Department of Mathematics
Pomona College

Math 188. Topics in Applied Mathematics Fall 2017

Time and Place:	MWF 10:00 am - 10:55 am Millikan 2393.
Instructor:	Dr. Adolfo J. Rumbos
Office:	Andrew 2287.
Phone/e-mail:	ext. 18713 / arumbos@pomona.edu
Office Hours:	TuTh 9:00 am - 10:00 am or by appointment
Texts:	*Calculus of Variations (with applications to physics and Engineering* by Robert Weinstock (Dover, 1974). *Introduction to Partial Differential Equations and Hilbert Space Methods* by Karl E. Gustafson (Dover, 1999).
Prerequisites:	Multivariable Calculus, Linear Algebra and Differential Equations (Math 102 at Pomona, or equivalent course).

Course Description. The topic for this year is Variational Methods and Optimization. This course is an introduction to the calculus of variations and the variational approach in the theory of differential equations. The calculus of variations is a subject as old as the Calculus of Newton and Leibniz. It arose out of the necessity of looking at physical problems in which an optimal solution is sought; e.g., which configurations of molecules, or paths of particles, will minimize a physical quantity like the energy or the action? Problems like these are known as variational problems. Since its beginnings, the calculus of variations has been intimately connected with the theory of differential equations; in particular, the theory of boundary value problems. Sometimes a variational problem leads to a differential equation that can be solved, and this gives the desired optimal solution. On the other hand, variational methods can be successfully used to find solutions of otherwise intractable problems in nonlinear partial differential equations. This interplay between the theory of partial differential equations and the calculus of variations will be one of the major themes in the course.

Course Requirements. Reading assignments will be given according to the attached (tentative) schedule. Problem sets will be assigned and collected on an alternate basis. Students are strongly encouraged to work on every assigned problem. Students will also be expected to give a written and oral formal presentation on some topic of their interest related to the course material or some suggested one (see attached list of **special topics**).

Grading Policy. Grades will be based on the homework, two examinations (see attached schedule), plus a written and oral presentation. The grades will be computed as follows:

Homework	20%
Two exams	50%
Paper and presentation	30%

Math 188 **Fall 2017**

Tentative Schedule of Topics, Presentations and Examinations

Date		**Topic**
W	Aug. 30	Soap films and minimal surfaces.
F	Sep. 1	Variational problems
M	Sep. 4	Variational problems (continued)
W	Sep. 6	Normed linear spaces
F	Sep. 8	Continuous functionals on normed linear spaces
M	Sep. 11	Indirect Methods
W	Sep. 13	Gateaux derivatives and the first variation
F	Sep. 15	The Euler-Lagrange equations
M	Sep. 18	The Euler-Lagrange equations (continued).
W	Sep. 20	Examples
F	Sep. 22	Problems
M	Sep. 25	Convex functionals.
W	Sep. 27	Convex functionals (continued).
F	Sep. 29	Minimization of convex functions
M	Oct. 2	Convex minimization theorem
W	Oct. 4	Examples
F	Oct. 6	Problems
M	Oct. 9	Review
W	Oct. 11	**Exam 1**
F	Oct. 13	Problems
M	Oct. 16	*Fall Recess!*
W	Oct. 18	Direct methods
F	Oct. 20	Isoperimetric problems
M	Oct. 23	The variational approach
W	Oct. 25	Hilbert space methods
F	Oct. 27	The Dirichlet principle
M	Oct. 30	Solving the Dirichlet problem
W	Nov. 1	Solving the Dirichlet problem (continued)
F	Nov. 3	Problems

Date		Topic
M	Nov. 6	Eigenvalues of the Laplacian
W	Nov. 8	Sturm-Lioville problems
F	Nov. 10	Problems
M	Nov. 13	Examples
W	Nov. 15	Examples
F	Nov. 17	Problems
M	Nov. 20	Review
W	Nov. 22	**Exam 2**
F	Nov. 24	*Thanksgiving Recess!*
M	Nov. 27	Special Topic
W	Nov. 29	Special Topic
F	Dec. 1	Special Topic
M	Dec. 4	Special Topic
W	Dec. 6	Special Topic