COURSE SYLLABUS

1 ECE 8700 - Comm Systems Engineering

2 Meeting Information

3 credits, 3 contact hours Example: (Two 75-minute lectures)

a. **Section 001:**
Lecture: Rfrom 12:00 pm to 02:30 pm in Drosdick Hall 314., **CEER 307**

b. **Section DL1:**
Lecture: Rfrom 12:00 pm to 02:30 pm in Online SYN.,

3 Course Instructor(s), TA(s)

a. **Section 001:**

Class Instructor:	Mojtaba Vaezi
Office Hours:	R3:00-4:00, appointment or email, or by appt.
TA:	None

b. **Section DL1:**

Class Instructor:	Mojtaba Vaezi
Office Hours:	, or by appt.
TA:	None

4 Textbook

Proakis, John G., Salehi Masoud, *Digital Communications, 5th Edition*, McGraw-Hill, Copyright © 2008. REQUIRED.

a. **Other Supplemental Materials:** Bernard Sklar, Digital Communications: Fundamentals and Applications, 2nd Edition, Prentice Hall, 2001.

Marc Lichtman, A Guide to SDR and DSP using Python, https://pysdr.org/index.html

5 Specific Course Information

a. **Catalog Description**
Basic topics in digital communications, including: modulation schemes, maximum likelihood symbol detection and sequence estimation, Viterbi algorithm, carrier and symbol synchronization, bandlimited channels, intersymbol interference modeling, channel equalization,

b. **Prerequisites:** ECE 3720 and ECE 3770; **Co-requisites:** None

c. Graduate

6 Learning Objectives

a. This course provides broad knowledge of how digital communication systems work from a system engineering point of view and how to apply itto real-world problems.

Course Objectives

- Introduce the basic building blocks of digital communication systems
- Discuss how signals are shaped for transmission/reception over channel
- Evaluate the performance of digital modulation/demodulation schemes
- Introduce channel capacity and basics of information theory
- Introduce channel coding and its discuss interplay with modulation
- Understand synchronization issues in communication systems.

7 List of Covered Topics

1. Deterministic and random signal analysis
2. Bandpass and lowpass signal representation
3. Vector space concepts and vector representation of signal representation
4. Orthogonal expansion of signals, Gram-Schmidt and signal dimensionality
5. Digital modulation schemes, optimal constellation design, and their bit error rates
6. Signaling schemes with memory, CPM and CPFSK signaling
7. Trellis-coded modulation
8. Optimum receiver and matched filter design
9. Carrier and symbol synchronization
10. Signaling through bandlimited channels
11. Introduction to information theory, mutual information, and entropy
12. Linear and cyclic block codes
13. Optimum receiver for channels with ISI and AWGN
14. Bit-interleaved coded modulation

8 Tentative Schedule

Tentative schedules for all sections follow. Be sure to refer to the schedule for your specific section, if more than one is provided.

Tentative Schedule for **All Sections**

Week	Date	Topic
1	1/16	Chapter 1 & 2: Elements of a comm system, comm channels, sampling theorem, channel capacity Fourier review, signal models, signal representation.
2	1/23	Bandpass and lowpass signal representation; analytic signal, Signal spaces; Basis, subspace, Signal space representation of signals, vector space concepts, orthogonal expansion of signals, Gram-Schmidt orthogonalization;
3	1/30	correlation, spectrum, communication-related distributions
4	2/6	Chapter 3: Representation of digitally modulated signals; Memoryless modulation ; Signaling with memory; Continuous-phase modulation - CPFSK ; Viterbi decoding; Power spectrum of digitally modulated signals.
5	2/13	Chapter 3: optimum constellation design, bit error rate evaluation, non-uniform constellation
6,7	2/20, 2/27	Optimum receiver; Waveform and vector channel; optimum detection; Matched filter; Maximum Likelihood detector; Bit error rate; Bandlimited and power limited signaling; Coherent and noncoherent . detection; Bandwidth and dimensionality; Maximum Likelihood Sequence Detector; Optimum detection of CPM signals.
8	3/6	SPRING BREAK
9	3/13	**Midterm Exam**
10	3/20	Chapter 6: Information theory the mathematical basis for communication
11	3/27	Chapter 7: Linear block codes
12	4/3	Bit-interleaved coded modulation (BICM)
13	4/10	Chapter 5: Signal parameter estimation; Carrier phase estimation; Symbol timing estimation
14	4/17	EASTER
15	4/24	Chapter 9: Communication through bandlimited channels
16	5/1	Final day of classes/**Final Exam**

9 Grading Policy

Your final grade will be determined from the following:
Midterm Exam: 30% , Homework: 30%, Final Exam: 40%
A(>=93), A-(<93), B+(<90), B(<87), B-(<83), C+(<80),C(<77),C-(<73)

10 HW Assignment and Laboratory Report Submission Policy

Homework is assigned weekly. Submission is online. Late homework is discounted 25% and not accepted if late by more than a week, unless cleared ahead of time.

