ANEXO I

Escuela Técnica Superior de Ingeniería

GENERAL SPECIFICATIONS

COURSE 22/23

Subject Data

Name:
Sistemas Eléctricos de Potencia

English name:
Electric Power Systems

Code:	**Type:**
606711215	Compulsory

Hours:			
	Total	**In class**	**Out class**
Time distribution	150	60	90

ECTS:				
Standard group	**Small groups**			
	Classroom	**Lab**	**Practices**	**Computer classroom**
	4.5			1.5

Departments:	**Knowledge areas:**
Electrical & Thermal Engineering, Design & Projects	Electrical Engineering

Year:	**Semester**
3rd	1st

TEACHING STAFF

Name:	**E-mail:**	**Telephone**
José Antonio Dueñas Díaz	jose.duenas@die.uhu.es	959217575

Others Data (Tutoring, schedule...)
Office: ETSI building, 3rd floor, door P341 Telephone: +34 959217575 Tutoring session: Monday-to-Wednesday from 9:00-to-11:00 (please, arrange the appointment in advance)

ANEXO I

SPECIFIC INFORMATION OF THE COURSE

1. Contents description:

1.1 In English:

This course familiarizes you with standards and policies of the electric utility industry, and provides you with basic vocabulary used in the business. It introduces the electric power systems, from generation of the electricity all the way to the wall plug. You will learn about the segments of the system, and common components like power cables and transformers. The course is a combination of online lectures, videos, readings and discussions. It has three main parts: Power System Fundamentals, Short Circuit Analysis and Protective Device Coordination. The simulation and calculations engineering part (PowerWorld software) will provide students with an in-depth review of fault analysis problems in industrial, commercial and institutional power systems and provide the means for solving such problems, and discusses the impact of short-circuit fault currents on equipment selection.

1.2 In Spanish:

Este curso te familiariza con los estándares y la legislación de la industria eléctrica, y te enseña el vocabulario profesional usado en los negocios. Te introduce en los sistemas eléctricos de potencia desde la parte generadora hasta la receptora. Aprenderás sobre las diferentes partes que componen el sistema como las líneas de transmisión y los transformadores. En esta asignatura se combinan las sesiones teóricas con videos, foros de discusión y de lectura. Tiene tres partes principales: los fundamentos de los sistemas eléctricos de potencia, el análisis de faltas o cortocircuitos y los elementos de protección. La parte de cálculo y simulación que se realiza (PowerWorld software) te da una visión profunda sobre el análisis de faltas a nivel industrial, comercial e institucional de los sistemas de potencia, viendo además el impacto que tienen las corrientes de cortocircuito en los mismos, y facilitando la resolución de problemas.

2. Background:

2.1 Situation within the Degree:

This subject deals with the behavior of power transformers, transmission-line parameters, steady-state operation of transmission lines, and power flows. These provide a basic understanding of power systems under balanced three-phase, steady-state normal operating conditions. Therefore, the engineering students are given an intuitive feel for the systems, which are, for the most part, complex. The subject is a fundamental part for the development of an electrical and energy engineer, especially now that there is a urge need for controlling the electrical power industry. Students will also benefit from the knowledge gained in this subject when approaching other subject such as Power Distribution and Electric Power Quality.

2.2 Recommendations

Students should have a theoretical knowledge of both DC & AC circuit analysis, as well as knowledge of three-phase electric power. Also knowledge of operations with complex numbers.

3. Objectives (as result of teaching):

The objective of this course is to present methods of power system analysis and design with the aid of a personal computer, in sufficient depth to give the student the basic theory at the undergraduate level. The approach is designed to develop students' thinking processes, enabling them to reach a sound understanding of a broad range of topics related to power system engineering, while stimulating their interest in the electrical power industry. Both theory and modelling are developed from simple beginnings so that their knowledge can be extended, allowing them to cope with new and complex situations.

4. Skills to be acquired

4.1 Specific Skills:

Knowledge of electric power systems

4.2 General, Basic or Transversal Skills:

- Problem solving ability.
- Ability to apply knowledge to solve real-world problems.
- Attitude of motivation and continuous improvements.
- Ability to analyse and summarize.
- Ability to think critically.
- Develop a critical attitude, being able to analyse and synthesize.
- Develop an attitude of inquiry that permanently enables to review and deepen in the knowledge.
- Acquire Computer and Information Skills (CI2) and apply them working.

5. Training Activities and Teaching Methods

5.1 Training Activities:

- Theory sessions.
- Problem solving sessions.
- Computer lab sessions.
- Other activities like: seminars, conferences, project supervision, tutorials and assessments.

5.2 Teaching Methods::

- Participative master class.
- Problem solving class with numerical exercises.
- Participative computer simulation class.
- Individual and small group tutorials.
- Written exams.

5.3 Development and Justification:

- Lectures by teacher where the teacher's primary role is to coach and facilitate student learning and overall comprehension of the material.
- Class discussion conducted by teacher where students play an active role in the learning process.
- Practical using computer-based simulator to help student see the details of how a problem is solved.
- Project-based learning in engineering where students are given a task to solve, involving mostly a background search of an interesting problem or a topic related to the subject.
- Tutorials where small groups of students discuss issues, essays or a topical problem. Also, individual or personal tutorials.

