

# EE558 - Digital Communications

## Lecture 1: Introduction & Overview

Dr. Duy Nguyen



SAN DIEGO STATE  
UNIVERSITY

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*Leadership Starts Here*

# Outline

1 Course Information

2 Introduction to Digital Communications

## Administration

### ■ Hours and Location

- ▶ Lectures: TTH 12:30 – 13:45
- ▶ Location: SH-127
- ▶ Office hours: Tue 14:00 – 16:00 or by email appointment

### ■ Course webpage:

<http://engineering.sdsu.edu/~nguyen/EE558/index.html>

### ■ Instructor: Dr. Duy Nguyen

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- ▶ Phone: (619) 594 2430
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- ▶ Webpage: <http://engineering.sdsu.edu/~nguyen>

### ■ Grader: Ms.Srilakshmi Alla

- ▶ Email: [shrilaksmialla94@gmail.com](mailto:shrilaksmialla94@gmail.com)

# Syllabus

## ■ Prerequisite

- ▶ EE 458 – Analog and Pulse Communication Systems
- ▶ Knowledge of MATLAB programming

## ■ References

1. B. Sklar, *Digital Communications: Fundamentals and Applications*, 2nd Ed., Prentice Hall, 2001.
2. J. Proakis, *Digital Communications*, 4th Ed., McGraw-Hill, 2000.

## ■ Homeworks: Bi-weekly, Total: 7 (6 best will be chosen). Late submission: maximum 1 day, 20% score deducted

## ■ Assessments: only textbooks, slides and lecture notes are allowed in Quizzes and Exams

- ▶ Homeworks: 20%
- ▶ 3 Quizzes: 15% (25-minute each)
- ▶ 2 Midterm Exams: 30% (1-hour and 15-minute each)
- ▶ Final Exam: 35% (2-hour)

## Syllabus

Week	Day	Task	Week	Day	Task
1 Aug 29	TU	First day of class	9 Oct 24	TU	Quiz 2
	TH			TH	
2 Sep 5	TU	HW1 out	10 Oct 31	TU	HW5 out, HW4 due
	TH			TH	
3 Sep 12	TU		11 Nov 7	TU	Midterm Exam 2
	TH			TH	
4 Sep 19	TU	HW2 out, HW1 due	12 Nov 14	TU	HW6 out, HW5 due
	TH			TH	
5 Sep 26	TU	Quiz 1	13 Nov 21	TU	Thanksgiving
	TH			TH	
6 Oct 3	TU	HW3 out, HW2 due	14 Nov 28	TU	HW7 out, HW6 due Quiz 3
	TH			TH	
7 Oct 10	TU	Midterm Exam 1	15 Dec 5	TU	
	TH			TH	
8 Oct 17	TU	HW4 out, HW3 due	16 Dec 12	TU	HW7 due Course Summary
	TH			TH	

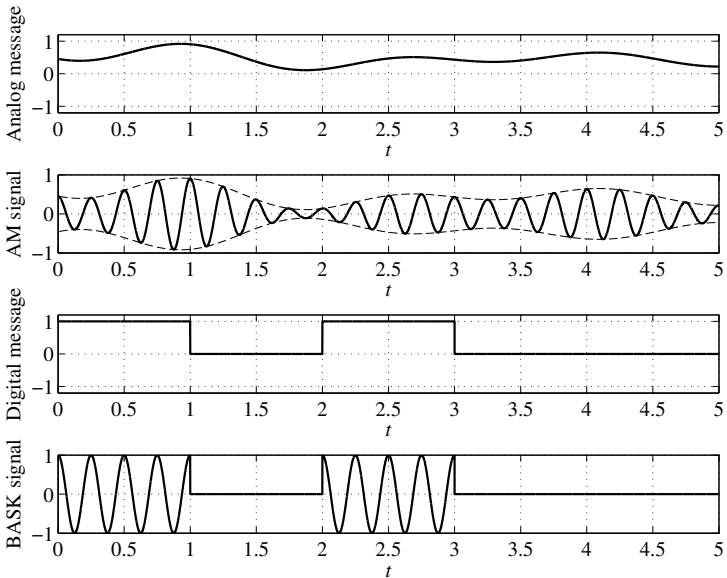
## Topics to Cover

- Related Background
  - ▶ Signals and systems
  - ▶ Probability and random processes
- Sampling and quantization techniques
- Noise figures and noise temperature of systems
- Communication link analysis and link budgets
- Baseband binary modulation techniques
- Optimum receiver design and performance
- Communication over band-limited channels (if time permits)
- Equalization and multi-carrier transmission (if time permits)

