EE1 and ISE1 Communications I

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Lecture one
Course Aims

To introduce principles of communication systems and methods used in modulating and demodulating signals in order to carry information from a source to a destination.
Recommended text book

B.P Lathi “Modern Digital and Analog Communication Systems”
Oxford University Press

- Highly recommended.
- Well balanced book.
- It will be useful in the future.
- Slides based on this book, most of the figures are taken from this book.
Handouts

- Copies of the transparencies
- Problem sheets and solutions
- Everything is on the web http://www.commsp.ee.ic.ac.uk/~pld/teaching/
Syllabus

- Fundamentals of Signals and Systems
  - Energy and power
  - Trigonometric and Exponential Fourier Series
  - Fourier transform
  - Signal Transmission through a Linear System
Syllabus (continued)

• Modulation
  – Amplitude modulation: DSB, Full AM, SSB
  – Angle modulation: PM, FM

• Transmission Lines
  – Signal propagation in a transmission line
  – Signal reflection in a transmission line

• Advanced Topics: Digital communications, CDMA, UWB
Three examples of communication systems
Another example of Communication Systems...

From the movie 'The Blues Brothers'
A **source** originates a message, such as a human voice, a television picture, a teletype message.

The message is converted by an input **transducer** into an electrical waveform (**baseband signal**).

The **transmitter** modifies the baseband for efficient transmission.

The **channel** is a medium such as a coaxial cable, an optical fiber, a radio link.

The **receiver** processes the signal received to undo modifications made at the transmitter and the channel.

The **output transducer** convert the signal into the original form.
Communication Systems
Analog and digital messages

- Messages are digital or analogue.

- Digital messages are constructed with a finite number of symbols. Example: a Morse-coded telegraph message.

- Analog messages are characterized by data whose values vary over a continuous range. For example, the temperature of a certain location.
Digital Transmission

Digital signals are more robust to noise.
An analog signal is converted to a digital signal by means of an analog to digital (A/D) converter.
A/D conversion

The signal $m(t)$ is first sampled in the time domain. The amplitude of the signal samples $m_s(kT)$ is partitioned into a finite number of intervals (quantisation).
Signal sampling

![Diagram showing signal sampling with quantized samples of m(t) and allowed quantization levels.](image-url)
The sampling theorem states that if the highest frequency in the signal spectrum is $B$, the signal can be reconstructed from its samples taken at a rate not less than $2B$ sample per second.
What did we learn today?

- The main elements of a communication systems
- The importance of the Fourier transform
- Concept of signal bandwidth
- Analog and digital signals.