Insegnamento: FEM IN NONLINEAR STRUCTURAL ANALYSIS	
Modulo /i: Theoretical lectures and practical training	
CFU: 9	**SSD:** ICAR/08
Ore di lezione: 50	**Ore di esercitazione: 30**
LAUREA MAGISTRALE IN INGEGNERIA STRUTTURALE E GEOTECNICA - Anno di corso: I o II	
Obiettivi formativi: Aim of the course is to illustrate the theoretical aspects and the numerical techniques underlying the analysis, in the static and dynamic case, of structures exhibiting geometrical and mechanical nonlinearities.	
Contenuti: Examples of the most frequent nonlinear behaviours in structural analysis. Geometrical and mechanical nonlinearities. Solution techniques of nonlinear problems: secant and tangent methods - Newton method and its variants. Line-search and arc-length. Examples of applications of such techniques to the ultimate limit state analysis of arbitrarily shaped reinforced concrete sections subject to axial force and biaxial bending. One-dimensional finite elements with mechanical nonlinearities: models with concentrated (plastic hinge) and distributed (fiber models) nonlinearities. Nonlinear analysis of framed structures and related solution techniques. Nonlinear static analysis (pushover) of framed structures. Comparison between limit analysis and ultimate limit analysis of framed structures. Numerical integration of the equations of motion of nonlinear structural systems. Dynamic analysis of frame structures subject to imposed accelerograms (time-history). Some examples of stability problems. Static and energetic approaches to the stability of elastic structures. Critical points of the equilibrium paths of a structural model: limit points of nonlinear models and bifurcation points (eulerian critical load). Sensitivity of structural problems to imperfections. Axial, flexural and torsion-flexural stability of beams. Stability of trusses and frames. The P-Delta method. Solution of stability problems by FEM.	
Docente: Luciano Rosati	
Codice:	**Semestre: I**
Prerequisiti / Propedeuticità: Scienza delle Costruzioni (Solid Mechanics)	
Metodo didattico: Lectures, Tutorials, Seminars	
Materiale didattico : Lecture notes provided by the teacher.	
Modalità di esame: Oral exam	