Master Renewable Energy in the Marine environment

First edition: 2018-2022 (MUNDUS)

120 ECTS

Resource and marine environment	
Resource assessment monitoring	
Theoretical foundations: early marine energy conversion	
Aerodynamics	
Electrical principles: electrical and electronic equipment	
Control principles	
Connection and integration into the electricity grid	
Integration of renewable energy into the electricity system	
Engineering, development and management of offshore parks	
Design of parks	
Operation and maintenance	
Conversion technologies	
Offshore wind turbines and wave systems	
Environmental, economic and legal aspects of marine renewable energy	
Sustainability and strategic environmental assessment	
Local culture	
Languaje and culture	
ECTS (lectures):	**90**
MSc Thesis	
ECTS (MSc Thesis):	**30**

"REM" pathways

Year	Sem.	ECTS	Specialization (A)	Specialization (B)
1	1	30	STRATH	
	2	30	UPV-EHU	
2	3	30	ECN	NTNU
	4	30	NTNU, UPV-EHU, STRATH, ECN, AACC (*)	

(A): "Offshore Renewable Energy Systems Engineering".
(B): "Power Electronics and Control for Offshore Renewable Energy Systems".
(*) AACC: Associate Centers

1st semester: STRATHCLYDE

	ECTS (A)	ECTS (A & B)	ECTS (B)	Sem.	Dept. (*)	Profs.
1. Resource and marine environment						
ECTS Module 1 (A):		**0**				
ECTS Module 1 (B):			**0**			
2. Theoretical foundations: early marine energy conversion						
Loads and structural mechanics and dynamics						
NM946 Inspection and Survey	5			1	NAOME	Julia Race
Electrical principles: electrical and electronic equipment						
EE9X1 Control Principles			5	1	EEE	Mohamed Reza Katebi, Hong Yue
ECTS Module 2 (A):		**5**				
ECTS Module 2 (B):			**5**			
3. Conversion technologies						
Offshore wind turbines						
EE9X2 Wind Energy and Distributed Energy Resources			5	1	EEE	David McMillan, Julian Feuchtwang
Marine current turbines						
NM833 Marine Renewable Energy Systems		5		1	NAOME	Tahsin Tezdogan
ECTS Module 3 (A):		**5**				
ECTS Module 3 (B):			**10**			
4. Connection and integration into the electricity grid						
EE9X3 Power Electronics Devices, Drives Machines and Applications			5	1	EEE	Max Parker
ECTS Module 4 (A):		**0**				
ECTS Module 4 (B):			**5**			
5. Engineering, development and management of offshore parks						
Marine structures						
NM968 Physical model testing for offshore renewables	5			1	NAOME	Sandy Day
NM962 Advanced Marine Structures	5			1	NAOME	Piero Caridis
ECTS Module 5 (A):		**10**				
ECTS Module 5 (B):			**0**			
6. Environmental, economic and legal aspects of marine renewable energy						
EC928 Energy Economics		5		1	BS	Grant Jordan Allan
EE9X4 Environmental Impact Assessment for Offshore Renewable Energy		5		1	CEE	Elsa Joao
ECTS Module 6 (A):		**10**				
ECTS Module 6 (B):			**10**			
7. Local culture						
ECTS Module 7 (A):		0				
ECTS Module 7 (B):			0			
TOTAL ECTS (lectures) (A):		**30**				
TOTAL ECTS (lectures) (B):			**30**			
8. MSc Thesis						
ECTS (Msc Thesis):		**30**		4	EEE	All the PhD lecturers involved + others TBD

(*) EEE = Electronic and Electrical Engineering; NAOME = Naval Architecture, Ocean and Marine Engineering; BS = Business School; CEE = Civil and Environmental Engineering

