Principles of Communications

Requirement

- Co-requisites
  - EE3210 Signals and Systems, or
  - EE3118 Linear Systems and Signal Analysis

- Math background
  - Calculus
  - Probability

Online ref: http://www.ee.cityu.edu.hk/~zukerman/classnotes.pdf

References

- R. E. Ziemer and W. H. Tranter, *Principles of Communications: Systems, Modulation and Noise* (6th edition), John Wiley & Sons, 2010.
- B. P. Lathi and Z. Ding, *Modern Digital Analog Communication Systems* (4th edition), Oxford University Press, 2009.
- J. G. Proakis and M. Salehi, *Communication Systems Engineering* (2nd Edition), Prentice Hall, 2002.
- B. Sklar, *Digital Communications: Fundamentals and Applications* (2nd Edition), Prentice-Hall, 2001.
- S. Haykin, *Communication Systems* (4th Edition), John Wiley & Sons, 2001.
- M. P. Fitz, *Fundamentals of Communications Systems*, McGraw Hill, 2007.

Assessment

Exam (50%) + Coursework (50%)

- Three Tests — 90%

  Week 5, 10 and 13

- Assignments — 10%

For details, please refer to the **Weekly Schedule Time** in the Canvas.

Frequently Asked Questions

Before the tests/exam:

- What formulas should I memorize?
- You don't have to memorize any formulas if you truly understand them.
- Could you give us more exercises?
- You'll find many exercises in the reference books.

After the tests:

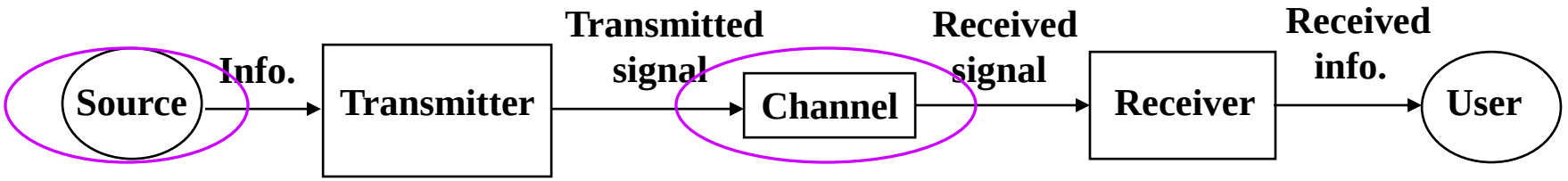
- Why are the questions DIFFERENT from those in tutorials?
- This is not a course that tests your memory.

After the final exam:

- Could you please LET ME PASS?
- Sorry, it's too late…

Lecture 1. Overview of Communication Systems

Block Diagram of Communication Systems



- Text
- Voice
- Image

- Cable
- EM wave
- Fiber

- Transmitter: to convert the electrical signal into a form that is suitable for transmission
- Receiver: to recover the message contained in the corrupted received signal

Source and Channel of Communication Systems

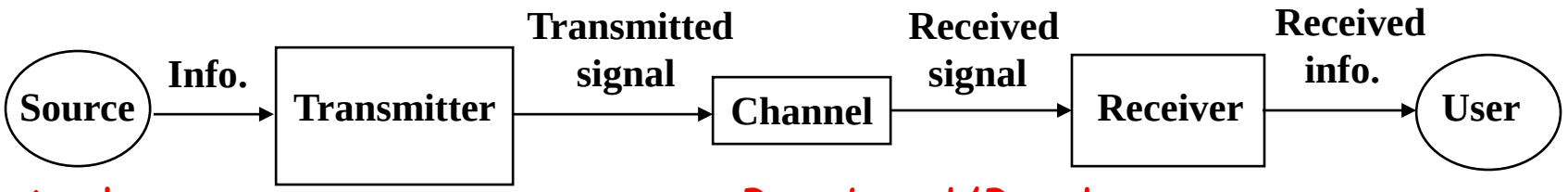
Source

- Text, voice, images, …
- How to model the source?
  - Analog System: How to represent the source information as a super-position of sinusoidal waves?
  - Digital System: How to represent the source information as a series of bits?

Channel

- Cable, EM wave, Fiber, …
- How to model the channel?
  - Baseband/Bandpass Channel: How to properly modulate the signals to pass the channel without distortion?
  - Additive White Gaussian Noise (AWGN) Channel: How to properly demodulate the signals to remove the effect of noise?

