



ΕΘΝΙΚΟ ΜΕΤΣΟΒΙΟ ΠΟΛΥΤΕΧΝΕΙΟ
ΤΜΗΜΑ ΜΗΧΑΝΟΛΟΓΩΝ ΜΗΧΑΝΙΚΩΝ
ΤΟΜΕΑΣ ΡΕΥΣΤΩΝ

Αρθούρος Ζερβός
Καθηγητής

NATIONAL TECHNICAL UNIVERSITY OF ATHENS
DEPARTMENT OF MECHANICAL ENGINEERING
FLUIDS SECTION

Arthouros Zervos
Professor

Examinations regulation of the Wind Specialization

Provided by NTUA in the framework of European Master in Renewable Energy (EUREC)

1. Scope of Application

This examinations regulation applies for the students who attend the Wind Specialization of the European Master in Renewable Energy (EUREC), hosted in the National Technical University of Athens.

2. Purpose of the Exams

The module examinations shall show that the student has acquired the technical knowledge to start professional work, the student is able to overview scientific coherences as well as to apply profound scientific methods and findings. The final examinations provide a professional qualification. The requirements for the examinations secure the standard of the training with regard to the standard period of the course, the standard of knowledge and the occupational requirements.

3. Duration, Scope, and Organisation of the Wind Specialization Semester

The total regular duration of the Wind Specialization Semester including the final examinations is 4 months from February to May. The last two weeks are dedicated for the examinations. The Wind specialization course comprises a total range of 30 credit points (CP).

Part time attendance is not permitted.

The curriculum is organised in such a way that students are able to successfully pass the examinations taken in the end of the semester.

The course programme is divided into four modules, as described in the "module handbook" document. In brief, the four modules, each one corresponding to 7.5 CP, are:

- Module 1. Wind potential, Aerodynamics & Loading of Wind Turbines
- Module 2. Wind Turbine Design, electrical & Control Issues, Certification
- Module 3. Wind Farm Technology, Economics & Environmental Issues
- Module 4. Mini Project

The exams are organized and accomplished by the master responsible in NTUA, in collaboration with all the academic staff involved.

4. Examiners

Examiners for these modules are academic staffs, invited professors and professionally experienced persons who are involved in the teaching of the relevant courses. In the module



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descriptions and in the schedule, the students are informed about the involved academic staff – examiners and in which exam they are included. In all the modules, different members of staff are teaching, and then examinations are carried out in cooperation.

5. Types of Module Examinations

For modules 1, 2 and 3, a written exam is held. The duration is 3 hours for each exam. Each exam is consisted of 6 questions and students should choose and answer 4 questions out of 6. Students are not to be allowed access to sources of information beyond any information given in the questions.

Under specific circumstances, an oral examination of a student could be approved by the master responsible in NTUA, after the recommendation of the Steering Committee.

For module 4 (mini project), a report should be submitted (up to 3500 words) and 15-20 minutes presentation plus 5-10 minutes of Questions & Answers is required. The presentations are organized after the end of the exams days at the end of the semester (end of May).

The four modules have equivalent weight.

6. Absence, Withdrawal, Deceit

An exam performance is assessed as “not passed” if the student without substantiated reasons: a) does not appear at an examination date, b) withdraws from the exam after the beginning of the exam, c) does not accomplish a repetition of an exam performance within the determinate period.

Asserted reasons for withdrawal or absence must be indicated in written form and justified to the master responsible; otherwise the concerning examination performance will be stated as “not passed”. In case of an illness, a medical certificate has to be presented. If the reasons are accepted, a new date will be appointed.

If a student tries to influence results of his examination performance by deceit or use of not admitted accessories, the concerning examination performance will be stated as “not passed”. A person committing an offense against examination regulations can be excluded from the continuation of the respective examination performance; in this case, the respective examination performance is stated as “not passed”.

7. Repetition of Module Examinations

Not passed module examinations can be repeated twice. If the module examination is not assessed as “passed” in the second repetition or is stated as “not passed”, the concerning module examination is assessed irrevocably as not passed. There are no more possibilities for repetition.

The semester is completed successfully if student pass successfully the examinations in the four modules.



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8. Module 4 (mini project)

The Module 4 (Mini project) should prove that the student is able to work independently on a problem of the chosen field after scientific methods within a given period. Subject and problem definition of the Master thesis should correspond to the examination purpose. The type of assignment and the problem definition have to be stated with the specification of the subject. The subject can be returned only once and only within the first two months of the processing time.

