

Academic Year: (2019 / 2020)

Review date: 27-03-2019

Department assigned to the subject: Department of Electrical Engineering

Coordinating teacher:

Type: Electives ECTS Credits : 6.0

Year : Semester :

COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

- CB1. Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
- CB2. Students can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study
- CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues
- CB4. Students can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
- CB5. Students have developed those learning skills that are necessary for them to continue to undertake further study with a high degree of autonomy
- CG2. Learn new methods and technologies from basic scientific and technical knowledge, and being able to adapt to new situations.
- CG3. Solve problems with initiative, decision making, creativity, and communicate and transmit knowledge, skills and abilities, understanding the ethical, social and professional responsibility of the engineering activity. Capacity for leadership, innovation and entrepreneurial spirit.
- CG4. Solve mathematical, physical, chemical, biological and technological problems that may arise within the framework of the applications of quantum technologies, nanotechnology, biology, micro- and nano-electronics and photonics in various fields of engineering.
- CG5. Use the theoretical and practical knowledge acquired in the definition, approach and resolution of problems in the framework of the exercise of their profession.
- CG6. Develop new products and services based on the use and exploitation of new technologies related to physical engineering.
- CG7. Undertake further specialized studies, both in physics and in the various branches of engineering.
- CE6. Solve problems of applied thermodynamics, heat transmission and fluid mechanics in the field of engineering.
- CE20. Understand and address the general problems of the field of Energy, as well as the scientific and technological foundations of its generation, conversion, transport and storage.
- CT1. Work in multidisciplinary and international teams as well as organize and plan work making the right decisions based on available information, gathering and interpreting relevant data to make judgments and critical thinking within the area of study.
- RA1. To have acquired sufficient knowledge and proved a sufficiently deep comprehension of the basic principles, both theoretical and practical, and methodology of the more important fields in science and technology as to be able to work successfully in them;
- RA2. To be able, using arguments, strategies and procedures developed by themselves, to apply their knowledge and abilities to the successful solution of complex technological problems that require creating and innovative thinking;
- RA3. To be able to search for, collect and interpret relevant information and data to back up their conclusions including, whenever needed, the consideration of any social, scientific and ethical aspects relevant in their field of study;
- RA4. To be able to successfully manage themselves in the complex situations that might arise in their academic or professional fields of study and that might require the development of novel approaches or solutions;
- RA6. To be aware of their own shortcomings and formative needs in their field of specialty, and to be able to plan and organize their own training with a high degree of independence.

DESCRIPTION OF CONTENTS: PROGRAMME

1- Introduction

- History of the wind energy development
- Wind energy statistics
- Current manufacturers and WT models
- Wind power myths

2- Aerodynamics of Wind Turbines

- Wind Speed
- Impact of Friction and Height on Wind Speed
- Air Density
- WT Blades
- Angle of Attack
- Relative Wind Speed
- Pitch Angle
- Coefficient of Performance
- Tip-Speed Ratio
- Blade Power
- Separation of WTs

3- Wind Statistics

- Average Variance and Standard Deviation
- Cumulative Distribution Function
- Probability Density Function
- Weibull Distribution Function
- Rayleigh Distribution Function
- Dependency and Repeatability
- Cross-Correlation

4- Overview of Wind Turbines

- Classification of Wind Turbines
- Alignment of Rotating Axis
- Types of Generators
- Speed of Rotation
- Power Conversion
- Control Actions
- Types of Wind Turbines
- Type 1 Wind Turbine
- Type 2 Wind Turbine
- Type 3 Wind Turbine
- Type 4 Wind Turbine

5- Wind turbine components

- Aerodynamic
- Mechanical
- Generators
- Power electronics

6- Type 1 Wind Turbine System

- Equivalent Circuit for the Squirrel-Cage Induction Generator
- Power Flow
- Electric Torque
- Maximum Power

Maximum Torque

- Assessment of Type 1 System
- Control and Protection of Type 1 System
- Reactive Power of Type 1 System
- Inrush Current
- Turbine Stability

7- Type 2 Wind Turbine System

- Equivalent Circuit of Type 2 Generator
- Real Power
- Electric Torque
- Assessment of Type 2 System
- Control and Protection of Type 2 System
- Inrush Current
- Turbine Stability

8- Type 3 Wind Turbine System

- Equivalent Circuit
- Simplified Model
- Power Flow

- Apparent Power Flow through rotor side converter
 - Apparent Power Flow through stator side converter
 - Speed Control
 - Protection of Type 3 Systems
 - Electrical Protection
 - Electromechanical Protection
- 9- Type 4 Wind Turbine
- Full Converter
 - Power Flow
 - Real Power Control
 - Reactive Power Control
 - Protection
 - Chopper System
 - Dynamic Resistance
- 10- Grid Integration
- System stability
 - Low-Voltage Ride-Through Compliance Techniques
 - Variability of the Wind Power Production
 - Uncertainty of Wind Speed
 - Variability of Wind Power Output
 - Wind turbine reactive power control
- 11- Economics of Wind Energy

LEARNING ACTIVITIES AND METHODOLOGY

- AF1. THEORETICAL-PRACTICAL CLASSES. Knowledge and concepts students must acquire. Receive course notes and will have basic reference texts. Students partake in exercises to resolve practical problems
- AF2. TUTORING SESSIONS. Individualized attendance (individual tutoring) or in-group (group tutoring) for students with a teacher. Subjects with 6 credits have 4 hours of tutoring/ 100% on-site attendance.
- AF3. STUDENT INDIVIDUAL WORK OR GROUP WORK. Subjects with 6 credits have 98 hours/0% on-site.
- AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
- AF9. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. It entails 4 hours/100% on-site
- AF8. WORKSHOPS AND LABORATORY SESSIONS. Subjects with 3 credits have 4 hours with 100% on-site instruction. Subjects with 6 credits have 8 hours/100% on-site instruction.
- MD1. THEORY CLASS. Classroom presentations by the teacher with IT and audiovisual support in which the subject's main concepts are developed, while providing material and bibliography to complement student learning
- MD2. PRACTICAL CLASS. Resolution of practical cases and problem, posed by the teacher, and carried out individually or in a group
- MD3. TUTORING SESSIONS. Individualized attendance (individual tutoring sessions) or in-group (group tutoring sessions) for students with teacher as tutor. Subjects with 6 credits have 4 hours of tutoring/100% on-site.
- MD6. LABORATORY PRACTICAL SESSIONS. Applied/experimental learning/teaching in workshops and laboratories under the tutor's supervision.

ASSESSMENT SYSTEM

- SE1. FINAL EXAM. Global assessment of knowledge, skills and capacities acquired throughout the course. The percentage of the evaluation varies for each subject between 60% and 0%.
- SE2. CONTINUOUS EVALUATION. Assesses papers, projects, class presentations, debates, exercises, internships and workshops throughout the course. The percentage of the evaluation varies for each subject between 40% and 100% of the final grade.

% end-of-term-examination:	60
% of continuous assessment (assignments, laboratory, practicals...):	40