UNIVERSITETI /UNIVERSITY
"ISA BOLETINI"
MITROVICË

Course Curriculum Model (Syllabus)		
Faculty:	**FACULTY OF MECHANICAL AND COMPUTER ENGINEERING**	
Department:	**Mechanical Engineering**	
Level:	Bachelor	
Code of the course:	302 ME	
Course:	**ENGINEERING METROLOGY AND MEASUREMENTS**	
Course Status:	**Mandatory**	Mandatory/Elective
Semester:	(V)	**Winter**/Summer
Number of hours per week:	2+2	
ECTS:	5	
Time / location:	Wednesday, 9^{00}-10^{30}, K5	
Year of studies:	2024/2025	
Lecturer:	Prof. Ass. Dr. Fitim Zeqiri	
Assistant:		
Contact details:	Professor	Assistant
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Telephone:		

Course description	This course provides a detailed exploration of metrology and measurement systems, covering fundamental concepts, methods of measurement, and various instruments used in the field. Participants will gain insights into the principles of accuracy, precision, calibration, and error analysis. The course also includes advanced topics such as laser interferometers, coordinate measuring machines, and measurement of force, torque, pressure, strain, and temperature.
Purpose (Goals)	The course aims to prepare participants for roles that involve precision measurement, quality control, and adherence to international standards. By combining theoretical knowledge with hands-on experience and exposure to advanced technologies, participants will be well-equipped to contribute effectively in industries where accurate measurements are critical.

Learning outcomes	Upon completion of the course on **ENGINEERING METROLOGY AND MEASUREMENTS**, students should be able to: ● Understand metrology, its advancements & measuring instruments, • Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements, Screw thread and gear measurement & comparators. • Equip with knowledge of limits, fits, tolerances and gauging. • Acquire knowledge of measurement systems and methods with emphasis on different transducers, intermediate modifying and terminating devices. • Understand the measurement of Force, Torque, Pressure, Temperature and Strain.

	Weeks	Lecture
Program	***First week:***	Introduction to Metrology: Definition, objectives and concept of metrology, Need of inspection, Principles, process, methods of measurement, Classification and selection of measuring instruments and systems. Accuracy, precision and errors in measurement.
	Second week:	System of measurement, Material Standard, Wavelength Standards, Subdivision of standards, Line and End standards, Classification of standards and Traceability, calibration of End bars(Numerical problems), standardization.
	***Third week*:**	Linear Measurement and angular measurements: Slip gauges- Indian standards on slip gauge, method of selection of slip gauge, stack of slip gauge, adjustable slip gauge, wringing of slip gauge, care of slip gauge, slip gauge accessories, problems on building of slip gauge.
	Fourth week:	Measurement of angles- sine bar, sine center, angle gauges, optical instruments for angular measurements, Auto collimator applications for measuring straightness and squareness.
	Fifth week:	System of Limits, Fits, Tolerance and Gauging: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, limits of size, Indian standards, concept of limits of size and tolerances, definition of fits, hole basis system, shaft basis system, types of fits and their designation, geometric tolerance, position-tolerances. Classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowanceon gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials.
	***Sixth week*:**	Comparators: Functional requirements, classification, mechanical- Johnson Mikrokator, sigma comparators, dial indicator, electrical- principles, LVDT, Pneumatic- back pressure gauges, solex comparatorsand optical comparators- Zeiss ultra-optimeter.
	Seventh week:	Measurement of screw thread and gear: Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3- wire methods, best size wire. Screw thread gauges, Tool maker's microscope.
	Eighth week:	Gear tooth terminology, tooth thickness measurement using constant chord method, addendum comparator method and base tangent method, measurement of pitch, concentricity, run out, and involute profile. Gear roll tester for composite error.

	Ninth week:	Advances in metrology: Basic concepts of lasers, advantages of lasers, laser interferometers, types, applications. Basic concepts of Coordinate MeasuringMachines-constructional features, applications.
	Tenth week:	Measurement systems and basic concepts of measurement methods: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-time delay. Errors in measurement, classification of errors. Transducers, transfer efficiency, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers.
	Eleventh week:	Intermediate modifying and terminating devices: Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers. Terminating devices, Cathode ray oscilloscope, Oscillographs.
	Twelfth week:	Force, Torque and Pressure Measurement: Direct methods and indirect method, force measuring inst. Torque measuring inst., Types ofdynamometers, Absorption dynamometer, Prony brake and rope brake dynamometer, and power measuring instruments.
	Thirteenth week:	Pressure measurement, principle, use of elastic members, Bridgeman gauge, McLeod gauge, Pirani gauge.
	Fourteenth week:	Measurement of strain and temperature: Theory of strain gauges, types, electrical resistance strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement.
	Fifteenth week :	Temperature Compensation, Wheatstone bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors. Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, optical pyrometer.

