PURDUE UNIVERSITY. FORT WAYNE Civil and Me Engineering

Department of Civil and Mechanical

Course	ME 545 — Finite Element Analysis: Advanced Theory and Application
Type of Course	Required course for MSE-ME specialization
Catalog Description	Theory of the course covers various algorithms for non-linear and time-depended problems in two and three dimensions. Applications of the course cover the advanced topics with problems chosen from chosen solid mechanics, heat transfer, and fluid dynamics. Commercial FEA packages such as ANSYS and/or Abaqus are applied to solve various engineering problems. Students must possess an appropriate level of mathematics and programming skills to understand, develop and problem solvers for finite element models.
Credits	3
Contact Hours	3
Prerequisite Courses	Graduate Standing or ME 48000 (or equivalent course)
Corequisite Courses	None
Prerequisites by Topics	Numerical calculation and Matlab programming skills
Textbook	Zhuming Bi, "Finite Element Analysis Applications: A Systematic and Practical Approach", 1st Edition, ISBN-13: 978-0128099520, Elsevier.
Course Objectives	To review the fundamentals of basic FEA and to introduce advanced topics which are not covered in sufficient detail in an introductory course of FEA. Emphasizes are on the mathematical foundations of the method, numerical algorithms for software implementation, and analysis of problems with materials and geometric nonlinear behavior. The course aims at giving the students a chance to investigate practical problems of their interest in detail.
Course Outcomes	 Students who successfully complete this course will be able to: [1]. An ability to perform complete FE formulations for engineering analysis (1,2) [2]. An ability to write codes for a finite element model (1,2) [3]. An ability to use commercial FEA software to solve engineering problems (1,2)

	 [4]. An ability to apply finite element methods in design engineering components or systems (1,2,6) [5]. An ability to write technical reports and convey engineering message efficiently (4,7)
Lecture Topics	 Overview of Basic FEA and Nonlinearity Mathematical preliminaries Finite element analysis preliminaries Material nonlinearities Dynamic problems Various formulations Solution of linear and nonlinear algebraic equations Programming and Software tools of FEA Finite element analysis using ABAQUS (optional) Finite element analysis using ANSYS MATLAB Programs for finite element analysis
	 3. Solid Mechanics Problems Finite element formulations of solid continua Nonlinear heat transfer and other field problems in one-dimension Nonlinear bending of beams Nonlinear bending of elastic plates Dynamic Analysis
	 4. Heat Transfer Problems 1-D nonlinear heat transfer and other field problems 2-D nonlinear heat transfer and other field problems 5. Fluid Mechanics Problems Flow of viscous incompressible fluids Nonlinear analysis of transient problems Compressible flows Solid-fluid interactions 6. Electromagnetic Problems Steady-state problems Poisson's Equation Transient Field Problems.
Computer Usage	High
Laboratory Experience	low
Design Experience	Low
Coordinator	Zhuming Bi, Ph.D.,
Date	17 October 2022