EEE.9-1.5 Economic design and operation of power electric systems

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING		
LEVEL OF STUDIES	UNDERGRADUATE		
COURSE CODE	**EEE.9-1.5**	**SEMESTER**	9
COURSE TITLE	Economic design and operation of power electric systems		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	4	6
Laboratory	0	
Total	4	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Special background course
PREREQUISITE COURSES:	Introduction to electric power systems, Power Generation Stations
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek (official)
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	www.eee.uniwa.gr

1. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

Upon successful completion of this course, students will possess highly specialized knowledge, some of which is at the forefront of knowledge in economic design and operation of electric power systems, and be enabled to:

1. Critically understand current trends in the field of economic design and operation of electric power systems, especially in the new frame of liberated electricity energy market, and its interrelation with Electrical and Electronics Engineering,
2. Understand, describe and applied specific technical data employed in economic design and operation of electric power systems, including load estimation and forecasting, reliability, economic dispatch, unit commitment, hydro-thermal co-operation, electric power and energy production based on probability functions, electricity energy markets, etc..
3. Collaborate with engineers / scientists' teams (such as economists) to comprehensively address a complex problem through analysis and synthesis, critically evaluate alternative solutions and make decisions,
4. Work in complex professional contexts that require collaboration with scientists from fields other than electrical power systems, e.g., power generation units, energy control center, regulatory

authorities, etc., and contribute to the professional knowledge and practice and the assessment of the team performance.

General Competences

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*……*
Production of new research ideas	*Others…*
	…….

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. Production of free, creative and inductive thinking
7. Criticism and self-criticism

2. SYLLABUS

1. Introduction to economic design and operation of electric power systems
2. Electric power load analysis – characteristic quantities (elements) – curves. Least squares method, analysis of electrical consumers, criteria of load satisfaction by electrical production systems
3. Load forecasting (regression models, stochastic models with weather variables, artificial intelligence etc.)
4. Reliability analysis. Basic principles of reliability for power generation systems and transmission systems.
5. Economic load dispatch of thermic energy plants, linear programming, Lagrange method, economic energy dispatch considering production-load equivalence, Newton-Raphson method, economic energy dispatch considering production-load equivalence and the functional limits of production plants, economic energy dispatch considering production-load equivalence, the functional limits of production plants and transmission losses, , generalized Kuhn-Tucker method
6. Hydro-thermic energy plant co-operation
7. Economic energy dispatch considering the transmission grid limits
8. Pump hydro-electric plants & renewable resources effects in economic dispatch
9. Unit commitment.
10. Maintenance programming of power plants & power system
11. Technic-economical design of power plants system
12. Power system development, loss power and loss energy calculation
13. Tariffs' policy
14. Electric energy exchanges, economic electric energy exchanges, energy exchanges and plant entry. Liberated electricity energy market
15. Effects of renewable energy resources & dispersed power plants in economic operation
16. Function and control of electrical energy systems, energy control centers, hardware and software of energy control

3. TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	• Lectures

USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• Teaching using ICT Communication and Electronic Submission (supplementary teaching data, exercises, etc.) • Use computer programs for load forecasting, reliability analysis, economic dispatch, etc. based on Matlab
TEACHING METHODS *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS*	Teaching uses lectures, exercises / projects and study. ***Activity*** — ***Semester workload*** Lectures — 52 Personal study for lectures — 89 Exercises /projects — 13 Personal study for exams — 26 Course total — **180**
STUDENT PERFORMANCE EVALUATION *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students.*	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. Weekly individual written exam - Individual technical reports - Grouping technical reports

