CLEMSON UNIVERSITY

ECE 4270 Online: Communication Systems
Summer Session II, 2020

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Welcome to ECE 4270!

My desire is that everyone succeed in this course to as great an extent as possible; furthermore, my desire is that you succeed not only in this course but in applying what you learn throughout your careers. For this reason we will cover a lot of material, but many of the procedures of the course have been designed to help you master the material. If you watch all the videos, do all the homeworks, take all the old tests, learn how to do everything correctly after getting anything wrong, and ask questions when needed, you should be able to do well in this course. I commit to treating you fairly and with respect and doing all that I can to help you succeed.

Contacting Me:

For questions about administrative procedures or other questions not related to course content, the best way to contact me is by email.

For technical questions (help with homework problems, understanding lectures, going over old tests, etc.), contact me via telephone during office hours. These times are strictly enforced. Note that telephone is a much more effective medium for conveying technical details than email. If you absolutely cannot contact me during office hours, send me an email so that we can schedule an alternate appointment.

Contacting You:

Important messages for the class will be communicated via Canvas announcements. You are responsible for the content of these messages. Canvas should be checked frequently so as to have the most recent information.

You may also be contacted individually via email, either via your university email ID or as a reply to an email initiated by you. It is your responsibility to check your email frequently or have it forwarded to an account that you check frequently. It is also your responsibility to make sure your email account stays below quota. Note that there are two email systems and corresponding addresses: username@clemson.edu and username@g.clemson.edu. You can set one to forward to the other or both to forward to another address. Make sure you can receive email from both addresses!

Course Objectives:

Upon completion of this course, you should have an understanding of principles of digital and analog communication including the following: signals and spectra, baseband signaling and detection in noise, digital and analog modulation and demodulation techniques, and communications link budget analysis.

Course Prerequisites:

If you are a Clemson University student, your prerequistes are ECE 3300 and ECE 3170. If you are a non-Clemson student, you should have completed a course in probability and random variables and a course in signals and systems. With regards to these courses, previous introductions to random processes and discrete-time signals and systems are helpful but not necessary.

Course Materials:

Course notes, homework assignments, videos, and other materials are available for download on Canvas via http://www.clemson.edu/canvas.

Optional textbook: *Introduction to Analog and Digital Communications 2e* by Haykin and Moher, Wiley Publishers, ISBN 0-471-43222-9. This course does not require or even directly refer to this textbook, but it does cover the majority of the material. The following textbooks are additional sources: *Communication Systems 3e* by Haykin, Wiley Publishers, ISBN 0-471-57176-8, *Modern Digital and Analog Communication Systems 4e* by Lathi and Ding, Oxford University Press, ISBN 978-0-19-533145-5, and *Digital Communications Fundamentals and Applications 2e*, Sklar, Prentice Hall Publishers, ISBN 0-13-084788-7.

Recommended Daily Learning Procedure:

On "regular" days:
(1) Use the daily planner (later in this syllabus) to look up the day's requirements. Do not fall behind!
(2) Watch the videos, annotating your notes as you watch. Do not multitask while doing this!
(3) Do the corresponding homework problems and online quizzes. This is an essential step to learning the material!
(4) Correct your work by looking at the detailed homework solutions. Don't "cheat" and just copy these, or you are likely to fail the tests. Contact me if there is something you still don't understand.

On test study days:
(1) Create your notes sheets. See the "Exam Content and Procedures" section of this syllabus for more information.
(2) Re-practice the homework problems. The test problems will be similar to these.

Grading:

Final grades will be determined by averaging the homework, online quizzes, exams, and the final exam based on the following scale:*

Homework Assignments	7.5%	A	90% – 100%
Concept Quizzes	7.5%	B	80% – 89%
Two Tests	45%	C	70% – 79%
Final Exam	40%	D	60% – 69%

Completion bonus: If you turn in every assignment on time, both the concept quizzes and the homeworks, you will receive a 5% bonus. This is added to your final total percentage for the course. For example, if you obtain an average of 85% for the entire course (including homeworks, concept quizzes, tests, and final), the completion bonus will raise your total score to 90%.

Syllabus Quiz: There is a required syllabus quiz. You must complete it to access the rest of the materials on Canvas.

Proctor Notification: You are required to either complete a proctor form (and get your proctor approved - see elsewhere in this syllabus) or to email the instructor that you will be taking exams on campus. If you do not do this by Tuesday of the second week of classes, you will be required to take all exams on campus (even if you live far away from Clemson).

*The 90/80/70/60 grade cutoffs may be modified to be lower at my discretion. Normally such modifications are by no more than a few points; for example, the A cutoff might change from 90% to 88%. I reserve the right to modify the overall weighting scheme; for example, the relative weight of the final exam might be increased or decreased. Reasons for such a modification include the situation that I deem that a particular exam did not accurately assess student ability.

