

ME 489
INTRODUCTION TO FINITE ELEMENT
ANALYSIS

Course Outcomes

1. Introduce concepts of finite element analysis [1,2]
2. Learn the use of matrix methods for solution of truss structures [1,2]
3. Learn strong and weak form for the solution of differential equations [1,2]
4. Learn how to define finite elements and finite element approximations [1,2]
5. Learn how to solve weak form formulations as a finite element approximation [1,2]
6. Apply these concepts to linear elastic and heat transfer problems [1,2]
7. Apply a commercial finite element code to linear elastic and heat transfer problems [1,2,3]
8. Understand the use of the Finite Element Analysis in engineering practice [6,7]

Fundamentals
(3 wks)

1. Review of Linear Elasticity
2. Review of Heat Transfer
2. 1D Bar Problems
3. 2D Bar Problems
4. Assembly and Global Solution

Strong and Weak Form
(4 wks)

1. Strong Form
2. Weak Form
3. Example Problems with Weak Form in Scalar Problems

FE Approximations
(4 wks)

1. Definition of finite elements in 1D
2. Definition finite elements in 2D
3. Weak Form Statement and Finite Element Approximation
4. Thermal Stress Analysis
5. Numerical Examples

Computations
(4 wks)

1. Matrix Method 1D (MatLab)
2. Finite Elements 1D (MatLab)
3. Model Building
3. A Commercial Finite Element Code: Examples

COURSE NUMBER: ME 489		COURSE TITLE: Introduction to Finite Element Analysis	
REQUIRED COURSE OR ELECTIVE COURSE: Required		TERMS OFFERED: Fall, Spring	
TEXTBOOK/REQUIRED MATERIAL: Jacob, Fish, and Belytschko Ted. <i>A first course in finite elements</i> . Wiley, 2007.		PRE-REQUISITIES: ME 323 Mechanics of Materials	
COORDINATING FACULTY: Thomas Siegmund, Ganesh Subbarayan			
COURSE DESCRIPTION: Principles of finite element analysis for truss structures, 1D and 2D elasticity as well as heat transfer. Introduction to advanced topics based on instructor.		COURSE OUTCOMES [Related ME Program Outcomes in brackets]:	
ASSESSMENTS TOOLS: <ol style="list-style-type: none"> 1. Bi weekly homework. 2. Bi weekly lab reports. 3. Exams and Quizzes. 4. Comprehensive final exam. 		<ol style="list-style-type: none"> 1. Introduce concepts of finite element analysis [1,2] 2. Learn the use of matrix methods for solution of truss structures [1,2] 3. Learn strong and weak form for the solution of differential equations [1,2] 4. Learn how to define finite elements and finite element approximations [1,2] 5. Learn how to solve weak form formulations as a finite element approximation [1,2] 6. Apply these concepts to linear elastic and heat transfer problems [1,2] 7. Apply a commercial finite element code to linear elastic and heat transfer problems [1,2,3] 8. Understand the use of the Finite Element Analysis in engineering practice [6,7] 	
NATURE OF DESIGN CONTENT: Numerical tools (the finite element analysis) is indispensable for the analysis of engineering components and thus for the design decision in product realization.		RELATED ME PROGRAM OUTCOMES:	
PROFESSIONAL COMPONENT: <ol style="list-style-type: none"> 1. Engineering Topics: Engineering Science – 4 credits (100%) 		<ol style="list-style-type: none"> 1. Engineering fundamentals 2. Engineering design 3. Communication skills 4. Ethical/Prof. responsibilities 5. Teamwork skills 6. Experimental skills 7. Knowledge acquisition 	
COMPUTER USAGE: Labs and lab reports require use of a finite element code, assignments using symbolic programming systems			
COURSE STRUCTURE/SCHEDULE: <ol style="list-style-type: none"> 1. Lecture - 3 days per week at 50 minutes 2. Laboratory - 1 day per week at 100 minutes. 			
PREPARED BY: Siegmund, Subbarayan		REVISION DATE: February 2019	