Literature	
Literature	**Mechanical Measurements**, Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006. **Instrumentation, Measurement and Analysis**, B C Nakra, K K Chaudhry, 4th Edition,cGraw –Hill **Engineering Metrology**, R.K. Jain, Khanna Publishers, Delhi, 2009. 1. **Engineering Metrology and Measurements**, Bentley, Pearson Education. 2. **Theory and Design for Mechanical Measurements**,III edition, Richard S Figliola, Donald E Beasley, WILEY India Publishers. 3. **Engineering Metrology**, Gupta I.C., Dhanpat Rai Publications. 4. Engineering Metrology and Measurements, N.V.Raghavendra and L.Krishnamurthy, Oxford University Press.

Teaching methodology	The teaching methodology for the CAD/CAM course may involve a combination of the following			
	Contribution to student workload (which should correspond to student learning outcomes - 1 ECTS credit = 25 hours)			
	Activity	**Hours**	**Days/weeks**	**Total**
	Lectures	2	15	30
	Exercise sessions (with TA)	2	15	30
	Practical work	3	3	9

	Office hours	1	15	15
	Fieldwork	1	2	2
	Midterms, seminars	2	2	4
	Homework	3	2	6
	Self-study	4	3	12
	Final exam preparation	3	3	9
	Time spent in exams	2	2	4
	Projects, presentations, etc.	2	2	4
Total				**125**

Evaluation	Lectures, exercises, individual work, experimental work, seminar papers, colloquia, essays, field work, group work, etc. Completed according to the specifics of your subjects!	
	Tests / Colloquia (First Test) (Second test)	15% 15%
	Practical test during exercises (Essay)	
	Interpretation and presentation of artistic creativity and other works.	
	Assignments and courses during the semester	15%
	Professional practice	
	Other,(Specify) Participation	10%
	Final exam	45%
	Total	100%
	Final grade	Points (%) Mark
		91 – 100 10
		81 - 90 9
		71 - 80 8
		61 - 70 7
		51 - 60 6

Criteria for regular attendance and rules of etiquette during the organization of the lesson are set.Computer work: Graphic works, I have to draw and write with a computer. In the works it is obligatory to respect the criteria for both the visual and the content aspect of the required works.

Ethics in teaching: Graphic works should be personal works of each student. There will be no tolerance for copying, "borrowing" from the Internet or any other material. The same or similar works will have negative evaluations in the final evaluation of the student.

Time: In agreement with the students, the deadlines for submitting works will be determined. There will be no tolerance for delays in the submission of works. Failure to arrive at the time when the assignment is explained does not justify the student for not submitting the paper. The deadline will be given earlier. If you are going to travel abroad, then you need to submit the paperwork in advance. The student has the right to request a consultation with the professor whenever he / she deems it reasonable and necessary for the performance of his / her work.

Rules of conduct and academic policies:

- active participation of students in lectures o participation in discussion, comments and free expression of opinion, opinion and academic position (with arguments)
- Mandatory independent work and use of additional sources of information (various scientific websites, scientific journals, conference proceedings, etc.)
- Respecting lecture schedules without compromising academic freedom (silent cell phones) of respecting the word, thoughts and ideas of colleagues,
- It is not allowed to arrive late and leave without a valid reason from the lecture, test or exam o preparation and holding of relevant lectures, (obligation of the teacher).
- if the student is absent more than four times without reason in lectures and exercises, does not receive the signature for attendance. o the student cannot take the exam without an official document,

if the student is dissatisfied with the grade obtained, has the right to complain in writing to the dean, within two working days after the announcement of the results, UMIB Statute o if the student does not follow the rules, in the exam uses tools that are not allowed, it is evaluated with a negative grade.

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Mitrovica; 29/04/2023 Prof. Ass. Dr. Fatmir Azemi