Wind Turbine Control Systems. Fernando D. Bianchi, Hernán De Battista and Ricardo J. Mantz. Springer (2007)

Onshore and Offshore Wind Energy. Paul A. Lynn. Wiley (2012)

Biblioteca sobre Ingeniería Energética. Pedro Fernández Díez. http://es.pfernandezdiez.es/

Modelado Energético de Convertidores Primarios para el Aprovechamiento de las Energías Renovables Marinas. Amable López P. et al. Revista Iberoamericana de Automática e Informática industrial Vol.2 2014. www.elsevier.es/RIAI.

Methodologies for Tidal Energy Converters Evaluation Early Project Phases. L.R. Núñez et al. 1st International Conference on Renewable Energies Offshore RENEW'14. Lisbon 2014

Significate Internet pages for Wave & Tidal Converters:

OES	https://www.ocean-energy-systems.org/	Ocean Energy Systems
OEE	https://www.oceanenergy-europe.eu/	Ocean Energy Europe
Aqua-RET	http://www.aquaret.com/	Aquatic Renewable Energy Technologies
IEC	http://www.iec.ch/index.htm	International Electrotechnical Commission TC 114 Marine energy - Wave, tidal and other water current converters
EMEC	http://www.emec.org.uk/	European Marine Energy Centre ltd
WavEC	http://www.wavec.org/en	Wavec Offshore Renewables
EWTEC	http://www.ewtec.org/	European Wave and Tidal Energy Conference
ICOE	https://www.icoe-conference.com/	International Conference on Ocean Energy

Lectures: 3.1.3, 3.1.4, 3.1.5, 3.1.6:

T. Burton, N. Jenkins, D. Sharpe, E. Bossanyi. *Wind Energy Handbook*
IEC 61400-1 Ed3. *Design Requirements*
IEC 61400-3, Ed1*. Design Requirements for Offshore Wind Turbines*
DNV-OS-J101. *Design of Offshore Wind Turbines*
GL2010. *Guideline for the Certification of Wind Turbines*

Lectures: 3.2.1:

Electric Machinery Fundamentals. Stephen J. Chapman. McGraw Hill (2012)

Induction Machines Design Handbook. Ion Boldea, Syed A. Nasar. CRC Press (2010)

Synchronous Generators. Ion Boldea. CRC Press (2016)

Lectures: 3.3.1, 3.3.2

Stolten D (editor), Samsun R C (editor), Garland N (editor), *Fuel Cells: Data, Facts and Figures,* Wiley, 2016.

Godula-Jopek A (editor), *Hydrogen Production: by Electrolysis*, Wiley-VCH, 2015.

2. Teaching methodology

Theoretical sessions: Lectures on the topics in the programme.

Practical sessions: Oral and written assignments on subjects in the programme. Seminars. Work done on the module Moodle page.

Independent study time: Reading, preparation of oral and written assignments, and Moodle tasks.

3. Student workload

		Nº hours	Percentage
Lecture and online sessions	Theoretical lectures	41 h	33% = 57 h
	Practical lectures	14 h	
	Tutorials	0 h	
	Final Exam	2 h	
Independent work/study time	Practical works	0 h	67% = 108 h
	Weekly study	93 h	
	Exam preparation	15 h	
Total load of working hours: 30 hours x 5.5 ECTS		**165 h**	

4. Evaluation procedures and relevance of components in the final assessment

This module will score a 9.2% of the final Master mark. Minimum mark to be obtained in this module will be 3 out of 10.

The final mark will be the average of all modules, and it must be above 5.0.

Final Module mark will be established:

- Exam/works: 70%
- Participation in class and on-line activities: 30%
- Module assignments: 0%

Students must hand in the assignments that make up the 30% of continuous assessment at the times set by the lecturer during the module period. On the contrary, who do not submit the continuous assessment activities during the module may sit for the final exam, receiving a maximum grade of 7.

Based on the proposal of the Module coordinator, the Academic Commission may propose and qualify a complementary exam or assignment in order to fulfil the necessary conditions to pass the Module.

5. Module calendar

A detailed and updated module calendar will be provided at the beginning of the module by the lecturer.

Tutorial times will be announced at the beginning of the module.

MODULE TITLE

4. Manufacturing and Marine Operations

1.1. Module number

4.

