

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/>

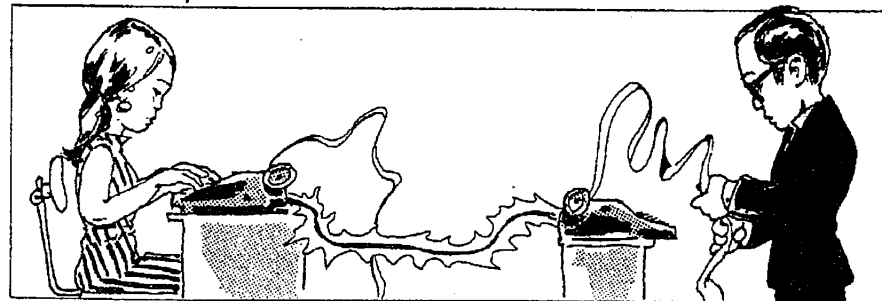
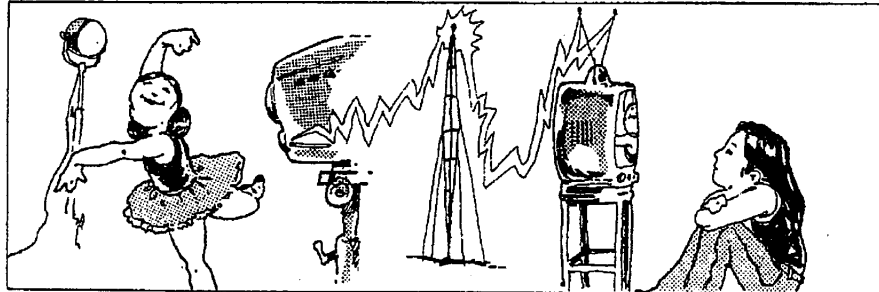
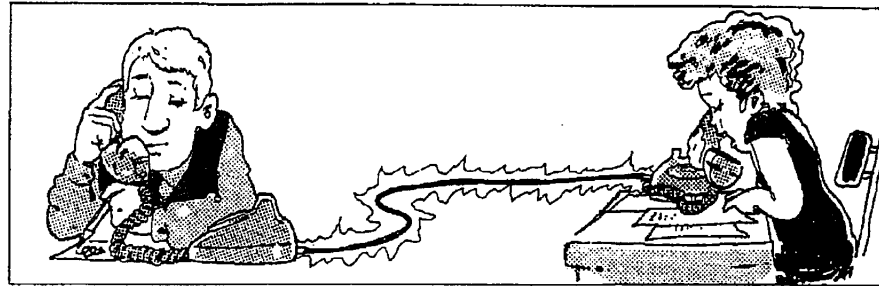
Syllabus

- 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'

Communication Systems

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**).

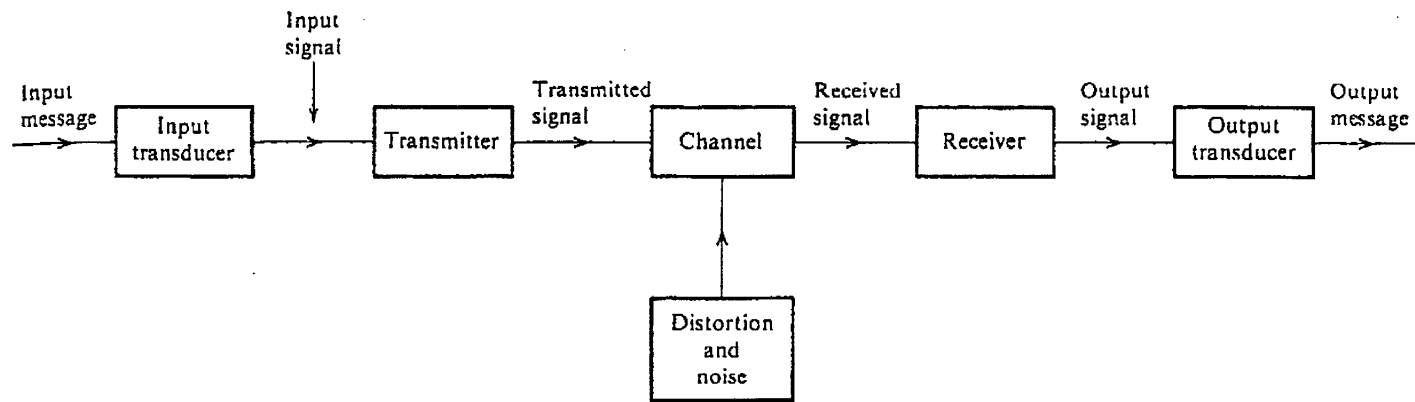
The **transmitter** modifies the baseband for efficient transmission.

