Sirindhorn International Institute of Technology

Thammasat University

School of Information, Computer and Communication Technology

EES452: Course Syllabus

Semester/Year: 2/2021

Course Title:	Digital Communication Systems
Instructor:	Asst. Prof. Dr.Prapun Suksompong (prapun@siit.tu.ac.th)
***Course Website*:**	https://classroom.google.com/u/0/c/NDUwMTExMTU1NjY1
	Log in with your "@g.siit.tu.ac.th account"
***Accompanying Website*:**	http://www2.siit.tu.ac.th/prapun/ees452/
***Line Group*:**	http://line.me/ti/g/uDUBtuu-CY

Live Sessions

- Tuesday 13:00-14:20
- Thursday 10:00-11:20

Access Link: https://meet.google.com/png-bomh-rba

Office Hours

Check the Calendar on the accompanying website.

Course Information

Official Prerequisite: EES 351

Recommended Additional Prerequisite: EES 315

Course Description: The subject of digital communications involves the transmission of information in digital form from a source that generates the information to one or more destinations. This course extends the knowledge gained from EES351 (Principles of Communications) and EES315 (Probability and Random Processes). Basic principles that underlie the analysis and design of digital communication systems are covered.

Grading Policy: Depending on how the exams will be arranged, different kinds of coursework will be weighted differently. Here are the weights for two extreme cases:

	On-site Exams	On-line Exams
Assignments	8%	20%
Class Discussion	7%	10%
In-Class Exercises	15%	20%
Midterm Examination	28%	22%
Final Examination (comprehensive)	42%	28%

- In the case that some exam(s) can be conducted on-site, the weights that are taken from such exam(s) and correspond to the work that hasn't been done will be returned to the exam(s).
- Late assignments will be heavily penalized or rejected.
- Cheating will not be tolerated.

Main Reference:

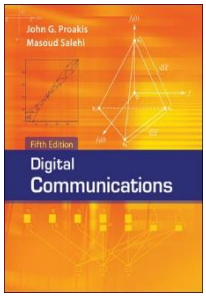
- P. Suksompong. Digital Communications [Class Handout], Sirindhorn International Institute of Technology, 2022.

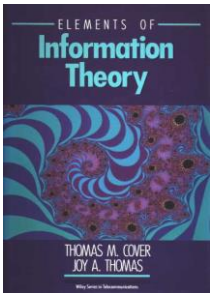
Textbook:

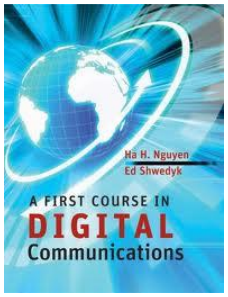
1. [P&S] John Proakis and Masoud Salehi, Digital Communications, 5th Edition, McGraw-Hill, 2007.
2. [C&T] Thomas M. Cover and Joy A. Thomas, Elements of Information Theory, Second Edition, Wiley-Interscience, 2006

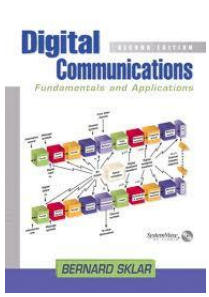
Additional References:

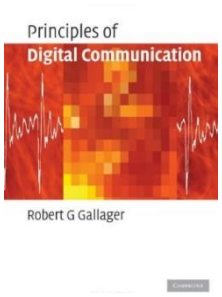
1. Ha H. Nguyen and Ed Shwedyk, A first course in digital communications, Cambridge University Press, 2009. https://doi.org/10.1017/CBO9780511841583 [Available on Cambridge Core]
2. Bernard Sklar, Digital communications: fundamentals and applications, Prentice Hall, 2001
3. Robert G. Gallager, Principles of Digital Communication, Cambridge University Press, 2008. https://doi.org/10.1017/CBO9780511813498 [Available on Cambridge Core]











Class Discussion: The score for this part is judged by the amount of active participation in the class discussion (with the instructor) either inside or outside of the classroom. Submit each event using the provided form(s) on Google classroom.

In-Class Exercises: In-class exercises will focus on current or recently-discussed topics. An exercise may be given at any time during any class period. Students are expected to work in groups. In-class exercises will be given only to those students who are present. There will be no make-up exercise.

Two lowest in-class exercise scores will be dropped. Additionally, one who has legitimate excuse (such as participating in competition, or university-approved curricular and extracurricular activity, career-related interview, being admitted to the hospital) may request that the corresponding missing score will not be counted. For such request, supporting document should be submitted to the instructor.

Assignments: There will be two types of assignments:

The first type will be referred to as "homework (HW)". Homework will be assigned throughout the semester. It will be graded on completeness, not correctness: if an honest attempt was made on an assigned problem, it will be considered complete.

The second type will be referred to as "assignment". Assignments will be given in the form of duration-limited, asynchronous, take-home, open book examinations.

Exams: A handwritten A4 study sheet is allowed. One side for the midterm exam.
Another side for the final exam.
Online exam(s) will be synchronous, time-limited, with live proctoring.

Students should notify the instructor before missing any exam if at all possible and immediately thereafter when not possible. The instructor (and/or the fact-finding committee) will determine if the absence from an exam is legitimate.

Course Outline

The following is a tentative list of topics.

1. Course introduction,
   Elements of a Digital Communication System
2. **Source Coding**: General Concepts, Expected Length, Uniquely Decodable Codes, Prefix Codes, Huffman Coding
3. Extension Coding, Entropy, Convergence to Entropy
4. **Digital Communication Systems Over Discrete Memoryless Channel (DMC)**: DMC, Optimal Detection for DMC, Binary Symmetric Channel, Binary Asymmetric Channel, Symbol Error Probability
5. Maximum a Posteriori Probability (MAP) detector, Maximum Likelihood (ML), Block Encoding, Minimum-Distance Decoder, Hamming Distance
6. **Mutual Information**
7. **Channel Capacity**
8. **MIDTERM: 1 Mar 2022 TIME 15:00 - 17:00**
9. **Channel Coding**: Linear Block Codes, Generator Matrix, Parity Check Matrix
10. Hamming Codes, Interleaving, Binary Convolutional Codes
11. State Diagram and Trellis Diagram, Viterbi Decoding
12. **Introduction to Digital Modulation**: *M*-ary Modulation, Symbol Rate, Average signal energy, Pulse Amplitude Modulation, ASK, Gray Coding,
13. Vector Space and Inner Product Space, Orthonormal Basis, Gram-Schmidt Orthogonalization Procedure, Constellations
14. **The Waveform Channel**: Random Processes, Autocorrelation Function, Wide-Sense Stationary (WSS) Random Processes, Power Spectral Density, White Noise
15. Wiener-Khinchine theorem, White Noise, Equivalent Vector Channel
16. **Optimal Detection for Additive Noise Channels**, Correlation detector, Matched filter
17. **FINAL: 19 May 2022 TIME 09:00 - 12:00**

Expectations: You should expect to spend extra 5-8 hours per week studying outside of class. However, the instructor does expect you to join the live sessions and ***participate actively*** in class discussions.

Academic Integrity

Unless explicitly specified otherwise, the work submitted in this class is expected to be the result of your individual effort.

It is your responsibility to protect your work from unauthorized access. For example, do not discard copies of your codes/assignments in public places.

Additional Remarks

1) Calculator: All models in Casio FX-991 Series are permitted.
2) MATLAB: Computer simulation will be used to enhance learning.
   Individual student can install the full MATLAB application on their computer using TU license. Registration using "@dome.tu.ac.th" account is required.

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