EE343
Introduction to Communications
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Analog Communication System

- Input transducer
- Transmitter
- Channel
- Receiver
- Output transducer

- m(t) input signal
- x(t) transmitted signal
- y(t) received signal
- \( \hat{m}(t) \) output signal

Additive noise & distortion
Digital Communication System

Input Message (source) → Source Encoder → Channel Encoder → Transmitter → Channel (>Additive noise & distortion) → Receiver → Output Message (destination)

Source Encoder: $m_k$ → Channel Encoder: $c_k$ → Transmitter: $x_k$ → Channel: $y_k$ → Receiver: $r_k$ → Source Decoder: $\hat{m}_k$
Digital Communication Blocks

- **Source encoder/ decoder**: convert input message into digital stream with minimum redundancy, recover without ambiguity. Compression (lossy/ lossless)
- **Channel encoder/ decoder**: add redundancy to protect information against channel noise and distortion, recovery without ambiguity
- **Transmitter/ receiver**: modify signal for transmission over channel
- **Physical channel**: telephone (coaxial cable), radio link, optical fiber. Waveform channel for digital communication system with each symbol corresponding to an analog waveform
Digital Communication Advantages

• Regeneration
• Computers
• Integrated circuits, DSP chips
• Integration of different traffic types
• Security
• Performance
I) Fourier Analysis (EE315 Review)

A) Motivation

- Frequency domain convenient for analyzing communication systems
- Sinusoids are basis functions (building blocks) for Fourier Analysis
- Sinusoids are eigenfunctions for LTI systems
- Sinusoids can carry information in amplitude, phase or frequency: \( x(t) = A(t) \cos(2\pi f_0 t + \Phi(t)) \)
Modulation Example