MFG 511 - Manufacturing Metrology
Spring 2021 - 2022

Lectures: Monday 08:40-11:30  School of Management G062,  Feb 28, 2022 - Jun 10, 2022
*It may be changed to Fridays depending on the availability of students and class - to be decided later.*

Zoom Link  https://sabanciuniv.zoom.us/j/97261038372

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**Reference Books and Other Documents:**
- Metrology for Engineers, John Frederick Wise Galyer, Charles Reginald Shotbolt
- METROLOGY - IN SHORT  
- International Vocabulary of Metrology – Basic and General Concepts and Associated Terms (VIM 3rd edition)  
  https://www.bipm.org/en/committees/jc/jcgm/publications
- 9th edition of the SI Brochure  
- GUM: Guide to the Expression of Uncertainty in Measurement  
  https://www.bipm.org/en/committees/jc/jcgm/publications

Further documents will be provided by the instructor during the course.

**Final Grades:**  
Homework Assignments: %20  
Midterm Exam: %25  
Term exercise report : % 25  
Final Exam: %30

**Syllabus:** The following topics will be covered during this semester. It will be to your advantage to read the material before coming to the lecture.
- Metrology: Science of measurement and SI units, World metrology system, Metrology Organizations, National Metrology Institutes (NMIs), Legal issues and regulations.
- Quality system standards (ISO9000s, ISO 17025, AQAP) and Conformity Assessment.
- Conformity Assessment Bodies (CABs), Notified Bodies (NA) in Europe and Product Certification.
- Metrology research programmes: European Metrology Programme for Innovation and Research (EMPIR) under Horizon 2020
• Terms and definitions in metrology: Traceability, uncertainty, accuracy, calibration, repeatability, reproducibility etc.). Calibration and Verification (Conformity assessment issues).
• Dimensional Metrology (Length and Angle), Manufacturing/Production Metrology, Engineering metrology.
• SI unit "metre" and realization. Traceability in dimensional measurements.
• Introduction to precision engineering and error sources: Abbe and Cosine errors, temperature effects, drifts etc.
• Error separation methods, self calibration examples, error compensations.
• Introduction to Uncertainty calculations.
• Basic standards and instruments in dimension measurements: Gauge blocks, ring-plug gauges, step gauges, stage micrometers etc. Calipers, micrometers, dial gauges, height gauges. Standards and guides for calibration.
• 1, 2 and 3 Dimensions measurements: Laser interferometers, length, diameter and Coordinate Measurement Machines (CMMs).
• Form and Surface roughness measurements.
• Machine tool metrology, in-process measurements.
• Optical tooling and large volume metrology: Applications in Aerospace and defense industries.
• Metrology for nanotechnology: Introduction to Nanometrology. Traceable Calibration of e.g. piezo actuators and nanosensor for nanometrology

**Term exercise report:**
Laboratory exercises will be carried out with selected examples such as
- calibration of CNC machine tools / CMMs using laser interferometers,
- or
- Calibration of rotary tables using optical components and non-contact measurement equipment.
- Students will prepare a report for the exercise. The date will be selected during course.

Note: Due to pandemic conditions, the format for the laboratory exercise will be decided during the course.