

ECE 4331 – Systems and Signals Laboratory

(Professor-In-Charge: Mohamad Hassoun)

Winter 2019

Section **28152** (10:00 am – 1:50 pm, Room 3350 Engineering)

TA: Mostafa Daneshgar Rahbar (fs6081@wayne.edu)

Office hours: Tuesdays and Thursdays 1:00 – 3:00.

Location: Room 3342 Engineering

WSU Catalog Description (2 cr.) Open only to students enrolled in professional engineering programs. Students will explore hands-on the concepts associated with linear systems. Experiments cover signal generation, signal manipulations and signal measurements, electronic oscillators, steady-state, zero-state and zero-input responses of linear circuits, harmonic sinusoidal content (Fourier Series) of periodic signals, low-pass, high-pass, band-pass and notch filter circuits, network functions, solution of differential equations using operational amplifier circuits, amplitude modulation and demodulation of speech signals, signal sampling and reconstruction

Prerequisite or co-requisite: ECE 4330.

Prerequisites and co-requisites are checked automatically at the time of registration. However, it is ultimately a student's responsibility to make certain that they have the prerequisites and co-requisites for a course. Students must remain registered for a co-requisite course throughout the semester. Advisors will check course prerequisites and co-requisites during the 5th and 6th week of the semester. Any student found to be registered for a course without meeting these requirements, and without an official waiver on file, will be administratively withdrawn from the course.

[Manuals and materials](#) are available on-line.

Table of Experiments:

Experiment 0: Introduction, Instrument Basics and Software

Experiment 1: Audio Generation, Multiplication, Squaring and Square-Rooting

Experiment 2: Basic Operational Amplifier Circuits

Experiment 3: Analog Integration and Application to oscillator Design

Experiment 4: Steady-State, Zero-State and Zero-Input Response of Second-Order Circuits

Experiment 5: Analog Circuit Realization of the Lorenz Chaotic System

Experiment 6: Active Butterworth Low-Pass Filters

Experiment 7: Fourier Series of Periodic Signals and Filtering

Experiment 8: Amplitude Modulation, Demodulation and Signal Reconstruction

Experiment 9: Sampling and Reconstruction of Signals

Student Outcomes:

- ABET-2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
- ABET-5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
- ABET-6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

Learning Objectives: After completing this course, students should be able to do the following:

1. Use the basic and advanced features of a modern waveform generator and oscilloscope to generate various signals, measure their parameters and perform mathematical signal operations
2. Build, test and explain the operation of analog circuits for signal multiplication, squaring and square-rooting.
3. Build and test and explain the operation of practical operational amplifier (op amp) circuits: Comparator, voltage follower, inverting amplifier, inverting adder, and RC relaxation oscillator.
4. Build and test and explain the operation of an inverting integrator circuit. Perform voltage and current offset compensation. Build and test a sinusoidal oscillator utilizing integrators.
5. Build, measure and explain the steady-state, zero-state and zero-input response of a second-order active linear circuit.
6. Build an analog circuit consisting of amplifiers, integrators and multipliers that implements the diffusion-less Lorenz dynamical system, and experimentally generate and explain its phase-plane dynamics.
7. Design and build an active circuit that realizes a fourth-order low-pass Butterworth filter and experimentally determine the frequency response (magnitude and phase), step-response and impulse-response.
8. Determine and measure experimentally the Fourier series of periodic signals and study the effect of various electronic filter types on a signal's waveform.
9. Build, test and explain the operation of an AM modulation/ demodulation system and study the effect of the reconstruction filter on the quality of the recovered signal.
10. Generate and characterize the spectra of the signals at various points in an AM communication system, and study the effect of phase difference between the modulation sinusoid and the demodulation sinusoid on the reconstructed signal.
11. Build, test and explain sampling/reconstruction circuits and study the effect of the reconstruction filter (order and cutoff frequency) on the quality of the recovered signal. Generate and characterize the spectra of the signals at different points in the sampling system.

Professor-in-Charge Information:

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Laboratory Policy: There is absolutely no smoking, eating or drinking in any ECE instructional laboratory. These labs must be kept neat and each student is responsible for insuring that the equipment on his/her workbench is neatly arranged, that all components and equipment are put away at the end of the session, and that there are no scraps of paper or other garbage left on or near his/her workstation. Coats, briefcases, knapsacks and other personal belongings are not permitted on or near the benches. The door to the lab must be kept locked at all times; unlocking or propping open the door at any time is expressly forbidden. Guests are not permitted in the lab at any time, and no one but the instructor may open the door to admit anyone after the class has begun. Cell phone use is prohibited while you are in the Lab. Additional laboratory policies may be provided by your TA.

Students may borrow lab kits overnight or over the weekend, but only after getting permission from the lab instructor. In this case, a student (or student team) must sign the kit out and be responsible for all its contents. A student who loses or damages a borrowed kit will be charged \$650. The TA is responsible for obtaining a student's signature (agreeing to the above charges) before he/she could borrow a kit. A borrowed kit must be returned to the next scheduled laboratory session and its contents inventoried by the TA.

Grading:

Laboratory participation and reports: 80%

Final Project: 20%

Grading Scale:

Percentage/Grade/(Honor Point Value)

95-100	A	(4.00)
90-94	A-	(3.67)
85-89	B+	(3.33)
80-84	B	(3.00)
75-79	B-	(2.67)
70-74	C+	(2.33)
65-69	C	(2.00)
60-64	C-	(1.67)
55-59	D+	(1.33)
50-54	D	(1.00)
45-49	D-	(0.67)
0-44	F	(0.00)

Drop & Withdraw Deadlines: Beginning the fifth week of class students are not allowed to drop but must [withdraw](#) from classes. It is the student's responsibility to request the withdrawal. Failure to do so will result in a grade of F. The withdrawal period

for full-term classes ends at the end of the tenth week of the term. See the [Academic Calendar](#) for specific information on when the withdrawal period ends.

Students with Disability: If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TDD only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your special needs. Student Disability Services' mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University. You can learn more about the disability office at: www.studentdisability.wayne.edu

[Academic Misconduct:](#) What every student should know

Cheating and Penalty for Cheating: Cheating is defined by the University as “intentionally using or attempting to use, or intentionally providing or attempting to provide, unauthorized materials, information, or assistance in any academic exercise.” This includes any group efforts on assignments or exams unless specifically approved by the professor for that assignment or exam. Evidence of fabrication or plagiarism, as defined by the University in its brochure “Academic Integrity,” will also result in downgrading for the course. Students who cheat on any assignment or during any examination will be assigned a failing grade for the course.

Rules and Penalties for cheating in ECE 4331: All work submitted for grading must be 100% individual effort (unless otherwise told beforehand by your instructor). You understand that once you submit your work for grading then you are automatically certifying that the work is 100% yours. The first cheating incidence (no matter how small) by a student will earn that student a zero for that piece of work (e.g., lab report). The second offence is an automatic failure of the course.