STUDIES ON CODES AND GRAPHS WITH ROSEBLOOM-TSFASMAN METRIC

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This thesis mainly concentrates on the significant role played by the new metric introduced by Rosenbloom and Tsfasman in diverse areas namely algebraic coding theory, metric graph theory and interconnection networks.

Most studies in algebraic coding theory deal with the Hamming metric. But this metric is not always well suited to the characteristics of the real channel, when the possible errors form patterns of a specific shape. A non-Hamming metric introduced by Rosenbloom and Tsfasman is well-suited in case of interference in several consecutive channels, starting from the last, which are occupied by a priority user.

This thesis introduces a new class of codes called circulant RT distance codes which are having high error detecting capacity. These codes defined on the space of all n x n matrices

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with entries from a finite field F_q. The RT weight properties of circulant matrices are discussed. An explicit formula to find the RT weight of a circulant matrix associated with a circulant vector is given. The minimum distance properties of these codes are also investigated. Further the existence of linear circulant codes are also investigated. Further the existence of linear circulant codes is given in this thesis. The error-detecting and erasure-decoding procedures for these class of codes are described.

A new notion called fuzzy RT distance codes is introduced in this thesis. Whether the distance between fuzzy RT distance codewords is dependent upon the dimension of the space as well as the RT distance between the non-fuzzy codewords on which they are based are investigated for the first time. This is done for symmetric, asymmetric and unidirectional error models. The results are compared and contrasted with the works in which Hamming metric is considered.

Further this thesis initiates the study of distance graphs on the space Z_nq with respect to the RT distance. The structure of these graphs were described explicitly. Various properties like chromatic number, components and degrees of vertices of these graphs are described. The automorphism groups of these graphs are given. Further the distance graphs on constant weight subspaces of Z_nq are studied and the various properties of these graphs are described.

For the first time in this thesis, the RT distance was defined on the space of permutations S_n. The various metric properties of this metric on S_n are described. Further the distance graphs on S_n with respect to RT metric are given. The chromatic number, degrees of vertices and components of these graphs are investigated. The automorphism groups of these distance graphs are given. The distance graphs on constant weight subspaces of S_n is given explicitly.

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Finally this thesis gives possible applications of the distance graphs on $Z_n q$ and S_n in the field of interconnection networks. Various algebraic and topological properties of these interconnection networks are also discussed. It is proved in this thesis that these networks have many desirable properties like symmetry and higher fault tolerance. An optimal routing algorithm for these interconnection networks is given.

Parts of this thesis have been published as the following papers.

1. *A Class of Cayley Graph Interconnection Networks based on Rosenbloom-Tsfasman Metric*, Proceedings of the 2009 International conference on Computer and Network Technology (ICCNT 2009), World Scientific, (2009), 66-72.

2. *Distance Graphs on Constant Weight Metric spaces with Rosenbloom-Tsfasman Metric*, Ultra Scientist, 22 (2010) 195-204.

3. *Some metrical problems on symmetric groups with Rosenbloom-Tsfasman metric*, Ultra Scientist, 22 (2010) 291-294.

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