

MODULE HANDBOOK

Academic year 2026/2027

SEMESTER 3	
Track 2	
Dynamics of Structures	6 ECTS
Theory and Analysis of Structures	9 ECTS
Seismic Retrofitting and Design of Structures	9 ECTS
Geotechnical Engineering for Land Protection	6 ECTS

Module #1	DYNAMICS OF STRUCTURES		
Information	Credit points: 6 ECTS	Workload: 51 contact hours	Mode: Compulsory
Instructor(s)	S. Lopez		
Content	The course develops structural dynamics for single- and multiple-degree-of-freedom systems and continuum models. Topics include Lagrange and Hamilton principles, analytical solutions, damping, modal analysis, eigenvalue problems and direct time integration. Finite element tutorials address beams, frames and plates, with applications to seismic response and wind-induced vibrations.		
Examination	Combined written/oral examination lasting approximately 90 minutes, assessing theoretical understanding and the development and testing of numerical models. The final grade is expressed out of 30.		
Requirement for examination	Concepts and methods of Calculus and Structural Mechanics. No formal prerequisite examination.		
Learning outcomes	Specific skills: - Model and analyse complex structures under dissipative, seismic and aeroelastic actions. - Apply numerical methods for structural dynamics and understand wave propagation in elastic domains. - Analyse vibration response using modal and time-integration methods. Transversal skills: - Develop and understand finite element algorithms. - Critically interpret numerical results and independently apply acquired knowledge to structural design.		

Module #2	THEORY AND ANALYSIS OF STRUCTURES		
Information	Credit points: 9 ECTS	Workload: 75 contact hours	Mode: Compulsory
Instructor(s)	G. Garcea		
Content	The course extends structural mechanics through finite element analysis, plate theory, and plasticity. Topics include beam elements, classical and shear-deformable plate theories, elastoplastic constitutive models, and the incremental evaluation of load-bearing capacity. Each topic is presented alongside its numerical formulation using the finite element method. Practical tutorials cover the development of MATLAB code for trusses, frames, and plates, as well as the use of ABAQUS for full-scale structural modeling.		
Examination	Oral examination lasting approximately 30-60 minutes, including discussion of a final project report and two or three questions on the programme. The oral test and report discussion contribute equally to the final grade, expressed out of 30.		
Requirement for examination	Good knowledge of the methods and analysis tools of Structural Mechanics. Basic knowledge of any programming language: MATLAB, Python, C++, Fortran. Submission of the final report is required before the oral examination. No formal prerequisite examination.		
Learning outcomes	Specific skills: - Model beams, plane stress/strain states, plates and shells in linear elasticity and elastoplastic analysis. - Apply finite element and nonlinear solution methods and assess safety using limit analysis. - Validate numerical models and report assumptions, limitations and conclusions. Transversal skills: - Solve structural mechanics problems using specialised software or self-developed tools. - Work in small groups, communicate with specialist and non-specialist audiences and study independently.		

Module #3	SEISMIC RETROFITTING AND DESIGN OF STRUCTURES		
Information	Credit points: 9 ECTS	Workload: 75 contact hours	Mode: Compulsory
Instructor(s)	F. Bencardino (lectures); R. Chimento (tutorials)		
Content	The course provides advanced methods for seismic design, safety verification and retrofitting. Topics include modelling and analysis of multi-storey buildings, slabs, beams, columns, stairs and shear walls; punching shear and strut-and-tie models; shallow/deep foundations and retaining structures. It covers bracing, energy dissipation and seismic isolation, and traditional and innovative strengthening techniques, with reference to Italian standards, Eurocodes and CNR guidelines.		
Examination	Individual oral examination, approximately 60 minutes, including presentation and discussion of the course project. Five questions cover the project (three) and other course topics (two). The final grade, out of 30, considers project completeness, accuracy and clarity and the oral examination.		
Requirement for examination	Good knowledge of the topics covered in the Structural Mechanics and Structural Engineering courses. A course project must be prepared for presentation at the examination. No formal prerequisite examination.		
Learning outcomes	Specific skills: - Design and verify structures in seismic zones according to Italian codes and Eurocodes. - Model structural members and details and validate finite element results using simplified models. - Apply strut-and-tie models. - Select materials and techniques for seismic retrofitting and structural regeneration. Transversal skills: - Solve structural problems independently, collaborate in groups and identify suitable construction materials and technologies.		

Module #4	GEOTECHNICAL ENGINEERING FOR LAND PROTECTION		
Information	Credit points: 6 ECTS	Workload: 51 contact hours	Mode: Compulsory
Instructor(s)	R. Cairo		
Content	The course applies geotechnical engineering principles to land protection. Topics include soil and rock strength, site investigations and geophysical field tests, ground classification and geotechnical models, landslides, subsidence and earthquakes. Advanced seismic slope stability methods and the seismic behaviour and design of retaining structures, underground works and earth dams are covered. Tutorials use specialist software and MATLAB for slope stability, seismic retaining-wall design and tunnel soil-structure interaction.		
Examination	Oral examination lasting 30-60 minutes, covering at least two programme topics and discussion of written technical reports with calculations. The oral test and report discussion contribute equally to the final grade, expressed out of 30.		
Requirement for examination	Good knowledge of the principles of Geotechnics. Written technical reports must be prepared for discussion at the examination. No formal prerequisite examination.		
Learning outcomes	Specific skills: - Apply geotechnical principles to assess land damage caused by natural hazards and human activities. - Analyse seismic slope stability and the behaviour of retaining structures, underground works and earth dams. Transversal skills: - Analyse complex problems and identify innovative intervention strategies. - Use advanced open-source and commercial software for geotechnical analysis.		