2nd semester: UPV-EHU

	ECTS (A)	ECTS (A & B)	ECTS (B)	Sem.	Dept. (*)	Profs.
1. Resource and marine environment						
Resource assessment monitoring						
OWEAOW Ocean wave energy and offshore wind energy assessment		4,5		2	INMF	Gabriel Ibarra, Ganix Esnaola, Alain Ulazia / Jon Saénz
ECTS Module 1 (A):		**4,5**				
ECTS Module 1 (B):			**4,5**			
2. Theoretical foundations: early marine energy conversion						
Aerodynamics						
AFDMFM Advanced fluid dynamics modeling for marine engineering applications	4,5			2	INMF	Jesús María Blanco, Gustavo Esteban, Alberto Peña, Unai Fernández
TANAIF Theoretical and numerical aspects in fluid dynamics and turbulent flow	3			2	M	Luis Vega / Francisco de la Hoz, Carlos Gorría
CFDFTF Computational fluid dynamics for turbulent flows	3			2	M (BCAM)	Johan Janson, Goran Stipch, Ali Ramezani
Electrical principles: electrical and electronic equipment						
502149 Modelling of wind/marine current turbine-driven electric generators			3	2	EE	Pablo Eguia / Inigo Martinez de Alegria
Control principles						
WATWIC Wave to wire control			4,5	2	AC & SE	Eider Robles (TECN), María Goretti Sevillano
ECTS Module 2 (A):		**10,5**				
ECTS Module 2 (B):			**7,5**			
3. Conversion technologies						
ECTS Module 3 (A):		**0**				
ECTS Module 3 (B):			**0**			
4. Connection and integration into the electricity grid						
502150 Integration of renewable energy into the electricity system (**)		3		2	EE	Pablo Eguia
502153 Operation of transmission and distribution networks (**)		3		2	EE	Marene Larruskain, Oihane Abarrategi
PEIOPS Power electronics in offshore power systems			3	2	ET	Inigo Martinez de Alegria, Jon Andreu, Inigo Kortabarria
ECTS Module 4 (A):		**6**				
ECTS Module 4 (B):			**9**			
5. Engineering, development and management of offshore parks						
Design of parks						
ECFMRC Environmental conditions for marine renewable concepts		3		2	ET (IH)	Iñigo Losada, César Vidal, Raul Guanche
Operation and maintenance						
OAMOME Operations and maintenance of marine energy arrays		3		2	AC & SE (TECN)	Jose Luis Villate, Pablo Ruiz Minguela, Germán Pérez, Vincenzo Nava, Raul Rodriguez
ECTS Module 5 (A):		**6**				
ECTS Module 5 (B):			**6**			
6. Environmental, economic and legal aspects of marine renewable energy						
ECTS Module 6 (A):		**0**				
ECTS Module 6 (B):			**0**			
7. Local culture						
BALACUL Basque languaje and culture		3		2	BLC	Itziar González, Beñat Muguruza Aseguinolaza
ECTS Module 7 (A):		**3**				
ECTS Module 7 (B):			**3**			
TOTAL ECTS (lectures) (A):		**30**				
TOTAL ECTS (lectures) (B):			**30**			
8. MSc Thesis						
ECTS (MSc Thesis):		**30**		4	(All Dpts.)	All the PhD lecturers involved + others TBD

(*) INMF = Nuclear Engineering and Fluid Mechanics; BCAM = Basque Centre for Applied Mathematics; ET= Electronic Technology; AC&SE = Automatic Control and Systems Engineering;
TECN = TECNALIA; EE = Electrical Engineering; M = Mathematics; IH = Instituto Hidrográfico (Cantabria); BLC: Basque Languaje and Comunication
(**) Subjects shared with the Máster: "Máster Universitario en Integración de las Energías Renovables en el Sistema Eléctrico"

3rd semester (A): ECN

	ECTS (A)	Sem.	Dept (*)	Profs.
1. Resource and marine environment				
Resource assessment monitoring				
WWSSM Water waves and sea states modelling (**)	4	3	MFE	G. Ducrozet, F. Bonnefoy
ECTS Module 1 (A):	**4**			
2. Theoretical foundations: early marine energy conversion				
Hydrodynamics				
GCHYD General concepts of hydrodynamics (**)	4	3	MFE	P. Ferrant, L. Gentaz, D. Le Touzé
NUMHY Numerical hydrodynamics (**)	5	3	MFE	D. Le Touzé, L. Gentaz, Z. Li
EXPHY Experimental hydrodynamics (**)	4	3	MFE	F. Bonnefoy
ECTS Module 2 (A):	**13**			
3. Conversion technologies				
Offshore wind turbines				
MRENE Marine renewable energy: a) Offshore wind turbines (***)	1	3	MFE	J.C. Gilloteaux
Marine current turbines				
MRENE Marine renewable energy: b) Tidal turbines (***)	2	3	MFE	A. Ducoin, B. Elie
Sensors of wave energy				
MRENE Marine renewable energy: c) Wave energy converters (***)	2	3	MFE	A. Babarit, S. Aubrun
ECTS Module 3 (A):	**5**			
4. Connection and integration into the electricity grid				
ECTS Module 4 (A):	**0**			
5. Engineering, development and management of offshore parks				
Marine structures				
WSINT Wave-structure interactions and moorings (**)	4	3	MFE	P. Ferrant, L. Gentaz, C. Berhault
ECTS Module 5 (A):	**4**			
6. Environmental, economic and legal aspects of marine renewable energy				
ECTS Module 6 (A):	**0**			
7. Local culture				
FRELA French language and culture (**)	4	3	CFCC	S. Ertl
ECTS Module 7 (A):	**4**			
TOTAL ECTS (lectures) (A):	**30**			
8. MSc Thesis				
ECTS (MSc Thesis):	**30**	4	MFE	All the PhD lecturers involved + others TBD

(*) MFE = Fluid Mechanics and Thermodynamics; CFCC = Communication, Foreign Languages & Corporate Cultures

(**) Subjects shared with the Máster Erasmus Mundus: advanced ship design (EMShip)

(***) There is only a 5 ECTS subject called: "Marine renewable energy". It is just splitted into three parts to show it covers different topics.

