

**E/CE DEPARTMENT**  
**THE COLLEGE OF NEW JERSEY**  
**FALL 2016**  
**ELC341 - COMMUNICATION SYSTEMS**

**2016-2017 Course Description:**

Digital and analog communication systems including baseband, pulse, AM, FM, and digital modulated systems.

**TEXT:** Communications Systems by A. Carlson and P. Crilly, McGraw-Hill, 2010 (5<sup>th</sup> Edition)

**Instructor:** Dr. Allen Katz, [alkatz@tcnj.edu](mailto:alkatz@tcnj.edu), x2666, 149 Armstrong Hall, Monday 3:00 to 3:30 PM, Wednesday 5:00 to 5:30 PM, Thursday 3:00 to 3:30 PM and 5:30 to 6:50 PM.

**Course Outline**

<b>Week</b>	<b>Material To Be Covered</b>	<b>Reading Assignments</b>	<b>Homework</b>
1	Introduction a. Communication Systems b. Information c. Concept of Frequency d. Modulation and Digital Communication	Chap. 1	PS-1
2	Spectrum of Periodic Signals a. Phasors and Line Spectra b. Periodic Signals and Average Power c. Fourier Series d. Properties & Applications	Chap. 2.1	Design Problems PS-2
3.	Fourier Transform a. Relation Between Aperiodic and Periodic Signals b. Energy Considerations c. Properties of Fourier Transform <b>Test 1</b>	Chap. 2.2,.3	2.2-1,3,5,7,11,13 2.3-1,3,5,9,11,13,15,17, 21
4	Bandwidth and Signal Transmission a. Convolution b. Impulses and Transforms c. Discrete Time Signals and Fourier Transforms	Chap. 2.4,.5,.6	2.4-3,5,7,9 2.5-1,3,7 2.6-4,6
5.	Signal Transmission and Filtering a. LTI Response b. Distortion in Transmissions	Chap. 3.1,.2	3.1-1,3,7,9,11,13,15,17 3.2-1,5,7,11,13
6.	Signal Transmission Continued a. Transmission Loss & dB b. Filters and Filtering	Chap. 3.3,.4	3.3-1,3,7,9,11 3.4-1,3,7,9
7.	Spectral Density and Correlation a. Quadrature Filters and Hilbert Transform b. Correlation	Chap. 3.5,.6	3.5-1,5,7 3.6-5,7,9,15 Corr. Problem PS-3

Week	Material To Be Covered	Reading Assignments	Homework
8.	Amplitude Modulation a. Bandpass Signals b. DSB & Standard AM c. Modulators and Transmitters d. SSB e. Frequency Conversion and Demod	Chap. 4 (all)	4.1-5,9,13 4.2-1,5,7,13 4.3-1,3,5 4.4-3,5,7 4.5-1,3,5,11
9.	Angular Modulation a. FM and PM b. Bandwidth and Distortion c. Generation and Detection d. Interference <b>Test 2</b>	Chap. 5 (all)	5.1-5,9,13,15 5.2-1,3,5,7,9 5.3-5,7,9 5.4-1,3,5,13
10.	Catch Up & Review		
11.	Sampling and Pulse Modulation a. Sampling Theory and Practice b. Pulse-Amplitude Modulation c. Pulse-Time Modulation	Chap. 6 (all)	6.1-1,5,7,11,15 6.2-3,5 6.3-1,3,5
12.	Analog Communication Systems a. Receivers b. Multiplex Systems c. Phase Locked Loops d. Television Systems	Chap. 7.1,.2,.3,.4	7.1-1,5,9,11,15 7.2—1,3,5,11,15 Digital Sys Proj. PS-4
13.	Bandpas Digital Transmission a. Digital CW Modulation b. Coherent Binary Systems c. Noncoherent Binary Systems <b>Test 3</b>	Chap. 14.1,.2,.3	14.1-1,3,5,13,15 14.2-1,3,5 14.3-1,3,5
14.	Digital Modulation Techniques Continued a. Quadrature-Carrier M-ary Systems b. OFDM c. Spread Spectrum d. Trellis-Coded Modulation	Chap. 14.4,.5,.6, Chap. 15.1,.2	14.4-1,1,3,9 14.5-1,3,5 15.1-1,3
15.	Catch Up & Review		

# **GRADING POLICY: ENGR 341 - Communication Systems**

50% - Tests & Design Projects

20% - Quizzes

30% - Final Exam

**Course Objectives:**

Objective 1: To introduce students to the basic concepts of communications systems.

