



UNIVERSITETI / UNIVERSITY  
"ISA BOLETINI"  
MITROVICË

| Course Curriculum Model (Syllabus) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                           |
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| Faculty:                           | <b>FACULTY OF MECHANICAL AND COMPUTER ENGINEERING</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                           |
| Department:                        | Mechanical Engineering and Economic Engineering                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                           |
| Study Program                      | MSc in Manufacturing Technology and Management                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                           |
| Level:                             | Master                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                           |
| Code of the course:                | 202MTM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                           |
| Course:                            | <b>Advanced Machine Design and Simulation</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                           |
| Course Status:                     | <b>Mandatory</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Mandatory/Elective</b> |
| Semester:                          | III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>Winter/Summer</b>      |
| Number of hours per week:          | 2+2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                           |
| ECTS:                              | 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |
| Time / location:                   | Wednesday, 9 <sup>00</sup> -10 <sup>30</sup> , K5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                           |
| Academic Year / Semester           | 2026/2027                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                           |
| Language of Instruction:           | Albanian (with flexibility in English)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                           |
| Lecturer:                          | Prof. Ass. Dr. Fatlume Zhujani                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                           |
| Assistant:                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                           |
| Contact details:                   | Professor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Assistant                 |
|                                    | Email: <a href="mailto:fatlume.zhujani@umib.net">fatlume.zhujani@umib.net</a> ,                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                           |
|                                    | Telephone: +383/49/830358                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                           |
| Course Description                 | This course provides an advanced understanding of machine design principles integrated with modern computational simulation techniques. Students will explore stress analysis, fatigue, dynamics, and optimization of complex machine components using CAD/CAE tools. Emphasis is placed on applying numerical simulations, finite element methods, and design optimization to solve real-world engineering challenges in mechanical and industrial systems.                                                                     |                           |
| Course Purpose / Course Aims       | The purpose of this course is to equip students with advanced knowledge and practical skills in designing and analyzing mechanical systems using simulation-driven methods. The course aims to bridge theory and practice by integrating classical machine design concepts with computational approaches, fostering innovation in mechanical design for high-performance, reliable, and sustainable engineering applications across diverse industries.                                                                          |                           |
| Course Objectives                  | <ul style="list-style-type: none"> <li>• To develop the ability to design and optimize complex machine components and systems.</li> <li>• To train students in applying numerical methods, including finite element analysis, to mechanical design problems.</li> <li>• To enhance skills in CAD/CAE simulation for evaluating stresses, fatigue life, vibrations, and thermal effects.</li> <li>• To prepare students for solving multidisciplinary engineering problems with innovative and sustainable approaches.</li> </ul> |                           |

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| <b>Intended Learning Outcomes (ILOs)</b> | <b>Knowledge</b> <ul style="list-style-type: none"> <li><b>K1:</b> Explain advanced principles of stress, strain, fatigue, and dynamic behavior in machine components.</li> <li><b>K2:</b> Describe computational methods such as FEM and optimization in machine design.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|                                          | <b>Skills</b> <ul style="list-style-type: none"> <li><b>S1:</b> Apply simulation tools (CAD/CAE, FEM) to analyze and optimize machine elements.</li> <li><b>S2:</b> Conduct fatigue, thermal, and vibration analyses of engineering systems.</li> <li><b>S3:</b> Integrate theory with simulation results to make rational design decisions.</li> </ul> <b>Competence</b> <ul style="list-style-type: none"> <li><b>C1:</b> Design reliable, efficient, and innovative mechanical systems for industrial applications.</li> <li><b>C2:</b> Collaborate effectively in design projects, presenting results professionally.</li> <li><b>C3:</b> Critically evaluate and validate simulation data against engineering standards.</li> </ul> |

|                | <b>Weeks</b>           | <b>Course Content / Lecture Plan</b>                                                         |
|----------------|------------------------|----------------------------------------------------------------------------------------------|
| <b>Program</b> | <i>First week</i>      | <b>Introduction to Advanced Machine Design and Simulation</b> – Scope, importance, tools.    |
|                | <i>Second week</i>     | <b>Review of Stress, Strain, and Failure Theories</b> – Advanced concepts.                   |
|                | <i>Third week</i>      | <b>Fatigue and Fracture Mechanics in Design</b> – Life prediction methods.                   |
|                | <i>Fourth week</i>     | <b>Finite Element Method (FEM) Basics</b> – Concepts and applications.                       |
|                | <i>Fifth week</i>      | <b>CAD/CAE Tools in Machine Design</b> – Modeling and pre-processing.                        |
|                | <i>Sixth week</i>      | <b>Static Structural Analysis</b> – Stresses, displacements, safety factors.                 |
|                | <i>Seventh week</i>    | Midterm Exam                                                                                 |
|                | <i>Eighth week</i>     | <b>Dynamic and Vibration Analysis</b> – Modal, harmonic, and transient response.             |
|                | <i>Ninth week</i>      | <b>Thermal Analysis in Design</b> – Steady-state and transient heat transfer.                |
|                | <i>Tenth week</i>      | <b>Surface Engineering in Machine Design</b> – Coatings, hardening, wear considerations.     |
|                | <i>Eleventh week</i>   | <b>Design Optimization Methods</b> – Topology optimization, parametric studies.              |
|                | <i>Twelfth week</i>    | <b>Multiphysics Simulation</b> – Coupled structural-thermal and fluid-structure interaction. |
|                | <i>Thirteenth week</i> | <b>Case Studies and Industrial Applications</b> – Aerospace, automotive, energy systems.     |
|                | <i>Fourteenth week</i> | <b>Project Presentations &amp; Course Review</b> – Simulation-driven design project defense. |
|                | <i>Fifteenth week</i>  | Final Exam                                                                                   |

