MAE 640 - CRN: 87454 - Continuum Mechanics – Fall 2014

Instructor: Dr. E. J. Barbero
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Schedule: **Tu-Th. 5:00—6:15**, ESB 251
Office hours: Tu-Th. 2:00—3:00, ESB 511

Textbook: Mase, T. G., Smelser, R. E., and Mase, G. E., Continuum Mechanics for Engineers-Third Edition (2010), ISBN 1420079158

Prerequisites: MATH 251 & 256.

Course Objective: For students to learn the mathematical foundations of continuum mechanics as it applies to fluid dynamics and solid mechanics. Applications to Linear Elasticity, Fluids, and Linear Viscoelasticity.

Outcomes: The course supports to some extent the following outcomes, with emphasis on those listed in the table below.

A. An ability to apply knowledge of mathematics, science, and engineering.
E. An ability to identify, formulate and solve engineering problems.
G. An ability to communicate effectively.
I. Recognition of the need for, and an ability to engage in life-long learning.
K. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Ability to apply modern computer tools for analysis	I,K
Ability to formulate complex problems of fluid dynamics and solid mechanics	A,E
Written assignments	G

Outline:

Week	Date	Topic	Notes
1	8/19	1 Introduction	
	8/21	2.1 Scalars, Vectors, Tensors	
		2.2 Tensor algebra	
2	8/26	2.2 Tensor algebra	
		2.3 Indicial notation	
		2.4 Matrices (*)	
	8/28	2.5 Coordinate Transformations	
		2.6 Principal Values and Directions	
3	9/2	2.7 Tensor Fields	
	9/4	2.8 Integral Theorems	
4	9/9	3 Stress	
		3.1 Forces	
		3.2 Cauchy Stress	
		3.3 Stress Tensor	
		3.4 Stress Tensor Symmetry (*)	
	9/11	3.5 Coordinate Transformation	
5	9/16	3.6 Principal Stresses and Directions (*)	
	9/18	3.7 Limit values (*)	
6	9/23	3.8 Mohr's Circles of Stress(*)	
	9/25	3.9 Plane Stress(*)	
7	9/30	3.10 Deviator and Spherical Stress States	
	10/2	3.11 Octahedral Stress	
8	10/7	Midterm #1	Chapters 2 & 3
	10/9	4.4 Displacement Field	Mid semester
		4.5 Material Derivative	
9	10/14	WVU Break	Break
	10/16	Break	Break
10	10/21	4 Deformation and Motion	
		4.1 Particles vs. Positions	
	10/23	4.2 Material vs. Spatial Coordinates	
11	10/28	4.3 Lagrangean and Eulerian Descriptions	
	10/30	4.6 Finite Strain Tensors	
12	11/4	4.7 Infinitesimal Deformations	
	11/6	4.9 Stretch Ratios	
		4.10 Stretch Tensors	
13	11/11	4.11 Velocity Gradient,… Vorticity	
	11/13	4.12 Material Derivative of Line Elements	
14	11/18	Midterm #2	Chapter 4
	11/20	5 Conservation Laws	
		5.1 Material Derivatives	
15	Thanksgiving		Break
16	12/2	5.2 Continuity	
	12/4	5.3 Equations of Motion	

17	12/9	5.4 Piola-Kirchhoff Stress	LAST DAY
	12/12	11:00 am	FINAL

(*) Assigned for reading. Additional sections may be assigned for reading as the course progresses, depending on time and other factors.
(brief) Reduced coverage w.r.t. to the book.

Grading:

Homework	25%
Midterms	25% each
Final (comprehensive)	25% + % form absent midterm (if any)
A	>90/100
B	>80/100
C	>70/100
D	>60/100
F	Otherwise
Grade curving	None.

Homework: Assigned weekly. Due in 7 days, on the instructor desk before the class starts. Homework accepted up to immediately following lecture, with 50% penalty.

Midterm: No make ups under any circumstances. If absent, grade % added to final. Maximum one midterm absence allowed but strongly discouraged.

Computer usage: MATLAB is used for visualization and simple symbolic computations.

Academic Honesty: Cheating in any way or form is unacceptable at WVU and may result in an F grade and disciplinary action, regardless of overall performance. For definition of "Academic Dishonesty" and code of conduct, refer to the WVU Student Handbook or "Mountie Publication" (http://www.arc.wvu.edu/admissions/integrity.html) and the WVU Undergraduate Catalog.

Equal Opportunity: WVU is committed to social justice. WVU does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to foster an open environment in this class will be appreciated and given serious consideration.

NO AUDIT STUDENTS ALLOWED, WITHOUT EXCEPTION.