DEPARTMENT: MECHANICAL ENGINEERING

COURSE #: EML4930/EGM 5611, 3 credits
http://www.eng.fsu.edu/~woates

COURSE TITLE: Introduction to Continuum Mechanics

TYPE COURSE:
Core graduate course/undergrad elective
Track: Thermal Fluids, Mechanics and Materials, Magnet Science and Technology, Aeronautics

TERMS OFFERED: Spring odd years

CATALOG DESCRIPTION:
This course explores the governing equations for studying solid and fluid media mechanics. It includes analysis of balance laws and constitutive relations necessary to understand a variety of material behavior.

PREREQUISITES: An understanding of calculus and the basic fundamentals of solid and fluid mechanics and heat transport.

AREA COORDINATOR: Dr. William S. Oates
RESPONSIBLE FACULTY: Dr. William S. Oates

INSTRUCTOR OF RECORD: Dr. William S. Oates
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Office Hours: Monday & Wednesday 10:45 – 11:45 (or by appointment)

DATE OF PREPARATION: 01/5/15 (WSO)

CLASS SCHEDULE:

Class: Two times weekly for 1 hr. and 15 min. M/W 9:30am—10:45:am

Lab: none

TEXTBOOKS/REQUIRED MATERIAL:

1. Introduction to the Mechanics of a Continuous Medium, Lawrence Malvern, Prentice-Hall, Inc., Upper Saddle River, NJ, 07458; 1969

References, Additional Resources:

- Nonlinear Solid Mechanics: A continuum approach for engineering, Gerhard Holzapfel, John Wiley & Sons, LTD; Chichester; 2000.

SCIENCE/DESIGN (%): 80% / 20%

CONTRIBUTION TO MEETING THE PROFESSIONAL COMPONENT:
80% engineering science
20% engineering design

COURSE TOPICS:
The topics to be covered includes (not necessarily in the order shown)

1. Vectors, tensors, orthogonal transforms
2. Eigenvalues, eigenvectors
3. Div, grad, curl operations
4. Stress, traction, and stress invariants
5. Mohr's circle
6. Plane stress
7. 2D and 3D small strain
8. Spatial and material derivatives
9. Finite strain and rates
10. Rotation and stretch
11. Green's thm., Stokes thm., divergence thm.
12. Conservation equations
13. Piola Kirchoff stress, Cauchy stress
14. First law of thermodynamics and virtual work
15. Second law, eqns. of state and dissipative functions

ASSESSMENT TOOLS:

1. Class participation, 10%
2. Homework, 20%
3. Midterm, 25%
4. Final, 45%

16. Constitutive relations and elastic symmetry 17. Legendre transformations 18. Behavior of fluids, polymers 19. Plasticity 20. Frame indifference, material symmetry 21. Navier Stokes	

Course Objectives for FSU Curriculum File Syllabus	At the end of the course the student should be able to • The objective of this course is to introduce fundamental concepts of continuum mechanics with an emphasis on balance laws, thermodynamics, and constitutive relations for solids and fluids
Justification for addition or change	Course is needed in order that students Except for changes that substantially affect implementation of the evaluation (grading) statement, this syllabus is a guide for the course and is subject to change with advanced notice.

Level of computer usage:	None ☐	Elementary ☑	Intermediate ☐	Advanced ☐	
Modes of Instruction:	Lecture ☑	Lab ☐	DIS ☐	Discussion ☑	Other ☐
Core Curriculum Course:	Yes ☑	No ☐			
Availability to other Majors:	Yes ☑	No ☐			

COURSE OBJECTIVES* [linked to Student Outcomes]	(Numbers shown in brackets refer to department **Student Outcomes** – Please ask Dr. Hollis to check these numbers) http://www.eng.fsu.edu/me/about_us/accred-info.html 1. To understand the [1-10] 2. Develop creativity and intellectual curiosity in graduates. 3. Understand and apply mathematics and physics to reason scientifically and solve quantitative problems. 4. Use the engineering design process by which mathematical and scientific facts and principles are applied. 5. Communicate in precise language, correct sentences, and concise, coherent paragraphs--each communication evincing clear, critical thinking. 6. Demonstrate commitment to progressive and continued educational development. Numbers refer to the Departmental Student Outcomes, e.g. for course objective 3, [1, 5] refers to student outcomes 1 and 5.
COURSE OUTCOMES*	*(Numbers shown in brackets are links to Course Objectives above) 1. Be able to recognize [1] 2. The application of indicial notation used to describe tensors and vector calculus. 3. Quantification of stresses in a solid and fluid. 4. Kinematics and strain in continuous media. 5. Development and application of momentum laws in continuous media. 6. Thermodynamic balance laws describing thermomechanical energy. 7. Development of constitutive laws and use of Legendre transformations 8. Origins and applications of Navier-Stokes equations for fluid flow Numbers refer to Course Objectives above, e.g. for course outcome 1, [1, 3] refers to course objectives 1, 3.