

## ME-CEE 327 Finite Element Methods in Mechanics Fall 2018

**Instructors:** Professors Wing Kam Liu and Mark Fleming Caulfield Engineering

Days and Times: ME 327, TuTh 12:30pm-1:50pm, Tech LR2

Office hour: Professor Wing Kam Liu: Tu Th 11:15am-12:15pm, Fri 9-10am, Tech A327

TAs: Mon Wed 3:30pm-5:00pm, Tech A311 or by appointments

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### COURSE OBJECTIVES:

To learn the basic theory behind the finite element method (FEM), how to program the FEM using MATLAB, and how to use a general commercial FEM code to write interface programs and solve typical engineering problems.

	Topics	Problems
<b>Week 1</b> Sept 27 & Oct 2	<b>Fish and Belytschko:</b> Ch. 2 (Sects. 2.1 to 2.3): 1D problems, element stiffness, assembly	<b>HW1:</b> 2.1, 2.2
<b>Week 2</b> Oct 4 & Oct 9	<b>Fish and Belytschko:</b> Ch. 3 (Sects. 3.1 to 3.6): Strong and weak forms	<b>HW2:</b> 3.1, 3.2, 3.3, 3.7
<b>Week 3</b> Oct 11 & Oct 16	<b>Fish and Belytschko:</b> Ch. 4 (Sects 4.1-4.5): Element Shape Functions, Gauss quadrature <b>Fish and Belytschko:</b> Ch. 5 (Sects 5.1-5.2): FEM for 1D Elasticity <b>Optional reading:</b> 1D Elasticity, Heat Conduction, Advection-Diffusion	<b>HW3:</b> 3.10, 4.1, 5.17 (a & b) <b>Comp HW1:</b> 1D FEM in MATLAB part 1 (due Oct 30)
<b>Week 4</b> Oct 18 & 23	<b>Fish and Belytschko:</b> Ch. 6: Strong and weak forms in 2D <b>Abaqus Tutorial 1</b> <b>Supplementary:</b> FEM for 2D & 3D problems with Laplace equation	<b>Comp HW2:</b> 2D Abaqus (due Nov 6)
<b>Week 5</b> Oct 25 & Oct 30	<b>Fish and Belytschko:</b> Ch. 7 (Sects. 7.1 to 7.2): Shape functions in 2D <b>Supplementary:</b> Lagrangian polynomials & numerical integration <b>Optional reading:</b> Ch. 7 (Sects 7.3-7.8)	<b>HW4:</b> 5.16, 6.1, 7.1
<b>Week 6</b> Nov 1 & Nov 6	Review <b>Midterm</b> – to be determined	
<b>Week 7</b> Nov 8 & 13	<b>Fish and Belytschko:</b> Ch. 4 (Sect 4.6) Gauss quadrature <b>Supplementary reading:</b> Elasticity tensor notes, principle of virtual work in multiple dimensions <b>Recommended:</b> Ch. 9: Stress analysis in 2D	<b>Comp HW3 (assigned on Thurs Nov 8):</b> 1D FEM in MATLAB part 2 (due Nov 22)
<b>Week 8</b> Nov 15 & 20 Thanksgiving	<b>Advanced Topics:</b> Hyperelasticity <b>Advanced Topics:</b> Viscoelasticity	<b>Comp HW5:</b> Viscoelasticity in Abaqus (due Nov 29)
<b>Week 9</b> Nov 27 & 29	<b>Advanced Topics:</b> Application of data mining in FEM	
<b>Week 10</b> Dec 4 & 6	Make-up lectures and review	
<b>Week 11</b>	<b>FINAL EXAM</b> – to be determined	

**GRADING:** Written homework 15% (due 1 week after assigned), computer assignments 25% (due 2 weeks after assigned), exams 60%

**TEXTBOOKS: Required:** J. Fish and T. Belytschko. *A first course in finite elements*. Wiley & Sons Ltd., West Sussex, UK, 2007. **Highly Recommended:** T.J.R. Hughes, *The Finite Element Method: Linear Static and Dynamic Finite Element Analysis*. Dover Publications, Inc., Mineola, NY, 2000.