Homework and Concept Quizzes:

There are 10 homework assignments and 10 concept quizzes. Homework assignments and solutions are posted in Canvas. To receive full credit on homework, all needed work must be shown. Just copying final answers from the solutions will give you zero credit. Homework must be written in your own handwriting and not be previously graded.

Homework must be scanned into a *single* multi-page pdf and uploaded as an assignment in Canvas. No other formats (such as jpg) are accepted. Homework is due on the dates and times indicated in the course schedule in this syllabus. Homeworks up to 24 hours late are penalized by subtracting 50% from the score. Homeworks more than 24 hours late receive a score of zero. There are no exceptions to this policy.

Concept quizzes are taken online on Canvas. You are allowed two attempts on a quiz. The quizzes do not have time limits and are open notes and unproctored. You must complete each concept quiz by the same deadline as the corresponding homework assignment. Late quizzes receive a score of zero.

Exam Content and Procedures:

Exams are problem solving (short answer). All work must be shown on the test, or the student will receive a zero on the entire exam. The two midterms each have a duration of 90 minutes, and the final has a duration of 150 minutes. Exam 1 covers Chapters 2 and 3 (Homeworks 1A, 1B, 2A, and 2B), Exam 2 covers Chapters 4 and 5 (Homeworks 3A, 3B, 4A, and 4B), and the final exam is cumulative for the entire course. For the first exam you may bring 2 sheets of notes (4 sides of paper); for the second, 4 sheets of notes (the two sheets from the first exam plus two new sheets), and for the final, 5 sheets (the four sheets from previous exams plus one new sheet). No equations are provided on any exam. If an exam requires the use of a Q table or the 4B3T, 8B6T, MLT-3, 4B1H, 4B5B, 8B10B, 64B66B, EFM, or EFM plus line codes, the appropriate tables/descriptions will be provided. (You are responsible for the other line codes.)

Your exam sheets may contain theory, examples from the notes, homework problems, etc. In addition to the notes sheets, you should bring a calculator (the calculator must not have communications capability).

Academic Integrity:

Anyone caught in an act of academic dishonesty (cheating) will be penalized in accordance with Clemson University Academic Regulations.

Disability Access:

It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. If you are such a student, you are encouraged to contact Student Disability Services to discuss your individual needs for accommodation, obtain a letter if appropriate, and then discuss these needs with me. In order to obtain accommodations, you must notify me no later than the end of the second week of class.

Statement of Instructor/Student Interaction:

Live telephone-based office hours are available every weekday (except for exam dates). See the Canvas front page for available times and the phone number.

Disputing Grades:

A student wishing to dispute a grade on homework or a test must do so by emailing the professor within 72 hours of the time that the item receives a grade in Canvas. Appeals made after this deadline will not be considered.

Exam Administration:

Exams must either be taken on site (at Clemson University) or remotely with a proctor. Detailed information regarding proctors is given in a later section of this syllabus. Proctors must complete a proctor form (available on Canvas) by the date indicated in the course schedule and be approved by me. *Without proctor approval, a student will be required to take exams on site.*

The on-site location for all exams will be announced on Canvas. Both on-site and off-site students must bring a photo ID to the exams (Clemson ID or driver's license). Off-site students must give the ID to their proctor who will scan this along with the test and notes sheets, emailing all materials to me. Many testing centers keep notes sheets, so you should make a copy of them before the exam so that you have them to use on the other exams.

Midterm 1: Tuesday, July 7, 90 minutes duration
- Start time: 11:30 a.m. EDT
- End time: 1:00 p.m. EDT
- Firm deadline for proctors to email completed exams to me: 2:00 p.m. EDT

Midterm 2: Tuesday, July 21, 90 minutes duration
- Start time: 11:30 a.m. EDT
- End time: 1:00 p.m. EDT
- Firm deadline for proctors to email completed exams to me: 2:00 p.m. EDT

Final: Friday, July 31, 150 minutes duration
- Start time: 11:30 a.m. EDT
- End time: 2:00 p.m. EDT
- Deadline for proctors to email completed exams to me: 3:00 p.m. EDT

Summary Topical Outline:

1. Introduction
2. The Fourier transform applied to communications: *signal concepts, Fourier transforms, energy, power, periodic signals, linear time-invariant systems, correlation, spectral densities.*
3. Amplitude, angle, and pulse modulation: *amplitude modulation with and without carriers, quadrature multiplexing, frequency and phase modulation, pulse amplitude and position modulation.*
4. Baseband data and digital bandpass modulation: *sampling and quantization, pulse code modulation, delta modulation, differential PCM, line codes, intersymbol interference, Nyquist channel, raised cosine signaling, eye patterns, equalization, partial repsonse signaling, signal space concepts, amplitude shift keying, phase shift keying, QPSK, OQPSK, MSK, signal design for noncoherent reception, M-ary signaling.*
5. Random signals and noise: *probability and random variables, random procsses, correlation and spectral densities, effects of filtering, detection theory.*
6. Noise analysis of communication systems: *noise in AM and FM, FM pre-emphasis, coherent baseband detection, coherent bandpass detection, detection and performance with block and convolutional coding, noise figure and temperature, link calculations, terrestrial radio models.*

