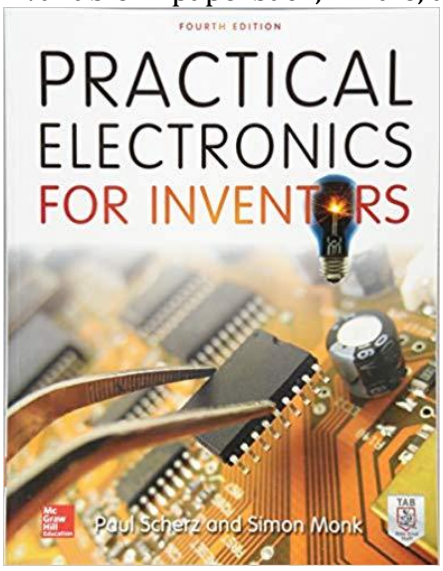
Point Loma Nazarene University
EGR 3053-01: Analog Electronics (2.0 units)
Fall Semester 2019

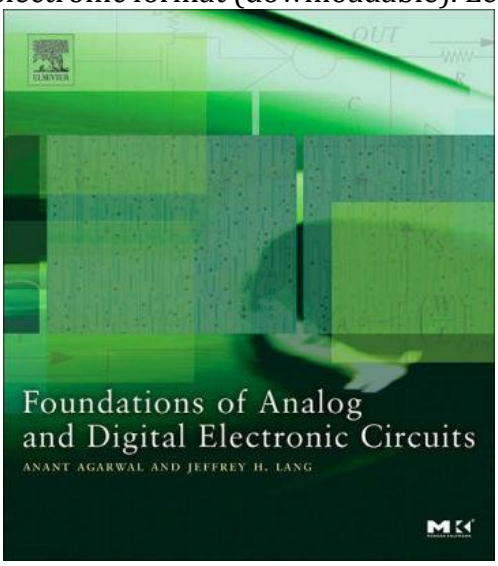
CREDIT AND CONTACT HOURS: 2 credit hours.
Class meets 2 times per week for 2 hours per week.
Lecture Class WF 2:55 – 3:50 p.m RS 295
EGR 3053L Lab Class: 1 credit hour
Class meets 1 time per week for 1.75 hours per week.
Lab Class T 3:00 – 4:45 p.m RS 295

INSTRUCTOR: Christopher T. Gabler
CONTACT INFO: cgabler@pointloma.edu
Office: Rohr Science 2nd Floor Adjunct office RS-282
Office hours: WR 11:00 – 1:00 pm, and by appointment
Phone: Cell: 858-354-8762

TEXTBOOK:
Materials – *Main text*: Practical Electronics for Inventors, by Scherz, P., and Monk, S., McGraw Hill, 2013, 3rd Edition, ISBN 978-0-07-177133-7. Lecture and Lab.

Supplemental text: Foundations of Analog and Digital Electronic Circuits ISBN #9781558607354, Argawal, A., Lang, J., Elsevier Inc., 2005, 1st edition. Available in paperback, Kindle, and electronic format (downloadable). Lecture.





Prerequisites or Co-requisites - PHY 142 or 242 University Physics; with analytic, and calculus-based study of mechanics, waves, and thermodynamics.

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CANVAS and COURSEWORK:
The online resource Canvas is integral for this course, and you are expected to login regularly. You need a reliable internet connection to be able to use this resource.

UNIVERSITY MISSION:
Point Loma Nazarene University exists to provide higher education in a vital Christian community where minds are engaged and challenged, character is modeled and formed, and service is an expression of faith. Being of Wesleyan heritage, we strive to be a learning community where grace is foundational, truth is pursued, and holiness is a way of life.

DEPARTMENT MISSION:
The Physics and Engineering Department at PLNU provides strong programs of study in the fields of Physics and Engineering. Our students are well prepared for graduate studies and careers in scientific and engineering fields. We emphasize a collaborative learning environment which allows students to thrive academically, build personal confidence, and develop interpersonal skills. We provide a Christian environment for students to learn values and judgment and pursue integration of modern scientific knowledge and Christian faith.

COURSE DESCRIPTION
EGR 3053: AC/DC circuit analysis, transients, characteristics of equivalent circuits for diodes, transistors, power supplies, transistor/operational amplifiers, and feedback applications.
EGR 3053L: A lab course designed for a hands-on exploration of Analog Electronics. Meets two hours per week.

COURSE LEARNING OUTCOMES - The objectives of the course are to:
1. Understand the concepts of the theory of electronics; current, voltage, resistance, electrical power supplies, inductance, and capacitance.
2. Understand the difference between passive and active devices, conductors, insulators, and semiconductors.
3. Learn and analyze electric circuits of various designs of components, and use Ohm's Law, Kirchhoff's laws, Thevenin's, the Superposition and Norton's theorems.
4. Understand DC and AC circuits, their differences, RMS Voltage, power and how AC current is generated.
5. Study the effects of current in capacitors, inductors and the concept of electromagnetism, and transients.
6. Study complex circuits with complex numbers, resonant circuits, input and output impedance, components, semiconductors (diodes, transistors, rectifiers and integrated circuit packages.

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7. Study feedback circuits, characteristics of equivalent circuits for diodes, transistors, power supplies, transistor/operational amplifiers, and feedback applications.

Course Topics in EGR 3053

Electrical variables and the application of fundamental circuit laws and theorems to DC/AC resistive circuits; the analysis of RLC circuits including resonance; the principles, construction, analysis and modelling of basic semi-conductor devices; and experimental work involving diodes, transistor amplifiers and op-amps.

