Digital Communication Systems
ECS 452

Asst. Prof. Dr. Prapun Suksompong

prapun@siit.tu.ac.th

Office Hours:
BKD 3601-7
Monday   14:00-16:00
Wednesday   14:40-16:00

Me?

- Ph.D. from **Cornell** University, USA
- In Electrical and Computer Engineering
- Minor: Mathematics (Probability Theory)
- Ph.D. Research: Neuro-Information Theory
- Current Research: Wireless Communications
- 2009 and 2013 SIIT Best Teaching Awards
- 2011 SIIT Research Award
- 2013 TU Outstanding Young Researcher Award
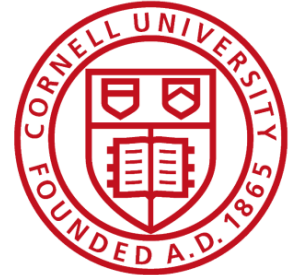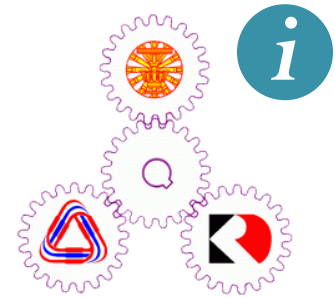
prapun.com

Getting Info About This Course

- The **syllabus** contains tentative information.

- I will announce **in class** and on the **web site** if there is any change.

- You are **responsible** for making sure that you obtain this information.

- Come to classes **on time** and listen carefully for **announcement(s)**.

- For those who want a preview of the class materials, old slides along with the notes and HWs from last year are available on my web site (**prapun.com**).

Course Web Site

prapun.com

Teaching

- For 1/2014, he teaches
  - ECS315 (Probability and Random Processes)
  - ECS452 (Digital Communication Systems)
- In 2014, Dr.Prapun received the 2013 Best Teaching Award fro
- Slides for EC Talk: Introducing ECS 452, ECS 455, and tentat:
- For 2/2013, he taught
  - ECS204 (Basic Electrical Engineering Laboratory) (For
  - ET601 (Computer Applications for Engineers) (For PEA
- In 2014, he received the 2013 Outstanding Young Researcher A
  อาจารย์) Thammasat University
- For 1/2013, he taught
  - ECS315 (Probability and Random Processes)
  - ECS203 (Basic Electrical Engineering) (For non-major s
  - ECS452 (Digital Communication Systems)
- For 2/2012, he taught
  - ECS204 (Basic Electrical Engineering Laboratory) (For
  - ECS455 (Mobile Communications)
  - SCS139 (Applied Physics II) (Last 5 weeks)
- For 1/2012, he taught
  - ECS315 (Probability and Random Processes)

Course Organization

- **Course Website:**
  http://www2.siit.tu.ac.th/prapun/ecs452/

- **Lectures:**
  - **Monday   10:40–12:00 BKD 3509**
  - **Wednesday   13:00–14:20 BKD 3511**

- **Textbook:** Digital Communications
  - By John Proakis and Masoud Salehi
    - Northeastern University
  - 5th (International) Edition
  - Call No. TK5103.7 P76 2008
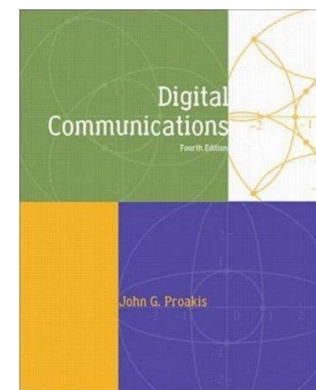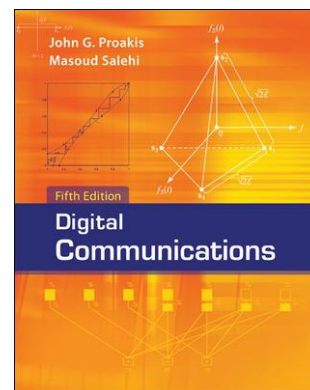
John Proakis

