**SEISMIC AND STRUCTURAL ENGINEERING (12 credits)**

*prof. eng. Oreste S. Bursi*

**Objectives of Seismic Engineering (6 credits)**

This course provides a rational basis for the design of earthquake-resistant structures. Therefore, the course touches upon pertinent information from engineering seismology, geotechnical engineering, risk and reliability theory and architecture in addition to advanced topics related to the dynamics and the analysis and design of structures. The focus of the course is on buildings, bridges, industrial facilities and other types of structures that are allowed to respond in the inelastic range. The course emphasizes a theoretical understanding of the fundamental factors influencing and controlling the response of these structures, and on the development of effective design procedures capable of achieving specified performance goals.

### Course Outline

***1. Elements of structural dynamics pertaining to seismic engineering***

Equations of motion. Dynamic analysis of elastic single-degree-of-freedom (SDoF) elastic systems. Dynamic analysis of multiple-degree-of-freedom (MDoF) elastic systems. Inelastic response of SDoF systems. Dynamic analysis of multiple-degree-of-freedom (MDoF) inelastic systems.

## Suggested textbooks

A. Parducci, *Progetto delle costruzioni in zona sismica*, Liguori, 2006

L.Petrini, R. Pinho, G.M. Calvi, *Criteri di Progettazione Antisismica degli Edifici*, IUSS Press, 2004

A.K. Chopra, *Dynamics of Structures - Theory and Application to Earthquake Engineering*, Prentice Hall, 1995

***2. Elements of engineering seismology***

Origin-geographical distribution of earthquakes. Instruments for recording seismic motion. The magnitude and the intensity of the earthquake. Seismicity and seismic hazard. Response spectra.

*Suggested textbooks*

Newmark, E. Rosenblueth, *Fundamentals of earthquake engineering*, Prentice Hall, 1971.

G.G. Penelis e A.J. Kappos, *Earthquake-resistant concrete structures*, E & FN Spon, 1997.

***3. Seismic analysis and design***

Soil-structure interaction. Structural regularity. Modelling of the structure. Methods of analysis. Simplified modal response spectrum analysis. Multimodal response spectrum analysis. Second-order (P - Δ) effects. The influence of masonry infilled frames on the seimic behaviour of structures. Safety verifications of concrete members and joints; steel and steel-concrete composite members and joints; masonry elements. Applications of modern design codes.

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Design of repair and strengthening. Introduction to systems employing seismic isolation and energy dissipation devices; its advantages and disadvantages.

*Suggested textbooks*

A. Parducci, *Progetto delle costruzioni in zona sismica*, Liguori, 2006

E.Cosenza, G. Magliulo, M. Pecce, R. Ramasco, *Progetto Antisismico di Edifici in Cemento Armato*, IUSS Press, 2004

M. Dolce, D. Cardone, F.C. Ponzo, A. Di Cesare, *Progetto di Edifici con Isolamento Sismico*, IUSS Press, 2004

G.G. Penelis e A.J. Kappos, *Earthquake-resistant concrete structures*, E & FN Spon, 1997.

M. P. Petrangeli, *Progettazione e Costruzione di ponti*, Masson, 1998.

M.J.N. Priestley, F. Seible e G.M. Calvi, *Seismic Design and Retrofit of Bridges, Wiley, 1996.*

Ministero delle Infrastrutture, Norme Tecniche per le Costruzioni, Supplemento Ordinario delle Gazzetta Ufficiale della Repubblica del 4 febbraio 2008, n. 29.

Eurocode N. 8. *Design Provisions for Earthquake Resistance of Structures. Part 1: General rules, seismic actions and rules for buildings*

Eurocode N. 8. *Design Provisions for Earthquake Resistance of Structures. Part 2 - Bridges.*

***4. Fire analysis and design***

Performance-based evaluation of concrete frame structures subjected to fire loading. Performance-based evaluation of steel and steel-concrete composite frame structures subjected to fire loading.

*Suggested textbooks*

A. H. Buchanan, *Structural Design for Fire Safety*, Wiley and Sons, 2001.

EN 1991-1-2, Eurocode 1 – Actions on Structures. Part 1-2: General Actions – Actions on structures exposed to fire, 2004.

EN 1994-1-2, Eurocode 4 – Design of composite steel and concrete structures. Part 1-2: General rules – Structural fire design, 2005.

### Total number of lectures: 60 hours

Total number of classwork sessions: 10 hours

### Examination procedures

Students are requested to develop the design of a building.

The exam consists of an oral test.

### Prerequisite

Structural Dynamics.