# Course content for MT5441, Channels

## **Prerequisites:**

UG courses in probability and algebra

## Aims:

To investigate the problems of data compression and information transmission in both noiseless and noisy environments.

## Learning outcomes:

- 1. State and derive a range of information-theoretic equalities and inequalities;
- 2. Explain data-compression techniques for ergodic as well as memoryless sources;
- 3. Explain the asymptotic equipartition property of ergodic sources;
- 4. Understand the proof of the noiseless coding theorem; define and use the concept
- of channel capacity of a noisy channel; explain the noisy channel coding theorem;
- 5. Understand a range of further applications of the theory.
- 6. Demonstrate independent learning skills

## Course content:

**Entropy**: Definition and mathematical properties of entropy, information and mutual information.

**Noiseless coding**: Memoryless sources: proof of the Kraft inequality for uniquely decipherable codes, proof of the optimality of Huffman codes, typical sequences of a memoryless source, the fixed-length coding theorem.

**Ergodic sources**: entropy rate, the asymptotic equipartition property, the noiseless coding theorem for ergodic sources. Lempel-Ziv coding.

**Noisy coding**: Noisy channels, the noisy channel coding theory, channel capacity. **Further topics**, such as hash codes, or the information-theoretic approach to cryptography and authentication.