- Adjunct Professor at the University of California at San Diego (UCSD)
- Professor Emeritus at Northeastern University.
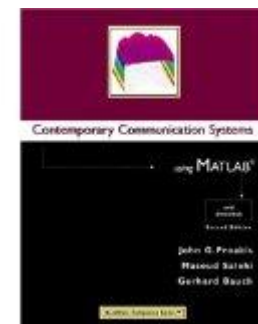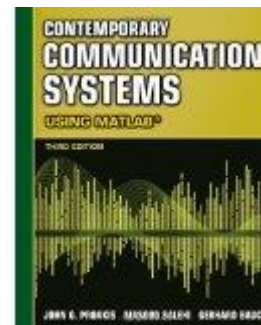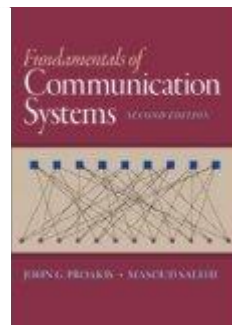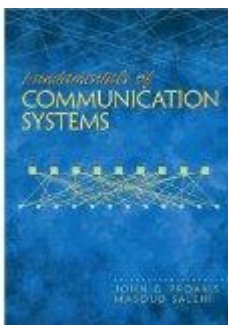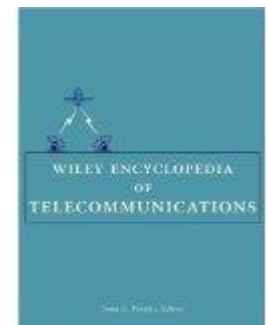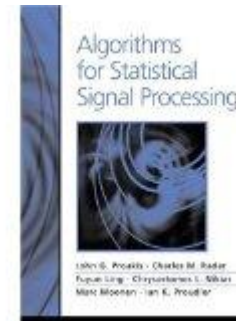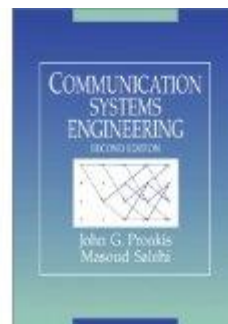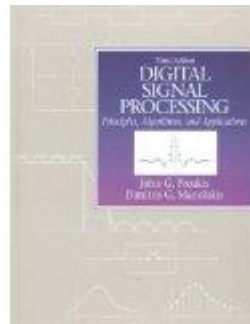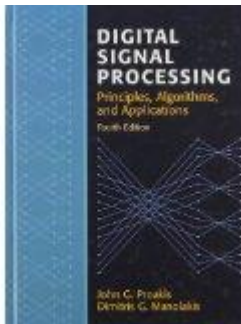
Course Web Site

- Please check the course website regularly.

- Announcements

- References

- Handouts (Posted before corresponding lectures)

- Slides (Posted after corresponding lectures)

- Calendar
  - Exams
  - HW due dates

www2.siit.tu.ac.th/prapun/ecs452/

Course Website: Notes & Slides

- **PDF notes** will be posted *before* the corresponding lectures.
  - Hard copies can also be purchased from the **copy center**.
- In lectures…
  - PDF notes will be highlighted and annotated with examples / comments.
  - Some lectures may use slides.
  - The slides and annotated notes will be **posted *after*** the corresponding lectures.
- I also frequently use Microsoft **OneNote** on my convertible tablet instead of the whiteboard. The files will be exported as pdf and posted *after* the corresponding lectures.
- **Remind** me the day after the lecture if the notes/slides from the day before are still not posted on the web.

