COURSE OUTLINE

1. GENERAL

SCHOOL:	Engineering		
DEPARTMENT:	Electrical and Computer Engineering		
LEVEL OF STUDY:	Undergraduate		
COURSE UNIT CODE:	9.006	**SEMESTER**	9th
COURSE TITLE:	Wind Power Engineering		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
Theory (Lectures)	3	3
Laboratory	1	1
TOTAL	**4**	**4**

COURSE UNIT TYPE:	Specialized knowledge/Consolidation
PREREQUISITES:	No
LANGUAGE OF INSTRUCTION/EXAMS:	Greek
COURSE DELIVERED TO ERASMUS STUDENTS	No
COURSE WEB PAGE (URL)	https://eclass.hmu.gr/courses/ECE166/

2. LEARNING OUTCOMES

Learning Outcomes

The course "Wind Power Engineering" aims to give students advanced knowledge in relation to the process of converting wind energy into electricity and its use by society. More specifically, the course covers theoretical and practical issues concerning the entire range of wind systems, from their categorization and the necessary meteorological data to the detailed description of their basic constituent parts, their economic evaluation and the environmental issues related to them. Also, the issue of the wind power integration into the electricity grid is thoroughly analyzed.
Upon successful completion of the course, the students will be able to:

1. Know the basic operating principles of a wind power system
2. Estimate the annual electricity production of a wind power system at a given location
3. Understand the interactions of wind power systems with the existing electricity grid to which they are connected
4. Compose a techno-economic study of the operation of a wind power system in an interconnected or autonomous system, with or without the use of electric energy storage technologies
5. Describe and explain the operation of wind power systems in the liberalized electricity market

General Skills

- Retrieve, analyse and synthesise data and information, with the use of necessary technologies
- Decision making
- Autonomous work
- Work in an interdisciplinary environment
- Project planning and management
- Respect for the natural environment

3. SYLLABUS

Theory:

- Introduction to wind power systems: Historical overview, technologies, key subsystems, power curve, current status and future prospects
- Characteristics of the wind, elements of aerodynamics

- Configuration of the electrical part of wind power systems: Electric machines, power converters, transformers, constant and variable speed operation, wind power systems control
- Siting, system design, wind farms, internal electrical networks of wind farms
- Connection of wind power systems to the electricity grid
- Energy and economic evaluation of wind power systems
- Environmental impacts
- Wind power forecasting
- Wind power systems penetration in power systems
- Electricity storage and hybrid power plants, operation of wind power systems in autonomous systems
- Legislative framework, operation of wind power systems in the liberalized electricity market

Laboratory:

1. Wind speed measurement with an anemometer
2. Implementation of a wind potential study
3. Construction of a wind rose diagram
4. Power curve for horizontal and vertical axis wind turbines
5. Operation of a wind turbine with an electricity storage unit – autonomous systems
6. Techno-economic study of a wind farm

4. TEACHING METHODS - ASSESSMENT

MODE OF DELIVERY	In-Class Face-to-Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	• Use of ICTs in lecturing • Use of ICT in Laboratory Teaching • Use of ICTs for the communication with students via the e-class platform
TEACHING ORGANIZATION	

Method description/Activity	***Semester Workload***
Lectures	40
Laboratory Work	20
Bibliographical survey	10
Tutorial	10
Non-guided personal study	40
Total Contact Hours	**120**

ASSESSMENT METHODS	**Assessment Language: Greek** All announcements for the course regulations and complementary reading material are permanently posted in the course e-class. The course grade incorporates the following evaluation procedures: **Student Assessment methods** 1. Written final exam (80%) which includes: • Solving problems related to quantitative and qualitative data • Short answer questions • Multiple choice questions 2. Laboratory reports (20%)

5. RECOMMENDED BIBLIOGRAPHY

-Recommended Bibliography:

- J. Kaldellis, Wind Energy Management (2nd Edition), Stamoulis, 2005 (in Greek).
- M. Papadopoulos, Electricity Generation from Renewable Energy Sources, NTUA, 1997 (in Greek).
- J. Kaldellis and K. Kavadias, Computational Applications of Renewable Energy Sources: Wind Energy – Small Hydro, Stamoulis, 2005 (in Greek).
- G. Bergeles, Wind Turbines, Symeon, 2006 (in Greek).
- G. M. Masters, Renewable and efficient electric power systems (2nd Edition), Wiley,2013.
- J. Walker and N. Jenkins, Wind energy technology, 1997.
- T. Ackermann (Ed.), Wind Power in Power Systems, Wiley, 2012.
- J. F. Manwell, J. G. McGowan, and A. L. Rogers, Wind Energy Explained - Theory, Design and Application (2nd Edition), Wiley, 2009.
- T. Burton, N. Jenkins, D. Sharpe, and E. Bossanyi, Wind Energy Handbook (2nd Edition), Wiley, 2011.
- S. Heier, Grid Integration of Wind Energy: Onshore and Offshore Conversion Systems (3rd Edition), Wiley, 2014.
- E. Hau, Wind Turbines: Fundamentals, Technologies, Application, Economics (3rd Edition), Springer, 2013.

- Relevant scientific journals:

- Wind Energy
- Journal of Wind Engineering and Industrial Aerodynamics
- IEEE Transactions on Sustainable Energy
- Renewable Energy
- Renewable and Sustainable Energy Reviews
- IET Renewable Power Generation
- Energy Conversion and Management