University of Science and Technology of Hanoi
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²COURSE SYLLABUS

Subject: Numerical Methods-Modelling:*An Introduction to the Finite Element Method*

Academic field: Space and Aeronautics

Lecturer: Benoit DELINCHANT

Phone:

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Academic year: 2015-2016

COURSE DESCRIPTION

Credit points	3 ECTS	
Level	Undergraduate	
Teaching time Location	USTH building	
Time Commitment	Lecture	**9_hrs**
	Assignments	**12_hrs**
	Computer Lab/Practice	**11_hrs**
	Total	32_hrs
Prerequisites	Numerical Analysis, Matrix Algebra, Differential Equations	
Recommended background knowledge	Maths, Physics	
Subject description:	This ‘An Introduction to the Finite Element Method’ course is designed for the first course in the Finite Element Method offered to engineering students in the 2rdyear graduate student. The course is to teach the fundamentals of finite element method with emphasize on the underlying theory,variational techniques, assumption, and modeling issues as well as providing hands on experience using MATLAB to model, analyze and design systems of mechanical and aerospace engineers. Prerequisites are the usual undergraduate courses inNumerical Analysis, Matrix Algebra, and Differential Equations The course consists of lectures combined with practical applications on Matlab. A project realization and a final examination.	
Objectives & Outcome	This introductory course on the finite element method is an important course designed for the engineering student. The aim of this course is to: (1) Teach the fundamentals of finite element method with emphasize on the underlying theory, assumption, and modeling issues. Teach students how to model engineering systems by mathematical and numerical models using the finite element method and (2) Teach students how to	

	use computer tools to solve the resulting mathematical models. The computer tool used is MATLAB and the focus will be on developing and solving models of problems encountered in engineering, especially aerospace engineering and mechanics. Students who successfully complete this course will demonstrate the following outcomes by a written report: 1. An ability to apply knowledge of math, science, and engineering. This will be accomplished by applying these disciplines to various problems in engineering (aerospace engineering and mechanics in particular). 2. An ability to identify, formulates, and solves engineering problems using the finite element method. This will be accomplished by using MATLAB to simulate the solution to various problems in engineering. 3. An ability to use the techniques and skills of modern engineering tools necessary for the engineering practice. This objective will be accomplished by using Matlab.	
Assessment/ Evaluation	Attendance/Attitude	20%
	Report/Lab-work	80%
Prescribed Textbook(s)	[1] Reddy JN., An Introduction to Finite Element Method. 3rd edition, Tata Mc Graw Hill, 2008. [2] Cook RD., Malkus DS., Plesha ME., Witt RJ., Concepts and Applications of Finite Element Analysis. 4th Edition, John Wiley &Sonss.	

COURSE CONTENTS & SCHEDULE

Class	Contents	Hours			Ref./Resources	Assignment(s)
		Lect.	Exr.	Prc.		
1	Chapter 1: Introduction • Numerical Simulation for Engineering • Physical modelling • Differential Equations • Initial/ Boundary Value Problem • Symbolic/Numerical solving	1	1	0		
2	Chapter 2: PDE numerical approximation	2	4	0		

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	• EDO Discretization (numerical scheme, absorption application) • PDE applications (convection, waves, heat)					
3	Chapter 3: Polynomial approximation • Polynomial approximation • Piecewise approximation	2	3	0		
4	Chapter 4: Finite Element Method of a 1D convective-diffusive model • Variational formulation • First order elements solving • Second order elements solving • Stabilisation technic	2	2	5		
5	Chapter 5: Finite Element Method of a 2D heat transfert model • Discretization • Matrix assembly • Boundary conditions • Optimisation	2	2	6		