EEE.6.2 Introduction to Electrical Power Systems

COURSE OUTLINE

1 GENERAL

SCHOOL	Engineering		
DEPARTMENT	Electrical and Electronics Engineering		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	EEE.6.2	**SEMESTER**	6
COURSE TITLE	Introduction to Electrical Power Systems		

INDEPENDENT TEACHING ACTIVITIES	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	4	5
Total	4	

COURSE TYPE:	Special Background Course
PREREQUISITE COURSES:	No
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (official)
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	www.eee.uniwa.gr

2 LEARNING OUTCOMES

Learning outcomes

The objective of the course is to introduce the student to the field of power systems and particularly the study and mathematical analysis of steady-state operation of power systems in terms of the electrical power transmission from power generation stations to consumers. It aims to provide the student with the proper technical tools in order to understand the operation of a power system in the context of his/her training as an electrical engineer.
Upon successful completion of the course, the student will be able to understand the operation principles of power systems at transmission level and work in related positions.

General Competences

The course aims at developing the following abilities:

1. Search for, analysis and synthesis of data and information, with the use of the necessary technology
2. Adapting to new situations
3. Decision-making
4. Working independently
5. Team work
6. Criticism and self-criticism

3 COURSE CONTENT

- Introductory concepts of sinusoidal voltage circuits, voltage, current, resistance, inductance, capacitance, Kirchhoff's rules, Ohm's law, power, real power, reactive power, apparent power, power factor, inductance and capacitance in transient and steady state, inductive and capacitive impedance in steady state.

- Distribution systems, computer applications in power systems, power systems' equipment.
- Overhead power lines, inductance of overhead lines, capacitance of overhead lines.
- Short transmission lines, medium-length transmission lines, long transmission lines.
- Representation of overhead lines using distributed elements, electrical equivalent of overhead lines considering distributed elements in steady-state, development of mathematical formulas of voltage and current at each point of the line assuming the electrical equivalent of overhead lines in steady-state.
- Theoretical interpretation of the above mathematical formulas, wave interpretation of voltage and current, calculation and interpretation of the parameters of the above mathematical formulas (characteristic line impedance, transmission coefficient, damping coefficient, phase coefficient, line wavelength, transverse wave, transverse coefficient, rate, wave traveling time, etc.).
- Special transmission line cases (lossless transmission line, transmission line without distortion, transmission line operating under normal conditions), wave equations for transmission lines, standard transmission line terminations (open-circuited line, Ferranti effect, short-circuited line, line with terminal impedance equal to the characteristic impedance), calculations of transmission line input impedance and output impedance, "π" and "τ" equivalent circuits, applications.
- Conductors' mechanical mode calculations for overhead lines, sag-tension calculations, form of thread curve for equal height attachment and thread's equation, sag for inclined spans, hyperbolic form of conductor sag equation, calculations, applications.
- Introduction to per unit quantities, study of a transmission line using per unit quantities, the per unit (p.u.) system, applications (p.u. equivalent circuit for transmission lines, p.u. equivalent circuit for transformers, pi-equivalent circuit for transmission lines, pi-equivalent circuit for transformers, "τ" to "π" / "π" to "τ" conversion).
- Electric and magnetic circuit models for synchronous machines, synchronous machine inductance and mutual inductance, differences between salient pole and cylindrical pole synchronous machines, flux linkage equations, voltage equations, Park transformation, electric machines steady-state operation, equivalent circuit model, power equations, capability curve of synchronous generator.
- Transformer types, characteristics and equivalent circuits, single-phase and three-phase transformers, equivalent models, autotransformers, tap changers, transformers in parallel connection, special transformers in power systems.
- Power flow analysis, definitions, formulation of power flow equations, power flow solution.
- Numerical methods for power flow solution, Gauss-Seidel method, Newton-Raphson method, decoupled method, linear method, etc.
- Applications - development of a power flow algorithm.
- Optimization of power system operation.
- Frequency control of generators and power systems – self-regulation of electrical power systems.
- Voltage and reactive power control in generators and power systems.

• Steady-state operational problems of interconnected systems. Special cases, such as multiphase and DC systems.

4 TEACHING and LEARNING METHODS - EVALUATION

DELIVERY	In the classroom with the physical presence of students
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY	Use of I.C.T. for communication with students
TEACHING METHODS	(see table below)
STUDENT PERFORMANCE EVALUATION	Final written exam of theoretical part includes (100% of the total score): - Solving theoretical problems relating to the subject of the course - Description / evidence theory data - Interim written assessments during the semester - Individual technical reports - Group technical reports

Activity Semester workload	***Activity Semester workload***
Lectures	52
Study	52
Exercises	26
Tutorial / interactive teaching	13
Exams preparation	7
Course total	150

5 ATTACHED BIBLIOGRAPHY

1. «Παραγωγή, Μεταφορά, Διανομή Μέτρηση και Εξοικονόμηση Ηλεκτρικής Ενέργειας», Ξάνθος Β., εκδόσεις Ζήτη, 2006.
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