UCLouvain

lgciv2042

2018

Dynamics of structures

4 credits	20.0 h + 15.0 h	Q2

Teacher(s)	Saraiva Esteves Pacheco De Almeida João ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	• Single and multi degree of freedom systems • Random vibrations and stochastic response of such systems • Introduction to seismic response of structures
Aims	**Contribution of the course to the program objectives:** AA1.1, AA1.2, AA1.3, AA2.1, AA2.2, AA2.3, AA2.4, AA3.1, AA3.2, AA4.2, AA4.4 **Specific learning outcomes of the course :** 1 • At the end of the course, the student will be able to: • Understand the field of application of different models: single-degree-of-freedom (SDoF) systems versus multi-degree of freedom (MDoF) systems, material and geometric linearity versus nonlinearity, static versus dynamic problems. • Write the equations of motion and understand solution methods for SDoF and MDoF systems, both for linear and nonlinear problems. • Characterize the dynamic properties of a SDoF system and compute its response under various loadings. • Characterize the dynamic properties of a MDoF system and compute its response under various loadings. • Characterize dynamically a system by the frequency response function, represent loading as a summation of harmonic components (Fourier transform), compute response to harmonic components (convolution in the frequency domain), transform sum of harmonic responses to time domain (inverse Fourier transform), understand consequences of sampling and aliasing errors. • Understand principles of seismic modelling and analysis of frame structures accounting for material and geometric nonlinearity. • Solve practical problems of different structures affected by critical vibrations (induced by people, machines, wind, traffic and construction activities, earthquakes) for serviceability and safety limit states. - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	Assignments, project, and written exam. Specific details indicated in the Moodle course page.
Teaching methods	Lectures based on course slides and exercise solving with student participation.
Content	• Singledegreeoffreedom (SDoF) systems: Free vibration, Response to harmonic and periodic excitations, Response to arbitrary, step, and pulse excitations, Numerical evaluation of dynamic response. • Multidegreeoffreedom (MDoF) systems: Natural vibration frequencies and modes, Free vibration, Damping in structures, Modal analysis and response of linear systems, Reduction of degrees of freedom, Numerical evaluation of dynamic response. • Introduction to random vibrations and stochastic response of linear SDoF and MDoF systems: Transfer functions, Relation between input and output autocorrelation functions, Power spectral density function, Narrowband systems, Frequency-domain method of response analysis. • Seismic Response: SDoF linear systems, SDoF nonlinear (inelastic) systems, MDoF linear systems; Extension of beam theory to model nonlinear material and nonlinear geometric behaviour; MDOF nonlinear systems.
Inline resources	Available on Moodle.
Bibliography	• Transparents du cours (disponibles sur Moodle) • « Dynamics of structures: Theory and Applications to Earthquake Engineering », Anil K. Chopra, Prentice Hall, 2012. • « Dynamics of structures », Ray W. Clough and Joseph Penzien, Computers & Structures, 2003. • « Vibration problems in structures: Practical guidelines », Hugo Bachmann et al., Birkhauser Verlag, 1995.
Other infos	• Assignments: use of Matlab scripts. • Project: use of commercial structural analysis software (e.g., SCIA and SeismoStruct).

Faculty or entity in charge	GC

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Electro-mechanical Engineering	ELME2M	4		
Master [120] in Mechanical Engineering	MECA2M	4		
Master [120] in Civil Engineering	GCE2M	4		