# Outline

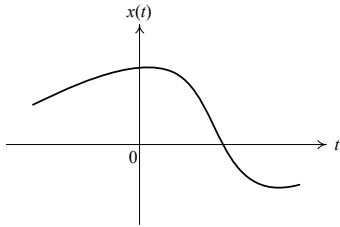
- 1 Course Information
- 2 Introduction to Digital Communications

## Analog and Digital Amplitude Modulations

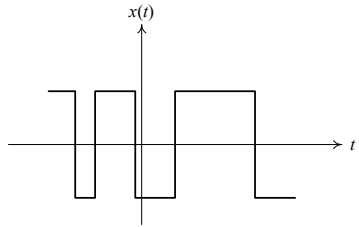




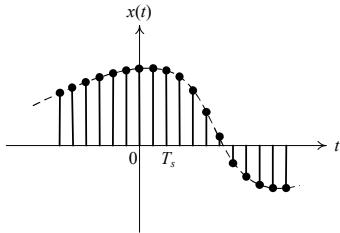
# What is Digital Communication?



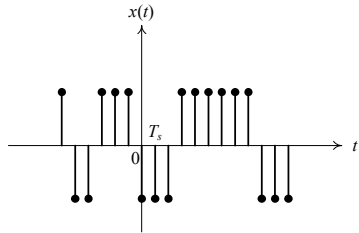
(a)



(b)

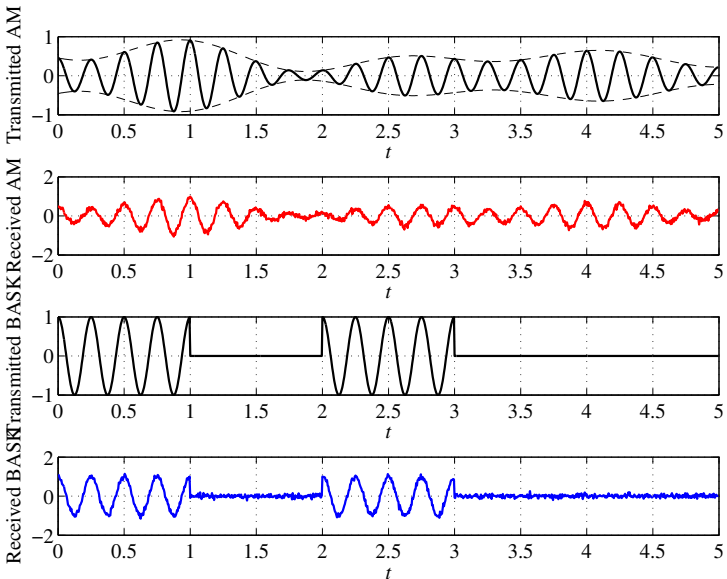


(c)

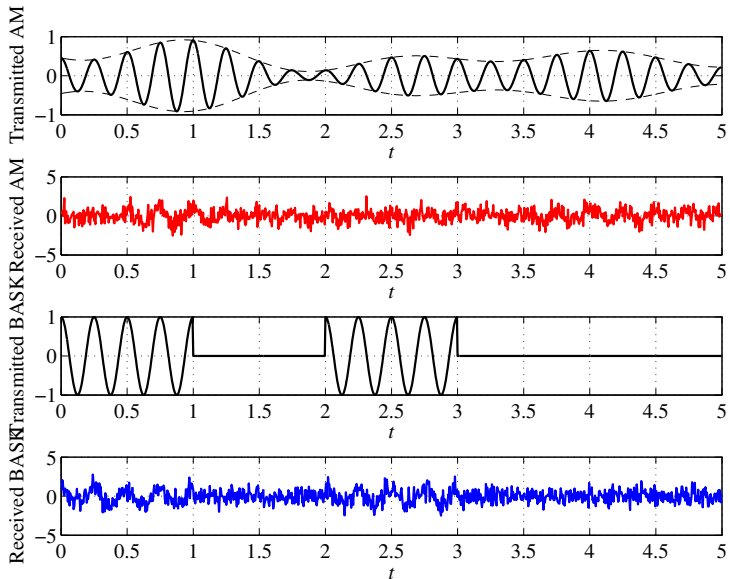


(d)

