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| The title of the course | Manufacturing Metrology |
| Faculty | [Faculty of Mechanical Engineering and Computer Science](http://eng.ath.bielsko.pl/index.php/faculties/gerg) |
| The level of studies | Engineer (BSc) |
| Semester | Winter/summer |
| The form of classes and number of hours | Lecture  15 h |
| Language of instruction | English |
| The number of ECTS | 1 |
| Teacher | Dr hab. inż. Wojciech Płowucha, prof. UBB |
| The aims of the course  (maximum 500 characters) | The students get acquainted with the role of metrology in quality management systems, basics of the design of standard gauges measuring instruments, in particular the issues of traceability, calibration of measuring equipment. Signaling the issue of measurement errors and measurement uncertainty. Students are introduced to the measuring techniques used in the engineering industry, including coordinate measuring technique and measurements of surface roughness. |
| The content of the course: main topics and key ideas | 1. Geometrical Product Specifications. Tolerances and fits.  2. Geometric tolerances according to ISO 1101. Tolerances of form (straightness, flatness, roundness, cylindricity). 3. Datums. Tolerances of orientation, location, and run-out. 4. Standard gauges and measuring instruments. Definition of meter. End gauges. Incremental measuring systems. Interferometers. 5. Calipers. Micrometers. Dial gauges. Angle measuring devices.. 6. Measuring Machines: lengthmeters and hightmeters, measuring microscopes and projectors. Equipment for the measurement of roundness and cylindricity. 7. Coordinate measurement technique. Design types of coordinate measuring machines. 8. Coordinate Measurement Planning. Styli. The machine coordinate system and the workpiece coordinate system. Workpiece fixing systems. Measuring strategy. Sampling strategy. 9. Evaluation of the measurement results. Calibration of coordinate measuring machines. 10. Indirect measurements. Measurements of angles. Measurements of cones. Measurements of curves and radii. 11. The surface roughness. The waviness profile, roughness profile. Surface roughness parameters. Material ration curve. Profilemeters. Surface roughness standards. Filters. 12. Tolerancing and measurements of threads. Metric parameters. Measurement of the thread with microscopes. Three wires method of thread measurements. Compensation and correction of systematic errors.  13. Tolerancing and measurements of gears. Parameters of cylindrical gears. Tolerance system of gears. Pitch deviations measurements. The definition and measurement of tooth line and profile deviations. Measurement of tooth thickness deviation. 14. Measurement errors and measurement uncertainty. Sources of errors. Errors of elastic deformation. Temperature error. Classification of measurement errors. Eliminating sources of errors. Correction of errors. Calculation and expression of measurement uncertainty. 15. Calibration and monitoring of measuring instruments. Traceability. Calibration of calipers, micrometers, dialgauges, gauge blocks. Error of indication. Surface flatness and parallelism measurements. Measuring force. Repeatability. Software support. |
| Didactics methods | Lecture |
| Course requirements | Exam/presentation/attendance/seminar paper |
| Literature (basic and supplementary) | 1. Humienny Z. (red.): Geometrical Product Specification (GPS). Wydawnictwa Naukowo-Techniczne. Warszawa 2002  2. GUM: Guide to the Expression of Uncertainty in Measurement (JCGM 100:2008, GUM 1995 with minor corrections)  3. VIM3: International Vocabulary of Metrology (JCGM 200:2012, VIM 3rd edition, 2008, with minor corrections)  4. interactive resources: elearning.ath.bielsko.pl |
| The effects of the education   * knowledge * skills * social competences | - student has knowledge necessary to use the measuring apparatus, metrology workshops and methods for estimating measurement errors  - student is able to obtain information from literature, databases, and other sources  - student is aware of and understands the importance of non-technical (economic) aspects and effects of metrological activity and the associated responsibility for decisions |