4. ATTACHED BIBLIOGRAPHY

-Proposed bibliography

1. «Ηλεκτρική Οικονομία», Β.Κ. Παπαδιάς, Γ.Κ. Κονταξής, Εκδόσεις Ε.Μ.Π., 1996.
2. «Οικονομική Λειτουργία Συστημάτων Ηλεκτρικής Ενέργειας», Μπακιρτζής Αν., εκδόσεις Ζήτη, 2001, ISBN: 960-431-452-1, [*ΚΩΔ. EUDOXUS:* 11321].
3. «Οικονομική ανάλυση ηλεκτρικών συστημάτων», Ε. Λεκατσάς, εκδόσεις ΤΕΕ, 1996.
4. «Παραγωγή, Μεταφορά, Διανομή Μέτρηση και Εξοικονόμηση Ηλεκτρικής Ενέργειας», Ξάνθος Β., εκδόσεις Ζήτη, 2006.
5. «Εισαγωγή στα συστήματα ηλεκτρικής ενέργειας», Γ. Γιαννακόπουλος, Ν. Βοβός, εκδόσεις Ζήτη, 2008, ISBN: 978-960-456-105-6, [*ΚΩΔ. EUDOXUS:* 11248].
6. «Εισαγωγή στα συστήματα ηλεκτρικής ενέργειας», Τόμος 1, , Π. Ντοκόπουλος, εκδόσεις Παρατηρητής,1986.
7. «Εισαγωγή στα συστήματα ηλεκτρικής ενέργειας», Τόμος 2 , Π. Ντοκόπουλος, εκδόσεις Παρατηρητής,1986.
8. «Συστήματα ηλεκτρικής ενέργειας», Λ. Οικονόμου, Δ. Καρβουνιάρη, Α. Μαλάμου, 2η Έκδοση. Θεσσαλονίκη: Τζιόλας, 2014, ISBN: 978-960-418-423-1, [*ΚΩΔ. EUDOXUS:* 32997433].
9. «Συστήματα ηλεκτρικής ενέργειας», Π.Β. Μαλατέστας, 2013, Θεσσαλονίκη: Εκδόσεις Τζιόλας, ISBN: 978-960-418-590-0, [*ΚΩΔ. EUDOXUS:* 59388044].
10. «Electric power system applications of optimization», J. A Momoh, Marcel Dekker Inc., 2001.
11. «Electric power systems, analysis and control», F. Saccomanno, IEEE press-Wiley Interscience, 2003.
12. «Reliability evaluation of power systems», R. Billinton, R. N. Alan, Plenum Press, 1996.

13. «Power system economics - Designing Markets for Electricity», S. Stoft, IEEE press-Wiley Interscience, 2002.
14. «Spot Pricing of Electricity», F. C. Schweppe, M. C. Caramanis, R. E. Bohn, R. D. Tabors, Springer, 1988.
15. «Understanding electric utilities and de-regulation», L. Philipson, H.L Willis, Taylor and Francis, 2η έκδοση, 2006.
16. «Electric Energy Systems», Elgerd O., McGraw-Hill,2004.
17. «Electric energy systems : An Introduction», O.I. Elgerd, McGraw-Hill,1982.
18. «Power system control and stability» , P. Anderson , A. Fouad, IEEE,1995.
19. «Computer modelling of electrical power systems», J. Arrilaga et al, John Wiley,1983.
20. «Electrical power system design», M. Deshpande, McGraw-Hill,1984.
21. «Electrical power system quality», R.C. Dugan et al, McGraw-Hill,1996.
22. «Electrical power systems», M. El-Hawary, IEEE, 1983.
23. «Simulation and control of electrical power systems», J.B. Knowles, Research Studies Press, 1990.
24. «Power system operation», B. Miller, J. Malinowski, McGraw-Hill,1994.
25. «Direct energy conversion: Fundamentals of electric power production», R. Decher, Oxford Univ. Press, 1997.
26. «Electric energy systems», S.A. Nasar et al, Prentice Hall,1996.
27. «Power generation operation and control», A. Wood , B. Wolenberg , John Wiley,1996.
28. «Computer methods in power systems analysis», G.W. Stagg , A.H. El-Abiad, McGraw-Hill,1986.