

ELEC 5606

Phase-Locked Loops and Receiver Synchronizers
Fall 2024

Instructor: Jim Wight
Office: 5154 Mackenzie
Office Hours: TBD
Lecture: Tuesdays/Thursdays (5:35 – 6:55p.m.)
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Lecture Outline:

Section I: Phase-Locked Loops

1. Loop Components: phase detectors, voltage-controlled oscillators, filters.
2. First-order and second-order loop operation.
3. Loop stability for first-order and second-order loops.
4. Transient response: phase step, frequency step, linear frequency variation.
5. Sinusoidal phase modulation, sinusoidal frequency modulation, use of a PLL as a discriminator.
6. Natural acquisition for first-order and second-order loops, phase plane method.
7. Additive noise response, signal-to-noise ratio of a PLL phase demodulator and of a PLL frequency demodulator.

Section II: Receiver Synchronizers

- 8,9. Carrier Synchronizers: Squaring loop, Costas loop, Remodulator, BPSK and QPSK bit error performance.
10. Clock Synchronizers: Early-late gate synchronizer, Inphase/midphase synchronizer, Delay line Multiplier, Narrow Band Synchronizers.
- 11,12. Code synchronizers: single-dwell and multiple-dwell serial PN acquisition, matched-filter PN acquisition, delay-locked loop and Tau-Dither loop PN tracking.

Text: Alain Blanchard, Phase-Locked Loops: Applications to Coherent Receiver Design, Wiley 1976. Reprinted 1992, Krieger.

References: Gardner, Phaselock Techniques, 2nd Edition, Wiley 1979.
Wolaver, Phase-Locked Loop Circuit Design, Prentice Hall, 1991.
Best, Phase-Locked Loops, McGraw-Hill, second edition 1993.
Simon, Omura, Scholtz, Levitt, Spread Spectrum Communications, Vol. III. Computer Science Press, 1985.

Course Grading:

The breakdown for grades will be as follows:

- a. Three (3) assignments worth 20% **each**
- b. One (1) written exam (**3 hours open book**) worth 40%

ACADEMIC ACCOMMODATION

Carleton is committed to providing academic accessibility for all individuals. You may need special arrangements to meet your academic obligations during the term. The accommodation request processes, including information about the *Academic Consideration Policy for Students in Medical and Other Extenuating Circumstances*, are outlined on the Academic Accommodations website (students.carleton.ca/course-outline).

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IMPORTANT DATES TO REMEMBER – Academic Year 2024-2025

WITHDRAWALS

The last day to withdraw from fall term courses with a **fee adjustment** is **September 30, 2024** (financial withdrawal). Withdrawals after this date will create no financial change to fall term fees and will result in a permanent notation of WDN appearing on your official transcript.

The last day to withdraw from fall courses without academic penalty is **November 15, 2024** (academic withdrawal).

OFFICIAL FINAL EXAMINATION PERIOD

Fall term: **December 9-21, 2024** – Examinations are normally held all seven days of the week.

For a complete listing of academic and financial dates and deadlines for the 2024/2025 academic year, please visit <https://carleton.ca/registrar/registration/dates/academic-dates/>.