ME 472: Finite Element Methods in Design

Course description:	Design of selected mechanical systems components using finite element analysis.
Number of credits:	3
Course Coordinator:	H.M. Zbib
Prerequisites by course:	ME 316
Prerequisites by topic:	1. Basic strength of materials 2. Failure theories applied to the prevention of machine element failures
Postrequisites:	None
Textbooks/other required materials:	Fish, J., *A First Course in Finite Elements (with CD)*. Wiley, 2007.
Course objectives:	1. Understand basic finite-element theory, computer implementation of this theory, and its practical applications 2. Understand finite-element analysis modeling and model verification techniques 3. Be able to develop and use appropriate assumptions and boundary conditions for the modeling of industrially realistic problems encountered in design and manufacturing 4. Be able to compose well-written and organized reports detailing the modeling effort including all assumptions, results, and verification efforts 5. Be able to critically analyze engineering problems and develop reasonable models to simulate them
Topics covered:	1. Vector-matrix algebra 2. Truss analysis 3. Variational and weighted residual formulations 4. Stress and structural analyses 5. Isoperimetric elements and quadrature 6. Transient and dynamic analysis
Expected learning outcomes:	1. Construct accurate finite-element models of various components loading scenarios, and processes 2. Develop appropriate engineering assumptions and their finite element implementation to allow components and/or processes to be modeled 3. Refine and adapt the finite-element mesh, boundary conditions, and all relevant loads for a given thermal/mechanical system

4. Demonstrate an ability to extend finite-element modeling to include non-traditional problems encountered in design and manufacturing such as time-dependent and non-linear problems
5. Demonstrate the ability to use existing analytical and approximate methods to verify their finite-element models and results
6. Clearly and effectively communicate their modeling efforts and results in written form
7. Critically analyze their assumptions, methods, and results

Class schedule: Three 50-minute lectures sessions per week, for one semester

Laboratory schedule: None. (A computer laboratory with Unix workstations is available for the students where they can use the finite elements software ANSYS for their assignments and class projects.)

Contribution to meeting the professional component: Engineering Topics

Relationship of course to student outcomes:
3 strongly supported; 2 supported; 1 minimally supported

Student Outcomes Pre-Fall 2018 (ABET EC2000)

a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**
3		2						1		3

Student Outcomes Fall 2018 forward (ABET EC2019)

1	**2**	**3**	**4**	**5**	**6**	**7**
3	2				3	1

Prepared by: Andrea Butcherite and H.M. Zbib *Date:* May 30, 2018