Course Organization



- Analog
- Digital

- Baseband/Bandpass
- AWGN

✓ How to model and characterize the analog and digital signals?
Lectures 2 and 5

✓ Why and how to modulate/demodulate an analog signal?
Lectures 3-4

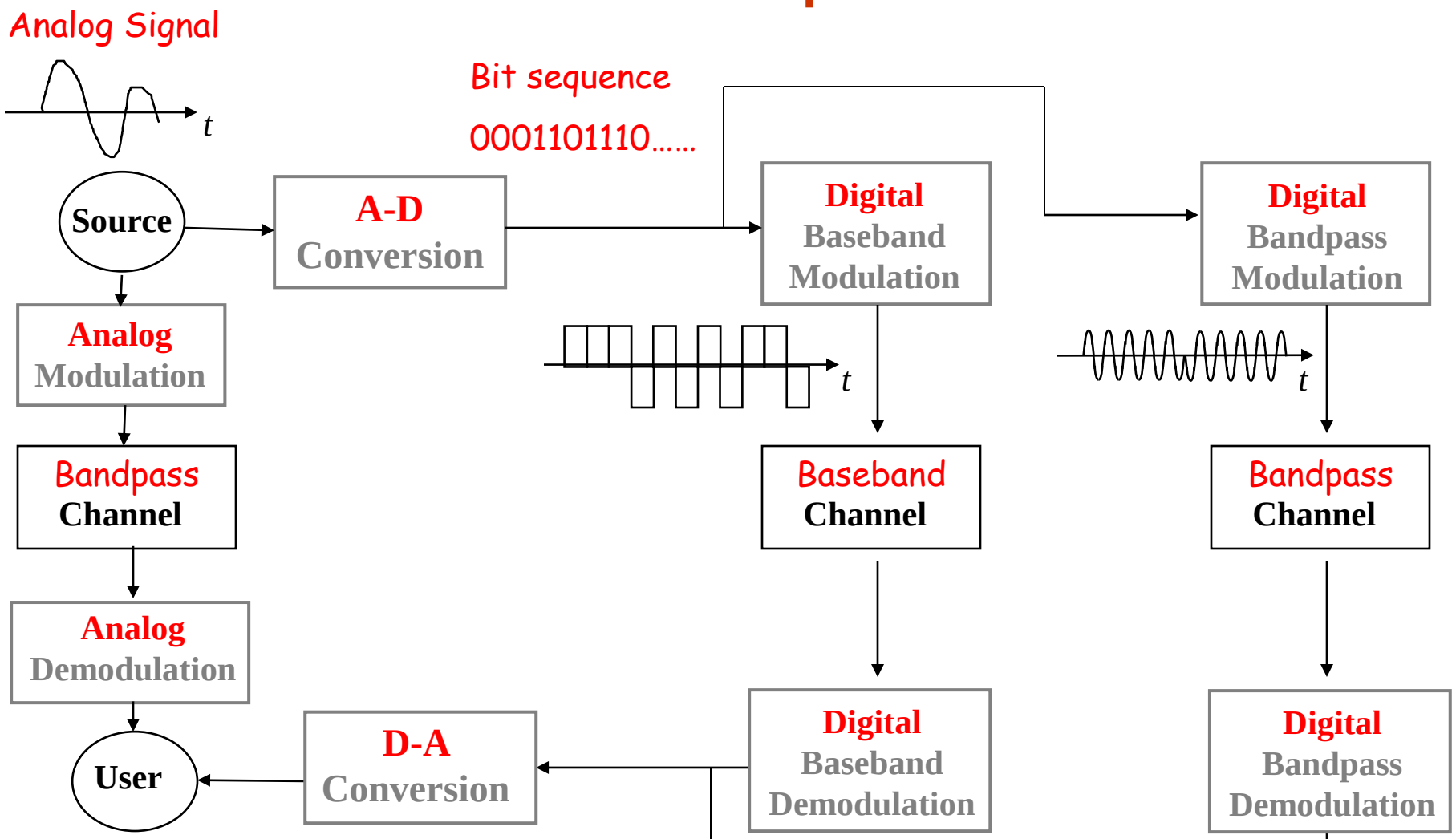
✓ Why do we prefer digital signal transmission and how to convert an analog signal to a digital signal?
Lecture 6

✓ Why and how to modulate/demodulate a digital signal?
Lectures 7-8

Course Organization

- Week 2: Lecture 2 – Deterministic Signal Analysis
- Week 3: Lecture 3 - Analog Communications Part I: Amplitude Modulation
- Week 4: Lecture 4 - Analog Communications Part II: Frequency Modulation
- Week 5: Test 1 (Coverage: Lectures 1-4)
- Week 6: Lecture 5 - Random Signal Analysis
- Week 7: Lecture 6 - Digital Communications Part I: Sampling and Quantization
- Week 8-9: Lecture 7 - Digital Communications Part II: Digital Modulation
- Week 10: Test 2 (Coverage: Lectures 5-7)
- Week 11-12: Lecture 8 - Digital Communications Part III: Digital Demodulation
- Week 13: Test 3 (Coverage: Lectures 5-8)

Road Map


Analog Signal
t
Bit sequence
0001101110……
Source
A-D Conversion
Digital Baseband Modulation
Digital Bandpass Modulation
Analog Modulation
t
t
Bandpass Channel
Baseband Channel
Bandpass Channel
Analog Demodulation
User
D-A Conversion
Digital Baseband Demodulation
Digital Bandpass Demodulation

Performance Metrics of Communication Systems

- Fidelity
  - It measures how accurate the received message is for given amount of transmission power.
- Spectral Efficiency (Bandwidth Efficiency)
  - It measures how efficient the spectrum is utilized.
- Complexity
  - The cost of complexity level changes over time.
  - It is a quantity that requires engineering judgement to estimate.