***MORE master basic syllabus***

**Title:**
*Operation of transmission and distribution networks*

**Credit value:**
*3 ECTS*

**Mandatory/Optional:**
*Optional*

**Semester:**
*2*

**Lecturer/s:**
*Dr. Oihane Abarrategi, Dr. D. Marene Larruskain*

**University:**
*Universidad del País Vasco UPV/EHU*

**Department:**
*Department of Electrical Engineering*

**Rationale:**
*This course intends to analyze the operation and planning of transmission and distribution networks. This way, classical aspects regarding network operation, the different network states and their main features will be analyzed. New stakeholders, procedures and technologies will be studied. These aspects are currently being developed and will affect future network definition and operation. Special stress will be put on Smart Grids.*

**Objectives:**
*The main objective of the course is to provide students with the knowledge of the operation of distribution and transmission grids.*

**Skills:** *(according to the list of skills provided)*

| Subject skills | More Master Skills | | | | | | |
|---|---|---|---|---|---|---|---|
| | **L2.1** | **L2.2** | **L2.3** | **L2.4** | **L2.5** | **L2.6** | **L2.7** |
| L3.1. To explain and demonstrate knowledge and understanding of the network operation principles, identifying the most significant parameters and understanding the causes of large disturbances and incidents of Power Systems. | X | | | | | | |
| L3.2. To analyze, summarize and employ the theoretical concepts of lectures in order to solve numerical problems and practical questions, being able to understand both qualitatively and quantitatively the obtained results. | | X | | | X | | |
| L3.3. To acquire new skills, organize information and make effective reports | | | | | | X | X |
| L3.4. To use communication skills in various forms: group discussion and exhibition | | | | | | X | |

**Teaching and learning methods:**
*The course methodology includes various techniques as individualized and group learning methodology, combining both throughout the whole learning process. Lectures, essays, field visits and tutorials will be used:*
*1. Lecture format with oral and audiovisual presentations.*
*2. Together with the lectures, essays carried out in small groups related to some aspect developed in lectures will be developed.*
*3. Field visits will allow to verify the theoretical concepts analyzed in lectures.*
*4. Individual monitoring of the learning process is done through mentoring.*

**Allocation of student time:**

| | **Attendance (classroom, lab,…)** | **Non attendance (lecture preparation, self study…)** |
|---|---|---|
| Lectures | 16 hours | 16 hours |
| Field visits | 4 hours | 4 hours |
| Essays | 10 hours | 25 hours |

**Assessment:**

*Procedures for assessment of the course are:*
*1. Through assistance and active participation in class.*
*2. Through assistance and reports of field visits.*
*2. By conducting group work*
*3. By conducting a final exam.*

**Assessment Matrix:**

| **Subject skills** | **Assessment method** | | | | | |
|---|---|---|---|---|---|---|
| | **Exam** | **Presentation** | **Essays** | **Report** | **…** | **…** |
| L3.1. | 50% | | 25% | 25% | | |
| L3.2. | 50% | | 50% | | | |
| L3.3. | | | 75% | 25% | | |
| L3.4. | | 100% | | | | |

**Programme:**

| | |
|---|---|
| Lesson 1 | TRANSMISSION NETWORK OPERATION<br>Introduction, Power System, Energy Management System (EMS), Transmission system states and Ancillary services.<br>*Distribution (4 h theory)* |
| Lesson 2 | DISTRIBUTION NETWORK OPERATION<br>Network states, Demand characterization, Network infrastructures, Demand forecasting, Connection point determination, Management of demand supply connection applications, Development and planning criteria of distribution networks, Installations, Maintenance, Functioning criteria, Information, Emergency and Reliability indexes.<br>*Distribution (2 h theory)* |
| Lesson 3 | SMART GRIDS<br>Definition, Characteristics, Solutions, Virtual Power Plants (VPP), Demand Side Management, Electric Vehicle, Prosumers and DMS Tools.<br>*Distribution (2 h theory)* |
| Lesson 4 | LARGE DISTURBANCES<br>Introduction and Case studies.<br>*Distribution (3 h theory)* |
| Lesson 5 | FAULT CURRENT LIMITERS<br>Introduction, Fault Current Reduction and Classification.<br>*Distribution (1 h theory)* |
| Lesson 6 | HVDC GRID OPERATION<br>Introduction, Topologies, HVDC Technologies, VSC-HVDC system operation, Faults in VSC-HVDC systems and HVDC grids.<br>*Distribution (4 h theory)* |

**Resources:**

*Classrooms, Blackboard, laptop, projector, audio, computer room, laboratory, security issues,…*
*All the material necessary to follow the course is facilitated by teacher of the subject during the course development, through eGela platform (https://egela.ehu.eus/).*
*The resources used include: A suitable classroom for small group activities; blackboard; laptop with projector; photocopies; library; a computer room.*

**Bibliography:**


*Basic textbooks:*
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*Deepening bibliography:*
[8] C.R. Mason, "The art and science of protective relaying" GE publication, 1998.
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[20] I. Rouco "Analisis y operación de sistemas de energía eléctrica". capitulo 10: "Estabilidad de ángulo y tensiones", McGraw-Hill, 2002.
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[23] J. Amantegui "Utilities approach to protection and control refurbishment", CIGRE, 34-208, 2002.
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**Further comments:**