# Course content for MT3610/MT4610, Error-Correcting Codes

**Prerequisites:**
MT1820 or MT2800

**Aims:**
To provide an introduction to the theory of error correcting codes employing the methods of elementary enumeration, linear algebra and finite fields.

**Learning outcomes:**
On completion of the course, students should be able to:

- calculate the probability of error of the necessity of retransmission for a binary symmetric channel with given cross-over probability, with and without coding;
- prove and apply various bounds on the number of possible code words in a code of given length and minimal distance;
- use MOLSs and Hadamard matrices to construct large linear codes of certain parameters;
- reduce a linear code to standard form, finding a parity check matrix, building standard array and syndrome decoding tables, including for partial decoding;
- MT4610: Demonstrate a breadth of understanding appropriate for an M-level course.

**Course content:**
**Basic theory of coding**: Words, codes, errors, t-error detection and t-error correction. The Hamming distance in the space $V_n(q)$ of n-tuples over an alphabet of q symbols (with emphasis on $(Z_2)^n$). Probability calculations.

**The main coding theory problem:** Construction of small binary codes. Rate of a code. Equivalence of codes. The Hamming, Singleton, Gilbert-Varshamov and Plotkin bounds. Puncturing a code. Perfect codes. Hadamard codes and Levenshtein's theorem. Codes based on mutually orthogonal latin squares (MOLS).
**Linear Codes**: Linear codes as linear subspaces of V(nq). Generator and parity check matrices, standard array and syndrome decoding, incomplete decoding. Dual of a code. Hamming codes.