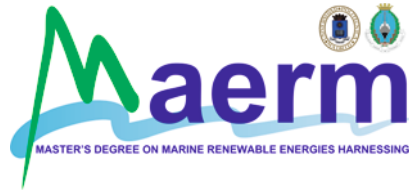




Universidad Politécnica de Madrid  
Escuela Técnica Superior de Ingenieros Navales



Universidad Politécnica de Madrid  
Escuela Técnica Superior de Ingenieros Navales

## Master's Degree on Marine Renewable Energies Harnessing

2021/22

4<sup>th</sup> EDITION





## MANAGING BOARD

### Director

**Antonio Crucelaegui Corvinos**  
Associate Professor  
Universidad Politécnica de Madrid - ETSI Navales

### General Coordinator

**José Luis Morán González**  
Director of Integrated Energy Solutions  
Green Enesys Group

### Secretary

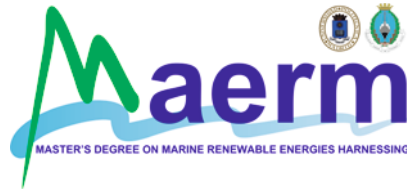
**Enrique Tremps Guerra**  
Associate Professor  
Universidad Politécnica de Madrid - ETSI Navales

## ACADEMIC BOARD

Antonio Crucelaegui Corvinos	-	UPM / ETSIN
José Luis Morán González	-	Green Enesys - UPM / ETSIN
Enrique Tremps Guerra	-	UPM / ETSIN
Vicente Negro Valdecantos	-	UPM / ETSICCP
Miguel Ángel Herreros Sierra	-	UPM / ETSIN
Sergio Martínez González	-	UPM / ETSII
Jaime Domínguez Soto	-	Iberdrola

## MASTER JUSTIFICATION

Although, *stricto sensu*, Marine Renewable Energies are defined as those energies generated by the ocean, harvesting the power of their waves, currents, tides and, in a smaller scale, thermal or salinity gradient, offshore wind is normally included among them since, although the power comes from the wind, not the sea, the challenges and technologies involved and the supply chain needed are similar. A special case is the floating offshore wind, where naval, oceanic and wind industries merge.



These energies, mostly offshore wind and, in a lower scale, waves and currents are soundly established in Northern Europe and in Australia and are showing clear forecasts of growth in America and in the Far East (China, South Korea, Taiwan, Japan,...). Lately, after a tortuous and long path, the United States has joined the countries that pioneered the sector in a commercial scale at a date as recent as the early years of the 21<sup>st</sup> century.

Leveraging on a current strong maritime industrial base and the relevant support from many Governments which have the binding commitment sanctioned by the UN's Framework Convention on Climate Change to increasing the low carbon technologies and reducing the greenhouse gases emissions, this sector shows, year after year, constant growth indexes.

Spain, a country with a huge maritime history and a powerful naval industry and technology, couldn't afford to be side-lined away from this revolutionary process.

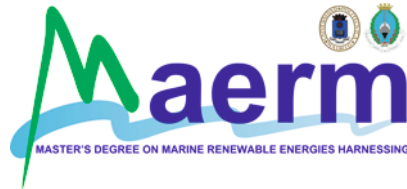
Indeed, Spain, even not having yet the marine renewable energies heavily targeted in our current National Energy Plan, is a world-class leader among the utilities developing Marine Renewable Power Plants, offshore wind generator designers and manufacturers, several wave and current technologies in prototype phase, offshore test sites and testing facilities, design offices for the entire range of specialized vessel that must support the installation and maintenance of the power plants offshore and, last but not least, the industrial supply chain, manufacturing all kind of machinery, structures, systems and devices needed in these offshore developments.

However, these strong companies missed within their technical staffs the right training in the technologies and knowledge that any interaction with the ocean demands.

This Master's Degree on Marine Renewable Energies Harnessing (MAERM, after its Spanish acronym) that you are taking an interest in is a comprehensive specialized academic training, long time sought-after by the sector, and the first in its type to be taught in Spain.

The program of the Master's Degree MAERM encompasses all the disciplines in this field, and studies every offshore-specific subject that fills the gap claimed by all companies in the sector.

The more than 40 lecturers in the staff of the Master's Degree MAERM are senior professionals, coming from Universities, Institutes of Technology and some of the most relevant offshore renewable companies, and all of them are specialized in one or several of the 94 lectures offered.



## MASTER OBJECTIVES

The main objective of the Master's Degree MAERM is to provide the students a complete expertise on matters necessary for a proper and comprehensive immersion in every single management and technical discipline in the area; that includes the design, project development, construction, operation and maintenance of an offshore renewable power plant.

