Subject Title: Nonlinear Structural Analysis

Basic information on the subject	
Academic unit:	**Faculty of Civil Engineering**
Subject title:	**Nonlinear Structural Analysis**
Level:	**Master**
Subject status:	**Elected**
Year of studies:	**Firs Year, second semester.**
Number of classes per week:	**2+1**
Credits - ECTS:	**3**
Time / location:	**According to time table**
Teacher:	**Prof.ass. Dr. Ragip Hadri**
Contact details:	*e*-**mail:** ragip.hadri@**uni-pr.edu**
Course description:	Overview of the linear analysis. General knowledge of nonlinear analysis of the structures. Geometrical nonlinearity of the structures. Nonlinearity of building materials. Methods of solving nonlinear problems. Change of stiffness of the elements in non-elastic domain.
Course objectives:	Knowledge about nonlinear analysis of the structures, increase of competences of the students in the field of theory of structures. Effects of geometrical changes – geometrical nonlinearity and building material, their application in the structures. Values of these effects in the structures.
Expected learning outcomes:	After completion of the course the student is able to: - Know the basics of nonlinear analysis of the simple elements starting from the truss. - Treat one delicate problem according to the nonlinear analysis.

Workload that falls on the student (shall correspond with Student Learning Outcomes)			
Activity	**Class hours**	**Days / Weeks**	**Total**
Lectures	2	15	30
Theory / Laboratory work / Exercises	1	15	15
Practical work			
Preparation for an intermediate test			
Consultation with the teacher	1	3	3
Field work			
Test, seminar paper	2	3	6
Home work	1	3	3
Individual learning (in the library or at home)	1	4	4
Preparation for the final exam	1	2	2
Evaluation time (test, quiz, final			

exam)			
Projects, presentations, etc.	1	2	2
Add any other activity that is not on the chart ...			
Total			**75**

Teaching methods:	Lectures, exercises and seminars - Presentation of the lectures with computer and projector. - Explanations with tables, - Colaboration of the lecturer with the student during the lecture or exercises of the numerical examples.
Evaluation methods:	Assessment methods include a combination of the formative assessments. Participation in the lectures, seminar work, presentation of the work and final exam.

Basic literature:	1 .R.Hadri-Analiza -Jolineare e Strukturave
Additional literature:	Sh. Dunica , Neliarna analiza konstrukcija A.Nayfeh,P.Frank Pal, Linear and Nonlinear Struktural Mechanics. S.T.Mau, Fundamentals of Structural Analysis.

Curriculum development	
Week	**Lecture title**
Week 1:	*General description of the nonlinear analysis*
Week 2:	*Structural calculations of the truss element (linear and nonlinear analysis)*
Week 3:	*Models of nonlinear analysis of the structures (types of nonlinearities and formats of numerical nonlinear analysis of the structures))*
Week 4:	*Material nonlinearity (models – elastic – elastic nonlinear, elastoplastic and behavior after yielding)*
Week 5:	*Constitutive equations for the elastoplastic material*
Week 6:	*Geometrical nonlinearity: behavior large deflection – small deformation and behavior large deflection and large deformation.*
Week 7:	*Discretization and solving the finite elements*
Week 8:	*Analysis of the geometrical nonlinear problems with the Finite Element Method (nonlinear expressions, Stress tensors and trusses)*
Week 9:	*General formulation according to the FEM – truss under axial stress*
Week 10:	*Alternative formulation of the basic equations.*
Week 11:	*Methods of solving nonlinear problems – Incremental Method*
Week 12:	*Iterative Method – Newton-Raphson Method and modified Method of the Newton - Raphson*
Week 13:	*Mixed methods*
Week 14:	*Linear load-bearing elements – Matrix of stiffness of the geometrical nonlinear element – beam.*
Week 15:	*Presentation of the work*

Academic Policies and Code of Conduct
– Entrance in the classroom on time. Entrance with delay interrupts the learning process;
– Keeping silence and respecting the code of ethics;
– The student is not allowed to make more than 3 absences in lectures and exercises;
– Cellular phones and other electronical tools need to be switched off during the teaching process;
– Laptops and tablets are allowed to be used only in silence during exercises. Other activities such as checking personal emails or web searching in internet are not allowed.
– Using illegally the sources (pllagiate) is not allowed and punished by the code of ethics;
– The right to take the ECTS, and to enter the exam have the students who have positive assessment in seminar work, have been present during the lectures according to the norms and standards of the Faculty and have positive assessment in the exam.
Contact with the professor about subject issues is done only through official email.

Note: If the student during exercises is assessed under 50%, he/she will lose the right to enter the final exam. Assessment is done from 0 to 100%.