Course Outline MATH 406 2026
Variational and Approximate Methods in Applied Mathematics

Prerequisites: One of MATH 307, CPSC 302 and either MATH 400 or 80% in M256, 257, 316, 358, MECH 358, PHYS 312

Credits: 3 Credits. Math M406 is credit excluded with MATH 401.

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

Course Canvas Page: https://canvas.ubc.ca/courses/151710

Lectures: Tuesday and Thursday in LSK 462 from 9:30-11 am.

Office Hours: Monday 10-11 am, Tuesday 11 am-12 noon, or Wednesday 10-11 in Math. 108..

Midterm Date: Thursday, March 26 th.

Assessment: The final grade will be based on regularly assigned homework or projects that will be posted on Canvas 45%, an in-class midterm exam (15%), and final exam (40%). The assignments will typically involve a significant MATLAB component. You should submit your solutions to Canvas in a legible .pdf file. No late assignments can be accepted.

Notes: A comprehensive set of written lecture notes is posted on the Canvas Page.

Useful Texts:

There is no one textbook that covers all the topics treated in this course. However, the following lists some classic textbooks that treat the various topics covered in the course:

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 Covered:

1. Introduction to numerical methods

 1.1 Interpolation (5 lectures)

 1.2 Integration (5 lectures)

 1.3 Numerical solution of initial value ODEs (3 lectures)

2. Boundary Value Problems for Ordinary Differential Equations

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

 2.2. Variational methods and the Finite Element method (5 lectures)

3. Partial Differential Equations

 3.1 Elliptic Boundary Value problems

  3.1.1 The Finite Element Formulation for the Poisson Problem with triangular tessellation of arbitrary regions (4 lectures)

  3.1.2 Green's functions and Boundary Integral formulations of Elliptic PDE (7 lectures)