Last update: 23-04-2019

220038 - Wind Turbines Design

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 220 - ETSEIAT - Terrassa School of Industrial and Aeronautical Engineering

Academic year: 2019

Degree: BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: FRANCISCO JAVIER SANZ CANO

Degree competences to which the subject contributes

Specific:

1. Understanding and mastery of basic concepts about the general laws of mechanics, thermodynamics and electromagnetism fields and waves and their application to solving problems in engineering.
2. An understanding of the basic principles of fluid mechanics and their application in solving engineering problems. The ability to calculate pipes, channels and fluid systems.
3. GrETA/GrEVA - An adequate understanding of the following, as applied to engineering: concepts and laws that govern the processes of energy transfer, the movement of fluids, the mechanisms of heat transfer and phase transition, and their role in analysis of the main aerospace propulsion systems.
4. GrETA - Applied knowledge of aerodynamics, mechanics and thermodynamics, flight mechanics, aircraft engineering (fixed-wing and rotary-wing), structural theory.
5. GrEVA - An adequate understanding of the following, as applied to engineering: the fundamentals of fluid mechanics describing flow in all regimes in order to determine the distributions of pressures and forces acting on aircraft.

Teaching methodology

The subject is divided in two parts:
Part 1: combines theoretical lessons plus a guided project development.
Part 2: attendance to conferences given by specialized professionals of the wind energy sector.

Lab practices
This subject does not contain laboratory practices. However, it is required to develop a project that will be guided by the professor of the subject.

Learning objectives of the subject

The main objective of the subject is to give a general view of the wind turbine design and its operation. Additionally, some aspects related to the wind energy, such as wind farm layout, deployment, energy management and grid connection, are also considered.

Last update: 23-04-2019

220038 - Wind Turbines Design

Study load

Total learning time: 75h	Hours large group:	30h	40.00%
	Self study:	45h	60.00%

Last update: 23-04-2019

220038 - Wind Turbines Design

Content

Module 1. Wind energy introduction

Learning time: 4h
Theory classes: 2h
Self study : 2h

Description:
Topic 1. Wind turbine history.
Topic 2. Wind turbine types.
Topic 3. Wind energy current status.
Topic 4. Wind turbine components.

Module 2. Wind turbine aerodynamics and performance

Learning time: 33h
Theory classes: 9h
Self study : 24h

Description:
Topic 5. Airfoil aerodynamics and selection criteria for wind turbine rotors.
Topic 6. Blade Element Momentum Theory
Topic 7. Wind turbine rotor blade geometry definition.
Topic 8. Wind turbine power and noise curves.

Module 3. Wind turbine design and certification process

Learning time: 6h
Theory classes: 3h
Self study : 3h

Description:
Topic 9. Wind turbine load assumptions standards:
- aerolastic simulations
- dynamic analysis
- ultimate and fatigue load analysis
Topic 10. Loads, power and noise measurement standards.

Module 4. Structural design of wind turbine rotor blades

Learning time: 4h
Theory classes: 2h
Self study : 2h

Description:
Topic 11. Structural solutions and materials
Topic 12. Blade-hub joint
Topic 13. Manufacturing process
Topic 14. Full scale test

Last update: 23-04-2019

220038 - Wind Turbines Design

Module 5. Wind resource	Learning time: 4h Theory classes: 2h Self study : 2h

Description:
Topic 15. Wind characterisation and prediction.
Topic 16. Weibull distribution and annual energy yield calculation.
Topic 17. Micrositing.

Module 6. Wind turbine conceptual design	Learning time: 4h Theory classes: 2h Self study : 2h

Description:
Topic 18. Nacelle lay-out, rotor and control strategy.

Module 7. Wind turbine control design	Learning time: 6h Theory classes: 3h Self study : 3h

Description:
Topic 19. Closed-Loop Control.
Topic 20. Supervisory control/Real-Time Systems.

Module 8. Wind turbine electrical design	Learning time: 4h Theory classes: 2h Self study : 2h

Description:
Topic 22. Electrical components.
Topic 23. Constant and variable speed systems.
Topic 24. Converter types.
Topic 25. Modulation and control techniques
Topic 26. Grid integration.
Topic 27. Power quality.

Last update: 23-04-2019

220038 - Wind Turbines Design

Module 9. Wind turbine mechanical design	Learning time: 4h Theory classes: 2h Self study : 2h
Description: Topic 28. Tools and methodologies. Power train, yaw and pitch systems. Design validation.	

Module 10. Structural design	Learning time: 6h Theory classes: 3h Self study : 3h
Description: Topic 29. Tower and substructures Topic 30. Nacelle	

Qualification system

The qualification of the subject is divided in two parts: guided project (40%) and written exam (60%). The guided project will be handed over at the end of the subject. The written exam will consist in a single exam that will be done at the end of the subject about part 1 as well as part 2. Attending the conferences given during part 2 is compulsory.
Mf = 0,60Me + 0,40Mp.
Mf : Final mark
Me : Exam mark
Mp : Project mark

Bibliography

Basic:

Burton, Tony [et al.]. Wind energy handbook [on line]. 2nd ed. Chichester [etc.]: John Wiley & Sons, 2011 [Consultation: 16/05/2014]. Available on: <http://onlinelibrary.wiley.com/book/10.1002/9781119992714>. ISBN 9780470699751.

Rodríguez, J.L.; Burgos, J.C.; Arnalte, S. Sistemas eólicos de producción de energía eléctrica. Alcorcón: Rueda, 2003. ISBN 8472071391.

Complementary:

Creus Solé, Antonio. Aerogeneradores. [S.l.]: Cano Pina, 2008. ISBN 9788496960213.