

## UBC Math 401: Green's Functions and Variational Methods, Spring 2016

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**Course web page:** [www.math.ubc.ca/~wachs/Courses/M401/](http://www.math.ubc.ca/~wachs/Courses/M401/)

**Lectures:** M/W/F 12:00-1:00, MATH104

**References:** There is no specific required textbook for this course. Some notes will be posted on the course web page (more to come, see course web page). Some helpful notions can be found in *Calculus of Variations*, I.M. Gelfand & S.V. Fomin, Dover Publications.

### Tentative course outline/content:

#### 1. Green's functions for ODEs and PDEs

- (a) General notions on solving ODEs and PDEs
- (b) Introduction to generalized functions
- (c) Green's functions for ODEs
- (d) Boundary conditions and self-adjoint problems
- (e) Modified Green's functions and solvability condition
- (f) Green's functions and eigenfunction expansion
- (g) Green's functions for PDEs and free space Green's functions
- (h) Method of images for simple boundary conditions
- (i) General theory of Green's functions for Laplacian operator
- (j) Maximum principle
- (k) Green's functions by eigenfunction expansion
- (l) Green's functions for time-dependent problems: from (g) to (k) for the heat equation and the wave equation

#### 2. Variational Methods

- (a) Eigenvalue problems and the Rayleigh quotient
- (b) Bounds on eigenvalues
- (c) Euler-Lagrange equations
- (d) Constrained variational problems
- (e) Rayleigh-Ritz method

### Grading scheme (TBD):

- regular homework assignments (every 4-5 lectures): 20%
- mid-term test (date TBA): 30%
- final exam: 50%