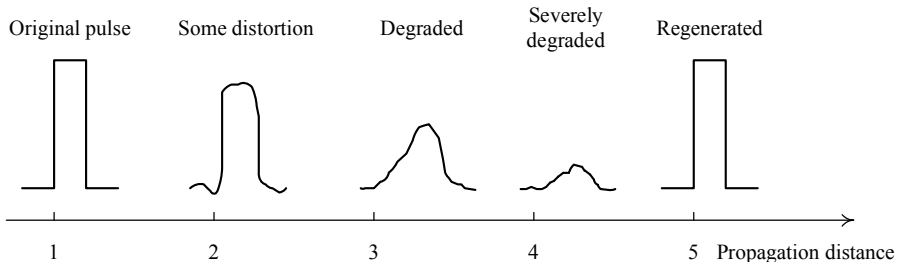
## Why Digital Communications?



## Why Digital Communications?

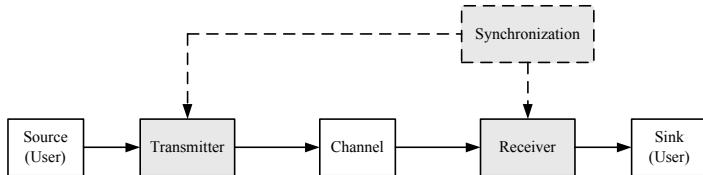


## Regenerative Repeater in Digital Communications

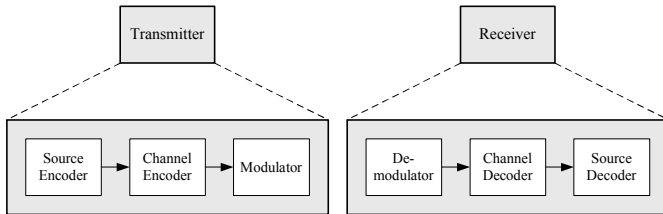


- **Digital communications:** Transmitted signals belong to a finite set of waveforms → The distorted signal can be recovered to its ideal shape, hence removing all the noise
- **Analog communications:** Transmitted signals are analog waveforms, which can take infinite variety of shapes → Once the analog signal is distorted, the distortion cannot be removed

# Block Diagram of a Communication System



(a)



(b)

**Note:** “Synchronization” block is only present in a digital system

## Digital vs. Analog

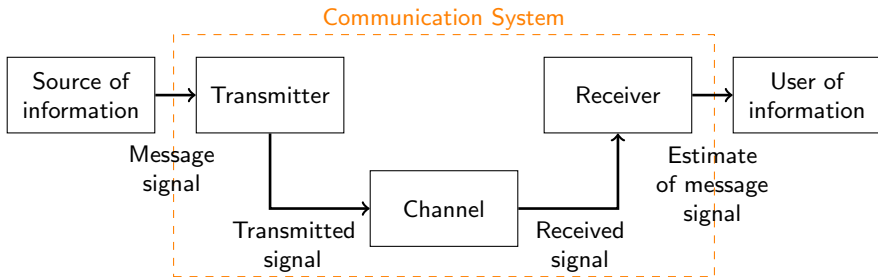
### Advantages:

- Digital signals are much easier to be regenerated
- Digital circuits are less subject to distortion and interference
- Digital circuits are more reliable and can be produced at a lower cost than analog circuits
- It is more flexible to implement digital hardware than analog hardware
- Digital signals are beneficial from digital signal processing (DSP) techniques

### Disadvantages:

- Heavy signal processing
- Synchronization is crucial
- Larger transmission bandwidth
- Non-graceful degradation

# Digital Communications



- The main objective of a communication system is the transfer of information over a channel
- Digital communication: transmitted signals belong to a finite set of waveforms
- Estimate of message signal: decision-making regarding the digital meaning of that waveform
- Performance is usually expressed as bit-error-rate (BER)

# Terminologies

- Information source
- Character and alphabet
- Bit and bit stream
- Symbol
- Baud
- Digital waveform
- Data rate
- BER