1.2. Module type

Compulsory subject

1.3. Module level

Master

1.4. Semester

1st

1.5. Credit allotment

7 ECTS credits

1.6. Prerequisites

To direct access to the Master the candidate should have an academic background in:

- Engineering degree or Master's Degree in Naval, Civil, Industrial, Energy or Aeronautical Engineering.
- Graduated in Naval Architecture, Marine Engineering, Mechanic Engineering, Electrical Engineering or Civil Engineering.

Special cases will be analysed by the Academic Commission.

Students are expected to have an upper intermediate level of English (B2 or higher). All module documentation is in English. Lectures will be carried out in English whenever there is a non Spanish speaking student in the module; otherwise, the lecturer will decide the language to be used.

1.7. Minimum attendance requirement

Attendance is highly recommended. Minimum attendance requirement: 80% of the sessions. Up to 25% of the contact hours can be accomplished via the on-line platform.

1.8. Module objectives

TC1 Understanding the offshore fabrication techniques, relevance of interfaces and all activities for sail away.
TC2 Knowledge of marine vessels and ability to select the most appropriate offshore spread. Ability to define the most suitable transport and installation strategies.
TC3 Understanding the figures involved in granting permits for marine operations and decision-making procedures under HES criteria.
TC4 Understanding of the construction phases happening offshore

1.9. Module contents

4.1. Fabrication
- 4.1.1. Manufacturing strategies
- 4.1.2. Load-out

7h theory + 5h tutorial/assignments

4.2. Marine vessel spread
- 4.2.1. Vessel spread typologies
- 4.2.2. Transport and installation operational requirements

9h theory

4.3. Marine operations
- 4.3.1. Marine Warranty Surveyor
- 4.3.2. Harbour Logistics
- 4.3.3. Transport operations
- 4.3.4. Installation Operations
- 4.3.5. Complementary Installation Strategies
- 4.3.6. Submarine cable laying
- 4.3.7. Commissioning
- 4.3.8. Offshore Logistics
- 4.3.9. Health & Safety

4.3.10. Environment
31h theory + 6h tutorial/assignments

4.4. Operation and Maintenance
4.4.1. Maintenance
4.4.2. Marine logistics for O&M
4.4.3. Assets Operation. Operational Tools
5h theory + 3h tutorial/assignments

Exam module 4
2h theory

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1.11. Module bibliography

Construction of Marine and Offshore Structures - Ben C. **Gerwick**
API Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – API RP 2A
DNVGL-OS-C401 Fabrication and Testing of Offshore Structures
DNVGL-ST-N001 Marine operations and marine warranty
DNVGL RP-J301 Subsea Power Cables in Shallow Water Renewable Energy Applications

2. Teaching methodology

Theoretical sessions: Lectures on the topics in the programme.

Practical sessions: Oral and written assignments on subjects in the programme. Seminars. Work done on the module Moodle page.

Independent study time: Reading, preparation of oral and written assignments, and Moodle tasks.

3. Student workload

		Nº hours	Percentage
Lecture and online sessions	Theoretical lectures	52 h	32% = 68 h
	Practical lectures	14 h	
	Tutorials	0 h	
	Final Exam	2 h	
Independent work/study time	Practical works	0 h	68% = 142 h
	Weekly study	117 h	
	Exam preparation	25 h	
Total load of working hours: 30 hours x 7 ECTS		**210 h**	

4. Evaluation procedures and relevance of components in the final assessment

This module will score a 11.7 % of the final Master mark. Minimum mark to be obtained in this course will be 3 out of 10.

The final mark will be the average of all modules, and it must be above 5.0.

Final Module mark will be established:

- Exam/works: 70%
- Participation in class and on-line activities: 30%
- Module assignments: 0%

Students must hand in the assignments that make up the 30% of continuous assessment at the times set by the lecturer during the module period. On the contrary, who do not submit the continuous assessment activities during the module may sit for the final exam, receiving a maximum grade of 7.

Based on the proposal of the Module coordinator, the Academic Commission may propose and qualify a complementary exam or assignment in order to fulfil the necessary conditions to pass the Module.

5. Module calendar

A detailed and updated module calendar will be provided at the beginning of the module by the module coordinator.

Tutorial times will be announced at the beginning of the module.

MODULE TITLE

5. Project Operation and Management

1.1. Module number

5.

1.2. Module type

Compulsory subject

1.3. Module level

Master

1.4. Semester

2nd

1.5. Credit allotment

8 ECTS credits

1.6. Prerequisites

Engineering degree or Master degree in Naval, Civil, Industrial, Energy or Aeronautical Engineering.

Graduated in Naval Arquitecture, Marine Engineering, Mechanic Engineering, Electrical Engineering or Civil Engineering.