Summer Session II, 2020 Course Schedule:

Date	*Day*	*Assignments*	*Item Due*	*Exam Time*	*Time Due*
06/24	Wed.	1.1-2.2	(none)		
06/25	Thu.	2.3-2.4	HW1A, CQ1A	Syllabus quiz due	11:00 p.m. EDT
06/26	Fri.	2.5-2.6	(none)		
06/29	Mon.	2.7-2.8	HW1B, CQ1B		11:00 p.m. EDT
06/30	Tue.	3.1-3.2	Proctor form		11:00 p.m. EDT
07/01	Wed.	3.3-3.4	HW2A, CQ2A		11:00 p.m. EDT
07/02	Thu.	3.5-3.6	HW2B, CQ2B		11:00 p.m. EDT
07/03	Fri.	Holiday	(none)		
07/06	Mon.	Study day	(none)		
07/07	Tue.	Midterm 1	Midterm 1	11:30 a.m.-1:00 p.m. EDT	2:00 p.m. EDT
07/08	Wed.	4.1-4.2	(none)		
07/09	Thu.	4.3	(none)		
07/10	Fri.	4.4-4.5	HW3A, CQ3A		11:00 p.m. EDT
07/13	Mon.	4.6-4.7	(none)		
07/14	Tue.	4.8-4.9	HW3B, CQ3B		11:00 p.m. EDT
07/15	Wed.	5.1-5.2	HW4A, CQ4A		11:00 p.m. EDT
07/16	Thu.	5.3-5.4	(none)		
07/17	Fri.	5.5	HW4B, CQ4B		11:00 p.m. EDT
07/20	Mon.	Study day	(none)		
07/21	Tue.	Midterm 2	Midterm 2	11:30 a.m.-1:00 p.m. EDT	2:00 p.m. EDT
07/22	Wed.	6.1-6.2	(none)		
07/23	Thu.	6.3-6.4	(none)		
07/24	Fri.	6.5	HW5A, CQ5A		11:00 p.m. EDT
07/27	Mon.	6.6-6.7	(none)		
07/28	Tue.	6.8-6.9	HW5B, CQ5B		11:00 p.m. EDT
07/29	Wed.	Study day	(none)		
07/30	Thu.	Study day	(none)		
07/31	Fri.	Final Exam	Final Exam	11:30 a.m.-2:00 p.m. EDT	3:00 p.m. EDT

Test Taking and Proctors:

If a student lives or works within 60 miles of Clemson University, they must take exams on site at Clemson.

Otherwise, a student should use a college/university testing center for taking exams. It is the student's responsibility to find such a testing center and arrange approval to take all 3 exams with them. The testing center must complete and sign the ECE 4270 TESTING CENTER FORM. This form must be emailed to me at baumc@clemson.edu by the deadline given in the course schedule. It is highly recommended that the form be sent *earlier* than the deadline, because a few testing centers have been deemed unacceptable and will be rejected. Generally speaking, a testing center will be approved if it is actually a part of an accredited college or university with at least 1000 students (although there may be exceptions).

Note that a testing center may charge the student a fee. Such a fee is the responsibility of the student.

The dates and times of the exams are given earlier in the syllabus and are generally *not* flexible more than 30 minutes earlier or later than the times given. The only reason an examine would be allowed to be 30 minutes earlier or later would be that the testing center is not open at the time of the exam. Starting at any time other than the required time requires prior approval by the instructor.

Using a professor or teacher is *not* the same as using a testing center and will *not* be approved. Online testing services will *not* be approved in any situation. As per Clemson ECE policy, the student must reside and take exams within 3 time zones of the Eastern US time zone. This means that students cannot take this course in Europe, the Middle East, etc.

Submission of a proctor form that is fraudulent in any manner (such as pretending to give a testing center when actually using an individual) will result in an F in the course.

Students who are currently working in the United States at an engineering co-op or engineering internship may alternatively use a proctor at their place of employment. Summer jobs that are not engineering co-ops or internships are not eligible. To be approved to use such a proctor, the student must have their proctor complete and sign the ECE 4270 CO-OP/INTERNSHIP PROCTOR FORM. All fields must be completely filled on the form or the request will be rejected. Suitable proctors include students' supervisors and human resources managers. Requests must include proof of the student's employment such as a copy of a pay stub or the offer letter providing employment. International students must also provide proof that they have permission to work in the United States. Note that many working students choose to use a testing center.