Name of the subject: **Measurements I.**	***NEPTUN-code:*** KMXMT1EBNF	***Contact hours/week:*** 1 lectures + 0 practice + 2 lab. practice
Credits: 4 ***Requrement:*** examination	***Prerequisite:*** Electricity I KHXVT1EBNF	
Lecturer: Zsolt Markella	***Beosztás:*** associate professor	***Kar és intézet neve:*** Kandó Kálmán Faculty of Electricity Department of Instrumentation and Automation

Subject		
Aim of the course: To attain the measuring principles, necessary for measuring basic electrical quantities. Knowledge of construction and handling of most important electrical measuring instruments, interpretation of their technical specification. Knowledge, necessary to select optimal measuring methods and instruments.		
Lecture thematics:	**Week**	**Cont. hours**
Basic concepts of measurements. Definition and aims of measurements. Classification of signals. Units of quantities. The SI system of technical units.	**1.**	**1**
Etalons of electical quantities. Classification of measuring methods. For of the result measurement. Sources of errors in measurements. Description of errors.	**2.**	**1**
Series of measurements, evaluation of the results. Hystogram and probability dension function. Distribution functions.	**3.**	**1**
Best estimation of the result of the measurement. Accumulation of the errors during mathematical operations. Displaying the measured results. Regression. Correlation.	**4.**	**1**
Measuring direct voltages. Classification of the instruments. Electromechanical instruments. Construction and operation of the hard-magnet instruments. Equation of the instrument, parameters, sources of errors. Application for measuring DC voltage and for DC current. Compensation method for measuring DC voltage.	**5.**	**1**
Oscilloscopes: classification, basic operation modes of analog oscilloscopes. Units of oscillloscopes: the mainframe, the vertical deflection system, operation modes, parameters.	**6.**	**1**
The horizontal deflection system, operation modes, parameters. Triggering modes. Application of oscilloscopes for measuring amplitude, frequency, time, phase-shift etc.	**7.**	**1**
Sampling modes in oscilloscopes. Digital Storage Oscilloscope: operation, blind time problem and solution modes.	**8.**	**1**
Classification of electronic voltmeters, block-diagrams, operation, application fields. Digital methods to measure direct current and voltage, their specifications. Methods for analog-digital conversion, their parameters.	**9.**	**1**
Measuring alternating voltage. Useful parameters of alternating voltage and current. Operating principle and specification of electromechanical measuring instruments for alternating voltage.	**10.**	**1**
Classification and parameters of analog electronic instruments for measuring alternating voltage. AC/DC converters and their specification. Digital instruments for measuring alternating voltage, the most important specification.	**11**	**1**
Measuring distortion of sinewave signals, block-diagram and application of distortion meters. Classification of generators, basic block-diagrams. Operation and specification of function generators.	**12**	**1**
Measuring current by converters. Measuring resistance.	**13**	**1**
Application of DC bridges for measuring electrical resistance. Digital method for measuring resistance. the four-wire method. Analog and digital multimeters, block-diagrams.	**14**	**1**

Lab. practice thematics:	**Week**	**Cont. hours**
Basics of the measurements	**1.**	2
Measuring current and voltage I.	**2.**	2
Measuring current and voltage II.	**3.**	2
Measuring current and voltage III.	**4.**	2
Oscilloscope and generator usage I.	**5.**	2

Oscilloscope and generator usage II.	**6.**	2
Oscilloscope and generator usage III.	**7.**	2
Measuring AC voltage and current I.	**8.**	2
Measuring AC voltage and current II.	**9.**	2
Measuring AC voltage and current III.	**10.**	2
Examination of test setup	**11.**	2
Evaluation of Measurements Results (series of measurements, characteristics)	**12.**	2
Replacement 1.	**13.**	2
Independent measurement	**14.**	2

Visit of the lectures and the laboratory practice is obligatory.

Conditions of entering to the exam:

Laboratory practice part
Students should write a test every weeks.
There are two type of test:

- „starter test": 2 questions from new measurements starter question lists
- „test for mark": 5 questions from the previously measured themas

At the end of the semester students should make an independent measurement.

The laboratory practice result is the mathematical average of independent measuremt mark and the „test for mark" marks.

You should retake every falid tests during the semester

Lectures part
During the semester we will write 3 tests.
The test work contains 7 questions. The student get 1 points for every correct answers.
Every test must reache at least 3,5 points.

At the end of the semester students should write an retake test from the whole semester.
This test contains 21 questions.
A test work is successful if it reaches at least 10,5 points

Signature replacement
In an examination period students should write an retake test from the faild tests. The maximum number of the retaken tests are 3.

Examination
The way of the exam is oral.
Calculation method for the mark: avarage of the laboratory practice result and the exam result.

Literature:

Compulsory:
Dr. Horváth Elek: Méréstechnika jegyzet (ÓE-KVK-1161)
Lecture slides https://elearning.uni-obuda.hu/
Zsolt Markella: Measurement Laboratory 1/A https://elearning.uni-obuda.hu/
Zsolt Markella: Measurement Laboratory 1/B https://elearning.uni-obuda.hu/
Zsolt Markella: Measurement Laboratory 1/C https://elearning.uni-obuda.hu/

Optional:
Kiss Ernő: Elektronikus műszerek
Schnell: Jelek és rendszerek méréstechnikája
Helfrick-Cooper: Modern Electronic Instrumentation and Measurement Techniques
Chin: Elektronic Instruments and Measurements