Course Announcement: Spring 2024

Finite Element Methods for Engineers

CEEN 406/506

3 Hours Credit

Time: TR 12:30-1:45 PM, Room: CO 210

Instructor: D.V. Griffiths

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This course combines finite element theory with practical programming experience in which the multi-disciplinary nature of the finite element method as a numerical technique for solving engineering problems is emphasized. Topics covered include structural systems involving beams and framed structures, 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; TR 2:00-4:00 and by appointment

Recommended Textbook:
Programming the Finite Element Method, I.M. Smith, D.V. Griffiths and L. Margetts, John Wiley, 5th ed, 2014. Online full text available at the Arthur Lakes Library.

Assessment:

Homework	1/3	
1st exam	1/3	TBA
2nd exam	1/3	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.
- High quality presentation is expected (word-processed or very neat hand work)
- Grades are rarely adjusted.
- All exams are open-book, open-notes.
- No make-up exams unless required by the Registrar.

Provisional schedule:

Topic	**Weeks**
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