Reading guidelines for course book in SF2561: Finite Element Methods

Computational Differential Equations by Eriksson, Estep, Hansbo, Johnson

Johan Hoffman

Chapter 1 and 2

Background and history. *Read through these chapters.*

Chapter 3

Background on Calculus; most should be familiar. Includes many concepts that are needed to understand the rest of the book. *Review this chapter.*

Chapter 4

Background Linear Algebra; most should be familiar. Includes many concepts that are needed to understand the rest of the book. *Review this chapter, section 4.6 is part of the course.*

Chapter 5

You should know the proofs of the max-norm estimates for the interpolation error, and state the corresponding estimates in the L_p-norm for $p = 1, 2, \infty$. *This chapter is part of the course.*

Chapter 6

You should be able to formulate Galerkin's method for linear differential equations, and compute matrix and vector entries for piecwise linear basis functions. *This chapter is part of the course.*

Chapter 7

We will not focus on solving linear algebraic systems in this course since this is considered in other courses. *Read through this chapter, in particular section 7.4 on Iterative methods which is important for FEM.*

Chapter 8

This is a very important chapter, with most of the aspects of FEM is presented for the two-point boundary value problem. *This is a key chapter of the course.*

Chapter 9

You should be able to formulate the cG(q) and dG(q) FEM methods for a scalar ODE (section 9.2). Adaptivity and a posteriori error estimation using a dual problem is important (section 9.3). A priori error estimation (section 9.4) is useful for understanding stability of initial value value PDE problems in Chapter 16-19. *This chapter is part of the course.*

Chapter 10

You should be able to formulate FEM methods for a system of ODEs (section 10.6). Adaptivity and a posteriori error estimation using a dual problem is important (section 10.7). Stability estimates (section 10.4) is useful for understanding stability of initial value value PDE problems in Chapter 16-19. *This chapter is part of the course.*

Chapter 11 and 12

Read through these chapters.

Chapter 13

Background on calculus in several dimensions; should be familiar. *Read through this chapter.*

Chapter 14

Meshes and interpolation in several dimensions. *You should know Theorem 14.2 and Theorem 14.3. No proofs are part of the course.*

Chapter 15

This chapter is an important part of the course, except section 15.0 and section 15.1.8 which you only have to read through.

Chapter 16

This chapter is part of the course, except sections 16.1-16.2 which you only have to read through.

Chapter 17

Sections 17.1, 17.2.4, 17.3.3, 17.4 are part of the course, the rest of the chapter you only have to read through.

Chapter 18

You should be able to explain the motivation for the streamline diffusion method, and how it improves stability of convection dominated problems. *This chapter is part of the course.*

Chapter 19

Read through this chapter. You should be able to explain the characteristic Galerkin method.

Chapter 20

Read through this chapter

Chapter 21

This chapter is part of the course, except the proofs of the Lax-Milgram theorem and the proof of Theorem 21.7.