Objective 2: To introduce students to engineering design in the area of communications systems.

**Performance Criteria:**

Objective 1.1: Students will demonstrate an understanding of the structure of basic communications systems and the concepts of time, frequency and information in these systems.

Objective 1.2: Students will demonstrate an understanding of time-spectrum analysis principles.

Objective 1.3: Students will demonstrate an understanding of different methods of modulation and demodulation for both analog and digital system.

Objective 1.4: Students will demonstrate an understanding of the different forms and effects of noise and distortion.

Objective 2.1: Students will demonstrate they can work both individually and in a team on the solution of open-ended communication system design problems.

Objective 2.2: Students will demonstrate the ability to research and solve communication system design problems.

**Educational Objectives:**

The School of Engineering at The College of New Jersey seeks to prepare its graduates:

- To contribute to the economic development of New Jersey and the nation through the ethical practice of engineering;
- To become successful in their chosen career path, whether it is in the practice of engineering, in advanced studies in engineering or science, or in other complementary disciplines;
- To assume leadership roles in industry or public service through engineering ability, communication skills, teamwork, understanding of contemporary global and socio-economic issues, and use of modern engineering tools;
- To maintain career skills through life-long learning and be on the way towards achieving professional licensure.

**Electrical and Computer Engineering Program Student Outcomes**

(What TCNJ Electrical and Computer Engineering students are expected to know and be able to do at graduation. What knowledge, abilities, tools and skills the program gives the graduates to enable them to accomplish the Educational Objectives)

The Student Outcomes listed below are expected of all graduates of the Electrical or Computer Engineering Program.

**ECE graduates will have:**

- a) **an ability to apply knowledge of mathematics, science and engineering;**
- b) an ability to design and conduct experiments, as well as to analyze and interpret data;
- c) **an ability to design a system, component, or process to meet desired needs;**
- d) an ability to function in multidisciplinary teams;
- e) **an ability to identify, formulate and solve engineering problems;**

- f) an understanding of professional and ethical responsibility;
- g) an ability to communicate effectively;**
- h) the broad education necessary to understand the impact of engineering solutions in a global and societal context;
- i) a recognition of the need for and an ability to engage in life-long learning;
- j) a knowledge of contemporary issues;
- k) an ability to use the techniques, skills and modern engineering tools necessary for engineering practice;**
- l) an ability to analyze and design complex electrical and electronic devices;
- m) an ability to analyze and design software and systems containing hardware and software components.

Specific to this course

- a) an ability to apply knowledge of mathematics, science and engineering;**  
Fourier series, Fourier Transforms, Hilbert Transforms, Probability, Sampling, Noise, I-Q signals
- c) an ability to design a system, component, or process to meet desired needs;**  
Home work problems involve design (television system, satellite system, modulation and demodulation components, coding, projects involve design of efficient harmonic generator and correlation coding system
- e) an ability to identify, formulate and solve engineering problems;**  
Harmonic content, modulation/demodulation performance, noise, information capacity, bandwidth, distortion,
- k) an ability to use the techniques, skills and modern engineering tools necessary for engineering practice;**  
MATLAB and Pspice are used in many homework/project problems

#### **DESCRIPTION OF DESIGN ACTIVITY**

Many home work problems involve design related issues plus two design projects.

Example: Design a simple television system photo diodes and optical detectors.

Example: Design a system that optimizes the 5<sup>th</sup> harmonic average power level for specific constraints.

Example: Determine Transmitter power required for a given path loss, information rate and receiver G/T.