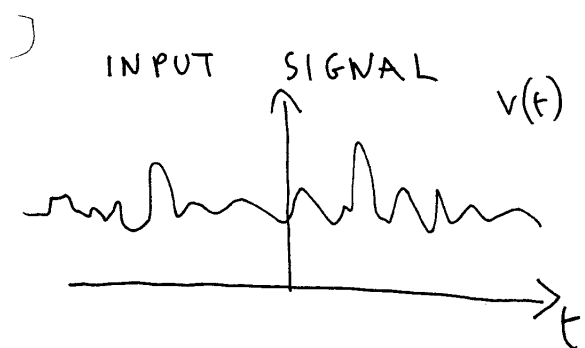
The **channel** is a medium such as a coaxial cable, an optical fiber, a radio link.

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

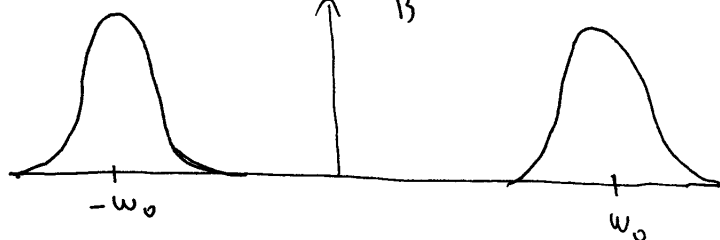
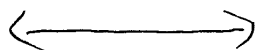
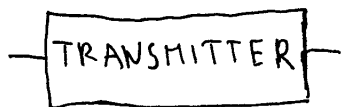
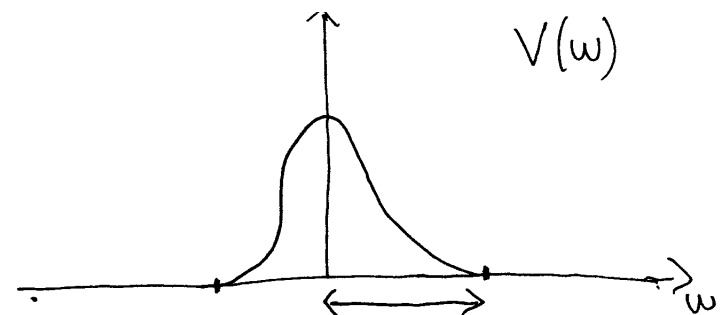
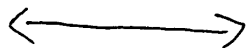
The **output transducer** convert the signal into the original form.

Communication Systems

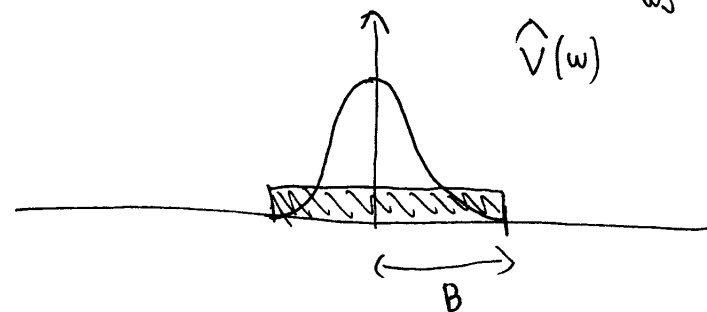
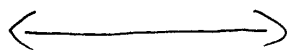
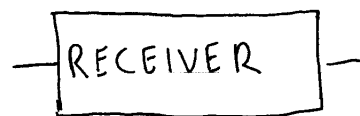
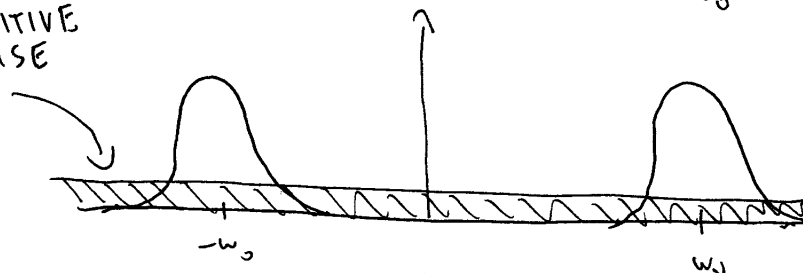