ECS 452 Topics

1. Elements of a Digital Communication System
2. Source Coding and **Entropy**
3. **Optimal Detection** for Discrete Channels
4. Mathematical Models for Physical Communication Channels
5. PAM: A Digital Modulation Scheme
6. Signal Space Representation of Waveforms
7. Constellations for Digital Modulation Schemes
8. **Optimal Detection** for Additive Noise Channels: 1-D Case
9. **Optimal Detection** for Additive Noise Channels: K-D Case
10. Random Processes and White Noise
11. **Optimal Detection** for Waveform Channels
12. **Mutual Information** and **Channel Capacity**
13. Channel Coding methods for error detection and correction.
14. An Introduction to Multiple-antenna system

General Ideas

- Extension of Principles of Communications (ECS332) and Probability and Random Processes (ECS315)

- Focus more on
  - Performance analysis (bit error rates),
  - Optimal receivers, and
  - Limits (information theoretic quantities).

More References

- A first course in digital communications
  - By Ha H. Nguyen and Ed Shwedyk
  - Call No: TK5103.7 N49 2009
  - Cambridge University Press
- Digital communications: fundamentals and applications
  - By Bernard Sklar.
  - Call No: TK5103.7 S55 2001
  - Prentice Hall
- Principles of Digital Communication
  - By Robert G. Gallager
  - 2008
  - Cambridge University Press
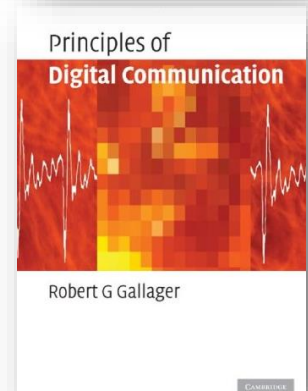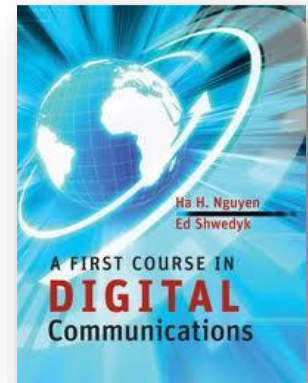
Calendar
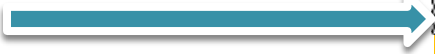
M	T	W	R	F
11-Aug-13	12-Aug-13	13-Aug-13	14-Aug-13	15-Aug-13
18-Aug-13	19-Aug-13	20-Aug-13	21-Aug-13	22-Aug-13
25-Aug-13	26-Aug-13	27-Aug-13	28-Aug-13	29-Aug-13
1-Sep-13	2-Sep-13	3-Sep-13	4-Sep-13	5-Sep-13
8-Sep-13	9-Sep-13	10-Sep-13	11-Sep-13	12-Sep-13
15-Sep-13	16-Sep-13	17-Sep-13	18-Sep-13	19-Sep-13
22-Sep-13	23-Sep-13	24-Sep-13	25-Sep-13	26-Sep-13
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1-Dec-13	2-Dec-13	3-Dec-13	4-Dec-13	5-Dec-13
8-Dec-13	9-Dec-13	10-Dec-13	11-Dec-13	12-Dec-13
15-Dec-13	16-Dec-13	17-Dec-13	18-Dec-13	19-Dec-13

Lecture →

Exam →

Please Double-Check Exam Dates!

12

Grading System

- Coursework will be weighted as follows:

Assignments	5%
Quizzes and In-Class Exercises	5%
Class Discussion/Participation	10%
Midterm Examination • 6 Oct 2014 TIME 09:00 - 12:00	40%
Final Examination (comprehensive) •15 Dec 2014 TIME 09:00 - 12:00	40%

2013: CLASS GPA: 2.82

FIX-RATE
AVG=70.3382
SD=14.9659
N=17

F	D	D+	C	C+	B	B+	A
	1	2	2	2	3	4	3

POINT |40 |50 |55 |58 |64 |74 |90

Please Double-Check Exam Days!
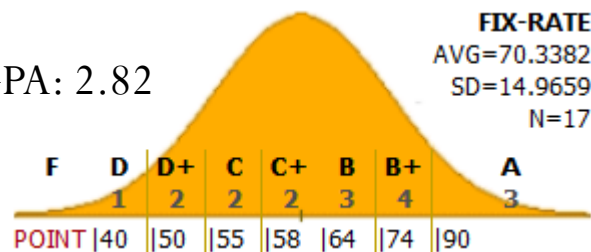
Class Participation

- NOT the same as class attendance!
- If you come only to **receive**, you will fall **asleep**.
  - Do not simply sit quietly in the class.
- Need **interaction** between lecturer and students.
- **Ask question** when there is something that you don't understand.
  - Don't be shy!
  - It is very likely that your friends don't understand it as well.
- If you already understand what I'm presenting, SHOW ME!
  - Point out the errors/typos.
  - I will raise many issues/questions in class. Try to comment on them.