#### **REALISTIC CONSTRAINTS**

Economic: Discuss relative costs and manufacturing considerations of different designs.

#### **PROFESSIONAL ENGINEERING TOOLS**

MATLAB, LABVIEW and Pspice are widely used in industry for the design of communications related hardware and systems.

#### **COMPUTER USAGE**

About thirty percent of the homework problems involve the use of a computer. The design project requires computer use.

#### **FEEDBACK MECHANISM**

Regular short quizzes with discussion of the solution in class.

#### **FOURTH HOUR EDUCATIONAL ACTIVITIES**

Fourth hour meetings are regularly required of students to meet in groups and with the instructor to discuss and present results of home work and intensive design projects required by this course (COM-PROJ-1, 2 and 3).

## **SELECTED TCNJ POLICIES**

TCNJ's final examination policy is available on the web:

<http://www.tcnj.edu/~academic/policy/finalevaluations.htm>

### **Attendance**

Every student is expected to participate in each of his/her courses through regular attendance at lecture and laboratory sessions. It is further expected that every student will be present, on time, and prepared to participate when scheduled class sessions begin. At the first class meeting of a semester, instructors are expected to distribute in writing the attendance policies which apply to their courses. While attendance itself is not used as a criterion for academic evaluations, grading is frequently based on participation in class discussion, laboratory work, performance, studio practice, field experience, or other activities which may take place during class sessions. If these areas for evaluation make class attendance essential, the student may be penalized for failure to perform satisfactorily in the required activities. Students who must miss classes due to participation in a field trip, athletic event, or other official college function should arrange with their instructors for such class absences well in advance. The Office of Academic Affairs will verify, upon request, the dates of and participation in such college functions. In every instance, however, the student has the responsibility to initiate arrangements for make-up work.

Students are expected to attend class and complete assignments as scheduled, to avoid outside conflicts (if possible), and to enroll only in those classes that they can expect to attend on a regular basis. Absences from class are handled between students and instructors. The instructor may require documentation to substantiate the reason for the absence. The instructor should provide make-up opportunities for student absences caused by illness, injury, death in the family, observance of religious holidays, and similarly compelling personal reasons including physical disabilities. For lengthy absences, make-up opportunities might not be feasible and are at the discretion of the instructor. The Office of Academic Affairs will notify the faculty of the dates of religious holidays on which large numbers of students are likely to be absent and are, therefore, unsuitable for the scheduling of examinations. Students have the responsibility of notifying the instructors in advance of expected absences. In cases of absence for a week or more, students are to notify their instructors immediately. If they are unable to do so they may contact the Office of Records and Registration. The Office of Records and Registration will notify the instructor of the student's absence. The notification is not an excuse but simply a service provided by the Office of Records and Registration. Notifications cannot be acted upon if received after an absence. In every instance the student has the responsibility to initiate arrangements for make-up work.

TCNJ's attendance policy is available on the web:

<http://www.tcnj.edu/~recreg/policies/attendance.html>

### **Academic Integrity Policy**

Academic dishonesty is any attempt by the student to gain academic advantage through dishonest means, to submit, as his or her own, work which has not been done

by him/her or to give improper aid to another student in the completion of an assignment. Such dishonesty would include, but is not limited to: submitting as his/her own a project, paper, report, test, or speech copied from, partially copied, or paraphrased from the work of another (whether the source is printed, under copyright, or in manuscript form). Credit must be given for words quoted or paraphrased. The rules apply to any academic dishonesty, whether the work is graded or ungraded, group or individual, written or oral.

TCNJ's academic integrity policy is available on the web:

<http://www.tcnj.edu/~academic/policy/integrity.html>.

### **Americans with Disabilities Act (ADA) Policy**

Any student who has a documented disability and is in need of academic accommodations should notify the professor of this course and contact the Office of Differing Abilities Services (609-771-2571). Accommodations are individualized and in accordance with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1992.

TCNJ's Americans with Disabilities Act (ADA) policy is available on the web:

<http://www.tcnj.edu/~affirm/ada.html>