ECE 447 Fall 2025

Lesson 01

Course Introduction

About Me

Your Turn!

Introductions

- Go-by name
- Hometown
- AFSC
- Surprise question!

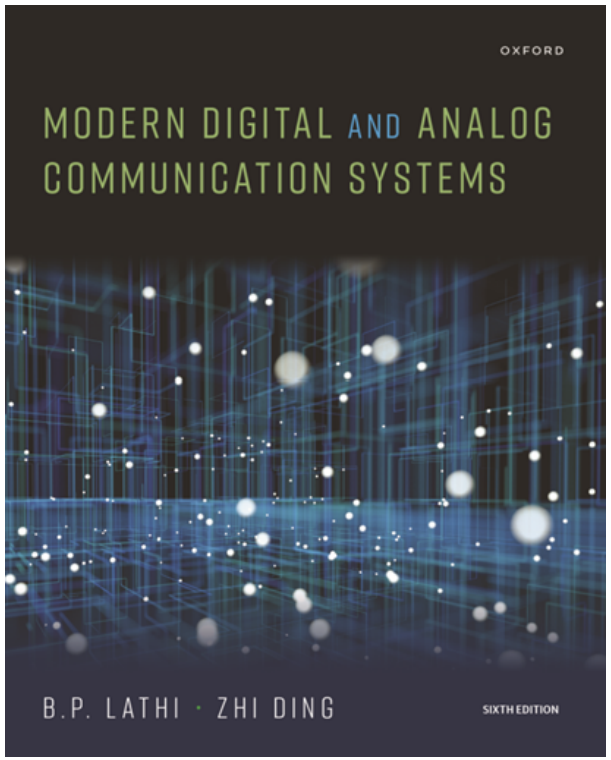
How to contact your instructor

- Office: 2E36A
- Outlook: Official (e.g., bedrest, SCA, etc.)
- Teams: Questions, problems, concerns
- EI: Prefer Outlook calendar invite (pick any available time) or schedule here - but walk-ins okay, too! (if available)

Course Textbook

- *Modern Digital and Analog Communication Systems*, B. P. Lathi and Zhi Ding, Oxford University Press, 2025
- Textbook is required
- Only available digitally
- Discount by using this link

(https://view-su3.highspot.com/viewer/6f8613b4e0d3ad3da4b97879342ea312?iid=6838256713d17dd25a3827f6&source=email.untracked)



Syllabus and Course Content

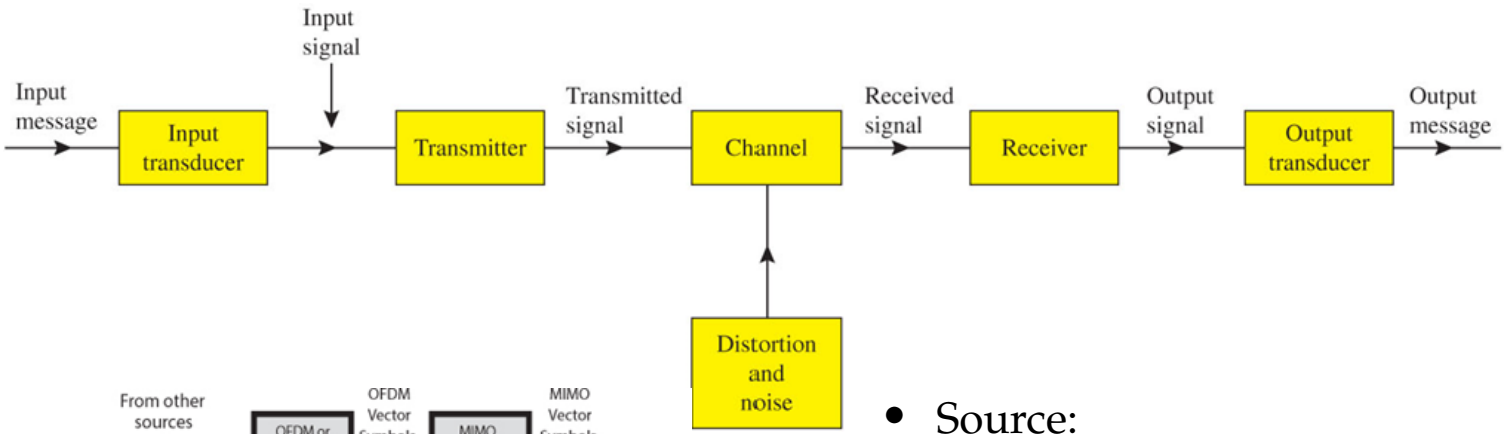
Let's take a look:
https://usafa-ece.github.io/ece447-book/intro.html

