MATH 5545 CRN 94360 Calculus of Variations, Fall 2012
McBryde 126, TuTh 11 a.m.–12:15 p.m.

INSTRUCTOR Joseph A. Ball, McBryde 554
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Office hours MW 2-4 p.m. and/or anytime by appointment.

TEXT AND OTHER RESOURCES:

- Daniel Liberzon, *Calculus of Variations and Optimal Control Theory: A Concise Introduction*, Princeton, 2012 (assigned text)
- John A. Burns, *Notes on Calculus of Variations With Modern Applications to Control Theory, Numerical Methods, and Differential Equations*, unpublished.
- George M. Ewing, *Calculus of Variations with Applications*, Dover, 1985
- Mike Mesterton-Gibbons, *A Primer on the Calculus of Variations and Optimal Control Theory*, American Mathematical Society 2009.
- Jürgen Jost & Xianqing Li-Jost, *Calculus of Variations*, Cambridge studies in advanced mathematics **64**, Cambridge Univ. Press, 1998
- J.L. Troutman, *Variational Calculus and Optimal Control: Optimization with Elementary Convexity, Second Edition*, Springer 1996 (used before)

SYLLABUS AND COURSE GOALS: A unified two-semester course in classical calculus of variations and modern optimal control. This includes the classical Euler-Lagrange necessary condition, Weierstrass-Erdmann corner condition, Weierstrass necessary condition, Legendre necessary condition, and Jacobi necessary conjugate-point condition from the classical calculus of variations to the Pontryagin maximum principle and Hamilton-Jacobi equation in optimal control theory. Motivating examples which inspired the historical development of the calculus of variations (brachistochrone problem, computation of geodesics, isoperimetric problems) will also be discussed.

HOMEWORK: Homework will be assigned and collected for grading regularly. You are encouraged to discuss with me and/or other students those problems which you find difficult, and are encouraged to do so prior to the original collection date. However, *the written work you turn in must be prepared independently* and represent your own understanding of the problem, even though that understanding may be the result of a lot of discussions with others. All work should comply with the University Honor Code. Make-up exams or late homework will only be accepted if permission was obtained *prior* to the original exam or due date.

EXAMS: There will be 1 in-class tests (date to be announced) plus a cumulative final exam (scheduled for **Monday December 17, 1:05–3:05 p.m.**).

GRADING: Your graded work will be combined according to the following percentages to obtain your final score: Homework = 200 points, 1 in-class tests (100 points), final exam (100 points) for 400 total points. Combined scores of 90%, 80% and 70% are guaranteed letter grades of A,B and C (respectively), but actual cutoffs may be lower. Credit will also be given for active class participation.

PREREQUISITES Some experience in Analysis, such as from MATH 4225-4226 Elementary Real Analysis.