

MZUZU UNIVERSITY

FACULTY OF EDUCATION

DEPARTMENT OF MATHEMATICS

SYLLABUS

1. **Programme** : Master of Science
2. **Subject** : Mathematics
3. **Course Title** : Error Correcting Codes 1
4. **Course Code** : MSC 5901
5. **Prerequisites** : EMT 3502 and EMT 3602
6. **Level of Study** : Five
7. **Duration** : 14 weeks
8. **Lecture Hours per week** : Two
9. **Tutorials/Seminars per week** : One
10. **Assessment** : Examination
11. **Aim(s) of the Course** : By introducing the basic topics in Coding Theory, to show how Coding Theory is a beautiful application of Abstract Algebra to the whole area of communications and information technology. To lay the foundations for deeper study and research in Error Correcting Codes.
11. **Objectives of the Course** : By the end of course the student should be able to define all the terms below, prove any results and discuss their significance.
12. **Topics of the course** : Source Coding and Channel coding:
Error Detection, Correction and Decoding.
Communication Channels
Maximum Likelihood Decoding
Hamming Distance
Nearest Neighborhood / Minimum Distance Decoding
Distance of a code
Linear Codes
Hamming Weight
Bases for linear codes
Generator Matrix of a code

Parity Check Matrix of a code
 Dimension of a code
 Dual of a code
 Equivalence of codes
 Encoding with a linear code
 Decoding of a linear code
 Syndrome Decoding
 Bounds in Coding Theory
 The Main Coding Theory Problem
 Sphere Covering Bound
 Gilbert Varshamov Bound
 Hamming Bound
 Perfect Codes
 Binary Hamming Codes
 Decoding of Binary Hamming Codes
 q-ary Hamming Codes
 Decoding of q-ary Hamming Codes
 Golay Codes
 Singleton Bound
 MDS Codes
 Plotkin Bound
 Non-linear Codes
 Hadamard Matrix Codes
 Nordstrom-Robinson Code
 Preparata Codes
 Kedrock Codes
 Griesmer Bound
 Linear Programming Bound
 Construction of codes
 Propagation Rules, lengthening, subcodes,
 shortening, puncturing, extending, direct sum, $(u, u+v)$ construction
 Reed-Muller Codes
 Subfield Codes
 Use of Maple Programming
 Use of Magma Programming

13. **Prescribed Texts:** Coding Theory, A first Course
 San Ling and Chaoping Xing
 Cambridge University Press 2004
 ISBN 0-521-52923-9

14. **Recommended Texts** :

[1] Notes on Coding Theory by
 J. Hall
 Department of Mathematics,

Michigan State, USA.

- [2] Introduction to Coding and Information Theory, by
Steven Roman
Springer-Verlag 1997

- [3] The Theory of Error Correcting Codes, by
F J MacWilliams and N J A Sloane
Elsevier Science B.V. 1977
ISBN 0-444-85193-3

- [4] Introduction to Coding Theory, by
J H van Lint
Springer-Verlag 1992
ISBN 0-387-54894-7
ISBN 3-540-54894-7 (Berlin)

- [5] A First Course in Coding Theory, by
Raymond Hill
Clarendon Press, Oxford, 1986
ISBN

- [6] Error-Correcting Codes and Finite Fields, by
Oliver Pretzel
Clarendon Press, 1992
ISBN 0-19-269067-1

- [7] Error Correcting Codes, a first course, by
Henk van Tilborg
Chartwell Brat, 1993
ISBN 0-86238-338-2

- [8] Elements of Algebraic Coding Theory
Lekh R. Vermani
Chapman and Hall, London, 1996
ISBN 0-412-57380-6

- [9] Maple 5 Learning Guide
by K.M. Heal, M.L. Hansen and K.M. Rickard
Waterloo Maple

- [10] Maple 6 Learning Guide
by K.M. Heal, M.L. Hansen and K.M. Rickard
Waterloo Maple
ISBN 1-894511-00-X

- [11] Maple 5 Programming Guide
by M.B. Monagan, K.O. Geddes, K.M. Heal
S.M. Vorkoetter and G. Labahn.

Waterloo Maple

- [12] On-line manual of the Maple software
- [13] On-line manual of the Magma software.