Course title: Earthquake Engineering and Structural Control

Course module (if applicable):

CFU: 9	**SSD:** ICAR/09
Lectures (hrs): 50	**Tutorials (hrs):** 22

TWO-YEAR MASTER DEGREE IN STRUCTURAL AND GEOTECHNICAL ENGINEERING - Year: I

Course objectives: Scope of the course is to provide the required background knowledge of structural dynamics and basic methodologies for the design of engineered structures in seismic zones, as well as to conceive structural control systems able to reduce vibrations induced by other sources (wind, human and ambient born, traffic, industrial machines, etc.).

Course contents:

Dynamics of elastic SDOF systems: free vibrations, steady-state and generic forced vibrations, response spectrum representation of input action - Dynamics of elastic discrete MDOF systems: periods and vibration modes, modal analysis technique - Dynamics of continuum systems: one-dimensional shear and flexural beams, wave propagation in a three-dimensional body - Dynamic testing of structures: free and forced vibration tests - Inelastic dynamic response of structures: method of analysis, local and global ductility, energy balance

Causes of earthquakes - Intensity and magnitude - Measurement instrumentation: seismometer, strong-motion accelerometer - Seismic waves – Amplification characteristics of surface waves and site response

Behavior of constructions materials under dynamic loading: concrete, steel, other materials – Dynamic analysis of building structures: torsional vibration of space structures – Behavior of reinforced concrete structures: interaction between concrete and steel (bond, confining effect of transverse reinforcement, buckling of reinforcing bars), flexural and shear behavior of members, shear walls, beam-column connections, lateral load resisting systems - Behavior of steel structures: local buckling under monotonic and cyclic loading, behavior of beam and columns under monotonic and cyclic loading, connections, bracings – Outlines of behavior of composite, masonry and timber structures

Earthquake resistant design: fundamental aseismic planning, static and dynamic analysis procedures, design earthquakes (response spectra and time histories), design of structural components (beams, columns, connections, shear walls, bracings, floor slabs) - Design of nonstructural elements, mechanical and electrical equipment - Aseismic design of foundations and retaining walls

Dynamic structural control: classification (passive, active, semi-active an hybrid control), energy dissipation devices (viscous, visco-elastic, hysteretic and friction dampers), isolation and filtering devices, tuned mass dampers and tuned liquid dampers, semi-active (oleodynamic, electrorheological and magnethoreological) and active devices, design of structural control systems

Instructor: Giorgio Serino

Code: 30334	**Semester:** 1st

Required/expected prior knowledge: Tecnica delle Costruzioni I.

Education method: The course is organized in theoretical lectures and practice sessions, during which numerous exercises and design problems will be considered and discussed. Every other week, a series homeworks will be assigned, to be completed within the subsequent two weeks.

Textbooks and learning aids: The slides and the lecture notes are available on the instructor's web site (http://www.docenti.unina.it/giorgio.serino), together with the homeworks and midterm exams given in previous years. As textbooks, reference can be made to the followings:

1. A.K. CHOPRA, *Dynamics of structures: theory and applications to earthquake engineering*, Prentice Hall, 3rd edition, 2006.

2. Y. BOZORGNIA AND V.V. BERTERO, *Earthquake engineering: from engineering seismology to performance-based design*, CRC Press, Taylor and Francis Group, 2009.

3. M. WAKABAYASHI, *Design of earthquake resistant buildings*, McGraw-Hill, 1986.

4. L. NUNZIANTE, S. CHANDRASEKARAN, G. SERINO, F. CARANNANTE, *Seismic design aids for nonlinear analysis of reinforced concrete structures*, CRC Press, Taylor and Francis Group, 2009.

5. T.T. SOONG, M.C. CONSTANTINOU, *Passive and active structural vibration control in civil engineering*, Springer Verlag, 2002.

Assessment: midterm examination, whose grade will be considered in the final score; final oral exam only after having completed all the homeworks, which have to be brought solved at the exam.