MORE master basic syllabus

Title:
Ocean wave energy and off-shore wind energy assessment

Credit value:
4.5 ECTS

Mandatory/Optional:
Mandatory

Semester:
2

Lecturer/s:
Full names of all the lecturers involved (as appears in the Proposal for MORE academic plan)
Gabriel Ibarra [(1)], Ganix Esnaola[(1)], Alain Ulazia[(1)], Jon Saénz[(2)]

University:
University of the Basque Country

Department:
NE & Fluid Mechanics Department[(1)], Applied Physics II[(2)]

Rationale:
Brief description (max 5 lines) of the subject and its relations with other relevant subjects of the master

*This subject belongs to the first module of MORE called **Resource and marine environment**. It deals with ocean waves and off-shore wind which are analyzed as geophysical fluids holding an energetic potential.*

Objectives:
To provide students with…

1. *The theoretical knowledge on Fluid Mechanics and Physics to understand the behaviour of wind and ocean waves as geophysical fluids in nature*
2. *The capability of evaluating ocean waves potential in any region*
3. *The capability of evaluating off-shore wind potential in any region*
4. *An introductory knowledge of the state-of-the-art software used(WRF, R, SWAN)*

Skills: *(according to the list of skills provided)*

Subject skills	**More Master Skills**						
	L2.1	**L2.2**	**L2.3**	**L2.4**	**L2.5**	**L2.6**	**L2.7**
L3.1. Students understand a scientific description of wind and ocean waves as geophysical fluids	X	X		X			X
L3.2. Students are able to evaluate the energetic potential of ocean waves		X	X		X		
L3.3. Students are able to evaluate the energetic potential of off-shore wind		X	X		X		
L3.4. Students are able to use software tools for evaluation and estimation of energetic potential		X			X	X	X

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Teaching and learning methods:
Description of the methodology: lectures, lab, group presentations…
The methodology in this subject is practical to a very high degree, based on a combination of theoretical introductory classes and intensive hands-on computer exercises. Occasionally, group presentations and invited lectures may also be incorporated.

Allocation of student time:

	Attendance (classroom, lab,…)	**Non attendance (lecture preparation, self study…)**
Lectures	16 hours	------
Lab	------	------
Presentations	------	------
Computers (hands-on)	29 hours	------
Homeworks	------	67.5 hours

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Assessment:

Basic description of the assessment methodology

Students will be evaluated by their degree of success on the homeworks proposed by teachers.

Assessment Matrix:

Subject skills	**Assessment method**					
	Exam	**Presentation**	**Home work**	**Report**	**…**	**…**
L3.1.	%	%	100%	%	%	%
L3.2.	%	%	100%	%	%	%
L3.3.	%	%	100%	%	%	%
...						
...						
...						

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Programme:

Lesson 1 (15h)	*Title: Atmospheric reanalyses and off-shore wind modelling. Introduction to WRF.* *Brief description (max. 2 lines)* *Fundamentals of meteorological forecast. The concept of meteorological analysis. The reanalysis concept. Example of practical use of WRF.* *Distribution (5 h theory + 5 h practical classroom + 5 h computer + 0 h seminar)*
Lesson 2 (10h)	*Title: Off-shore wind energy evaluation and assessment.* *Brief description (max. 2 lines)* *Evaluation and spatial representation of offshore wind energy potential using R and Geographical Information Systems (Qgis).* *Distribution (2 h theory + 0 h practical classroom + 8 h computer + 0 h seminar)*
Lesson 3 (10h)	*Title: Ocean modelling and ocean wave modelling. Oceanic reanalyses.* *Brief description (max. 2 lines)* *Introduction to ocean modelling, ocean wave modelling and ocean reanalyses. Practical use of major ocean reanalysis products.* *Distribution (4h theory + 0h practical classroom + 6h computer + 0h seminar)*
Lesson 4 (10h)	*Title: Ocean wave energy evaluation and assessment.* *Brief description (max. 2 lines)* *Introduction. Reanalysis and satellite data for wave enrgy assessment. Practical evaluation and spatial representation of the wave energy flux using R.* *Distribution (0h theory + 0h practical classroom +10 h computer + 0 h seminar)*

Resources:

Classrooms, Blackboard, laptop, projector, audio, computer room, laboratory, security issues,…

Computer room. Classrooms. Projector.

