Instructor: Zak M. Kassas

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Course Webpage: Available through iLearn
Office Hours: T. 6:30 pm – 8:00 pm, and by appointment

Lectures: Tue. & Thu., 2:10 pm – 3:30 pm, SPR 2355


Suggested References:

Prerequisites: Consent of instructor

Course Objective: This course develops a comprehensive understanding of GNSS signal structure, GNSS communication channel, received power, RF front-end receiver design, sampling, correlation, acquisition techniques, tracking loop theory, noise and bandwidth concepts, generation of GNSS observables, and software-defined radio (SDR) implementation.

Exams: There will be one midterm exam and a final. Missed exams may not be made up (unless it is the result of an officially excused absence).

Project: There will be a final project to design and implement a GPS SDR via high-level programming tools (e.g., MATLAB and LabVIEW). The project will integrate many of the topics introduced in the course.

Attendance and Course Policy: Attendance is expected. You are responsible for material covered in class and in the reading assignments.

Grading:

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<tr>
<th>Component</th>
<th>Percentage</th>
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<tr>
<td>Project</td>
<td>20%</td>
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<tr>
<td>Midterm Exam</td>
<td>40%</td>
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<td>Final Exam</td>
<td>40%</td>
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# Tentative Topical Coverage:

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<tr>
<th>Week</th>
<th>Topics</th>
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| 1    | **GNSS Fundamentals:**  
Methods of radionavigation; GNSS system architecture; Doppler, pseudorange, and carrier phase measurement models |
| 2    | **Noise in Communication Systems:**  
Received signal-to-noise levels, carrier-to-noise ratio, noise in cascaded systems |
| 3    | **Spread Spectrum Signaling:**  
Power spectrum of binary data sequences, direct sequence spread spectrum, multiple access |
| 4    | **GPS Signal Structure:**  
Model, linear feedback shift registers, Gold sequences |
| 5    | **GNSS Radiowave Propagation Effects:**  
Ionospheric effects, code-carrier divergence, phase and group delay, calibration for ionospheric effects, scintillation effects, neutral atmospheric effects |
| 6    | **Signal Conditioning:**  
RF front-ends, frequency conversion, analog-to-digital conversion, bandpass sampling, practical sampling, uniform sampling and down-conversion, quantization |
| 7    | **Signal Acquisition:**  
Statistics of signal acquisition, hypothesis testing, Neyman-Pearson Lemma, FFT-based acquisition |
| 8    | **Coherent and Non-Coherent Integration:**  
Coherence time, signal models for long coherent integration, high-sensitivity receivers |
| 9    | **Tracking Loops:**  
Steady-state tracking error and loop type, phase tracking loops, code tracking loops, loop filters, code generation |
| 10   | **Software-Defined GNSS Receiver Design:**  
Combined code and carrier tracking, GNSS receiver block diagram, GNSS observables and navigation solutions |