Special cases will be analyzed by the Academic Commission.

Students are expected to have an upper intermediate level of English (B2 or higher). All module documentation is in English. Lectures will be carried out in English whenever there is a non Spanish speaking student in the module; otherwise, the lecturer will decide the language to be used.

1.7. Minimum attendance requirement

Attendance is highly recommended. Minimum attendance requirement: 80% of the sessions. Up to 25% of the contact hours can be accomplished via the on-line platform.

1.8. Module objectives

TC1 Sound knowledge of the political, economical and technological drivers guiding the development of the RME.

TC2 Sound understanding of the regulatory environment in which the RME projects are developed. Europe and USA. Spain and its specific case.

SC3 Full comprehension of the different phases of a RME Project and the specific characteristics of each one of them: Development, Permitting, Construction, Operation and Decommissioning.

TC4 Understanding of the financial inputs and outputs regarding the economical feasibility of a RME project of a mature technology. The case of projects of emerging technologies.

SC5 Knowledge of the different approaches to develop, build and operate a RME project. Cost structure of the project and differences among the different possibilities.

TC6 Sound knowledge of the building up of a RME Project business case and the different possibilities for its financing.

TC7 Sound knowledge of the contractual tools for the adequate management of an RME Project, both in the initial development and permits phases and in the construction and operational phases.

GC8 Robust knowledge of the different approaches to monetize risks. Contingency concept and valuation.

SC9 Understanding of the main risks arising during the different development phases of a RME Project. Classification, evaluation and mitigation of these risks. Contingency management.

1.9. Module contents

Theme 5.1: Financial Principles

5.1.1 Development phases of a Power Production Project. Specific case of an OWF. Development, Permits, Construction and O&M. FID Milestone.
5.1.2 Environmental & socio-economic impact of the RME.
5.1.3 Electric market and its Regulation principles. Germany, UK and France. Status in Spain. Economic remuneration to the marine energy projects
5.1.4 Cost structure of a Renewable Marine Energy Project. Turn Key Projects vs. Package Split. Packages splitting levels and needs for owner's resources.
5.1.5 Valuation of an Energy Project. IRR/VNA/WACC. The business plan.
5.1.6 Project Financing alternatives. Non-recourse financing: "Project Finance".
5.1.7 Principles of risk assessment. Concept of contingency.

Theme 5.2: Contract Assessment

5.2.1 Detailed assessment of the business plan. Incomes and costs of he business plan of an OWF.
5.2.2 Risk assessment. Contingency evaluation methodologies.
5.2.3 Contract suites. FIDIC, LOGIC and others.
5.2.4 Basic notions on insurances.
5.2.5 Consolidation of the business plan to take the FID.

1.10. Academic Staff

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1.11. Module bibliography

Finance for managers. Eduardo Martínez Abascal. McGraw Hill Higher Education. 2012

FIDIC. A guide for practitioners. Axel-Volkmar Jaeger & Dr. Götz-Sebastian Hök. Springer-Verlag Berlin Heidelberg 2010

Financing Large Projects: Using Project Finance Techniques and Practices
M. Fouzul Kabir Khan y Robert J. Parra. Prentice Hall College Div 2007
Random

East Anglia ONE Offshore Windfarm. 500MW – 600MW Project. Supply Chain Plan. Available in www.gov.uk

Estimating Project Cost Contingency-A model and exploration of research questions. David Baccarini-2004

A decision support tool for the Risk Management of offshore Wind Energy Projects-2013

Project Definition Rating Index PDRI RR113-11 CII-1996

Project Risk Analysis and Management. The association for Project Management
A Guide to the Project Management Body of Knowledge (PMBOK® Guide) – Fifth Edition

Specification for Invitation to Tender No. 2011/S 126-208873 relating to offshore power generation wind installations in Metropolitan France. Available in French in www.cre.es

Construction Contract 1st Ed (1999 Red Book), and Plant and Design-Built Contract 1st Ed (1999 Yellow Book). International Federation of Consulting Engineers.

BIMCO Time Charter Party for Offshore Service Vessels. Baltic and International Maritime Council

LOGIC. General Conditions of Contract (including Guidance Notes) for Services (On- and Off-shore)

A review of regulatory framework for wind energy in European Union countries: Current state and expected development.
Javier Serrano González, Roberto Lacal-Arántegui
European Commission, Joint Research Centre, Institute for Energy and Transport, Westerduinweg 3, NL-1755 LE Petten, The Netherlands
Available in http://ac.els-cdn.com/S1364032115013581/1-s2.0-S1364032115013581-main.pdf?_tid=51057716-67e9-11e7-ba13-00000aacb360&acdnat=1499963924_83fecf7eb89141221c9143ba5231d533

Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the promotion of the use of energy from renewable sources. Available in: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52016PC0767R%2801%29

2. Teaching methodology

Theoretical sessions: Lectures on the topics in the programme.