Class Participation (2)

- Record what you have done.
  - Submitted before the midterm and before the final.

ECS 452: Self-Evaluation

1. The class participation score for this class is judged by how much you actively participate in the class discussion both inside and outside of the classroom.
2. Please honestly answer the following questions. Please provide as much information as possible. Do not include the activities that you have already stated in the first self-evaluation form.

Name

Student ID

How many times have you been absent from the class? Are there any specific reason(s)? Please explain.

How many times have you been late (> 30s) for the class? Are there any specific reason(s)? Please explain.

How many times have you participated (provided comments, asked questions, answered questions, etc) in the lectures? Be specific. Provide some short description for each event. Number alone does not count.

How many times have you correctly informed the instructors the typo or mistake on the whiteboard/slides/hw/etc? Please provide some short description about each of the issues.

How many times have you discussed with the instructor outside of class? (Ask questions, express concerns, etc.) Be specific.

Policy

- We will start the class on time and will finish on time.
  - Raise your hand and tell me immediately if I go over the time limit.
  - Does NOT mean that I will leave the room immediately after lecture.
    - I will stay and answer questions.
- Mobile phones *must* be turned off or set in silent mode.
- We may have some **pop quiz**zes (without prior warning or announcement) and in-class activities.
- Attendance and pop quizzes will be taken/given irregularly and randomly.
- Cheating will not be tolerated.

Policy (con't)

- Feel free to stop me when I talk too fast or too slow.
- I will surely make some **mistakes** in lectures / HWs / exams.
  - Some amount of class participation scores will be reserved to reward the **first** student who inform me about each of these mistakes.
    - Grammatical errors are best informed/corrected after class.
- Points on quizzes/ exercises/ exams are generally based on your entire solution, not your final answer.
  - You can get full credit even when you have the wrong final answer.
  - You may get **zero** even when you write down a right answer without justification.

Policy (con't)

- Please stop me if I go over the time limit.
- Please stop me if I talk too fast.
- Please stop me if you have any question.

Help and Office Hours

- Get some help!
  - Do not wait until the final exam time or after the grade is out.
  - Right after lecture is always a good time to ask question.
- Office Hours (BKD-3601)
  - Time: Monday 14:00-16:00, Wednesday 14:40-16:00
  - Appointment can be made.
  - Tutorial session can be arranged.
  - Feel free to come to my office and chat!
  - Don't be shy.

Warning

- This class can be **difficult**.
  - Keep up with the lectures.
  - Make sure that you understand the concepts presented in the lecture <u>before</u> you go home.
- I will evaluate your understanding of the course regularly through
  - In class problems/activities
  - Quizzes
  - Exams

Tips

- Almost everything including what I have written on my tablet will be saved and posted on web soon after class.

- No need to take detailed lecture notes (if you don't want to).
  - Put all of your energy into understanding the material.
  - Of course, there is always someone (in the class) who will take good notes anyway and you can (potentially) borrow or make a copy of the notes from them.

- Have fun with the materials presented in class.

Remarks

- Get as much legitimate help as you can
- **Participate actively in class** and outside of class
  - Record what you have done.
- If you feel that the class is very easy, you might overlook something.
- If you feel that the class is very difficult, you are probably not the only one who feel that way.
  - Don't give up. Chat with me.
  - It takes me a long time to feel comfortable with these materials; yet, I still make mistakes.
- My notation can be different from the textbook.
  - Every notation has some advantages and disadvantages.