

Course Announcement: Spring 2020

## Finite Element Methods for Engineers

CEEN 406/506

3 Hours Credit

Time: MW 10:00-11:15, Room: CO 131

**Instructor: D.V. Griffiths**

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This course combines finite element theory with practical programming experience using programs described in a textbook co-authored by the instructor “*Programming the finite element method*”, by I.M. Smith and D.V. Griffiths, John Wiley and Sons, 5th ed., 2014 in which the multi-disciplinary nature of the finite element method as a numerical technique for solving differential equations is emphasized. Topics covered include simple ‘structural’ elements, beams on elastic foundations, solid elasticity, steady state and transient analyses. Students get a copy of all source code.

### Course Outline:

- a The finite element method is introduced via weighted residuals with examples of how differential equations are turned into matrix equations.
- b Initial applications are in the field of ‘structural analysis’. Pin-jointed and rigid jointed frames. Beams on elastic foundations.
- c Incorporation of boundary conditions and storage strategies for large sparse systems of equations.
- d Solution of the equations of elasticity in 2- and 3-dimensions. Prediction of deformations, stresses and moments in elastic media.
- e Solution of the equations of steady state fluid flow. Elliptic problems such as steady seepage or heat conduction.
- f Solution of transient problems with finite elements in space and finite differences in time. Time-dependent fluid or heat flow.

**Office Hours:**

**D.V. Griffiths:** CO 252; 1:00-2:00 pm MW and by appointment

**Textbook:** <https://www.wiley.com/WileyCDA/Section/id-831824.html>

**Assessment:**

Homework	20%	
1st exam	40%	TBA
2nd exam	40%	TBA

$A \geq 90\%$ ,  $B \geq 80\%$ ,  $C \geq 70\%$ ,  $D \geq 60\%$ ,  $F < 60\%$

- Homework will be due one week after being assigned.
- No late submissions will be accepted.
- All homework assignments must be word processed.
- Grades are rarely adjusted.
- All exams are open-book, open-notes.
- No make-up exams unless required by the Registrar.

**Provisional schedule:**

<b>Topic</b>	<b>Weeks</b>
Introduction. Weighted Residual Methods	1
Rod elements. Shape functions	2
Stiffness, mass and loads	3
Assembly, storage, fixed freedoms	4
Beam elements, translations, rotations	5
Beam on an elastic foundation (BOEF)	6
Buckling of beams	7
2-d elements	8
Solid elasticity	9
Stresses and strains	10
Element types. Pascal's triangle	11
Laplace's equation. Steady state problems	12
Transient analysis	13
Implicit and explicit methods	14