Course Outline MATH 406 2019
Variational and Approximate Methods in Applied Mathematics

Prerequisites: One of MATH 307, CPSC 302 and either MATH 400 or 80% in M256, M257, or M316.

Credits: 3 Credits. 3 Credits. Math M406 is credit excluded with M401 and M405.

Learning Objectives: This course introduces fundamental tools of scientific computing such as interpolation, numerical integration, and schemes for solving initial value ODEs. We construct Green's functions for ODEs and PDEs and discuss the approximate solution of these equations by the Boundary Integral Method. We discuss Variational formulations of ODE and PDE boundary value problems and approximate methods based on these variational formulations such as the Finite Element Method.

Instructor: Anthony Peirce, **Office:** Mathematics Building 108, **Home Page:** http://www.math.ubc.ca/˜peirce

Office Hours: Monday: 12:30-1:30 am, Wed: 3-3:55 pm, Fri: 10-11 am.

Midterm Test Date: Wednesday, November 6th.

Assessment: The final grades will be based on homework (45%) (including MATLAB projects), an in-class midterm exam (15%), and a final exam (40%).

Assignments are to be submitted in hard-copy from at the designated class – no late assignments can be accepted.

Missing exams and homework deadlines: There are no make-up exams or assignments in this course. If you miss any of the exams or assignment deadlines for a valid reason, the weight of that assessment will be transferred to the final exam. Any student who misses an assessment must present to me within 72 hours the completed Department of Mathematics self declaration form (available on my website).

Notes: A comprehensive set of lecture notes will be posted online.

Useful Texts:

1. Burden and Faires, Numerical Analysis, 10 th Edition, Brooks Cole (2015).

2. Zauderer, Partial Differential Equations of Applied Math., Wiley-Interscience, 3 Ed. (2006).

3. Stakgold and Holst, Green's functions and Boundary value problems, Wiley, 3 Ed. (2011).

4. Crouch, S.L. and Starfield, A.M., Boundary Element Methods in Solid Mechanics, George Allen and Unwin, London, 1983.

5. Courant and Hilbert, Methods of Math. Physics Vol. 1 & 2.

6. Hildebrand, Methods of Applied Mathematics, Dover Books on Math., 1992.

Topics:

1.Course overview (1 lecture)

2. Introduction to numerical methods

 2.1 Interpolation (5 lectures)

 2.2 and Integration (5 lectures)

3. Boundary Value Problems for Ordinary Differential Equations

 3.1. Green's Functions for Boundary Value Problems (8 lectures)

 3.2. Variational methods and the Finite Element method (6 lectures)

4. Partial Differential Equations

 4.1 Elliptic Boundary Value problems

  4.1.1 The Finite Element Formulation for the Poisson Problem with triangular tessellation of arbitrary regions (3 lectures)

  4.1.2 Green's functions for Elliptic PDE (3 lectures)

5. Numerical solution of evolution equations (4 lectures)