6. Detailed Contents

1. TRANSFORMER MODEL & THE PER-UNIT SYSTEM

1.1. Introduction
1.2. Power transformer
1.3. The Per-Unit system
1.4. Regulating transformer
1.5. Three-Winding transformer

2. TRANSMISSION LINE MODEL

2.1. Introduction
2.2. Line parameters
2.3. Line model
2.4. Lossless line
2.5. Line compensation
2.6. Line transient analysis

3. BALANCED FAUL

3.1. Introduction
3.2. Fault far from a generator
3.3. Fault at the terminal of a generator
3.4. Balanced three-phase fault
3.5. Bus impedance matrix
3.6. Protections

4. UNBALANCED FAULT

4.1. Introduction
4.2. Symmetrical components
4.3. Systematic fault analysis
4.4. Fault models
4.5. Systematic faults analysis using bus impedance matrix

5. LABORATORY (Computer simulations)

5.1. Line model and power flow
5.2. Power flow control
5.3. Voltage control of transformer
5.4. Electromagnetic transients
5.5. Line flows and losses
5.6. Balanced three-phase faults
5.7. Unbalanced faults

7. Bibliography

7.1 Basic Bibliography:

- Power System Analysis, S.H. Saadat, McGraw-Hill (2nd-3rd Editions).
- Power System: Analysis & Design, J.D. Glover, T.J. Overbye, M.S. Sarma, Cengage Learning (4th-6th Editions).

7.2 Additional Bibliography:

- Fundamentals of Electric Power Engineering, I.D. Mayergoyz & P. McAvoy, World Scientific.
- Power System Analysis, J.J. Grainger & W.D. Stevenson Jr, McGraw-Hill.

8. Systems and Assessment Criteria

8.1 System for Assessment:

• Written exams.
• Laboratory sessions.
• Voluntary assignment.

8.2 Assessment Criteria and Marks:

8.2.1 Examinations Convocatory I

• Written exams. There will be three of them, the first one will cover chapters 1 & 2, and the second exam chapters 3 & 4. Should any student fail to pass any of these exams there will be a last third exam to compensate for those specific chapters. Each of these exams will contain two parts, the first one consisting of short questions (short answers just a few words), and the second of numerical problems. The weights of these parts are 20% and 50% respectively. The pass mark for any of the written exams is 50%. This written exams part will be the 70% of the final mark.

• Laboratory sessions. Computer simulation of electrical power systems employing PowerWorld software. Students will be given a schematic of a power system to be modelled and analysed. The pass mark for the simulation part is 50%. This laboratory sessions part will be the 20% of the final mark.

• Voluntary assignment. Students may or may not undertake a small project where he or she will propose a course-related theme. Any media tool can be employed. This will be the 10% of the final mark.

FINAL MARK (100%) = WRITTEN EXAMS (70%) + LABORATORY SIMULATIONS (20%) + VOLUNTARY ASSIGMENT (10%)

8.2.2 Examinations Convocatory II

There will be two exams:

- Written exam. It will contain two parts, the first one consisting of short questions (short answers just a few words), and the second of numerical problems. The weights of these parts are 30% and 50% respectively. The pass mark for any of the written exams is 50%. This written exams part will be the 80% of the final mark.
- Laboratory exam. Computer simulation of electrical power systems employing PowerWorld software. Students will be given a schematic of a power system to be modelled and analysed. The pass mark for the simulation part is 50%. This laboratory sessions part will be the 20% of the final mark.

FINAL MARK (100%) = WRITTEN EXAMS (80%) + LABORATORY SIMULATIONS (20%)

Important Note: Students who passed any of the parts in "convocatory I" (i.e. written exam or laboratory) may ask to do just the failed part.

8.2.3 Examinations Convocatory III

There will be two exams:

- Written exam. It will contain two parts, the first one consisting of short questions (short answers just a few words), and the second of numerical problems. The weights of these parts are 30% and 50% respectively. The pass mark for any of the written exams is 50%. This written exams part will be the 80% of the final mark.
- Laboratory exam. Computer simulation of electrical power systems employing PowerWorld software. Students will be given a schematic of a power system to be modelled and analysed. The pass mark for the simulation part is 50%. This laboratory sessions part will be the 20% of the final mark.

FINAL MARK (100%) = WRITTEN EXAMS (80%) + LABORATORY SIMULATIONS (20%)

8.2.4 Extraordinary Convocatory

There will be two exams:

- Written exam. It will contain two parts, the first one consisting of short questions (short answers just a few words), and the second of numerical problems. The weights of these parts are 30% and 50% respectively. The pass mark for any of the written exams is 50%. This written exams part will be the 80% of the final mark.
- Laboratory exam. Computer simulation of electrical power systems employing PowerWorld software. Students will be given a schematic of a power system to be modelled and analysed. The pass mark for the simulation part is 50%. This laboratory sessions part will be the 20% of the final mark.

FINAL MARK (100%) = WRITTEN EXAMS (80%) + LABORATORY SIMULATIONS (20%)

8.3 Single Final Evaluation:

There will be two exams:

- Written exam. It will contain two parts, the first one consisting of short questions (short answers just a few words), and the second of numerical problems. The weights of these parts are 30% and 50% respectively. The pass mark for any of the written exams is 50%. This written exams part will be the 80% of the final mark.
- Laboratory exam. Computer simulation of electrical power systems employing PowerWorld software. Students will be given a schematic of a power system to be modelled and analysed. The pass mark for the simulation part is 50%. This laboratory sessions part will be the 20% of the final mark.

FINAL MARK (100%) = WRITTEN EXAMS (80%) + LABORATORY SIMULATIONS (20%)