PARTIAL DIFFERENTIAL EQUATIONS II
Variational Methods in PDE and Hamiltonian Systems Math 517,

This course, together with Math 516, is an introduction to the qualitative theory of partial differential equations. This part is an introduction to variational methods from minimization to min-max procedures and Morse theory. The ideas and techniques introduced in this course are broadly applicable in PDE, as well as in differential geometry, Hamiltonian mechanics, mathematical physics, and applied analysis.

Course Outline:

1. The direct method in the calculus of variations and applications to semi-linear PDE and sub-quadratic Hamiltonian systems
2. The mountain pass theorem and applications to semi-linear super-quadratic PDEs and Hamiltonian systems
3. Ljusternik-Schnirelman theory, equivariant homotopy and multiplicity.
4. Borderline variational problems (Prescribed curvature problems à la Yamabe)
5. Morse theory and Palais-Smale compactness (Hartree-Fock equations)

Useful Texts:

- Michael Struwe, *Variational Methods and Their Applications to Nonlinear Partial Differential Equations and Hamiltonian Systems*, Springer-Verlag, New-York, 1990.
- Lawrence C. Evans, *Partial Differential Equations*, AMS, 1998.
- David Gilbarg and Neil S. Trudinger, *Elliptic Partial Differential Equations of Second Order*, 2nd ed., Springer-Verlag, Classics in Mathematics series.
- Nassif Ghoussoub, *Duality and Perturbation Methods in Critical Point Theory*, Cambridge Tracts in Mathematics, Cambridge University Press, Cambridge, 1993.
- Ivar Ekeland, *Convexity Methods in Hamiltonian Mechanics*, Springer-Verlag, Berlin, 1990.
- J. Mawhin, M. Willem: *Critical point theory and Hamiltonian systems.* Applied Mathematical Sciences, **74**, Springer Verlag (1989).

Typical but not mandatory pre/co-requisite: Math 420/507 or equivalent. Math 516