The scope of the Modules has been carefully designed after a complete assessment of the training needs based on major world-class companies already working in offshore renewable energy harnessing, an industry that demands engineers with multi-disciplinary background.

This Master is addressed to both experienced professional engineers and young ones interested in a specific and specialized training to get into a growing and demanding green industry.

## MASTER CONTENTS

The Master Degree on Marine Renewable Energies Harnessing is a qualification from the Universidad Politécnica de Madrid. It is a 60 ECTS title, divided in eight modules that sum 46 ECTS plus a Final Master Assignment (FMA) of 14 ECTS. The eight modules that compose the Master are:

- 1.- Oceanology
  - 1.1.- Site conditions and resources
- 2.- Structural design
  - 2.1.- Site Assessment
  - 2.2.- Design
  - 2.3.- New Technologies. The business ahead.
- 3.- Generation and Export Technologies
  - 3.1.- Offshore energy converters
  - 3.2.- Grid Technology
  - 3.3.- Next storage offshore technologies



#### 4- Manufacturing and Maritime Operations

- 4.1.- Fabrication
- 4.2.- Marine vessel spread
- 4.3.- Marine operations
- 4.4.- Operation and Maintenance

#### 5- Project Operation and Management

- 5.1.- Financial principles
- 5.2.- Contract assessment

#### 6.- Structural Analysis of Offshore Platforms

- 6.1.- Full-Structural Design of a substructure for a WTG: jacket, monopile, by modeling with ANSYS. Case study
- 6.2.- Testing an offshore foundation on basin

#### 7.- Development of the Electrical Network of an Offshore Power Plant

- 7.1.- Wind farm layout
- 7.2.- Off-shore electrical substations
- 7.3.- Transmission of electrical energy to shore
- 7.4.- Wind farm control and connection to the grid

#### 8.- Project Development of an Offshore Power Plant

- 8.1.- Pre-FID (Final Investment Decision)
- 8.2.- Post-FID
- 8.3.- Grid Connection considerations
- 8.4.- Contractors Market Place
- 8.5.- Offshore Wind Sector Overview

Final Master Assignment

## MASTER CALENDAR

The Master lasts 9 months, from September to June. Lecture sessions will take place on Mondays and Wednesdays from 18:15 to 21:15 (3 hours) and Fridays from 16:00 to 20:00 (4 hours).

Preliminary calendar:

### September '21

Mo	Tu	We	Th	F	Sa	Su
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

### October '21

Mo	Tu	We	Th	F	Sa	Su
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

### November '21

Mo	Tu	We	Th	F	Sa	Su
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

### December '21

Mo	Tu	We	Th	F	Sa	Su
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

### January '22

Mo	Tu	We	Th	F	Sa	Su
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

### February '22

Mo	Tu	We	Th	F	Sa	Su
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28						

### March '22

Mo	Tu	We	Th	F	Sa	Su
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

### April '22

Mo	Tu	We	Th	F	Sa	Su
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

### May '22

Mo	Tu	We	Th	F	Sa	Su
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

### June '22

Mo	Tu	We	Th	F	Sa	Su
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

General issues

Module 1:

Module 2:

Module 3:

Module 4:

Module 5.1:

Modules 5.2:

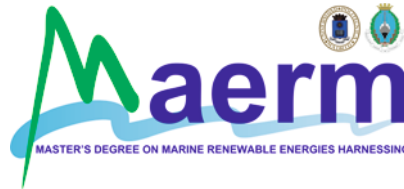
Modules 6 & 7:

Module 8:

TFM



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



## LANGUAGE

The Master will be bilingual Spanish and English, given the international framework of this sector. All written documentation will be in English. The lecturer will decide the language to be used.

## ACADEMIC STAFF

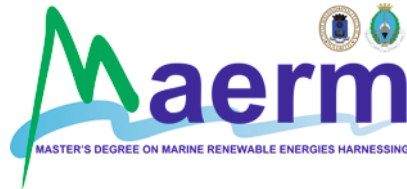
The academic staff is a group of Full and Associate Professors from the Universidad Politécnica de Madrid, teaching in the Schools of Naval Engineering (ETSIN), Civil Engineering (ETSICCP) and Industrial Engineering (ETSII), and professionals with a solid experience working for the most relevant companies in the Renewable Energy Sector, such as Iberdrola, Siemens, Scottish Power Renewables, Gamesa-Siemens, Sener, Naturgy, Proes, etc.

