Course Title	**Nonlinear Mechanics & Modelling of Solids**				
Course Code	**MME 539**				
Course Type	**Elective**				
Level	Graduate				
Year / Semester	Spring Semester				
Teacher's Name	Vasileios Vavourakis				
ECTS	8	Lectures / week	2 × 1 ½ hours	Laboratories / week	0 hours
Course Purpose and Objectives	The purpose of this course is to cover particular topics in continuum mechanics in applied mechanics, biomechanics and materials science: nonlinear mechanics of solid matter. As such, this course provides the students with the opportunity to familiarise themselves with concepts pertinent to nonlinearity and nonlinear behaviour of materials and structures. In particular, fundamental principles of analytical methods used in nonlinear solid mechanics are examined, while simple nonlinear engineering problems are modelled and analysed using the Finite Element (FE) method.				
Learning Outcomes	This course has in its core a two-fold learning outcome: the students (1) will obtain the fundamental theoretical knowledge in the mechanics of nonlinear solids (from metals to ceramics, from polymers and plastics to biological tissues), (2) will obtain the theoretical knowledge in computer modelling of nonlinear solid mechanics problems, and thus (3) will gain experience utilizing a commercial FE software (ABAQUS). (4) will be capable to employ analytical methods to evaluate stresses, strains, deformations, etc. in simple nonlinear elastostatic problems, (5) will be able to design and construct 2D and 3D FE models in nonlinear solid mechanics problems, and (6) will be able to develop their critical thinking towards assessing, improving and correcting their calculations and model predictions.				
Prerequisites	NO		Required	NO	
Course Content	The course opens in the first part presenting the fundamental theory in continuum solid mechanics – applicable to nonlinear solids – that spans from the various stress and strain measures to a short outline of constitutive laws of solid materials. In the second part of the				

	course, the derivation of the equations of motion and equilibrium for deformable solids is presented, while also briefly covering the fundamentals of variational principles. In the third and major part of the course, the constitutive equations that describe the mechanical behaviour of elastic solids is presented; the course material will span from linear elastic (including isotropic and anisotropic) solids, to hypo- and hyperelastic materials, as well as viscoelastic, poroelastic and elastoplastic solids.
Teaching Methodology	Communicative, Collaborative • Class lectures (PowerPoint, Socrative, Screencast-o-matic); • Laboratory lectures – hands-on practice at the School computing center. During the first week of the semester, the Syllabus of the course is given by the teacher, which includes information on the course content, expected learning outcomes, assessment and office hours.
Bibliography	• Lawrence E. Malvern. Introduction to the Mechanics of a Continuous Medium. ISBN-13: 978-0134876030 • G.A. Holzapfel. Nonlinear Solid Mechanics: A Continuum Approach for Engineering. ISBN-13: 978-0471823193 • Ray W. Ogden. Non-linear Elastic Deformations. ISBN-13: 978-0486696485 • G.T. Mase, G.E. Mase. Continuum mechanics for engineers. ISBN-13: 978-0849388309 • A.J.M. Spencer. Continuum Mechanics. ISBN-13: 978-0486435947 • Vlado A. Lubarda. Elastoplasticity Theory. ISBN-13: 978-1420040784 • Aleksey D. Drozdov. Finite Elasticity and Viscoelasticity: A Course in the Nonlinear Mechanics of Solids. ISBN-13: 978-9810224332
Assessment	One final written exam (30%), bi-weekly homework assignments (40%), and a project assignment (30%).
Language	English