# COE-C3005 Finite Difference and Finite Element Methods

## Spring 2022

<u>General description</u>

Introduction to approximate methods for *initial* and *boundary* value problems in solid mechanics. After the course, student understands the physical background of the bar and string model problems, knows the basic ideas of (1) particle surrogate, (2) finite difference, (3) finite element methods, is able to apply the methods to the model problems (1D), and knows the extensions to the thin slab and membrane models of solid mechanics (2D).

**Responsible teacher:** D.Sc. (Tech.) Mari Åman (MÅ)

**Course assistant:** PhD Markku Malmivuori (MM)

Contact: Primarily during lectures and calculation hours.

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**LECTURES AND CALCULATION HOURS**

**ONLINE: Lectures (MÅ)** on Tue and Wed are based on the weekly lecture notes of the home page. After a short break, lectures are followed by lecture assignments about some of the key topics of the lecture.

**CAMPUS: Calculation examples (MÅ and/or MM)** on Thu discusses the weekly example problems of the home page. Example problems are similar as homework and exam problems. Lecture room: R001/U119 DELOITTE. Sessions are not recorded, but the material will be provided after the lecture to the course home page.

**ONLINE: Calculation hours (MM)** are informal meetings for instructions and questions about the home assignments. Join the meeting to solve the home assignments during the session and/or get step-by-step instructions.

The online lectures are arranged at Zoom. Download the software and practice with the user interface unless you are familiar with it:

https://www.aalto.fi/en/services/zoom-quick-guide

**Since there are no mandatory events, except the exam, the course can be taken 100% remotely.**

## COURSE MATERIAL

The weekly material consists of lecture notes, exercise problems, home assignments, and lecture assignments. The exercise material of the orientation week (week 16) consists of an essay assignment only.

**Lecture notes** are published in the home page on Monday of each week.

**Exercise problem** are published in the home page on Monday of each week. Exercise problems contain answers and full solutions. Some problems may be solved during the calculation examples sessions and uploaded later to the homepage.

**Lecture assignments** are published in the homepage after the lectures on Tue and Wed 10:35 and the solutions should be returned before the deadline at noon.

**Home assignments** are published in the homepage on Mon of each week and should be returned through the homepage before Sun 23:30 of the same week. Some of the problems are structured and contain templates to be completed, some are non-structured to be solved from scratch.

Assignments are published in docx and pdf versions. With the docx versions, you can use MathType equation editor to fill the missing parts of a structured assignment or write the full solution to a non-structured assignment. Also handwriting is acceptable. However, the returned solution should be of good quality and pdf in type.

## FINAL EXAM

**Exam is arranged at the campus.** Duration of the exam is four (4) hours. Exam contains four (4) problems. You may use calculator and formulae collection provided together with the exam.

*Participation in the final exam is possible only if the points from the graded assignments exceed 44 assignment points.*

## GRADING

AP = assignment points, EP = exam points, AG = assignment grade, EG = Exam grade

Final grade = 0.4*AG + 0.6*EG

Both AG and EG must be 1 or larger to pass the course.

Grading Table.

| AP | < 44 | 44–54 | 55–62 | 63–70 | 71–79 | 80 ≤ |
|---|---|---|---|---|---|---|
| AG | 0 | 1 | 2 | 3 | 4 | 5 |
| EP | < 8 | 8–10 | 11–13 | 14–17 | 18–20 | 21 ≤ |
| EG | 0 | 1 | 2 | 3 | 4 | 5 |