

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>

Instructor : Tanfer Yandayan e-mail : tanfer.yandayan@tubitak.gov.tr voice : (0262) 679 5000 (ext. 5312) office: will be informed later.	TA's : N/A
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Text Book: Fundamentals of Dimensional Metrology Paperback– November 21, 2006 by Connie L Dotson (Author).

Reference Books and Other Documents:

- Metrology for Engineers, John Frederick Wise Galyer, Charles Reginald Shotbolt
- METROLOGY - IN SHORT
<https://www.euramet.org/publications-media-centre/documents/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
<http://www.bipm.org/en/publications/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 Infrastructure (QI): Metrology, Standardization, Testing and Accreditation.
- 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.

- Angle metrology: Angle encoders, autocollimators, small angle generators and angle standards (Rotary and indexing tables, angle gauge blocks, laser angle interferometers). Performance of encoders in automation and robots . New generation angle encoders. Nanoradian angle metrology and high level demands.

- 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.