The definition of the subject of the mini project is students' responsibility. Thesis might be determined in collaboration with the master responsible in NTUA.

If the "Mini project" has been evaluated as "not passed" or stated as not "passed", after the submission of the final report and the oral presentation, it can be repeated once in a new appointed date.

9. Marks

Each Student's examination results shall be communicated as soon as available to the Coordinator (EUREC). NTUA officially communicates the marks that Students have earned during their Wind Specialisation to each Core Provider that their Students have attended in writing form.

The Core Providers will translate the marks communicated to them by the master responsible in NTUA into equivalent marks on the scale that each Core provider uses, and to use only these translated marks as the basis on which to assess and report their Students' performance.

10. Syllabus of the wind specialization – Contents of each exam

The content of wind specialization is described by the syllabus, presented in the following table briefly:

Syllabus
1. Introduction
- Status of wind technology - Status of European Wind Energy R&D
2. Advanced Wind Structure and Statistics
- Gusts and gust probability distributions - Effects of topography
3. Evaluation of Wind Energy Potential
- Wind modeling in flat and complex terrain - Wind energy siting approaches
4. Wind Turbine Aerodynamics
- Advanced methods - Aerodynamic stall - Unsteady aerodynamics - Vortex wake structure - Advanced wake models - Optimum design of wind turbine blades
5. Static and Dynamic Loading of Wind Turbines



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<ul style="list-style-type: none">- Aerodynamic and gravity loading- Inertial and structural loads- Aeroelastic modeling- Fatigue of wind turbine blades
6. Electrical Conversion Systems
<ul style="list-style-type: none">- Synchronous and induction generators- Direct drive generators- Constant and variable speed systems
7. Wind Turbines Control
<ul style="list-style-type: none">- Aerodynamic power control (stall, pitch, yaw)- Electromagnetic torque control- Control - dynamic analysis and stability- Control strategies
8. Design of Wind Turbines
<ul style="list-style-type: none">- Important factors- Design options- Design parameters- Design of components- System design- Megawatt scale design- Offshore design
9. Performance Testing and Modelling
<ul style="list-style-type: none">- Measurements under controlled conditions- Field testing instrumentation
10. Wind Farm Technology Issues
<ul style="list-style-type: none">- Wind exploitation in wind farms- Energy predictions and optimization- Balance of plant- Wind farm electrical design
11. Electrical Integration
<ul style="list-style-type: none">- Weak grids- Power quality- Network costs and benefits
12. Standards and Certification
<ul style="list-style-type: none">- WT certification- International standards
13. Economics of WT
<ul style="list-style-type: none">- Calculation methods- Current plant costs- Wind energy prices- The value of wind energy- External costs- Future price trends
14. Environmental Issues
<ul style="list-style-type: none">- Environmental benefits- Environmental effects- Amenity (land use, visual impact)- Technical analysis of noise and electromagnetic interference- Ecology (birds)- Consumption of energy and materials
15. Market Development and Status of Industry
<ul style="list-style-type: none">- Characteristics of the EU industry- Present status of wind power- Market description- Market predictions- Wind energy targets- Wind energy market incentives
Laboratory: A lab on testing of a Wind turbine model is offered (since 2012)



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The syllabus of the wind specialization is organized in three modules and one mini project:

- Module 1: Wind potential, Aerodynamics & Loading of Wind Turbines
- Module 2: Wind Turbine Design, electrical & Control Issues, Certification
- Module 3: Wind Farm Technology, Economics & Environmental Issues
- Module 4: Mini-Project

The evaluation of students' performance is carried out through three examinations - one for each module, and the submission of the mini-project (report and oral presentation). All the examinations and submission of the mini-project are held at the end of the semester.

Following the numbering in the syllabus, the contents of the three exams are defined hereafter (small changes might be decided and announced to the students by the master responsible in NTUA):

Exam1

- o 1 Introduction
- o 2 Advanced wind structure and Statistics
- o 3 Evaluation of Wind energy Potential
- o 4 Wind turbine Aerodynamics
- o 5 Static and dynamic Loading of Wind turbines

Exam 2

- o 6 Electrical Conversion Systems
- o 7 Wind turbines control
- o 8 Design of wind turbines
- o 9 Performance Testing and Modelling
- o 11 Electrical Integration
- o 12 Standards and Certification

Exam 3

- o 10 Wind Farm technology issues
- o 13 Economics of WT
- o 14 Environmental Issues
- o 15 Market development and status of industry

Professor Ilias Tatsiopoulos
Dean of School of Mechanical Engineering



Arthouros Zervos
Prof NTUA, Master Responsible