UCLouvain

lgciv2042

2019

Dynamics of structures

In view of the health context linked to the spread of the coronavirus, the methods of organisation and evaluation of the learning units could be adapted in different situations; these possible new methods have been - or will be - communicated by the teachers to the students.

4 credits	20.0 h + 15.0 h	Q1

Teacher(s)	Saraiva Esteves Pacheco De Almeida João ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	See Content
Aims	AA 1.1, AA 1.2, et AA 1.3 • 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. • Model and solve practical problems of different structures affected by vibrations (induced by earthquakes, machines, people, wind, traffic and construction activities) 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	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Assignments and written exam.
Teaching methods	**Due to the COVID-19 crisis, the information in this section is particularly likely to change.** Lectures based on course slides and exercise solving with student participation.
Content	• Linear singledegreeoffreedom (SDoF) systems: free vibration, damping values in structures, harmonic loading, evaluation of viscous damping and frequency, response to unit impulse and other forces, methods of solution, force transmission, response to ground motion, and vibration isolation. • Nonlinear SDoF systems: numerical time-domain integration (central difference, constant average acceleration and linear acceleration, Newmark), classification, stability, computational error, algorithmic damping, inelastic response (bilinear system). • Linear multidegreeoffreedom (MDoF) systems: free vibration of undamped systems (natural vibration frequencies and modes, modal and spectral matrices, orthogonality of mode shapes, normalisation, modal expansion), free vibration of damped systems, damping and energy dissipation in linear (and nonlinear) analyses, damping models, modal analysis, displacement response and element forces, restated form, modal contribution factors, modal responses and required number of modes, influence of dynamic response factor, applications (including ground motion). • Nonlinear multidegreeoffreedom (MDoF) systems: numerical time-domain integration, applications. • Frequency-domain method of response analysis.
Inline resources	Available on Moodle.
Bibliography	• « 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 Mechanical Engineering	MECA2M	5		
Master [120] in Civil Engineering	GCE2M	4		
Master [120] in Electro-mechanical Engineering	ELME2M	5		