Bibliography:

Basic textbooks, deepening bibliography, Internet addresses of interest, specific journals, etc…

Basic textbooks/deepening bibliography

1. *Burton, T., Sharpe, D., Jenkins, N, & Bossanyi, E. (2001). Wind energy handbook. John Wiley & Sons.*
2. *Crawley, M.J. , 2013. The R Book (2nd Edition) John Wiley & Sons.*
3. *DeCaria, J.A. and G. E. van Knowe, A First Course in Atmospheric Numerical Modeling. 2014. Sundog Publishing, Madison, 320 pages.*
4. *Evensen, Geir, 2009. Data Assimilation. The Ensemble Kalman Filter. Springer-Verlag Berlin Heidelberg. DOI: 10.1007/978-3-642-03711-5. ISBN: 978-3-642-03710-8.*
5. *Holthuijsen. L.H. 2007. Waves in Oceanic and Coastal Waters. Cambridge University Press*
6. *Jacobson, M.Z.Fundamentals of Atmospheric Modeling, 2nd ed. 2005. Cambridge University Press, Cambridge, 813 pages*
7. *Kalnay, E. Atmospheric modeling, data assimilation and predictability, 2002. Cambridge University Press, Cambridge, 368 pages.*
8. *Kämpf, Jochen, 2009. Ocean Modelling for Beginners. Using Open-Source Software. Springer-Verlag Berlin Heidelberg. ISBN: 978-3-642-00819-1.*
9. *Kämpf, Jochen, 2010. Advanced Ocean Modelling. Using Open-Source Software. Springer-Verlag Berlin Heidelberg. ISBN: 978-3-642-10609-5.*
10. *Lahoz, William, Khattatov, Boris, Menard, Richard, 2010. Data Assimilation. Making Sense of Observations. Springer-Verlag Berlin Heidelberg. ISBN: 978-3-540-74702-4.*
11. *Manwell, J. F., McGowan, J. G., & Rogers, A. L. (2010). Wind energy explained: theory, design and application. John Wiley & Sons.*
12. *Multon, B. 2012. Marine Renewable Energy Handbook. ISTE Ltd John Wiley & Sons.*
13. *Sarkisyan, Artem S., Sündermann, Jürgen, 2009. Modelling ocean climate variability. Springer Netherlands. ISBN: 978-1-4020-9207-7.*

14. *Siedler, Gerold, Griffies, Stephen, Gould, John, 2013. Ocean Circulation and Climate. A 21st century perspective. Academic Press. ISBN: 9780123918512.*
15. *Stull, R.B., Meteorology for Scientists and Engineers, 2nd ed. 2000. Brooks/Cole Thomson Learning, Pacific Grove, CA, 520 pages.*
16. *Twidell, J., & Gaudiosi, G. (Eds.). (2009). Offshore wind power. Multi-Science Publishing Company.*

Internet addresses of interest:

http://www.reanalyses.org
https://reanalyses.org/ocean/overview-current-reanalyses
http://www.ecmwf.int/en/research/climate-reanalysis
http://www.ecmwf.int/en/research/modelling-and-prediction/marine
http://apps.ecmwf.int/datasets/
http://gmao.gsfc.nasa.gov/reanalysis/MERRA-2
http://www.nodc.noaa.gov
http://www.nodc.noaa.gov/BUOY/
http://www.ewea.org/
http://icdc.zmaw.de/projekte/easy-init/easy-init-ocean.html
http://marine.copernicus.eu/
http://www.puertos.es/es-es/
http://www.puertos.es/es-es/oceanografia/Paginas/portus.aspx
http://swanmodel.sourceforge.net/

Journals

Bulletin of the American Meteorological Society
Climate Dynamics
Journal of Advances in Modeling Earth Systems
Journal of Geophysical Research
Journal of Oceanic Engineering IEEE
Monthly Weather Review
Ocean Dynamics
Ocean Engineering
Ocean Modelling
Ocean Science
Renewable Energy
Review of Geophysics
Wind Energy

Further comments: