Name of the subject: **Measurements**		***NEPTUN-code:*** KMAMT1AMND	***Contact hours/week:*** 2 lectures + 0 practice + 1 lab. practice
Credits: 2 ***Requrement:*** examination	***Prerequisite:*** Electricity I practice. K**VT12*ND		
Lecturer: Zsolt Markella	***Beosztás:*** associate professor	***Kar és intézet neve:*** Kandó Kálmán Faculty of Electricity Institute 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.	
Thematics:	**Cont. hours**
Basic concepts of measurements. Definition and aims of measurements. Classification of signals. Units of quantities. The SI system of technical units. Etalons of electical quantities. Classification of measuring methods. For of the result measurement. Sources of errors in measurements. Description of errors.	**3**
Series of measurements, evaluation of the results. Hystogram and probability dension function. Distribution functions. Best estimation of the result of the measurement. Accumulation of the errors during mathematical operations. Displaying the measured results. Regression. Correlation.	**3**
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.	**2**
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.	**2**
Measuring alternating voltage. Useful parameters of alternating voltage and current. Operating principle and specification of electromechanical measuring instruments for alternating voltage. Classification and parameters of analog electronic instruments for measuring alternating voltage. AC/DC converters and their specification	**2**
Oscilloscopes: classification, basic operation modes of analog oscilloscopes.	**3**
Units of oscilloscopes: the mainframe, the vertical deflection system, operation modes, parameters. The horizontal deflection system, operation modes, parameters. Triggering modes. Application of oscilloscopes for measuring amplitude, frequency, time, phase-shift etc.	**3**
Classification of generators, basic block-diagrams. Operation and specification of function generators.	**2**
Measuring current by converters. Measuring resistance.	**2**
Application of DC bridges for measuring electrical resistance. Digital method for measuring resistance. the four-wire method. Analog and digital multimeters, block-diagrams.	**2**
Digital methods of frequency, period and time measurement. Power measurement methods. Basics of impedance measurement. Applications of electrical measuring non-electrical quantities.	**4**
lab. practice	
Basics of the measurements	**2**
Measuring current and voltage	**6**
Oscilloscope and generator usage	**6**

Visit of the lectures is obligatory.
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 accidental test from the whole semester. This test contains 21 questions.
A test work is successful if it reaches at least 10,5 points

The lecture part mark:
points 0 – 10,49: 1
points 10,5 – 12,49: 2
points 12,5 – 14,49: 3
points 14,5 – 16,99: 4
points 16,99 – 21: 5

Visit of the laboratory practice is obligatory.

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 themes

The laboratory part mark is the mathematical average of the „test for mark" marks.

The complete semester mark = (The laboratory part mark + The lecture part mark * 2) / 3

Literature:	
Compulsory:	
Dr. Horváth Elek:	Méréstechnika jegyzet (ÓE-KVK-1161)
Optional:	
Kiss Ernő:	Elektronikus műszerek
Schnell:	Jelek és rendszerek méréstechnikája
Helfrick-Cooper:	Modern Electronic Instrumentation and Measurement Techniques
Chin:	Elektronic Instruments and Measurements