MM/73/2025. September 1, 2025

NOTICE

Course information and requirements for PhD Students of the István Sályi Doctoral School at the Faculty of Mechanical Engineering, University of Miskolc

Continuum Mechanics (GEMET401, GEMET401-a)

Fall Semester, Academic Year 2025/2026

Lectures: Mondays, 10:00–11:45 a.m., Building A/4, Room 439

General Information

Instructor:	Edgár Bertóti, PhD, DSc
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Office hours:	by appointment

Prerequisites

An understanding of the fundamental concepts and principles of engineering mechanics, a strong mathematical background in vector algebra and analysis, and a good command of English are required for the effective and productive participation in the course.

Course Objectives

The main objective of this postgraduate course is to introduce students to the fundamentals of Continuum Mechanics. Special emphasis is placed on the theory of non-linear deformations using advanced tensor notation. A further aim is to present the key concepts, principles, and methodologies of the subject in a manner that supports the study and application of the finite element method in engineering computations.

Course Content

Mathematical Preliminaries: Index notation of tensors in an orthonormal basis; summation convention; products of tensors using index notation; second-order tensors: eigenvalues, eigenvectors, and scalar invariants; change of frame and transformations; higher-order tensors; differentiation and integration of tensor fields.

Kinematics of Deformation: Bodies, configurations, motions; deformation gradient; polar decomposition; deformation and strain measures; displacement and velocity gradients; material time derivatives; rate of deformation and rotation; rate of change of volume and surface elements; isochoric motion.

Concept of Stress: Traction vectors and the Cauchy stress tensor; alternative stress measures and stress tensors.

Balance Laws: Conservation of mass; balance of linear and angular momentum; balance of mechanical energy; laws of thermodynamics; free energy imbalance and dissipation.

Constitutive Theory: Principle of frame-indifference; constitutive equations for non-linear elastic materials; compressible and incompressible solids.

Instructional Method

Students are required to be available on Mondays from 10:00 to 11:45, throughout the semester to attend lectures. Regular attendance is strongly recommended to ensure effective and systematic progress in the course. Students are also expected to complete homework assignments regularly to reinforce and deepen their understanding of the material.

Requirements for Signature

Students are expected to learn the course material through lectures and by completing homework assignments satisfactorily. The **signature**, which certifies course participation and is required to sit for the final exam, **is granted based on** the evaluation and scoring of the **submitted homework** problems.

The **maximum score** attainable from homework is **100 points**. To receive the signature, a **minimum of 40 points** must be achieved. Additionally, **half of the score exceeding 40** will be added to the student's final exam score.

Students who do not reach the minimum required 40 points from homework will not receive the signature and will not be eligible to take the final exam. In such cases, students may make up for the missing signature at the beginning of the exam period by taking a 45-minute written make-up exam. The maximum score on this exam is 40 points, and the minimum passing score required to obtain the signature is 20 points.

Final Exam

Only students who have obtained the signature are eligible to take the final exam during the examination period at the end of the semester. The final exam is a **written test** lasting 45 minutes, with a **maximum** attainable score of **40 points**.

The final grade is determined by combining the homework scores and the final exam score. Grading is based on a five-level scale: excellent (5), good (4), fair (3), pass (2), and fail (1), according to the following table:

Score	0 – 19	20 – 23	24 – 27	28 – 31	32 –
Mark	fail (1)	pass (2)	fair (3)	good (4)	excellent (5)

Textbooks

1. Holzapfel, G. A.: *Nonlinear Solid Mechanics*, John Wiley & Sons Ltd., Chichester, 2000.
2. Szeidl, Gy.: *Introduction to the Continuum Mechanics of Solid Bodies*, University of Miskolc, 2025. ISBN 978-615-02-3942-2. [Download]

[Some notations used in the textbooks may differ from those used in the lectures.]

Dr. Edgár Bertóti
Professor of Mechanics, Head of Institute