A full list of the Master's lecturers is included at the end of this document.

## TEACHING METHODOLOGY

- Theoretical sessions: lectures on the topics in the programme. 50% of the lecturers can be attended via the on-line platform Webex.
- Practical sessions: oral and written assignments on subjects in the programme. Seminars. On-line assignments via the learning platform Moodle.
- Independent study time: reading, preparation of oral and written assignments, and Moodle tasks.
- Hydrodynamic tests in facilities such as ETSIN and ETSICCP's Towing Tanks.
- Internships in companies: in some cases Final Project Assignments may be done in companies or Research Groups.





## ASSESSMENT

Modules (46 ECTS): will be assessed by a combination of continuous assessment (assignments and mini design projects) and traditional examinations.

Each module will score according to its ECTS weight in the Master. Minimum mark to pass each 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 as follows:

Modules 1 to 5:

- Written exam: 70%
- Participation in class and on-line activities: 30%

Modules 6 to 8:

- Module assignments: 70%
- Participation in class and on-line activities: 30%

The Final Master Thesis (14 ECTS) will be assessed by means of a written project and oral presentation to a Board of Examiners appointed by the Academic Board.

In case a student fails a module, the Academic Board may propose and qualify a complementary exam or assignment in order to fulfil the necessary conditions to pass the Master's Degree MAERM.

## PREREQUISITES

To get a direct access to the Master's Degree MAERM the candidate must 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 Board.





Students are expected to have an upper intermediate level of English (B2 or higher).

Candidates will be accepted depending on the level and affinity of their studies and also on their academic record. Interest in Renewable Marine Energies will be also taken into consideration.

## PRE-REGISTRATION AND REGISTRATION

Students interested in joining the Master should pre-register, contacting the Administrative Secretary, between April 1<sup>st</sup> and September 10<sup>th</sup>, 2021.

Due to the limited number of places, there will be a first pre-selection of candidates with the applications received before July 15<sup>th</sup>, 2021. Pre-selected candidates will be requested a payment of 900 € as place reservation.

Accepted students should register during July and September 2021.

Students are required to pay fees in three installments:

- The first installment of 900 € is paid at preregistration.
- The second installment of 3,600 € is paid at registration between July 15<sup>th</sup> and September 30<sup>th</sup>.
- The third installment of 4,500 € is due in March.

Maximum number of students has been limited to 20.

Total Master's fee is 9,000 €.

<b>VENUE</b>  Escuela Técnica Superior de Ingenieros Navales  Universidad Politécnica de Madrid Avda. de la Memoria, 4 Ciudad Universitaria 28040 Madrid, Spain	<b>CONTACT</b> <u>Administrative Secretary:</u> Mr. José Antonio Muñoz Cubillo E-mail: <a href="mailto:master.maerm.navales@upm.es">master.maerm.navales@upm.es</a> Phone: +34 910676108  <u>Master coordinator:</u> Mr. José Luis Morán González E-mail: <a href="mailto:joseluis.moran@upm.es">joseluis.moran@upm.es</a>
Web: <a href="http://www.etsin.upm.es/Escuela/Estudios/Titulos_Propios_UPM/Master_en_Energias_Renovables_Marinas">http://www.etsin.upm.es/Escuela/Estudios/Titulos_Propios_UPM/Master_en_Energias_Renovables_Marinas</a>	



POLITÉCNICA

Universidad Politécnica de Madrid  
Escuela Técnica Superior de Ingenieros Navales



