1. Overall objectives of the course

Upon successfully completing this course, the students will have demonstrated good understanding of the following:

- Basics of digital communication systems, including a brief introduction to different types of coding: source, channel, spreading, synchronization.
- The physical aspects of: signal spectrum and bandwidth, circuit (channel) bandwidth and frequency response.
- Fourier analysis and transform as a tool used to relate signal representations in both time domain and frequency domain with an emphasis on Fourier transform properties, with some distinction between periodic and non-periodic signals.
- The need for signal modulation and an introduction to the different types of modulation.
- The relationship between baseband signal bandwidth and modulated signal bandwidth, especially using the frequency translation property of Fourier transform.
- Noise effect on signals and statistical characterization of noise, bit error rate and symbol rate.
- Antenna directivity: main lobe and side lobes, beam width in different planes, reciprocity theory, and Signal polarization.
- Basics of Information theory: Entropy, channel capacity, variable length coding, and data transmission rate.
- Analog to digital conversion: sampling and quantization. Pulse modulation techniques: pulse code modulation (PCM), pulse amplitude modulation (PAM), pulse width modulation (PWM), Pulse position modulation (PPM),...
- Digital modulation techniques: On-Off keying, phase shift keying, and frequency shift keying.
- Basics of spread spectrum systems (SSS) and the necessity for code division multiplexing.
- Maximal length sequences.
- Basics of number theory and finite fields.
- Basics of binary sequence sets for direct-sequence SSS.
- Basics of multilevel sequence sets for frequency hopping SSS.
- Basics of error control coding.

All of the above topics should not be taught aiming to give the student the ability to designing single elementary units. Instead, it should be taught to give the student the background required to enhance her/his understanding of the basic physical concepts used in the overlapping area of computer science and digital communication systems.

Detailed design and analysis of communication units should be the job of a communication engineer with a background in Electrical Engineering.

PROCEDURES: Classroom work will consist of discussion, demonstration and student participation. Scheduled homework is to be completed prior to the class time for which it is assigned. No homework will be accepted late. Lecture notes are given in class; however, the student is expected to take notes and copy examples given in class. A marker will be a useful tool to mark on the definitions emphasized by the instructor.
## 2. Tentative syllabus

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basics of digital communication systems, including a brief introduction to different types of coding: source (encryption), channel, spreading, synchronization,…</td>
<td>5</td>
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<tr>
<td>The physical aspects of: signal spectrum and bandwidth, circuit (channel-system) bandwidth and frequency response.</td>
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<tr>
<td>The need for signal modulation and an introduction to the different types of modulation.</td>
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<tr>
<td>The relationship between baseband signal bandwidth and modulated signal bandwidth, especially using the frequency translation property of Fourier transform.</td>
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<tr>
<td>Fourier analysis and transform as a tool used to relate signal representations in both time domain and frequency domain with an emphasis on Fourier transform properties, with some distinction between periodic and non-periodic signals (pulse radar signal will be the illustrating example on the periodic signals).</td>
<td>5</td>
</tr>
<tr>
<td>Noise effect on signals and statistical characterization of noise, bit error rate and symbol rate.</td>
<td>5</td>
</tr>
<tr>
<td>Basics of Information theory: Entropy, channel capacity, variable length coding, and data transmission rate.</td>
<td></td>
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<tr>
<td>Antenna directivity: main lobe and side lobes, beam width in different planes, reciprocity theory, and Signal polarization (radar antenna directivity will be the illustrating example).</td>
<td></td>
</tr>
<tr>
<td>Analog to digital conversion: sampling and quantization. Pulse modulation techniques: pulse code modulation (PCM), pulse amplitude modulation (PAM), pulse width modulation (PWM), Pulse position modulation (PPM) Digital modulation techniques: On-Off keying, phase shift keying, and frequency shift keying.</td>
<td>5</td>
</tr>
<tr>
<td>Basics of spread spectrum systems (SSS) and the necessity for code division multiplexing.</td>
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<tr>
<td>A revision of number theory and finite fields.</td>
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<tr>
<td>Maximal length sequences.</td>
<td>5</td>
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<tr>
<td>Basics of binary sequence sets for direct-sequence SSS.</td>
<td>5</td>
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<tr>
<td>Basics of multilevel sequence sets for frequency hopping SSS.</td>
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<tr>
<td>Basics of error control coding</td>
<td>5</td>
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<tr>
<td>Two midterm tests: week 7 and week 11</td>
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</tr>
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</table>

## 3. Course units and grading

Number of Hours: 42 hours (3 hours weekly).

Two midterm tests and final exam.

Grading:

- 15 marks for the 1st midterm test.
- 15 marks for the 2nd midterm test.
- 15 marks for projects.
- 15 marks for class activities.
- 40 marks for final exam.

All tests are to be taken on the assigned date, unless special permission is given by the instructor in cases of emergency. Makeup exams are given only to those students who have an absence that has been approved by the instructor.
ATTENDANCE: Attendance is a vital part of the learning experience and each student is expected to be present each time. After three un-excused absences, 1/2 point will be deducted from the final grade for each un-excused absence.

4. References

Books:
2- OPTIONAL TEXT: Digital communications: fundamentals and applications, by Sklar Bernard,
   2008.
4- OPTIONAL TEXT: Introduction to Digital Communications, by Pursley, Michael B.

Papers:
1- Sarwate, D. V. and Pursly, M. B., Cross-correlation properties of pseudorandom and related
   frequency-hopped spread-spectrum systems”, IEE Proceedings, Vol. 131, Pt. F, No. 7,
   December 1984, PP 719-724.

4. Notes

NEITHER cell phones NOR mp3 players (or other audio/visual equipment) are to be used during class
(No calls and no text messaging during class). Silence your phones for all classes.

If you must leave the class early for a legitimate reason, please inform the instructor before the class
starts. Leaving a class early without notifying the instructor is the same as an absence. If an emergency
arises that you must leave the class (even if you return), please inform the instructor at the end of the
class.

Food and drinks are not to be taken into the classroom.

GRADING SYSTEM
A 90-100
B 80- 89
C 70- 79
D 60- 69
F 0- 59

OFFICE: Perdue Hall  room 228.
OFFICE HOURS: 10-12, MWF