COURSE SYLLABUS AND COURSE REQUIREMENTS
ACADEMIC YEAR 2024/25 SEMESTER 2

Course title	Finite Element Modelling
Course Code	MSB168ANEP
Hours/Week: le/pr/lab	202
Credits	5
Degree Programme	Civil Engineering BSc
Study Mode (training schedule)	English course
Requirements	Exam (with grade)
Teaching Period	4.
Prerequisites	MSB112ANEP Structural Analysis
Department(s)	Department of Civil Engineering
Course Director	Vanda Olimpia Pomezanski Dr., associate professor
Teaching Staff	Vanda Olimpia Pomezanski Dr., associate professor

COURSE DESCRIPTION

In this course, students will learn about the behaviour of statically determinate and indeterminate plane structures under a moving vehicle load. They will master the process of creating maximum force diagrams for distributed and concentrated loads. They will learn the principles of the finite element method, its solution techniques, and the development of computational models of structure types. Finite element modelling of beam structures: beams, frames, discs, plates, and shells. This is complemented by finite element modelling of computational problems, determination of the stiffness matrix or load vector, and solution of the system of equations. Use of commercial finite element programs like Axis and Excel, and solution of practical problems using them. By the end of the course, the student will be able to apply his/her knowledge to design tasks at a skill level.

SYLLABUS

[1.] GOALS AND OBJECTIVES

Goals:
The course is based on individual engineering skills with regular consultations and presentations.
Methodology:
The course is based on collaboration, participation, and discussions through lessons. This is an interaction between Students and Faculty, using teaching methods like 'Problem-based learning' and 'learning-by-doing'. The communication and work should reflect a respect for fellow students and their desire to work regarding noise levels, noxious fumes, etc., from each site of participants.

[2.] COURSE CONTENT

	TOPICS
LECTURE	1. Introduction, the concept of influence line diagrams, and characteristics of diagrams in the case of simple structures 2. Internal force influence line diagrams of statically determinate structures (simple supported beam, cantilevered simple supported beam, three-hinged and Gerber style structures) 3. Influence lines of statically determinate truss-type structures 4. Influence lines of statically indeterminate structures by the force method 5. Influence lines of continuous multi-post beam structures by the force method 6. Maximal internal force/envelope diagrams in case of distributed and concentrated loads 7. Mathematical concepts of finite element modelling. 8. Models of 2D and 3D Truss type structures, equilibriums.

9. The Flexibility and Stiffness Matrices of a Beam. FE Models for simple supported beams.
10. Frame structures. Local and global coordinates. Coordinate transformation.
11. Plane surfaces like slabs or walls, 3D elements. FE Meshes.
12. Plane surfaces like slabs or walls, 3D elements.
13. Complex structures, summary.

LABORATORY PRACTICE

1. Introduction, the concept of influence line diagrams, and characteristics of diagrams in the case of simple structures
2. Internal force influence line diagrams of statically determinate structures (simple supported beam, cantilevered simple supported beam, three-hinged and Gerber style structures). Axis documentation.
3. Influence lines of statically determinate truss-type structures. Axis documentation.
4. Influence lines of statically indeterminate structures by the force method.
5. Influence lines of continuous multi-post beam structures by the force method. Axis documentation.
6. Maximal internal force/envelope diagrams in case of distributed and concentrated loads. Axis documentation.
7. Using an Excel spreadsheet to solve engineering problems, including mathematical operations.
8. Truss-type structures, equilibria. Excel and Axis documentation.
9. FE Models for simple supported beams, continuous beams, and Gerber-beams. Excel and Axis documentation.
10. Frame Structures. Excel and Axis documentation.
11. Multi-level 2D and 3D frames. Excel and Axis documentation.
12. Grillages, plane surfaces like slabs or walls, 3D elements. Axis documentation.
13. 3rd Test

DETAILED SYLLABUS AND COURSE SCHEDULE

LECTURE

week	**Topic**	**Compulsory reading; page number (from … to …)**	**Required tasks (assignments, tests, etc.)**	**Completion date, due date**
1.	**Lecture 1:** Introduction, the concept of influence line diagrams	[1.], [2.], [4.], Lecture 1.		
2.	**Lecture 2:** Internal force influence line diagrams of statically determinate structures	[1.], [2.], [4.], Lecture 2.		
3.	**Lecture 3:** Influence lines of statically determinate truss-type structures	[1.], [2.], [4.], Lecture 3.		
4.	**Lecture 4:** Influence lines of statically indeterminate structures by the force method	[1.], [2.], [4.], Lecture 4.		
5.	**Lecture 5:** Influence lines of continuous multi-post beam structures by the force method	[1.], [2.], [4.], Lecture 5.		
6.	**Lecture 6:** Maximal internal force/envelope diagrams in case of distributed and concentrated loads	[1.], [2.], Lecture 6.		
7.	**Lecture 7:** Mathematical concepts of finite element modelling.	[1.], [2.], Lecture 7.		

8.	**Lecture 8:** Models of 2D and 3D Truss-type structures, equilibria.	[1.], [2.], [3.], Lecture 8.		
9.				
10.	**Lecture 9:** The Flexibility and Stiffness Matrices of a Beam. FE Models for simple supported beams.	[1.], [2.], [3.], Lecture 9.		
11.	**Lecture 10:** Frame structures. Local and global coordinates. Coordinate transformation.	[1.], [2.], [3.], Lecture 10.		
12.	**Lecture 11:** Plane surfaces like slabs or walls, 3D elements. FE Meshes.	[1.], [2.], [3.], Lecture 11.		
13.	**Lecture 12:** Plane surfaces like slabs or walls, 3D elements.	[1.], [2.], [3.], Lecture 12.		
14.	**Lecture 13:** Complex structures, summary.	[1.], [2.], Lecture 13.		
15.				

