COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING SCHOOL		
ACADEMIC UNIT	DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING		
LEVEL OF STUDIES	UNDER GRADUATE		
COURSE CODE	EEE.6.5	SEMESTER	4
COURSE TITLE	ELECTRICAL MEASUREMENTS		

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 Exercises	1	
Total	5	
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:	
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	NO
COURSE WEBSITE (URL)	http://moodle.teipir.gr/course/view.php?id=231 http://eemlab.teipir.gr

(2) 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*

The course aims at introducing students to measurement procedures, both theoretically and practically, in order to be able to estimate the real value of electrical and non-electrical quantities. Upon completion of the course, students will have acquired:

1. In-depth knowledge and understanding of the International System of units and the electrical quantities measuring standards, and ability to successfully convert magnitudes of measured quantities in different unit systems.
2. Understanding of the important role that correct and accurate measurements play in any human activity.
3. Understanding of the errors in any measurement and ability to perform error analysis, following international standards.
4. In-depth knowledge and understanding of the characteristics of measuring

instruments and ability to choose the most suitable instrument to perform the required measurement.

5. Ability to conduct measurements and use the applied standards to calculate error and uncertainty of measurements in order to present the value.
6. Ability to design / select measuring devices and determine the error associated with this, in order to measure the necessary electrical quantities, even when the instruments scales are not very small or large.
7. Ability to use oscilloscopes even without a manual.

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

The course aims at fostering the following capabilities:

1. Search for, analysis and synthesis of data and information, with the use of the necessary technology
2. Decision making
3. Independent work
4. Teamwork
5. Work in a multidisciplinary environment
6. Project planning and management
7. Respect for the natural environment
8. Production of free, creative and inductive thinking

(3) COURSE CONTENT

A. THEORY

The theory part of the course consists of the following modules:

1st Module: Measuring Units Systems: Historic data on measuring units. Units of Measuring Systems. The International System of Units (S.I.). Modern Measuring Units and Standards. International Bureau of Weights and Measures.

2nd Module: Error Analysis: Errors in Measurements. Classification, analysis, determination. Statistical processing in measurements. Statistical Distributions. Errors in direct and indirect measurements. Uncertainties type A and type B. International standard defining uncertainty GUM.

3rd Module: Instruments and measuring devices: Static and dynamic characteristics of instruments. Mathematical models of measuring devices. Analog and digital instruments. General concepts and descriptions. Analysis of the main types of analogue and electronic instruments.

4th Module: Basic measuring devices: Ideal and real capacitor. Ideal and real coil. Measurements using ammeter - voltmeter circuits. Voltage divider, resistive, capacitive and mixed. Instrument transformers, current and voltage measurements using transformers.

5th Module: Balancing Methods – Measuring Bridges: DC and AC Bridges. Wheatstone, Kelvin, Sauty - Wien, Schering, Wien - Robinson, Maxwell, Hay, Heaviside Bridges.

6th Module: Oscilloscopes: Basics of oscilloscope. Oscilloscope functions. Analog oscilloscopes. Digital Storage Oscilloscopes. Digital Phosphor oscilloscopes. Digital Oscilloscopes Mixed Signal - Joint Field. Digital Sampling Oscilloscopes. Sampling methods. Oscilloscope terminology. Operations - Functions - Settings of oscilloscopes. Measurement Techniques.

B. LABORATORY

The Laboratory part of the course consists of the following separate modules:

1nd Module: Resistance measurement with voltmeter and ammeter
2rd Module: Measurement of coil inductance and capacitor capacity
3RD Module: Potential - Earth resistance measurement
4th Module: MURRAY method
5th Module: Wheatstone Bridge
6th Module: Measuring transformers
7th Module: Oscilloscope operation

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Lectures, laboratories , distance learning methods
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	Teaching using ICT, Communication and Electronic Submission
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*	*Activity* / *Semester workload* Lectures: 52 Lectures study: 52 Exercises: 13 Laboratory exercises: 13 Group Technical Reports: 26 Personal Study: 24 **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.*	Evaluation Language : Greek **Theory** Final Written Exams: 100% **Laboratory** weekly individual written exam weekly group technical reports written final exam practical final examination The grade of the course is 70% x Theory + 30% x Laboratory grades

(5) ATTACHED BIBLIOGRAPHY

1. Psomopoulos C.S., (2013), Electrical Measurements, Tsotras Publ, Athens, in Greek.
2. Mathioulakis M.E., (2004), Measurement, Measurement Quality and Uncertainty, Hellenic Labs Association, Athens, in Greek
3. Fridman A.E., (2012), The Quality of Measurements: A Metrological Reference, Springer Science+Business Media, New York
4. Fornasini P., (2008), The Uncertainty in Physical Measurements: An Introduction to Data Analysis in the Physics Laboratory, Springer Science+Business Media, New York
5. Gertsbakh I., (2003), Measurement Theory for Engineers, Springer-Verlag Berlin Heidelberg GmbH, New York
6. Rabinovich S.G., (2013), Evaluating Measurement Accuracy: A Practical Approach, Springer Science+Business Media, New York
7. Gasteratos A., Mouroutsos S.G., Andreadis I., (2013), Measuring Technology – Sensors, Tsotras Publ, Athens, in Greek
8. Theodorou N., (2004), Electrical Measurements, Part I: Classical Measurements, Symmetry Publ., Athens, in Greek.
9. ABB, (2011), Made to measure. Practical guide to electrical measurements in low voltage switchboards, ABB, Sweden
10. ISO, (1995), Guide to the Expression of Uncertainty in Measurement. 2nd ed., Geneva
11. Internet References (updated in a year basis)
12. Laboratory and lecture notes