CARLETON UNIVERSITY
Department of Civil and Environmental Engineering
CIVE 5708 / ENVE 5402 – Finite Elements in Field Problems

Fall 2011

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Lectures: Tuesday 18:05 - 20:55 (Mackenzie 3356)

Office Hours: Tuesday 15:00 – 16:30 (or by appointment)

Objectives: The main goal of this course is to familiarize students with the finite element techniques to solve generic engineering problems. The course will be organized in a way that it will not be specific to a particular discipline, but it will have a general emphasis on the fundamentals. The applications of the theory to different disciplines will be presented throughout the term. No previous background in finite element method is required. Necessary mathematical theory will be provided in the course, but a basic knowledge of third year-level undergraduate engineering mathematics and physics is required. The course is not a training course for a specific software package; however, free student edition of a commercial FEM software may be used in some of the assignments and project.

Marking: Assignments (25%) + Project (25%) + Final Exam (50%)

Textbook: No textbook is required; however, reference texts will be suggested during the term.

Topics: Mathematical Background: Introduction to boundary value problems (BVP); mathematical representation of BVP; elliptic, parabolic and hyperbolic equations; strong and weak formulations; boundary conditions.

Introduction to FEM: Finite element (FE) approximation; discretization; one, two and three dimensional elements; shape functions; local, natural and area coordinate systems; numerical integration techniques; geometric interpretation of FE solutions; general review of FE formulation methods (Direct integration, Ritz, Weighted residuals); introduction to error analysis.

Steady-State Problems: One and two dimensional FE formulation by the Galarkin method; formulation of source/sink terms; derivative boundary conditions; applications.

Transient Problems: Galarkin formulation of transient problems, consistent formulation; lumped formulation; time-marching schemes; interpretation of transient solutions; numerical oscillations; applications.

Introduction to Coupled and Nonlinear Problems: FE formulation of coupled problems; solution techniques; applications; material nonlinearity; geometric nonlinearity; nonlinear boundary conditions; non-linear solution algorithms; convergence.

Note: Students with disabilities requiring academic accommodations in this course must register with the Paul Menton Centre for Students with Disabilities for a formal evaluation of disability-related needs. Registered PMC students are required to contact the centre, 613-520-6608, every term to ensure that I receive your letter of accommodation, no later than two weeks before the first assignment is due or the first in-class test/midterm requiring accommodations. If you require accommodation for your formally scheduled exam(s) in this course, please submit your request for accommodation to PMC by November 11, 2011, for December examinations.