3rd semester (B): NTNU

	ECTS (B)	Sem.	Dept (*)	Profs.
1. Resource and marine environment				
ECTS Module 1 (B):	**0**			
2. Theoretical foundations: early marine energy conversion				
Electrical principles: electrical and electronic equipment				
TET5100 Applied electromagnetics in power engineering	7,5	3*	EPE**	Arne Nysveen/Robert Nilssen
ECTS Module 2 (B):	**7,5**			
3. Conversion technologies				
Offshore wind turbines				
ELK-23 Power electronics in future power systems[§]	3,75	3*	EPE**	Elisabetta Tedeschi
ELK-12 Wind power in electric power systems[§]	3,75	3*	EPE**	Kjetil Uhlen
ECTS Module 3 (B):	**7,5**			
4. Connection and integration into the electricity grid				
TET4190 Power electronics	7,5	3*	EPE**	Dimosthenis Peftitsis
TET4115 Power system analysis	7,5	3*	EPE**	Vijay Venu Vadlamudi / Kjetil Uhlen
ELK-10 Quality of supply in electrical power systems[§]	3,75	3*	EPE**	Kjell Sand
ECTS Module 4 (B):	**18,75**			
5. Engineering, development and management of offshore parks				
ECTS Module 5 (B):	**0**			
6. Environmental, economic and legal aspects of marine renewable energy				
ECTS Module 6 (B):	**0**			
7. Local culture				
ECTS Module 7 (B):	**0**			
(***) TOTAL ECTS (lectures) (B):	**30**			
8. MSc Thesis				
ECTS (MSc Thesis):	**30**	4	EPE	All the PhD lecturers involved + others TBD

(*) 1/3 = Autumn semester; 2/4 = Spring semester

(**) EPE = Electric Power Engineering

(***) Students must select any two of the 3.75 credit courses and the three of the 7.5 credit courses, completing 30 ECTS of lectures.

([§]) In the transcript, ELK-XX courses will not be specified individually, but grouped together under a 7.5 credit course titled
TET 5505 'Electric Power Engineering, Specialization Course'

"REM" distribution statistics

a) ECTS Distribution by Module	ECTS (*) TOTAL
1 Resource and marine environment	8,5
2 Theoretical foundations: early marine energy conversion	48,5
3 Conversion technologies	22,5
4 Connection and integration into the electricity grid	32,75
5 Engineering, development and management of offshore parks	20
6 Environmental, economic and legal aspects of marine renewable energy	10
7 Local culture	7
LECTURES:	***149,25***
8 Master Thesis	30
TOTAL MASTER:	**179,25**

(*) Considering the total offer of subjects by all the partners.

b) ECTS Distribution by Module and Specialization	ECTS (*) (A)	(B) (**)
1 Resource and marine environment	8,5	4,5
2 Theoretical foundations: early marine energy conversion	28,5	20
3 Conversion technologies	10	17,5
4 Connection and integration into the electricity grid	6	32,75
5 Engineering, development and management of offshore parks	20	6
6 Environmental, economic and legal aspects of marine renewable energy	10	10
7 Local culture	7	3
LECTURES:	***90***	***93,75***
8 Master Thesis	30	30
TOTAL MASTER:	**120**	**123,75**

(**) Offer including all the optional subjects; students must choose among a specified combination of such optionals, completing 30 ECTS of lectures.

c) ECTS Distribution by Module, Specialization and Partner	ECN (A)	UPV-EHU (A)	UPV-EHU (B)	STRATH (A)	STRATH (B)	NTNU (**) (B)
1 Resource and marine environment	4	4,5	4,5	0	0	0
2 Theoretical foundations: early marine energy conversion	13	10,5	7,5	5	5	7,5
3 Conversion technologies	5	0	0	5	10	7,5
4 Connection and integration into the electricity grid	0	6	9	0	5	18,75
5 Engineering, development and management of offshore parks	4	6	6	10	0	0
6 Environmental, economic and legal aspects of marine renewable energy	0	0	0	10	10	0
7 Local culture	4	3	3	0	0	0
LECTURES:	***30***	***30***	***30***	***30***	***30***	***33,75***
8 Master Thesis	30	30		30		30
TOTAL MASTER:	**60**	**60**		**60**		**63,75**