Practical sessions: Oral and written assignments on subjects in the programme. Seminars. Work done on the module Moodle page.

Independent study time: Reading, preparation of oral and written assignments, and Moodle tasks.

3. Student workload

		Nº hours	Percentage
Lecture and online sessions	Theoretical lectures	60 h	33% = 79 h
	Practical lectures	15 h	
	Tutorials	0 h	
	Final Exam	4 h	
Independent work/study time	Practical works	0 h	67% = 161 h
	Weekly study	137 h	
	Exam preparation	24 h	
Total load of working hours: 30 hours x 8 ECTS		**240 h**	

4. Evaluation procedures and relevance of components in the final assessment

This module will score a 13.3% of the final Master mark. Minimum mark to be obtained in this module will be 3 out of 10.

The final mark will be the average of all modules, and it must be above 5.0.

Final Module mark will be established:

- Exam/works: 70%
- Participation in class and on-line activities: 30%
- Module assignments: 0%

Students must hand in the assignments that make up the 30% of continuous assessment at the times set by the lecturer during the module period. On the contrary, who do not submit the continuous assessment activities during the module may sit for the final exam, receiving a maximum grade of 7.

Based on the proposal of the Module coordinator, the Academic Commission may propose and qualify a complementary exam or assignment in order to fulfil the necessary conditions to pass the Module.

5. Module calendar

A more detailed and updated module calendar will be provided at the beginning of the module by the module coordinator.

Tutorial times will be announced at the beginning of the module.

Week		Course	Theme	Lecture	Lectures hours	Assignments hours	Total hours	Indep. Study Time	Lecturer
Nº	Day								
23-24	F_M	5. Project Operation and Management	5.1.- Financial principles	5.1.1.- Development phases of a Power Production Project. Specific case of an OWF. Development, Permits, Construction and O&M. FID Milestone	7	0	7	15	Salvador Fernández Uranga
25	M			5.1.2.- Environmental & socio-economic impact of the RME	3	0	3	6	Jose Ignacio González Iglesias
24	W_F			Electric market and its Regulation principles. Germany, UK and France. Status in Spain. Economic remuneration to the marine energy projects	7	0	7	15	Laura Rol Rúa
25	F			5.1.4.- Cost structure of a Renewable Marine Energy Project. Turn Key Projects vs. Package Split. Levels of splitting packages and need of owner's resources	4	0	4	8	Julio de la Jara
25-26	W_M			5.1.5.- Valuation of an Energy Project. IRR/VNA/WACC. The business plan	6	3	9	18	Salvador Fernández Uranga
26	F			5.1.6.-Project Financig modalities. Non recourse financing. "Project Finance"	4	4	8	16	José Luis Morán
26	X			5.1.7.- Principles of risk assessment. Concept of contingency	3	0	3	6	Ricardo Izquierdo Labella
27-28	M-W-M		5.2.- Contract assessment	5.2.1.-Detailed assessment of the business plan. Incomes and costs of the business plan of a OWF	9	4	13	27	Salvador Fernández Uranga
27	F			5.2.2.- Risk assessment. Contingency evaluation methodologies.	4	2	6	12	Pedro Fernández Viñuela
28	W-F			5.2.3.- Cotract suites. FIDIC, LOGIC and others	7	2	9	22	Julio de la Jara
29	M			5.2.4.- Basic notions on insurances	3	0	3	6	Jose Ignacio González Iglesias
29	W			5.2.5.- Consolidation of the business plan to take the FID.	3	0	3	6	Patricia Salamanca
29	F			MODULE TEST	4				Salvador Fernández Uranga
				Total hours module	**64**	**15**	**79**	**157**	**Salvador Fernández Uranga**

MODULE TITLE

Structural Analysis of Offshore Platforms

1.1. Module number

6

1.2. Module type

Compulsory subject

1.3. Module level

Master

1.4. Semester

2nd

1.5. Credit allotment

4 ECTS credits

1.6. Prerequisites

Engineering degree or Master degree in Naval, Civil, Industrial, Energy or Aeronautical Engineering.