FOURIER TRANSFORM



ADDITIVE NOISE



Analog and digital messages

- Message 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.

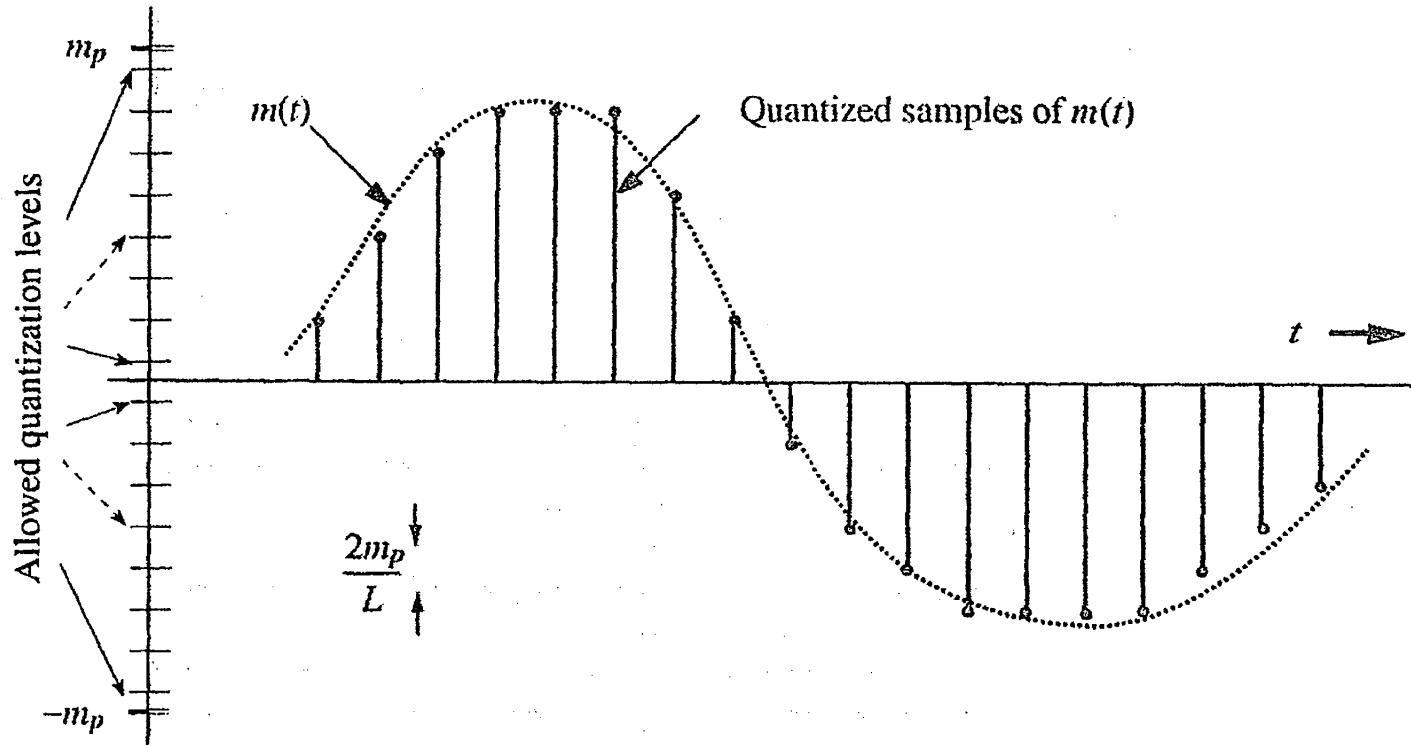


A/D conversion

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



Sampling theorem

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.