



# COLLOQUIUM

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**A Confluence of Coding Theory, Combinatorics, and  
Commutative Algebra**

**Friday April 14th at 2:30pm in RT 1516**

*Bio:* Professor Ghorpade graduated with his Ph.D. in Mathematics from Purdue University in 1989. His research interests lie in Algebraic Geometry, Combinatorics, Coding Theory, and Commutative Algebra.

*Abstract:* We will outline some interactions between linear error correcting codes, combinatorial structures known as matroids, and certain notions and results in commutative and homological algebra. In particular, we will discuss a relatively recent work of Johnsen and Verdure where they associate a fine set of invariants, called Betti numbers, to linear codes. These are obtained by considering certain Stanley-Reisner rings corresponding to linear codes and studying the graded minimal free resolutions of these rings. It turns out that these Betti numbers determine several important parameters of linear codes such as generalized Hamming weights and generalized weight enumerators. However, computing Betti numbers is usually a hard problem. But it is tractable if the free resolution is "pure". We will review these developments and then outline an intrinsic characterization of purity of graded minimal free resolutions associated with linear codes. Further, we will discuss a characterization of (generalized) Reed-Muller codes that admit a pure resolution. We shall then turn to rank metric codes, which have been of some current interest, and discuss appropriate analogs of generalized Hamming weights in the context of rank metric codes. Motivated by a quest for a suitable definition of Betti numbers and minimal free resolutions associated with rank metric codes, we revisit a classical notion in combinatorial topology known as shellability, and then discuss its " $q$ -analogs" and some computations of homology. The talk is based on joint works with (i) Prasant Singh, (ii) Rati Ludhani, (iii) Trygve Johnsen, and (iv) Rakhi Pratihar and Tovohery Randrianarisoa. An attempt will be made to keep the prerequisites at a minimum.

**Refreshments will be served in RT 1517 at 2:10pm**