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 2019/20
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

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written examination (main exam period)</td>
<td>70%</td>
</tr>
<tr>
<td>Coursework</td>
<td>15%</td>
</tr>
<tr>
<td>Coursework</td>
<td>15%</td>
</tr>
</tbody>
</table>

Find out more

For more information about the department, programmes, relevant open days and to browse other modules, visit ucl.ac.uk

Disclaimer: All information correct as of August 2019. Please note that aspects of the module may be subject to change. UCL will make best efforts to inform applicants of major changes.
- 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.
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**

<table>
<thead>
<tr>
<th>Year</th>
<th>2019/20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit value</td>
<td>15 (150 study hours)</td>
</tr>
<tr>
<td>Delivery</td>
<td>UGM L7, Campus-based</td>
</tr>
<tr>
<td>Reading List</td>
<td>View on UCL website</td>
</tr>
<tr>
<td>Tutor</td>
<td>Prof Gert Van Der Heijden</td>
</tr>
<tr>
<td>Term</td>
<td>Term 2</td>
</tr>
<tr>
<td>Timetable</td>
<td>View on UCL website</td>
</tr>
</tbody>
</table>

**Assessment**

- Written examination (main exam period): 70%
- Coursework: 15%
- Coursework: 15%

**Find out more**

For more information about the department, programmes, relevant open days and to browse other modules, visit ucl.ac.uk

**Disclaimer:** All information correct as of August 2019. Please note that aspects of the module may be subject to change. UCL will make best efforts to inform applicants of major changes.
- 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.