

UBC Math 401: Green's Functions and Variational Methods, Winter 2020

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Course web page: www.math.ubc.ca/~wachs/Teaching/MATH401/math401-2019W2.html

Lectures: M/W/F 12:00-1:00, Buchanan B215

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

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):

- 8 homework assignments (one assignment every 4-5 lectures): 20%
- mid-term test (Friday before Spring break): 30%
- final exam: 50%