Finite-Element Modelling and Numerical Methods (CEGE0038)

**Description**

Fundamentals of finite-element modelling and analysis: energy method (variational formulation), Galerkin weak formulation, choice of elements and shape functions (conformity, accuracy, efficiency); mesh generation; isoparametric elements; time-stepping methods (implicit methods, explicit methods, stability); finite-difference approximation of differential equations; applications to 1D and 2D models taken from various areas of engineering: structural mechanics and dynamics (beams, frames, torsion, plates, membranes, vibration), heat/fluid flow, soil mechanics, etc.; nonlinear problems; limitations of finite-element approximation: shear and membrane locking, reduced integration, hourglassing; use of finite-element software.

Learning outcomes:

- Knowledge of how to discretise one- and two-dimensional structures using different kinds of finite elements, how to assemble elements and how to solve the resulting equations (statics and dynamics and including nonlinear problems).

- Knowledge of how to obtain approximate solutions to boundary-value problems using the Galerkin and energy methods.

- Knowledge of limitations of finite-element approximations such as shear and membrane locking, reduced integration, hourglassing and nonconformity of finite-element meshes.


- Understanding the concept of natural frequency, natural mode shape and resonance in multi-degree-of-freedom systems.

**Key information**

- **Year**: 2020/21
- **Credit value**: 15 (150 study hours)
- **Delivery**: PGT L7, Campus-based
- **Reading List**: [View on UCL website](#)
- **Tutor**: Prof Gert Van Der Heijden
- **Term**: Term 2
- **Timetable**: [View on UCL website](#)

**Assessment**

- Written examination (main exam period): 70.0%
- Coursework: 15.0%
- Coursework: 15.0%

**Find out more**

For more information about the department, programmes, relevant open days and to browse other modules, visit [ucl.ac.uk](http://ucl.ac.uk)
- Understanding of how modern software packages can be used for finite-element modelling, with emphasis on how their output can be used in seismic design.

- Knowledge of applications to bars, beams, frames, torsion, heat flow, fluid flow, membranes, plates.
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Disclaimer: All information correct as of March 2020. Please note that aspects of the module may be subject to change. UCL will make best efforts to inform applicants of major changes.
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