11 Attendance Policy

General Rules

The full version of the official Villanova class attendance policy is posted at https://live-villanova-catalog.cleancatalog.io/class-attendance, but the main points are as follows.

Attendance strongly recommended.

Whenever possible, students should inform the instructor if they plan to be late or absent from class. In all cases, documentation is required to petition for *excused* absences to the Associate Dean for Student and Strategic Programs, Dr. Stephen Jones. The excused absence form is posted at: https://forms.office.com/r/H2kbHKLUmw.

Excused absences do not count towards a failure in the course for first year students. Absence from class does not release the student from assigned work. Students who miss an in-class obligation such as an exam, a presentation, etc., due to an excused absence will not be penalized - the instructor may offer a make-up test, arrange an alternative time for a presentation, exempt a student from the assignment, or provide another arrangement. In the case of illness or injury, the form must be submitted within 24 hours of missing a class. The University's list of excused absences for all students includes the following:

(a) Participation in NCAA athletic competitions
(b) Participation in special academic events such as: conferences, field trips, project competitions, etc., and in official university business such as student representatives attending meetings related to university governance
(c) Attendance at significant events of the immediate family such as: funerals, weddings, etc.
(d) Religious holidays - see the University's policy on Religious Holidays
(e) College-approved participation in placement activities such as: job interviews, graduate school interviews, job fairs
(f) Legally required absence such as: jury duty, court appearance, short-term military service
(g) Documented serious illness or disability

Personal Days

Personal Days are NOT allotted for laboratory sessions and courses that meet once a week. For all other courses that meet at least twice a week, students are entitled to excused absences for any reason that may contribute to their personal wellness. The following rules apply.

Students must advise the instructor by email *before* class of their intent to utilize a Personal Day as the reason for their absence. A Personal Day will not be approved retroactively. Students may, but are not required, to provide additional information regarding their absence. A Personal Day does not grant an automatic extension for items due. Students remain responsible for all assignments, exams, presentations, etc. due on that date. The instructor may apply her/his discretion on a case-by-case basis to

determine whether an extension on a deliverable item is appropriate.

For classes that meet thrice a week (50 mins $\times$ 3), TWO personal days are allowed in the semester. These personal days may not be used ...
(a) on consecutive class days
(b) in the same week
(c) immediately preceding or following a University holiday or break period, and
(d) on days when exams, presentations or other major assignments are scheduled.

For classes that meet twice a week (75 mins $\times$ 2), ONE personal day is allowed in the semester. This personal day may not be used ...
(a) immediately preceding or following a University holiday or break period, and
(b) on days when exams, presentations or other major assignments are scheduled.

12 Examination Policy

The College of Engineering has adopted the following general examination guidelines:
(a) Students must arrive before the start of the examination. Under exceptional circumstances a student may need to arrive late, but he/she can enter the examination room no later than five (5) minutes after the start of the exam.
(b) Cell phones must be turned off until the student exits the examination room.
(c) The official Villanova class attendance policy must be followed when requesting excuses for absences or lateness to an examination.
(d) Each student must write and sign the following statement, "I have neither given nor received any unauthorized assistance in the completion of this examination."
(e) For online examinations, the instructor may implement video proctoring or other measures to ensure academic integrity. For consent purposes, the instructor will inform students in advance if (s)he plans to use any form of video-proctoring and whether the examination will be recorded.

13 Academic Integrity Policy

The College of Engineering is committed to creating an environment of academic integrity and ethical decision-making that we hope is reflected in the actions of our students and graduates. As Villanova students, integrity is central to the University mission. As engineers, our code of conduct requires us to place honor and integrity at the forefront of everything we do. As engineering students, it is expected that you will begin to adopt these values and instill them into your work habits. Students violating the academic integrity policy will receive a zero on that assignment or exam and the violation will be reported to the Associate Dean for Academic Affairs. The University's academic integrity policy can be found on the following web page:
https://live-villanova-catalog.cleancatalog.io/academic-integrity-0.

