Colloquium Series
Department of Mathematics and Statistics

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From Finite to Infinite Dimensions: Morse Theory and Applications to Partial Differential Equations

Abstract: Morse theory, a cornerstone of differential topology, establishes deep connections between the topology of smooth manifolds and the critical points of smooth functions defined on them. In finite-dimensional settings, it provides tools to analyze the structure of critical points, enabling the classification of manifolds and the computation of topological invariants. Extending these ideas to infinite-dimensional manifolds, such as function spaces, has paved the way for significant advances in the study of nonlinear partial differential equations (PDEs).

In this talk, I will explore the transition from finite-dimensional Morse theory to its infinite-dimensional counterpart. We will discuss the functional analytic framework required for such generalizations, focusing on Palais-Smale conditions, Morse indices, and variational approaches to PDEs. Special attention will be given to applications in the existence and multiplicity of solutions to semilinear elliptic equations and boundary value problems. Using critical point theory and minimax methods, we will illustrate how variational principles reveal multiple solutions.

This presentation aims to bridge foundational Morse theory with advanced techniques in nonlinear analysis, offering insights into how topological and variational methods can unravel the complexity of infinite-dimensional problems.

Wednesday, March 5, 1:05 – 1:50 pm in 4-1-314