## LIST OF MASTER'S LECTURERS

Surname	Name	Academic Education	Company	Present Professional responsibility
Aguinaga Arena	Manuel	Industrial Engineer	Scottish Power	O&M Package Manager
Aguirre Altí	Jon	Lawyer	Scottish Power	Principal Contract Manager
Barredo López	Jorge	Naval Engineer	Naturgy	Energy Director
Crucelaegui Corvinos	Antonio	Ph.D. Naval Engineer	UPM-ETSIN	Associate Professor
Cruz Fernandez	Jonay	Sea Sciences	Worley Parsons España	Principal Coastal Engineer
Cuadrado Martín	Alejandro	Naval Engineer	Ocean Winds (EDP)	Offshore T&I Engineer
de Castro Fernández	Rosa María	Ph.D. Industrial Engineer	UPM-ETSII	Associate Professor
de Faragó Botella	Enrique	Civil Engineer	Robert West Consulting	Marine Department Director
de la Jara	Julio	Industrial Engineer MSc Renewable Energies	Scottish Power	Principle Contract Manager
de Vicente Peño	Mario	Naval Engineer MEng. Numerical Simulation	Sener UPM-ETSIN	Structural Design Leader Part-time Lecturer
Domínguez Soto	Jaime	Naval Engineer	Iberdrola Ingeniería y Construcción	Specialist in Marine Renewable Projects
Esteban Pérez	M <sup>a</sup> Dolores	Ph.D. Civil Engineer	Iberdrola UPM - ETSICCP	Part-time Lecturer
Fernández Beites	Luis	Ph.D. Industrial Engineer	UPM-ETSII	Associate Professor
Fernández Uranga	Salvador	Industrial Engineer	Independent Advisor	Advisor
Fernández Viñuela	Pedro	Industrial Engineer	Scottish Power	Head of Contract Management
García Muiña	José Manuel	Civil Engineer	Proes	Harbours Director
Gómez Alonso	Pablo	Ph.D. Mechanical Engineer	Iberdrola Ingeniería y Construcción	Engineer
González Palacios	Ángel	Aeronautic Engineer	Siemens Gamesa	Floating offshore wind R&D engineer
González Palacios	Leo M.	Ph.D. Industrial Engineer	UPM-ETSIN	Associate Professor
Herreros Sierra	Miguel Ángel	Ph.D. Naval Engineer	UPM-ETSIN	Associate Professor Deputy Director
Izquierdo Labella	Ricardo	Naval Engineer	Naturgy	Construction and Engineering Director
Lampreave García	Óscar	Industrial Engineer	Scottish Power	Lead Contract Manager
Leo Mena	Teresa	Ph.D. Chemistry	UPM - ETSIN	Full Professor Deputy Director
López Gutiérrez	José Santos	Ph.D. Civil Engineer	UPM - ETSICCP	Associate Professor Deputy Director
López Leiva	Juan de Dios	Aeronautic Engineer	Siemens Gamesa	Chief Functional Engineer
Martínez Caminero	Alfonso	Naval Engineer	Iberdrola Ingeniería y Construcción	Project Manager
Martínez González	Sergio	Ph.D. Industrial Engineer	UPM-ETSII	Associate Professor
Martínez Palacio	Álvaro	Civil Engineer	Iberdrola	Project Management Director. Offshore Wind
Migoya Valor	Emilio	Ph.D. Industrial Engineer	UPM-ETSII	Associate Professor



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Universidad Politécnica de Madrid  
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Surname	Name	Academic Education	Company	Present Professional responsibility
Morán González	José Luis	Ph.D. Naval Engineer	Green Enesys Group UPM-ETSIN	Director of Integrated Energy Solutions
Moya García	Juan	Naval Engineer	SAITEC Offshore Technologies	Business Development Manager
Muñoz Paniagua	Jorge	Ph.D. Industrial Engineer	UPM-ETSII	Assistant Professor
Negro Valdecantos	Vicente	Ph.D. Civil Engineer	UPM - ETSICCP	Associate Professor Deputy Director
Palacín Sotillo	Diego	Naval Engineer	Iberdrola Ingeniería y Construcción	Project Manager
Paredes Ortiz	Juan Luis	Industrial Engineer	Iberdrola Engineering and Construction	Commissioning Manager
Pérez Arribas	Francisco	Ph.D. Naval Engineer	UPM - ETSIN	Associate Professor Department Director
Pérez de Andrés	Juan Miguel	Industrial Engineer	Siemens SA	Division Director (Energy Management)
Pérez Fernández	Rodrigo	Ph.D. Naval Engineer	Sener UPM-ETSIN	Responsible Military Area (Naval Business)
Pérez Maza	Óscar	Industrial Engineer	Iberdrola Renovables	Project Manager
Pérez Rojas	Luis	Ph.D. Naval Engineer	UPM - ETSIN	Full Professor
Platero Gaona	Carlos	Ph.D. Industrial Engineer	UPM-ETSII	Research Associate
Rol Rúa	Laura	Industrial Engineer	Repsol	Senior Analyst in Energy Markets
Saettone	Simone	Naval Engineer	UPM-ETSIN	Researcher in CEHINAV
Soria Ruiz	Pedro	Naval Engineer	Siemens Gamesa	Offshore Wind Loads and Control Specialist
Souto Iglesias	Antonio	Ph.D. Naval Engineer	UPM - ETSIN	Full Professor
Suárez Bermejo	Juan Carlos	MSc Physics Ph.D. Materials Science and Engineering, IWE	UPM - ETSIN	Director of CIME Full Professor
Tremps Guerra	Enrique	Ph.D. Mining Engineer	UPM - ETSIN	Associate Professor