The Finite Element Method, FHL064

Division of Solid Mechanics

Course program, vt2, 2017

Course description
The finite element method (FEM) is a numerical method able to solve differential equations, i.e. boundary value problems. The method is today the most powerful numerical method within solid mechanics; this since arbitrary geometries and complex material models can be treated. Within the modern industry the finite element method is the key factor in many construction phases. Since the method is a solution method for any partial differential equations it can be used for any problem that is controlled by field equations, for instance heat conduction, diffusion, electromagnetism and solid mechanics.

The emphasis in the course in placed on the understanding of the fundamental principles of FEM and its numerical formulation. During the course, the participants implement their own finite element program and thereby gain understanding of the method in detail.

Lectures
Ralf Denzer, Division of Solid Mechanics, ralf.denzer@solid.lth.se

Problem sessions
Sally Issa, Sally.Issa@solid.lth.se
Philip Oppermann, Philip.Oppermann@solid.lth.se

Course literature
1. Ottosen, Niels Saabye and Petersson, Hans: *Introduction to the Finite Element Method*, Prentice Hall. The course book can be bought at KFS.
2. Wallin, Mathias: *Introduction to the Finite Element Method- Exercises*, Solid Mechanics, 2012. The exercises can be downloaded from the course website.

Additional notes on transient problems are available on the course home-page.

Matlab programming exercises will be provided by the live@lund course page.

Assignment
The course includes a mandatory assignment. The assignment is performed in groups of two. **The assignment shall be hand in not later than May 26 at 16.00**. The assignment will be graded with up to 5 points which can be added to the points obtained at the exam May 29, 2017. Note that the bonus points are only valid at the exam May 29, 2017. A report that is handed in after May 26 will be given 0 points. The report must be approved not later than June 12.

Submission of the assignment
You should submit your report in **PDF** format to FHL064@solid.lth.se. In addition to your report you should also attach your m-files in the email. Moreover, a paper version should also be hand in to the Division of Solid Mechanics.

Examination
The examination of the course consists of a final examination and an assignment. The amount of points to pass the exam is 30. Total amount of points is 60.

Preliminary lecture schedule

Lecture 1	Introduction, Chap. 2
Lecture 2	Chap. 4 Strong and weak form – 1d heat flow and elastic bar
Lecture 3	Chap. 7 1d Approx. functions, Chap. 9 FE-formulation 1d heat flow
Lecture 4	Chap. 9 FE-formulation elastic bar, Chap. 5 Gauss integration theorem
Lecture 5	Chap. 6 Strong and weak form 2/3d heat flow
Lecture 6	Chap. 7 2/3d Approx. functions, Chap. 10 FE-formulation 2/3d heat flow
Lecture 7	Chap. 10 (continued) + Transient heat flow, Chap. 11
Lecture 8	Chap. 12 Stresses and strains, Chap. 13 Linear elasticity
Lecture 9	Chap. 15 Approx. functions, Chap. 16 FE-formulation 2/3d elasticity
Lecture 10	Chap. 19 Isoparametric finite elements
Lecture 11	Chap. 19 Isoparametric finite elements (continued)
Lecture 12	Chap. 20 Numerical Integration
Lecture 13	Chap. 17 FE-formulation for beams
Lecture 14	Reserved
Lecture 15	Guest lecture. P-O Sturesson, Noice and Vibration Center, Volvo

Computer Lab Exercise
We offer 5 computer lab exercises in the computer rooms EMMA4-5, M-huset

1. Programming FEM method with Matlab, 29.03, Group A 13h-15h, Group B 15h-17h
2. Programming FEM method with Matlab, 03.04, Group A 10h-12h, Group B 13h-15h
3. Programming FEM method with Matlab, 26.04, Group A 13h-15h, Group B 15h-17h
4. Programming FEM method with Matlab, 02.05, Group A 13h-15h, Group B 15h-17h
5. Programming FEM method with Matlab, 10.05, Group A 13h-15h, Group B 15h-17h

More information and Matlab FEM codes will be uploaded to the live@lund course page.
Lists for computer lab Group A and Group B will be hand out Tuesday 21/3.

Exercises

Exercise 1	Chap. 2 (not 2.1, 2.2, 2.5, 2.6, 2.7)
Exercise 2	Chap. 4 (not 4.1, 4.3)
Exercise 3	Chap. 5 (not 5.4), Chap. 6 (not 6.1, 6.3, 6.4)
Exercise 4	Chap. 7 (not 7.1, 7.6)
Exercise 5	Chap. 9 (not 9.4 and 9.5)
Exercise 6	Chap. 10
Exercise 7	9.4, 9.5 and Chap. 11
Exercise 8	Chap. 12, Chap. 13
Exercise 9	Chap. 15, Chap. 16
Exercise 10	Chap. 19
Exercise 11	Chap. 20
Exercise 12	Chap. 17
Exercise 13+	Consultation

Course Schedule

See TimeEdit