

## Course Specification Document

<b>Title</b>	Measurements and Electronic Instrumentation
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<b>Credits</b>	3.5 ECTS
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<b>Aims</b>	This course aims to provide the student with knowledge related to the analysis and description of electronic measurement systems, enabling him to optimally choose measurement devices and methods and to process measurement results.
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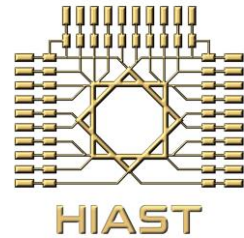
### Intended learning outcomes

On successful completion of this course, the student will be able to:

- Identify and understand measurement errors.
- Know the methods of processing experimental results.
- Identify noise and understand its impact on measurement and ways to treat it.
- Identify basic measuring devices.
- Analyze and characterize measurement systems.
- Determine the appropriate measurement range and error limits.
- Test basic circuits and measurement methods.

### Syllabus

- **Measurement Errors/Uncertainty:** Measurement, classification of measurement errors, the propagation of systematic errors in indirect measurements, the useful numbers in measurement results, limits of error, law of distribution of random errors, distribution law  $\bar{X}_i, S_{\bar{X}_i}$ , estimation of the standard deviation of random error, Henry's law, analysing measurement results, correcting systematic errors, total error, measurement terminology:
- **Processing experimental results:** Final form of results, graphical representation of measurement results, weighting of measurement results, application in the case of a straight line, application in the case of a polynomial, Applying least squares to a set of nonlinear equations, weighted least squares.
- **Noise phenomena that lead to disturbances in measurements and limit measurement accuracy:** Methods of noise correlation, methods of eliminating interference, capacitive correlation and the effect of shielding on it, magnetic correlation, the effect of shielding on magnetic correlation, magnetic correlation between the shield and the central bus, the shielding necessary to eliminate magnetic correlation, application on an impedance comparator bridge, disturbances resulting from electrostatic bonding, the effect of stray capacitances in the presence of common mode voltage, damping the effect of common mode voltage, disturbances resulting from leakage resistors, disturbances resulting from bonding by common impedance, disturbances



resulting from measuring devices, ground loops of loop analysis, low frequency common mode isolation, high frequency common mode isolation loop analysis.

- **Measurement Bridges and their applications:** Wheatstone bridge, Kelvin bridge, the effect of conductor resistances, double Kelvin bridge, applications, shielded Wheatstone bridge, shielding circuits, Wheatstone bridge unbalanced voltage nonlinearity, bridge circuits linearization, elimination of disturbances resulting from connecting wires, general form of an alternating current bridge, comparison bridges (Maxwell bridge, Hay bridge, Wien bridge, Schering Bridge, Wagner arm), radio frequency bridge for impedance measurement, general form of a vector impedance meter.
- **Analog direct and alternating current measuring devices:** D'Arsenval kinematics or moving coil kinematics, direct current meters, constant voltage meters, series ohmmeter, parallel ohmmeter, meters based on the rectifier method, basic circuit analysis of meters with a full wave rectifier, the effect of form factor on meter reading, meters that rely on thermocouples, the basic circuit of the meter, a thermal transducer, power meters that rely on a thermal transducer, electrodynamic meters, voltage meters, current meters, ratio meters, power meters, power factor meters, frequency meters.
- **Electronic measuring devices:** Electronic voltmeters, direct-connection DC voltmeters, DC voltmeters with a Chopper amplifier, AC voltmeters with a rectifier, digital voltmeters, general characteristics, Ramp type DMM, Integrated Type DMM, Successive Type DMM.