ECE 421: Telecommunications I

IN

ODE and Transfer Function

- Describe key properties of LTI systems
  - Transfer functions
  - Impulse response
  - Complex frequency
- Understand connections between transfer functions, poles and zeros, impulse response, complex frequency response, and ODE

Fourier Analysis

- Analyze spectral components of periodic inputs and outputs of systems
- Understand complex spectra of aperiodic and periodic continuous time signals
- Compute transforms for standard pulses

Block Diagrams

- Determine behavior of a system built of other interconnected linear systems

Simulation Analysis

- Analyze systems in time and frequency domain using MATLAB and Simulink tools

Random Variables

- Compute pmf, pdf, cdf, characteristic functions, and moments
- Compute pdf for functions of independent random variables

Pre-requisites

- ECE303 or STAT303 minimum grade of C; ECE312 with a minimum grade of C

Concepts:

- Modulation:
  - Amplitude modulation (AM)
  - Double sideband modulation (DSB)
  - Single sideband modulation (SSB)
  - Frequency modulation (FM)
  - Phase modulation (PM)
- Demodulation:
  - Envelope detector
  - Quadrature demodulator
  - Phase-locked loop
- Sampling and reconstruction:
  - Sampling theorem
  - Aliasing
- Quantization techniques:
  - Pulse amplitude modulation (PAM)
  - Pulse-code modulation (PCM)
  - Differential PCM
- Baseband data transmission:
  - Inter-symbol interference
  - Equalization
- Digital band-pass modulation:
  - Amplitude-shift keying (ASK)
  - Frequency-shift keying (FSK)
  - Phase-shift keying (BPSK and QPSK)
  - Quadrature amplitude modulation (QAM)
- Noise in communication systems:
  - Signal to noise ratio analysis

Applications:

- Digital communications
- Channel modeling
- Information transmission
- Estimation and detection

OUT

Bandwidth Analysis

- Analyze the bandwidth of a communication system with analog modulation schemes, including AM, DSB, SSB, FM and PM schemes

Sampling and Quantization

- Understand Nyquist sampling rule and the effect of sampling in the frequency domain
- Analyze quantization error and bit rate of a uniform quantizer
- Understand the design concerns of advanced quantizers in the context of joint quantization and modulation design

Equalization and Modulation

- Understand symbol waveform design for inter-symbol interference avoidance
- Understands key parameters of an eye diagram.
- Design a zero-forcing equalizer
- Understand the basic baseband and passband modulation schemes such as PAM, PCM, ASK, PSK, FSK, and QAM
- Compute error probability for a digital communication system

Basic Digital System Design

- Follow the basic diagrams to design a standard digital communication system to deliver a continuous-time signal waveform from a transmitter to a receiver

Random Signals and Noise

- Understand basics of random signals and noise
- Analyze signal to noise ratio of an analog-modulated communication system

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