Course Syllabus

24.4.2023-8.6.2023

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 2023 (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	24.04.2023	12:15 - 14:00	Introduction to experimental testing methods / Error analysis
Wed	26.04.2023	10:15 - 12:00	Structural condition assessment
Fri	28.04.2023	12:15 - 14:00	NDT devices and mock-up wall visiting
Mon	01.05.2023	NO Lecture	Vappu - 1st of May
Wed	03.05.2023	10:15 - 12:00	Electromagnetic testing techniques
Fri	05.05.2023	12:15 - 14:00	Field measurements: GPR, Concrete cover meter
Mon	08.05.2023	12:15 - 14:00	Moisture measurement in building materials
Wed	10.05.2023	10:15 - 12:00	Ultrasonic testing techniques
Fri	12.05.2023	12:15 - 14:00	Field measurements: iCor device, UPV
Mon	15.05.2023	12:15 - 14:00	Electrochemical testing techniques
Wed	17.05.2023	10:15 - 12:00	Destructive measurements on cores (Strength and Porosity)
Fri	19.05.2023	12:15 - 14:00	Field measurements: Surface MC, Rebound Hammers
Mon	22.05.2023	12:15 - 14:00	Digital Image Processing (DIP) and Correlation (DIC)
Wed	24.05.2023	10:15 - 12:00	Application of computed tomography (CT) in civil engineering
Fri	26.05.2023	12:15 - 14:00	AFRY excursion
Mon	29.05.2023	12:15 - 14:00	Scanning electron microscope for the investigation of building materials
Wed	31.05.2023	10:15 - 12:00	Thin section analysis (Petrography)
Fri	02.06.2023	12:15 - 14:00	Seminar
Thu	08.06.2023	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 12:15 – 14:00.

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 a written report about a particular NDT device, performed measurements and data analysis. The assignment groupwork value is 20% of the final grade.

4.3 Field measurements

The course includes field measurements using some non-destructive testing NDT devices (6 devices) available in the laboratory. Students are asked to submit 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 (students can select only 5 devices) value is 10% of the final grade.

4.4 Final exam

The written exam includes 4 questions covering the course outcomes. The exam value is 70% 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 (Hour)	Total workload (Hour)	Total hours	Portion %
Individual work - Exam					
Lectures including guest lectures	11	3	33		
Course excurion	1	4	4		
Independent reading for the exam	1	55	55		
Final examination	1	3	3	95,0	70
Individual work - NDT measurements					
Field measurements - sessions	3	3	9	13,5	10
Data analysis and reporting	3	1,5	4,5		
Group work - Course assignment					
Assinment work (group meeting, discussions etc.)	3	3	9	27,0	20
Writing the assignment report	1	18	18		
Total workload (Hours)			137		
ECTS Credit of the course (workload / 27)			5		

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 (50) points are required.

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