Sirindhorn International Institute of Technology

Thammasat University

School of Information, Computer and Communication Technology

ECS452: Course Syllabus

Semester/Year: 2/2018

Course Title: Digital Communication Systems
Instructor: Asst. Prof. Dr.Prapun Suksompong (prapun@siit.tu.ac.th)
***Course Website*:** http://www2.siit.tu.ac.th/prapun/ecs452/

Please check the course web site regularly for updated information about this course.

QR code for the course website	QR code for the Line group
QR code for this course syllabus	QR code for the slides

Lectures

- Thursday 10:40-12:00 BKD 3506
- Friday 10:40-12:00 BKD 3506

Office Hours

Check the Calendar on the course website.

Course Information

Official Prerequisite: ECS 332 or consent of Head of School

Recommended Additional Prerequisite: ECS 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 ECS332 (Principles of Communications) and ECS315 (Probability and Random Processes). Basic principles that underlie the analysis and design of digital communication systems are covered.

Grading Policy: Coursework will be weighted as follows:

Assignments (HWs)	5%
Class Discussion	5%
In-Class Exercises	10%
Midterm Examination	35%
Final Examination (comprehensive)	45%

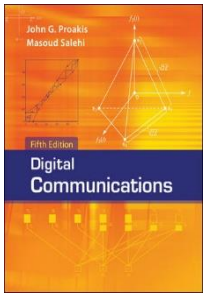
- Late assignments will be heavily penalized or rejected.
- Cheating will not be tolerated.

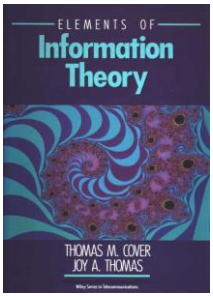
Textbook:

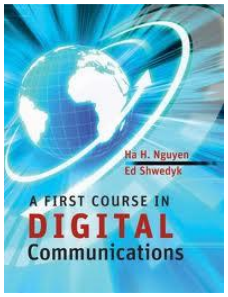
1. [P&S] John Proakis and Masoud Salehi, Digital Communications, 5th Edition, McGraw-Hill, 2007.
2. [C&T] Thomas M. Cover and Joy A. Thomas, Elements of Information Theory, Second Edition, Wiley-Interscience, 2006

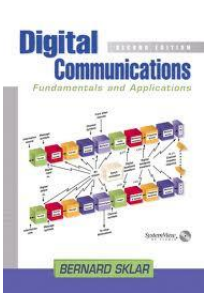
Additional References:

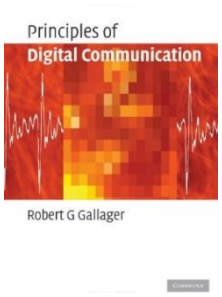
1. Ha H. Nguyen and Ed Shwedyk, A first course in digital communications, Cambridge University Press, 2009
2. Bernard Sklar, Digital communications: fundamentals and applications, Prentice Hall, 2001
3. Robert G. Gallagher, Principles of Digital Communications, Cambridge University Press, 2008.











Assignments: Homework will be assigned throughout the semester. Most assignments will be graded on completeness, not correctness: if an honest attempt was made on an assigned problem, it will be considered complete. The lowest assignment score will be dropped. The complete solutions to all problems (not just answers) will be posted on the course web site.

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. There will be (self-evaluation) forms for collecting information about this twice (one right after the midterm exam and another one right after the final exam.)

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 of at most three persons. 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 and the student must explicitly provide the missing exercise number and date in the (self-evaluation) forms.

Exams: A handwritten A4 study sheet is allowed. One side for the midterm exam. Another side for the final exam.

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. Simply not feeling well is not a reason to miss an exam. In the case of legitimate absence, an oral and/or written make-up exam could be arranged.

Expectations: You should expect to spend extra 5-8 hours per week studying outside of class. However, the instructor does expect you to come to class and *participate actively* in class discussions. If you must miss a class, you must find out and catch up with what happened in lecture, either from the instructor or one of your classmates. You are responsible for all materials that are discussed in class.

Academic Integrity

The work submitted in this class is expected to be the result of your individual effort. You are free to discuss course material, approaches to problems with your colleagues or the instructor but you should never misrepresent someone else's work as your own.

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

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: 15 Mar 2019 TIME 09:00 - 11:00 (2 Hrs)**
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: 24 May 2019 TIME 09:00 - 12:00 (3 Hrs)**

Additional Remarks

1) Calculator: Casio FX-991 is permitted in exams and for in-class exercises
2) MATLAB: Computer simulation will be used to enhance learning.
   MATLAB is available in SIIT computer labs.