Course title: FEM APPLICATION IN THE ANALYSIS OF STRUCTURES

Course code	*Course status*	*Semester*	*Number of ECTS credits*	*Number of classes*
	Mandatory	*II*	*5*	*2P+1V+1L*

Study programs for which it is organized: Master studies – Study program Civil engineering - Structures, duration 4 semesters and 120 ECTS credits.

Conditionality to other subjects:

Course study objectives: Acquiring knowledge in the field of theory of structures.

Learning outcomes: After passing this exam the student will be able to:
1. Understand basic matrix relations and basic equations of linear theory of elasticity,
2. Understand the basics of finite element method theory,
3. Understand terms: discretization, nodal unknowns, finite elements, interpolation functions,
4. Apply the finite element method (i.e. to make the choice of finite elements and interpolation functions) depending on the engineering problem (plane load, bending of slabs, three-dimensional problem, shells, etc.), as well as to apply the method in structural dynamics,
5. Implement at least one finite element software (SAP, Tower, ANSYS, etc.).

Name and surname of professor and teaching assistant: ***Dr Marina Rakočević, Vasilije Bojović***

Teaching and learning methods: Lectures, practise, elaborate, consultations, additional classes and consultations before the final exam, tasks, seminar paper, colloquia, final exams.

Course content:

1st week of course	Historical development of FEM. Fundamentals on which FEM is based. Different models of FEM-bases.
2nd week of course	Analysis of FE, interpolation functions, stiffness matrix, geometric-static meaning.
3rd week of course	Equations of the FE system. Boundary conditions. Accuracy and convergence of solutions.
4th week of course	Two-dimensional problems. In plane state of stress and strain, axis-symmetry.
5th week of course	*COLLOQUIUM I*
6th week of course	Triangular finite elements. Stiffness matrices and equivalent load vector.
7th week of course	Rectangular finite elements. Isoparametric elements. Stiffness matrices and equivalent load vector.
8th week of course	Three-dimensional problems, forms of FE, interpolation functions.
9th week of course	Three-dimensional problems of symmetry.
10th week of course	Plate bending in the finite element method.
11th week of course	Force method models and hybrid models. Models according to Reissner-Midlin theory.
12th week of course	Thin shells. About models and elements for discretization. Triangular FE. Symmetric FE.
13th week of course	Finite element method in structural dynamics. Introduction to nonlinear analysis.
14th week of course	FEM-based software.
15th week of course	*COLLOQUIUM II*

Student obligations during course: Attendance at lectures and practises, making elaborate and seminary work, making assignments, taking a colloquium and final exam.

STUDENT WORKING LOAD

Weekly

5 credits x 40/30 = 6 hours and 40 min
Structure:
2 hours of lectures
2 hours of practise
2 hours and **40** minutes individual work including consultations

During the semester

Lectures and final exam: (6 hours and 40 min) x 16 = **106 hours and 40min**
Necessary preparations before the beginning of the semester (administration, enrollment, certification):
2 x (6 hours and 40 min) = **13 hours and 20 min**

Total workingload for course: 5x30 = 150 hours

Additional work for exam preparation in the remedial exam period, including taking the remedial exam from 0 to 30 hours (remaining time from the first two items to the total workload for the course 135 hours)

Workingload structure:
106 hours and 40 min (lectures)+13 h and 20 min (preparation)+30 h (additional work)

Literature: M.Sekulović, Metod konačnih elemenata, GK Beograd; K.J.Bathe, Finite element procedures in ingineering analysis; Vuksanović, Pujević,Teorija savijanja ploča; Carlos A. Felippa, Introduction to finite element methods, Department of Aerospace Engineering Sciences and Center for Aerospace Structures University of Colorado; V.P.Agrapov, Metod konačnih elemenata u statici, dinamici i stabilnosti konstrukcija

Forms of exams and grading:
The knowledge test is performed continuously during the semester and at the final exam. The maximum student can earn 50 or 100 points during the semester. The following is evaluated:

- Elaborate from 4,0 to 10,0 poins
- Colloquia 2x (from 10,0 to 20,0) or 2x(22,5 to 45,0) points
- Final exam from 22,5 to 50,0 points

The student is obliged to regularly work elaborate and seminary tasks according to the established program.
At the colloquia, the theoretical part of the exam and the tasks with the stated minimum and maximum number of points are taken orally or in writing.
At the final exam, an oral or written exam is taken with the entire material with the stated minimum and maximum number of points.
A passing grade is obtained when at least 50 points are collected.

Special notes for the course:

Name and surname of the professor who prepared the data: ***Dr Marina Rakočević***

Note: Additional information about the subject can be obtained from the course lecturer, teaching assistant, head of the study program and vice dean.