Graduated in Naval Arquitecture, Marine Engineering, Mechanic Engineering, Electrical Engineering or Civil Engineering.

Special cases will be analysed by the Academic Commission.

Students are expected to have an upper intermediate level of English (B2 or higher). All module documentation is in English. Lectures will be carried out in English whenever there is a non Spanish speaking student in the module; otherwise, the lecturer will decide the language to be used.

1.7. Minimum attendance requirement

Attendance is highly recommended. Minimum attendance requirement: 80% of the sessions. Up to 25% of the contact hours can be accomplished via the on-line platform.

1.8. Module objectives

TC1 Ability to perform a numerical model analysis and sizing a WTG structure

TC2 Ability to assess the equivalent model for test basin

TC3 Ability to build the equivalent design load cases for test basin

TC4 Understanding of differences between numerical modelling and testing on a basin, and obtaining conclusions

1.9. Module contents

Theme 6.1: Full-Structural Design of a substructure for a WTG: jacket, monopile, by modelling with ANSYS. Case study

6.1.1. Building the model and applying constraints
6.1.2. Definition of a specific site and building the design load cases
6.1.3. Sequential analysis: tower+WTG with foundation

Theme 6.2: Testing an offshore foundation on basin

6.2.1. Definition of model for test basin
6.2.2. Preparing the model for testing and load conditions
6.2.3. Test result comparison test basin vs. Software modelling

1.10. Academic Staff

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1.11. Module bibliography

- E. Oñate: Cálculo de estructuras por el método de los elementos finitos. 1- análisis estático lineal, 2- análisis no lineal, CIMNE, 1992.

- Zienkiewicz O. O.: The finite element method, mcgraw-hill, 1989.

- Bathe, K. J.: Finite element procedures. 2nd ed. klaus-jürgen bathe, 2014.

- Offshore Structures: Design, Construction and Maintenance
  By Mohamed El-Reedy. Gulf Pub. Co., Book Division. ISBN: 978-0-12-385475-9

- Introduction to offshore structures: design, fabrication, installation.
  William J. Graff.
  Gulf Pub. Co., Book Division.

- Essentials of Offshore Structures: Framed and Gravity Platforms.

D.V. Reddy, A. S. J. Swamidas. CRC Press.

- Offshore Wind Power.
  Edited by John Twidell and Gaetano Gaudiosi. Multi-Science.

- WEB resources.
  "Ocean Wave Interaction with Ships and Offshore Energy Systems"
  http://ocw.mit.edu/courses/mechanical-engineering/2-24-ocean-wave-interaction-with-ships-and-offshore-energy-systems-13-022-spring-2002/
  at MIT-OPEN-COURSE-WARE®

- NREL – National Renewable energy Laboratory. NREL Publications Database
  /http://www.nrel.gov/publications/

- Chopra A.: Dynamics of structures. Theory and applications.
  Edited by Prentice Hall, 2000 ISBN: 0130869732

2. Teaching methodology

Theoretical sessions: Lectures on the topics in the programme.

Practical sessions: Oral and written assignments on subjects in the programme. Seminars. Work done on the module Moodle page.

Independent study time: Reading, preparation of oral and written assignments, and Moodle tasks.

3. Student workload

		Nº hours	Percentage
Lecture and online sessions	Theoretical lectures	25 h	33% = 40 h
	Practical lectures	15 h	
	Tutorials	0 h	
	Final Exam	0 h	
Independent work/study time	Practical works	65 h	67% = 80 h
	Weekly study	15 h	
	Exam preparation	0 h	
Total load of working hours: 30 hours x 4 ECTS		**120 h**	

4. Evaluation procedures and relevance of components in the final assessment

This module will score a 6.7% of the final Master mark. Minimum mark to be obtained in this module will be 3 out of 10.

The final mark will be the average of all modules, and it must be above 5.0.

Final Module mark will be established:

- Exam/works: 0%
- Participation in class and on-line activities: 30%
- Module assignments: 70%

Students must hand in the assignments that make up the 70% of continuous assessment at the times set by the lecturer during the module period. On the contrary, who do not submit the continuous assessment activities during the module may sit for a final exam, receiving a maximum grade of 3.

Based on the proposal of the Module coordinator, the Academic Commission may propose and qualify a complementary exam or assignment in order to fulfil the necessary conditions to pass the Module.

5. Module calendar

A detailed and updated module calendar will be provided at the beginning of the module by the lecturer.

Tutorial times will be announced at the beginning of the module.