| Literature / Reading List: |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
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| Literature                 | <p><b>Primary Literature:</b></p> <ol style="list-style-type: none"> <li>1. <b>Pham, D.T., Lei, Y. &amp; Yanshan, L.</b> (2025). Mechanical Design and Simulation: Exploring Innovations for the Future. Springer Nature, Singapore.</li> <li>2. <b>Mott, R. L., Vavrek, E. M. &amp; Wang, J.</b> (2021). Machine elements in Mechanical Design, 6th Edition, Pearson © 2018.</li> <li>3. <b>Young, W.C. &amp; Budynas R.G.</b> (2020). Roark's Formulas for Stress and Strain (9th Edition, McGraw-Hill)</li> </ol> <p><b>Supplementary/Recent Literature:</b></p> <ol style="list-style-type: none"> <li>4. <b>Kyratsis, P., Manavis, A. &amp; J. Paulo Davim, J. P.</b> ( 2025). CAD/CAM: Computer-Aided Design and Manufacturing (Advanced Mechanical Engineering, 17) 1st Edition. De Gruyter.</li> <li>5. <b>Ivanov, V., Pavlenko, I., Liaposhchenko, O., Machado J. &amp; Edl, M.</b> (2021). Advances in Design, Simulation and Manufacturing IV. Proceedings of the 4th International Conference on Design, Simulation, Manufacturing.</li> </ol> |

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| Teaching and Learning Methods | Lectures, Case Studies, Group Projects, Practical Lab Sessions, Industrial Guest Lectures                          |       |            |            |
|                               | 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          |
| <b>Total</b>                  |                                                                                                                    |       |            | <b>125</b> |

|             |                                                               |            |  |
|-------------|---------------------------------------------------------------|------------|--|
| Evaluation  | Assessment Methods and Criteria:                              |            |  |
|             | Activity                                                      | Weight (%) |  |
|             | Midterm Exam                                                  | 20%        |  |
|             | Project Report & Defense                                      | 30%        |  |
|             | Seminar Presentation                                          | 10%        |  |
|             | Final Exam                                                    | 40%        |  |
|             | Total                                                         | 100%       |  |
|             | (according to the Statute and Regulation for studies of UMIB) |            |  |
| Final grade | Points (%)                                                    | Mark       |  |

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| Academic policies | <b>Attendance, Ethics and Deadlines (Advanced Machine Design and Simulation)</b><br>Criteria for regular attendance and rules of conduct during the teaching process are established. Students are expected to actively participate in lectures, exercises, laboratory activities, modeling tasks, simulations, and discussions related to machine design and mechanical system analysis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |          |    |
|                   | <b>Computer-Based Work</b><br>All assignments, 3D models, simulations, projects, technical reports, and presentations must be prepared using appropriate CAD/CAE software and engineering simulation tools. Students are required to comply with technical and professional standards in design, analysis, simulation, and documentation of results. Clear presentation of models, technical drawings, simulation parameters, and analysis results is mandatory.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |    |
|                   | <b>Academic Ethics</b><br>All assignments, projects, simulations, and reports must be the original work of the student or assigned group. Copying models, designs, analyses, or materials from other sources without proper citation is strictly prohibited. Any violation of academic integrity will result in negative evaluation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |          |    |
|                   | <b>Deadlines</b><br>Submission deadlines for assignments, projects, and reports will be defined at the beginning of the semester or activity. Late submissions will not be accepted without valid justification. Students are responsible for completing all course requirements within the specified deadlines.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |          |    |
|                   | <b>Consultations</b><br>Students have the right to request consultations with the instructor regarding machine design, 3D modeling, simulations, engineering analyses, and technical report preparation whenever necessary.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |          |    |
|                   | <b>Rules of conduct and academic policies:</b> <ul style="list-style-type: none"> <li>● active participation of students in lectures or participation in discussion, comments and free expression of opinion, opinion and academic position (with arguments)</li> <li>● mandatory independent work and use of additional sources of information (various scientific websites, scientific journals, conference proceedings, etc.)</li> <li>● respecting lecture schedules without compromising academic freedom (silent cell phones) of respecting the word, thoughts and ideas of colleagues,</li> <li>● it is not allowed to arrive late and leave without a valid reason from the lecture, test or exam or preparation and holding of relevant lectures, (obligation of the teacher).</li> <li>● if the student is absent more than four times without reason in lectures and exercises, does not receive the signature for attendance. or the student cannot take the exam without an official document,</li> <li>● 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 or if the student does not follow the rules, in the exam uses tools that are not allowed, it is evaluated with a negative grade.</li> </ul> |          |    |
|                   | Plagiarism or cheating will be penalized according to university regulations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |          |    |
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