Course Syllabus

20.04.2022 – 02.06.2022

1. Course information

Status of the Course: Programme Name: Building Technology
Major studies; Construction and Maintenance
Level of the Course: Aalto Eng., Master and postgraduate degree course
Teachers in charge: Prof. Jouni Punkki
Staff Scientist, Fahim Al-Neshawy, D.Sc.
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Teaching Period: Spring 2022 (Period V)
Registration for Courses: Registration to course using https://sisu.aalto.fi
Language of Instruction: English

2. Learning Outcomes

The goal of the course is to familiarize students with advanced experimental and characterization techniques commonly used in construction engineering.

Upon successful completion of the course, students will be able to:

1) Distinguish the basic conceptual, theoretical and analytical tools necessary for experimental testing of the building materials and structures.
2) Explore theoretical and practical information for the common non-destructive and destructive testing methods and techniques for building materials and structures.
3) Gain experience with and understanding of the advantages and applications of common experimental field and laboratory testing methods
4) Be able to plan a suitable experimental testing program for building materials and structures.

3. Course Content

The course covers the following topics:

- Physical nature of the material property or discontinuity to be inspected
- Visual inspection of structures
- Non-destructive testing techniques
- Destructive testing and evaluation techniques
- Microstructure analysis of building materials – Petrographic analysis, microscopy analyses and computed tomography
- Digital Image Processing (DIP) and Digital Image Correlation (DIC) in Civil Engineering

4. Teaching methods

The course includes the following teaching methods and activities:

1) Lectures
2) Course assignment (group work)
3) Field measurements
4) Final exam

4.1 Lectures – covers the course content

The course lectures will be held at R5 at the civil engineering department and the lecture schedule is presented in Table 1. The schedule listed in the table is preliminary and may change during the course

Table 1. Course lectures and field demonstrations.

Date			Topics
Mon			
Wed	20.04.2022	10:15 - 12:00	No lecture due to the teachers' participation in a workshop in Denmark
Fri	22.04.2022	12:15 - 14:00	Introduction to experimental testing methods / Error analysis
Mon	25.04.2022	12:15 - 14:00	Structural condition assessment
Wed	27.04.2022	10:15 - 12:00	Electromagnetic testing techniques
Fri	29.04.2022	12:15 - 14:00	Field measurements: GPR, Concrete cover meter
Mon	02.05.2022	12:15 - 14:00	Electrochemical testing techniques
Wed	04.05.2022	10:15 - 12:00	Ultrasonic testing techniques
Fri	06.05.2022	12:15 - 14:00	Field measurements: iCor device
Mon	09.05.2022	12:15 - 14:00	Moisture measurement in building materials
Wed	11.05.2022	10:15 - 12:00	Destructive measurements on cores (Strength and Porosity)
Fri	13.05.2022	12:15 - 14:00	Field measurements: Surface MC, Rebound Hammers
Mon	16.05.2022	12:15 - 14:00	Digital Image Processing (DIP) and Correlation (DIC)
Wed	18.05.2022	10:15 - 12:00	Application of computed tomography (CT) in civil engineering
Fri	20.05.2022	12:15 - 14:00	Field measurements: Ultrasonic Pulse Velocity
Mon	23.05.2022	12:15 - 14:00	Scanning electron microscope for the investigation of building materials
Wed	25.05.2022	10:15 - 12:00	Thin section analysis (Petrography)
Fri	27.05.2022	12:15 - 14:00	Course seminar
Thu	02.06.2022	9:00 - 12:00	Course examination

The course also includes a demonstration of most of the non-destructive devices covered in the course (available from the laboratory). The demonstration sessions will be on Fridays from 10:15 – 12:00.

4.2 Course assignment (group work)

The main objective of the assignment is to enable students to preform mainly non-destructive testing NDT measurement and data analysis of building materials (mainly concrete structures) and combine knowledge with practice. Groups of four students are asked to prepare (i) written report about a particular NDT device, performed measurements and data analysis and (ii) a presentation at the course seminar about the assignment. The assignment groupwork value (report and presentation) is 25% of the final grade.

4.3 Field measurements

The course includes field measurements using some non-destructive testing NDT devices available in the laboratory. Students are asked to submit weekly reports about the used device(s) including (i) principle of the measurement, (ii) measurement procedure and (iii) measurement data and simple analysis of the results. The field measurement reports (4 reports) value is 15% of the final grade.

4.4 Final exam

The written exam includes 4 questions covering the course outcomes. The exam value is 60% of the final grade.

5. Course Workload

Student workload include attending the lectures, excursions, seminars, participating the group work, writing learning (reflecting) diaries and self-study work. The course ETCS/workload is presented in the following table.

Table 2. Course workload – estimated.

Student activities	Quantity	Duration (h)	Total (h)	% grade
Lectures				
Attending lectures	12	2	24	≈ 75%
Self-study: Independent work				
Field measurement reports (4 reports)	4	5	20	
Independent reading	1	54	54	
Final examination	1	3	3	
Group assignments				≈ 25%
Presentations	4	2	8	
Preparing theoretical background, performing measurements and writing report	4	7	28	
Total workload (Hours)			137	100 %

6. Assessment methods and grading scale

The total points of the course are 100 and the grading scale for course is: 5 (highest); 4; 3; 2; 1 (lowest passing grade); 0 (failed). For passing the course, a minimum of (15) points are required for group work and a minimum of (35) points are required for the exam.

Table 3: Course grading

Total points	Grade
<50	0
50 to <60	1
60 to <70	2
70 to <80	3
80 to <90	4
90 to 100	5

7. Study Materials

- Recommended book for the course:
  - Jean-Paul Balayssac and Vincent Garnier, (2017). Non-Destructive Testing and Evaluation of Civil Engineering Structures. https://ebookcentral.proquest.com/lib/aalto-ebooks/detail.action?docID=5165459
    - Chapter 2. Ultrasonic Methods
    - Chapter 3. Electromagnetic Methods
    - Chapter 5. Electrochemical Methods
    - Chapter 9. Applications In Situ
    - Chapter 10. Methodological Guide
- Course handouts: include slides from lectures, explanatory notes, and additional readings.

8. Prerequisites

- CIV-E1010 Building Materials Technology
- CIV-E2020 Concrete Technology
- CIV-E2060 Production technology of concrete structures