14 Adherence to the Student Code of Conduct

Students are expected to act in a professional and respectful manner to their fellow students, faculty, and staff. Students should become acquainted with and understand the responsibilities set forth in the Student Handbook, especially those in the sections on Policy and Regulations. Adherence to university regulations is expected and required for successful completion of the program of studies. Enforcement within the classroom

of policies regarding classroom behavior is the responsibility of the faculty member. All other discipline problems are to be referred to the Dean of Students.

15 Inclusive Classroom

This classroom is a place where you will be treated with respect; we welcome individuals of all ages, backgrounds, beliefs, ethnicities, gender, gender identities and expressions, sexual orientation, and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment to allow all among us to learn and flourish.

16 Students with Disabilities

It is the policy of the university to make reasonable academic accommodations for qualified individuals with disabilities. If you are a person with a disability (non-physical) please register with the office of Learning Support Services (LSS) by emailing Learning.support.services@villanova.edu or by phoning 610-519-5176 as soon as possible. Registration is *required* in order to receive accommodations. In addition, please contact the instructor during office hours in order to make the appropriate arrangements.

The Office of Disability Services (ODS) collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The ODS provides Villanova University students with physical the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact and register with Gregory Hannah, advisor to students with disabilities at 610-519-3209 or visit the office on the second floor of the Connelly Center.

17 Tutoring Services

Villanova's tutoring services include The Writing Center, The Learner's Studio, and The Center for Speaking and Presentation. These services are offered free of charge to students. Drop in as-needed or book a regular weekly session to supercharge your academic success. Sessions can be 30 or 60 minutes in length.

Register for an account and book sessions in advance at villanova.mywconline.com. If you don't see your class listed, request a tutor for a missing subject at: tutorrequest.villanova.edu For more information, contact Juliana Struder at juliana.studer@villanova.edu or at 610-519-5862.

18 Online Expectations

Some or all sessions of this class may be recorded for educational purposes and for later playback. In order to foster a professional environment, please wear appropriate clothes, refrain from eating, mute your microphone when you are not talking so as to eliminate background noise, and select an appropriate setting free of distractions. You may turn off your webcam for privacy reasons unless explicitly instructed not to do so by the instructor (such as during the conduct of online examinations).

19 Electronics Policy

The use of electronic devices, such as phones, laptops, tablets, calculators, etc., during class is generally allowed, unless their use causes a disturbance to others. During examinations, the use of any electronic device is prohibited, unless it is expressly authorized by the instructor.

Students are prohibited from making any audio or visual recordings (including taking photographs) of lectures, discussions, or other classroom activities, unless a student (1) has written permission in advance from the instructor, or (2) is permitted to record under terms and conditions as approved by the University's Office of Disability Services or Learning Support Services. Students who have received approval to record classes as an academic accommodation must provide supporting documentation from the Office of Disability Services or Learning Support Services in advance of any recording. Students may use authorized recordings only for the purposes of individual study in the course, and may not disseminate or share them with a wider audience without explicit permission.

20 Copyright Policy

The materials used in Villanova University courses ("Course Materials") generally represent the intellectual property of course instructors, third parties and/or the university which may not be disseminated or reproduced in any form for public distribution (e.g., sale, exchange, etc.) without the written permission of the course instructor. Course materials include all written or electronic documents and materials, including syllabi, current and past examination questions/answers, and presentations such as lectures, videos, slides, etc., provided by a course instructor. Course materials may only be used by students enrolled in the course for academic (course-related) purposes.

Published course readings (book chapters, articles, reports, etc.) available in "Blackboard" are copyrighted materials. These works are made available to students through licensed databases or fair use. They are protected by copyright law, and may not be further disseminated or reproduced in any form for distribution (e.g. uploading to websites, sale, exchange, etc.) without the permission of the copyright owner.

Follow these links for more information on Intellectual Property, Copyright, and Computer Acceptable Use.

21 Professorial Duties

It is important to note that teaching is one of the many duties that professors perform as part of their job responsibilities. In addition to teaching, professors perform research, advise graduate students, edit journals and review journal articles, serve on committees for the university and professional societies, travel to conferences to remain abreast of current developments and to present their results... to name just a few commitments.