CS-455 – Data Communications

*"The Internet has changed everything. We expect to know everything instantly.
If you don't understand digital communication, you're at a disadvantage."*

Bob Parsons

Instructor

Dr. Edward Chlebus
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Office hours: Monday through Thursday, SB 218D, noon – 1 pm

I do my best to be available in my office during my office hours but I strongly suggest making an appointment in advance. Send me an email from your IIT email address, sign your message and give your A#, and the course and section numbers. Usually I need to uniquely identify a sender before I reply. I teach over 50 students this semester and I'm an advisor of all European exchange students in our department so I receive many emails every day. If you don't receive my response within 24 hours, resend you email.

Teaching Assistants

No TA has been assigned to this course.

Lectures

Monday and Wednesday, 8:50 am – noon, Stuart Building 113
- 455-01: live section, SB 113
- 455-02: online section

All the lectures are recorded and uploaded to Blackboard by the IIT Office of Technology Services (OTS). The lecture videos are available to all the students enrolled in CS-455. Let me know if there are any technical issues with video or audio quality. I have a good working relationship with the OTS and will contact them if necessary.

I encourage all my students to attend live classes but your attendance doesn't affect your final grade (for obvious reasons remote students can not join us on campus).

Homework Assignments

There are two assignments (weight of each of them is 15%) consisting of a set of review questions that will help you study for the exams. No coding required to solve the HW problems. HW1 will be given before the midterm, HW2 before the final. Teamwork is allowed and encouraged but individual submissions are also OK. Teamwork means discussing and brainstorming problems to obtain the best solutions, not waiting for the remaining teammates to do the job. The results of your teamwork are graded but I reserve the right to reduce individual grades for students whose contribution to the final results is insufficient.

You will be notified via email after the assignments (along with the detailed submission instructions and a clearly specified due date) are uploaded to Blackboard. I strongly encourage all of you to review your graded assignments with me to clear your doubts.

Exams

There are two exams (closed book, a double-sided A4/letter format cheat sheet and calculators allowed). Weight of each of them is 35%. They are scheduled as follows:
- midterm: Wednesday, June 7th
- final: Friday, June 23rd

The final exam is not cumulative and will cover only the material presented after the midterm.

I encourage you to visit me to individually review your graded exams. I will accommodate absolutely all students who are interested in receiving feedback.

In-class Media

I keep uploading lecture slides to the folder
Blackboard/Content/Lecture Slides
as we proceed with the course material. This way you know what material I have already presented.

From my point of view there is a significant difference between a slide show and a lecture. My lectures are NOT slide shows. I like explaining problems and interacting with the audience so I also use a whiteboard. We will analyze many examples in this course. Before the exams I will show you some animated presentations to review the covered material. Students studying the course material by reviewing only the slides will be at a disadvantage.

Grading

All the students will be graded based on the assignments and exams specified above. No extra credit assignments will be given to individual students at the end of the semester. Absolutely no favoritism in my courses.

I don't use the traditional grading scale (A – 90%, B – 80%, C – 70%) which is completely unrealistic from my point of view. The grade cut-off points in this course are usually lower and oscillate around 85% for A and 70% for B. They are determined at the end of the semester based on the distribution of all students' percentage grades. This concept of adaptive grading is equivalent to curved grading but eliminates curving grades of individual assignments or exams.

The grading criteria and the final grade cut-offs are identical for all the enrolled students. Absolutely no exceptions to this rule. It's a matter of fairness.

Academic Honesty

Zero tolerance for cheating and cheaters. Absolutely no excuses. All the students caught cheating will receive zero for the assignment or exam, and may be expelled from the course. Their behavior will be reported to the CS Department Chair and the Dean, and an academic honesty violation report will be filed.

Textbook

Forouzan B.A., Data Communications and Networking, McGraw-Hill, 5th Edition, 2013, ISBN 978-0-07-337622-6

Course Description

CS-455 is the first of the sequence of four networking courses:
- CS-455: Data Communications
- CS-542: Computer Networks I: Fundamentals
- CS-544: Computer Networks II: Network Services
- CS-547: Wireless Networking

that I teach in our department. They present a coherent and comprehensive overview of wireline and wireless network technologies, architectures and protocols.

This course covers the functions of the OSI reference model. The emphasis is on the physical and data link layers: basic signal processing, analog and digital transmission,

and multiplexing and switching technologies. The students are provided with background knowledge to take aforementioned advanced graduate networking courses offered by our department.

Topics Covered

- Basic concepts of data communications
  - definition of data communications
  - components of data communications
  - data representation
  - data flow
  - point-to-point vs. multipoint connection
  - physical topology of a network
  - categories of networks: LAN, MAN, WAN
  - Internet

- The OSI model and the TCP/IP protocol suite
  - network models
  - layered network architecture
  - duties of the physical, data link, network, transport, session, presentation and application layers

- Data and signals
  - analog and digital data/signals
  - periodic and nonperiodic signals
  - signal parameters
  - time and frequency domains
  - composite signals
  - bandwidth
  - bit rate
  - baseband transmission vs. transmission using modulation
  - transmission impairment: attenuation, distortion and noise
  - data rate limits: Nyquist bit rate and Shannon capacity
  - network performance: bandwidth, throughput, delay, jitter

- Digital transmission
  - converting digital data into digital signals
  - data element vs. signal element
  - data rate vs. signal rate
  - line coding schemes
  - block coding
  - analog-to-digital conversion

- sampling and the Nyquist theorem
- parallel transmission vs. serial transmission

- Analog transmission
  - digital-to-analog conversion
  - amplitude shift keying
  - frequency shift keying
  - phase shift keying
  - constellation diagram
  - analog-to-analog conversion
  - amplitude modulation
  - frequency modulation
  - phase modulation

- Multiplexing
  - frequency-division multiplexing
  - analog multiplexing hierarchy
  - synchronous time-division multiplexing (TDM)
  - digital TDM hierarchy
  - statistical time-division multiplexing
  - frequency hopping spread spectrum technique

- Switching
  - circuit-switched networks
  - packet switching: datagram networks and virtual-circuit networks

- Data transmission over telephone and cable networks
  - major components of a telephone network
  - signaling systems
  - services provided by telephone companies
  - dial-up modems
  - digital subscriber line (DSL)
  - traditional cable networks
  - hybrid fiber-coaxial networks
  - high-speed data transfer offered by cable companies