Finite Element Method

MAT514

Prof. Dr Shamsun Naher Begum
Shahjalal University of Science and Technology

Edited by
Mehedi Hasan

Preface

This is a compilation of lecture notes with some books and my own thoughts. If there are any mistake/typing error or, for any query mail me at mehedi12@student.sust.edu.

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Part I

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Chapter 1

History of Finite Element Method

Chapter 2

Approximation Solutions

We will discuss the following methods,

(i) Galerkin Method

(ii) Least Square Method

(iii) Collocation Method

(iv) —-

(v) Petrov-Galerkin Method

The main idea behind all these methods are to minimize the error using different weight function.

2.1 Galerkin Method

2.1.1 Method

In this method

Step (i): Assume a solution $\bar{u}(x)$ as a polynomial such that the degree of polynomial is greater than the order of differential equation by at least one.

Step (ii): Satisfy the boundary conditions to get values of two unknown coefficients.

Step (iii): Differentiate the assumed solution $\bar{u}(x)$ to satisfy the differential equation.

Step (iv): Take error/residual as $\varepsilon(x)$

Step (v): Take weight function as

Chapter 3

Shape Functions

Shape Function: The basic idea of the FEM is a piecewise approximation, that is, the solution of a complicated problem is obtained by dividing the region of interest into small regions (finite element) and approximating the solution over each such region by a simple function. Thus a necessary and important step is to choosing a simple function for the solution in each element. The functions used to represent the behavior of the solution within an element are called interpolating functions or approximating functions, those are known as shape function for each element. The general nth order 1D shape function at node for is defined by

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