Structural Dynamics and Seismic Engineering :

Calendar: 1st Year 1st Semester

Contact Hours15h00T +30h00 T/P++ 7h30 EL/OT

Syllabus:
Characterization of a dynamic problem. Dynamic action. Structural system discretization. Formulation of the equations of motion. One degree of freedom linear oscillator. Free and forced response of single degree of freedom systems. Periodic actions – harmonics and non-periodic actions (Duhamel integral). Determination of equivalent viscous damping. Multiple degrees of freedom linear systems. Characteristic equation. Vibration modes. Modal coordinates. Modal superposition method. Stodola method. Simplified Rayleigh method. Introduction to Earthquake Engineering. Basic concepts of seismology. Definition of seismic action. Analysis of seismicity. Seismic hazard analysis. Seismic zoning. Descriptive models of seismic actions. Local effects. Seismic structural analysis (2D and 3D). Analysis using modal response spectra. Simplified methods for seismic analysis. Seismic behavior of buildings. Earthquake-resistant structural conception. Capacity Design. Eurocode 8.

Intended learning outcomes of the curricular unit:
The main objective is to initiate students to the study of Structural Dynamics. Earthquake Engineering problems are studied based on previous knowledge. Basics of Engineering Seismology and Geotechnical Engineering are revised in seismic structural response context. At the end of the course students will acquire the ability to perform seismic analysis of structures in the context of Eurocode 8.

Demonstration of the syllabus coherence with the curricular unit's intended learning outcomes:
At first structures dynamics is studied with concern to any dynamic action. Dynamic response of a linear structure of one degree of freedom oscillator is studied in the time domain. The concepts of frequency (and period) natural vibration damping and dynamic amplification are also studied. Then this knowledge is extrapolated to dynamic systems of several degrees of freedom, also in the time domain. Problems of various degrees of freedom are transformed into the same number of problems with one degree of freedom in modal coordinates, using the modal superposition approach. This allows the student to make the connection between subjects. The problems of Earthquake Engineering are then addressed. Phenomena that influence seismic action are studied so that student acquires a global view of the problem. After he acquired the global view of the problem within the scope of Engineering Seismology and Earthquake Engineering Geotechnical, he will focus the study on seismic structural analysis. Problems are studied in frequency domain and seismic code context. This strategy allows the student to understand the dynamic structural behavior in general, and then to extrapolate that knowledge to the specific problem of the seismic action effects of, in a modern perspetive of Earthquake Engineering. Particular attention is paid to problems involving the seismic behavior of buildings, including the correlation of architectural typology, materials, and construction process used, with structural models and adopted seismic analysis methods. The whole learning process is accomplished, first by the theoretical study, and followed by the solution of problems that reflect the reality of professional activity. The study is in the context of Structural Eurocodes (particularly of Eurocode 8), and fulfill polytechnic goals.

Teaching methodologies (including evaluation):Overall exposure of materials using presentations (with animations and images) in Power-Point. Presentation of practical examples. Self-learning of theoretical and practical proposed problems. Use of computer programs for dynamic analysis of structures.
Classes will be held in computer rooms where students use computer programs to solve problems that were previously solved manually. In class-oriented guidance tutorial will discuss the proposed resolutions of problems, with guidance from teachers, but aimed at empowering learning. Some lessons are in the laboratory context. The evaluation is composed by three individual practical problems and one test. There will be a final exam, also.