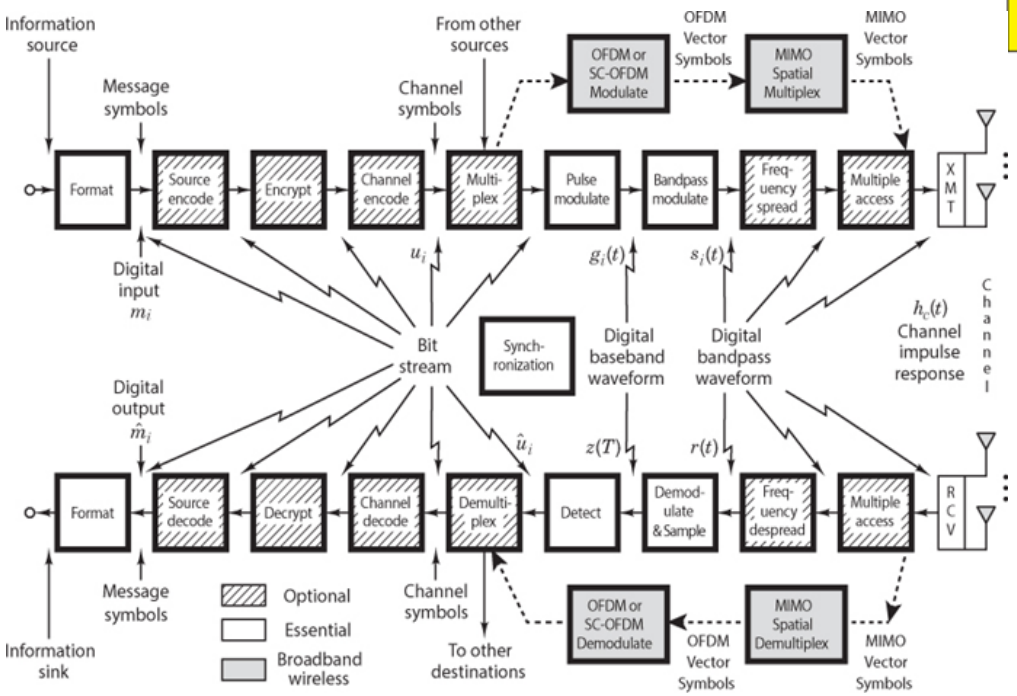
Why this course?

- Primary application of EE
- **Focused** on general communication principles
- Many concepts may be familiar from Signal Processing and Linear Systems (ECE 333) and Electromagnetics (ECE 343)
- Will do lots of example problems in class
- Expectation: you **MUST** read the text
- Expectation: you **MUST** do homework problems
- Will have practical applications in computer experiments and Software Defined Radio (SDR) labs

- Python or MATLAB?

Communication Systems

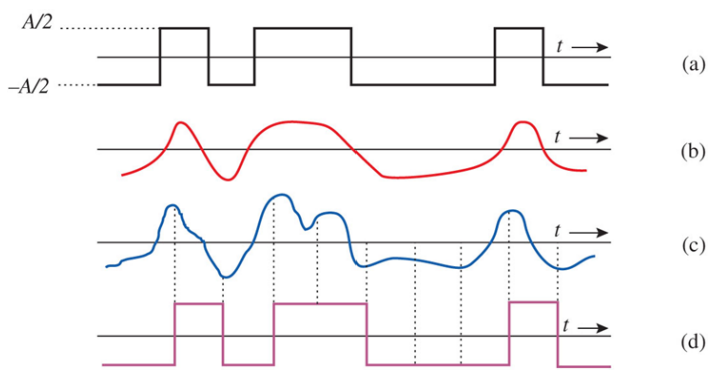




- Source:
- Input transducer:
- Transmitter:
- Channel:
- Noise:
- Receiver:
- Output transducer:
- Destination:

TERMS

- Channel **bandwidth**: Range of frequencies a channel without too much distortion; should exceed signal BW
- System Analysis
  - **Time** and **Frequency** Analysis: Use Fourier instead of Laplace, assume steady-state
  - **Deterministic**: Mathematical representation of well-behaved signals
  - **Probabilistic**: Random signals either noise or information signals
- Information Theory and Coding
  - **Shannon Limit**: Information rate vs. channel capacity
  - **Forward Error Correction**: Added redundancy, turbo codes, convolutional codes, block codes



Shannon-Hartley Law

Digital Version: The capacity C of a channel is given by

$$C = BW \cdot \log_2(1 + SNR)$$

where C is in bits/second or bps, BW is the bandwidth in Hz, and SNR is the signal-to-noise ratio in absolute units (not dB).

- Note both sides of equation in units of "per second"
- What parameters can we control?
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