

Course Announcement: Spring 2022

Finite Element Methods for Engineers

CEEN 406/506

3 Hours Credit

Time: TR 12:30-1:45 PM, Room: LB 121

Instructor: D.V. Griffiths

Coolbaugh CO 252, Tel: 273 3669, Email: d.v.griffiths@mines.edu

Web: www.mines.edu/~vgriffit

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; TR 2:00-4:00 and by Zoom appointment

Recommended Textbook:

wiley.com/en-us/Programming+the+Finite+Element+Method%2C+5th+Edition-p-9781119973348

Assessment:

Homework	30%	
1st exam	35%	TBA
2nd exam	35%	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