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| **University:** University of Žilina | |
| **Faculty:** Faculty of Mechanical Engineering | |
| **Course ID:** 2Y031 | **Course name:** Finite Element Method II |
| **Course obligation:** Compulsory **Completion:** Exam | |
| **Profile course:** yes **Core course:** yes | |
| **Form, extent and method of teaching activities:** | |
| Number of classes per week in the form of lectures, laboratory exercises, seminars or clinical practice | Lectures: 1 classes<br>Seminars: 0 classes<br>Lab.exercises: 3 classes |
| Methods by which the educational activity is delivered | Present form of education |
| Applied educational activities and methods suitable for achieving learning outcomes | **Lectures:**<br>interpretation with the support of multimedia (systematic theoretical approach to methods and relevant concepts, relationships and contexts in the field of non-linear structural analyses, using problem-based interpretation (application of the presented theory on simple and illustrative examples) with an interactive approach (engagement of students in the discussion).<br>**Exercises:**<br>with a focus on the practical mastery of the ANSYS computer system and the theoretical material covered in the lectures, supplemented by practical examples demonstrating the interdependence of the solved tasks with similar tasks in practice, the causes of the non-convergence of the solution discussed in detail with possible ways of remedying it.<br>Students have the possibility of individual consultations with all teachers of this subject. |
| **Number of credits:** 5 | |
| **Study workload:** 150 hours;<br>The total time required for the course is 150 hours per semester, of which 52 hours per semester are direct teaching and 98 hours per semester are reserved for independent study and independent creative activity of the student. | |
| **Recommended semester/term of study:** winter, 2. year | |
| **Study degree:** 2 | |
| **Required subsidiary courses:**<br>Prerequisites:<br>Co-requisites: | |
| **Course requirements:**<br>**Continuous assessment / evaluation:**<br>During the semester, 2 semester papers will be assigned, evaluated for 20 points, the maximum number of points during the semester is 40 points. The minimum number of points for the exam is 20 points.<br>**Final assessment /evaluation:**<br>The exam takes place in the form of a presentation of the results of solving back problems, and the student can get a maximum of 60 points, if excellent knowledge is demonstrated during the presentation of the results on the exam, the number of 60 points can be increased during the exam, but the total number of points for the semester cannot exceed 100.<br><br>The specific method of evaluating the student's work during the semester and the exam is specified at the beginning of the semester by the subject teacher. The final evaluation of the student's study results for completing the subject - expressed by the grade - is governed by § 9 of the Study Regulations for the 1st and 2nd degree of university studies of the University of Žilina in Žilina.<br><br>The summary assessment (max. 100 points = 100%) consists of the assessment of the results of work during the semester (max. 40 points = 40%) and the assessment of the exam result (max. 60 points = 60%). | |

**Resulting subject classification:**
Grade A: minimum 93 points
Grade B: minimum 85 points
Grade C: minimum 77 points
Grade D: minimum 69 points
Rating E: minimum 61 points
FX rating: less than 61 points
To enroll for an exam the student must have at least 20 points.

| Forms and methods of assessment | Predetermined weight % | Area of knowledge, skills and competence |
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| 1-2 intermediate tests | 40 % | professional knowledge, work with Ansys, independence |
| exam (theoretical and practical part + interview) | 60 % | professional knowledge - theoretical and practical part, presentation and defense of solved projects, discussion |

**Course outcomes:**
The student will understand and be able to explain the basic types of non-linear structural analyses. It has an overview of the possible types of boundary conditions in these analyses. Knows possible problems with the convergence of a solution and procedures for obtaining a convergent solution. After successful completion of the subject, he can recognize, formulate, solve and interpret problems of statics and dynamics of a non-linear flexible body when solving problems in practice. Based on the acquired knowledge, which he can use, he is able to formulate requirements for input material data for models of nonlinear material behavior and can apply them in technical practice, respectively. in future theoretical projects. He can use and implement the acquired knowledge in all engineering disciplines and create a basis for further study of mechanics.

**Course scheme:**
1. Introduction, sources of nonlinearities.
2. Material and geometric nonlinearities, examples.
3. Geometric nonlinearities, examples.
4. Basics of nonlinear continuum mechanics.
5. Scales of deformations and stresses.
6. Analysis of linear buckling and collapse of structures.
7. Material models.
8. Concepts of the theory of plasticity, criteria of plasticity.
9. Computational plasticity.
10. Viscoelastic and viscoplastic behavior of materials.
11. Modeling of hyperelastic materials.
12. Body contact analysis.
13. Summary of findings.

The contents of the exercises correspond to the lecture outline of the subject.

**Literature:**
Sapietová, A. – Žmindák, M. –Sága, M. –Lack, T. – Gerlici, J. – Dekýš, V.: Application of Computational and Experimental Methods in Machine Mechanics, Paerson, 2013.
Žmindák, M. – Grajciar, I.: Modelovanie a výpočty v metóde konečných prvkov. Žilina, 2003.
Madenci, E. - Guven, I.: The Finite Element Method and Applications in Engineering using ANSYS. Springer Science +Business Media, Inc. 2006.

**Instruction language:** english

**Notes:**

**Course evaluation:**
Total number of evaluated students: 41

| A | B | C | D | E | FX |
|---|---|---|---|---|---|
| 60.98 % | 2.44 % | 12.20 % | 21.95 % | 2.44 % | 0.00 % |

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| **Course teachers:**<br>Lecture: Ing. Pavol Novák, PhD.<br>Lecture: prof. Ing. Milan Sága, Dr.<br>Laboratory: Ing. Pavol Novák, PhD. |
| **Last updated:** 2022-01-17 14:11:03.273 |
| **Approved by:** prof. Ing. Milan Sága, Dr. |