PRACTICE, LABORATORY PRACTICE

week	**Topic**	**Compulsory reading; page number (from … to …)**	**Required tasks (assignments, tests, etc.)**	**Completion date, due date**
1.	**Lab.1:** Introduction, the concept of influence line diagrams, and simple structures.	[1.], [2.] Lab.1		
2.	**Lab.2:** Internal force influence line diagrams of statically determinate structures.	[1.], [2.] Lab.2		
3.	**Lab.3:** Influence lines of statically determinate truss-type structures.	[1.], [2.] Lab.3		
4.	**Lab.4:** Influence lines of statically indeterminate structures by the force method. Axis documentation.	[1.], [2.] Lab.4		
5.	**Lab.5:** Influence lines of continuous multi-post beam structures by the force method.	[1.], [2.] Lab.5	Test 1.	
6.	**Lab.6:** Maximal internal force/envelope diagram.	[1.], [2.] Lab.6		
7.	**Lab.7:** Excel spreadsheet to solve engineering problems, mathematical operations. Axis documentation.	[1.], [2.] Lab.7		Test 1.
8.	**Lab.8:** Truss-type structures, equilibria. Excel and Axis documentation.	[1.], [2.] Lab.8	Test 2.	
9.				
10.	**Lab.9:** FE Models for simple supported beams, continuous beams, and Gerber-beams. Axis documentation.	[1.], [2.] Lab.9		Test 2.
11.	**Lab.10:** Frame Structures. Excel and Axis documentation. Axis documentation.	[1.], [2.] Lab.10		
12.	**Lab.11:** Multi-level 2D and 3D frames.	[1.], [2.] Lab.11		RT-Test 1
13.	**Lab.12:** Grillages, plane surfaces like slabs or walls, 3D elements. Axis documentation.	[1.], [2.] Lab.12		
14.	**Lab.13:** 3rd Test	[1.], [2.] Lab.13, Lab.14	Test 3.	RT-Test 2
15.			RT-Test 3, signature	

[3.] ASSESSMENT AND EVALUATION

ATTENDANCE

Unexcused absences will adversely affect the grade, and in case of absence from more than 30% of the total number of lessons will be grounds for failing the class. To be in class at the beginning time and stay until the scheduled end of the lesson is required; tardiness of more than 20 minutes will be counted as an absence. In the case of an illness or family emergency, the student must present a valid excuse, such as a doctor's note. (13 Lec. + 13 Lab. = 26 meeting. 70% of this is 20. Thus, you must attend at least 20 times. Maximum 3 lectures and 3 Labor practices can be missed.)

Method for monitoring attendance: attendance sheet

ASSESSMENT

3 midterm tests.

Tests 1-2 should be submitted by the specified deadline. Tests 1-2 must be submitted in print and electronically (TEAMS). Delay is not accepted. Test3 should be written at the time of the schedule. At the end of the diligence period, we provide a replacement for all the tests once!

Mid-term assessments, performance evaluation and their weighting as a pre-requisite for taking the final exam

Type	Assessment	*Weighting as a proportion of the pre-requisite for taking the exam*
1. Test 1	max 50 points	33,3 %
2. Test 2	max 50 points	33,3 %
3. Test 3	max 50 points	33,3 %
sum:	**max 150 points**	**100%**

Requirements for the end-of-semester signature:

Recognition of the semester is subject to a minimum of 40% (20 points) each, and of 40% (60 points) for all, and attendance at lectures and practice.

Re-takes for the end-of-semester signature:

If the result of Test 3 is under the 40%, the test must be retaken at a given time. If the result of Test 1 or Test 2 is under the 40%, the assignment must be corrected by the given deadline. Only submitted assignments can be corrected. The unsubmitted test can be retaken at the end of the semester. At the end of the semester, the results of the retake and corrections will be considered.

Type of examination: presentation

The exam is successful if the result is a minimum 40%.

Calculation of the grade:

The mid-term performance accounts for **50**%, and the performance at the exam accounts for **50**% in the calculation of the final grade.

Calculation of the final grade based on aggregate performance in percentage.

Course grade	Performance in %	Performance in points
excellent (5)	85 % …100%	255- -300
good (4)	70 % ... 85 %	210 - 255
satisfactory (3)	55 % ... 70 %	165 - 210
pass (2)	40 % ... 55 %	120 - 165
fail (1)	below 40 %	0 - 120

The lower limit given at each grade belongs to that grade.

[4.] SPECIFIED LITERATURE

COMPULSORY READING AND AVAILABILITY

[1.] Materials of lectures and practices, uploaded into TEAMS (TEAMS, Files, Class materials)

[2.] Materials of lectures and practices, uploaded into Moodle

[3.] Daryl L. Logan: A first course in the FINITE ELEMENT METHOD, Sixth edition, SI, 2016 USA, ISBN-13: 978-1-305-63734-4, library

[4.] R.C.Hibbeler, Structural analysis, ninth edition, section 6. 2015. ISBN-13: 978-0-13-394294-2

RECOMMENDED LITERATURE AND AVAILABILITY

[3.] ……

[4.] ……

[5.] ……