- Circuits and linear systems.
- Review of DC circuit analysis: Ohm's law, Kirchhoff's laws: KCL, KVL, dependent sources.
- The use of circuit analysis techniques (Node-Voltage & Mesh- Current methods).
- The concepts and types of amplifiers.
- The electric behavior of circuit elements Inductors & Capacitors (Time & Frequency domains).
- The concepts of Sinusoidal steady-state analysis and the calculations of Power types.
- The concepts, the models, the use and the analysis of MOS and BJT transistors in different circuits and applications.
- The concepts, the models, the use and the analysis of single stage and two stage op-amps indifferent circuits and applications.
- Complex numbers and functions of a complex variable.
- Impedance, phasors, and sinusoidal steady-state systems.
- Frequency response and multi-frequency circuits.
- Fourier Series.

Class Meetings – Studying analog electronics requires active learning and participation during class. In preparation for each class meeting there is a reading assignment. To maximize your learning and participation during our meetings it is very important that you have read this material before class.

Class Enrollment:

It is the student's responsibility to maintain his/her class schedule. Should the need arise to drop this course (personal emergencies, poor performance, etc.), the student has the responsibility to follow through (provided the drop date meets the stated calendar deadline established by the university), not the instructor. Simply ceasing to attend this course or failing to follow through to arrange for a change of registration (drop/add) may easily result in a grade of F on the official transcript.

Class Conduct – Attendance and punctuality are requirements for the course to help the student maximize his overall learning experience.

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Class exercises, questions and other elements of participation are factors in the students' overall grade assessment. The student is accountable for *all material* covered in class. In addition, students need to respect the classroom environment, and activity such as cell phone use, talking during the class lecture portions (when not engaged in questions and answers) and/or any other related behavior that interferes with the learning experience will be addressed to the student by the instructor.

Course Objectives – An emphasis is placed on both conceptual understanding and the ability to solve problems dealing with the concepts studied.

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design a system, component, or process to meet desired needs
(c) an ability to identify, formulate, and solve engineering problems
(d) a recognition of the need for, and an ability to engage in life-long learning
(e) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
(f) an ability to apply principles of engineering, basic science, and math to model, analyze, design and realize physical systems, components or processes

General Education Learning Outcomes: GELO 1e will be assessed directly using problems on the final exam that are quantitative in nature.

Homework – Homework is worth 10% of your final grade.
Submission: Written homework solutions should be worked neatly in clear logical steps. (Solutions and explanations should be clear enough that one of your peers could easily follow what you did if they had not worked the problem before.)

Collaboration: We expect and encourage collaboration between you and your peers while working on your homework, but your work should be your own original solutions. Allow adequate time to work and think about problems by yourself first before you work together with your peers or ask questions of me. When you sit down to write up a problem, you should not use notes copied from someone else. The guideline is that you should have no trouble explaining or repeating work that you turn in.

Late Work
Late Submission: Normally, there is no late work. Some exceptions at the discretion of the instructor may be accepted late with a 10% reduction in grade for every day it is late. This begins with a 10% reduction for an assignment turned in later in the day after this homework has been collected at the beginning of class.

Lab – You will participate in a lab designed to give you hands-on experience with the concepts covered in the class meetings.

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Lab will also provide an opportunity for you to use instruments common to the physical sciences, perform measurements, and analyze data using the scientific method. Labs will be completed in small groups, with each member of the team completing his or her own worksheet. Labs comprise 20% of your final grade. You must pass the lab portion of the class to pass the course.

Exams – Examinations will be given in class, which count toward 40% of your final grade, consisting of three midterms. The final exam is comprehensive and counts for 15% of your grade. Exams will be closed book. Partial credit will be given for correct reasoning at any step of the problem, but only if it is communicated clearly enough for me to understand. For problems that call for a solution or explanation, no credit will be given for an answer alone; the method or reasoning must also be shown.

Missed Exams: Exams are **mandatory** and **not missed.** If there are circumstances beyond your control that you know in advance that may cause you to miss an exam, the instructor needs to know well before the exam.

Final Grades – The grade you earn in this course is roughly based on the following scale: 100%-88% A, 88%-85.5% A-, 85.5%-83% B+, 83%-78% B, 78%-75.5% B-, 75.5%-73% C+, 73%-68% C, 68%-65.5% C-, 65.5%-63% D+, 63%-58% D, 58%-55.5% D-. The points you receive during the course are weighted accordingly: in-class quizzes: 20%, homework: 10%, labs: 20%, exams (3): 50%.

Academic Honesty – Students should demonstrate academic honesty by doing original work and by giving appropriate credit to the ideas of others. Academic dishonesty is the act of presenting information, ideas, and/or concepts as one's own when they are the results of another person's creativity and effort. A faculty member who believes a situation involving academic dishonesty has been detected may assign a failing grade for that assignment or examination, or, depending on the seriousness of the offense, for the course. Faculty should follow and students may appeal using the procedure in the university Catalog. See Academic Policies for definitions of kinds of academic dishonesty and for further policy information.

Academic Accommodations While all students are expected to meet the minimum standards for completion of this course as established by the instructor, students with disabilities may require academic adjustments, modifications or auxiliary aids/services. At Point Loma Nazarene University (PLNU), these students are requested to register with the Disability Resource Center (DRC), located in the Bond Academic Center. (DRC@pointloma.edu or 619-849-2486). The DRC's policies and procedures for assisting such students in the development of an appropriate academic adjustment plan (AP) allows PLNU to comply with Section 504 of the Rehabilitation Act and the Americans with Disabilities Act. Section 504 (a) prohibits discrimination against students with special needs and guarantees all qualified

students equal access to and benefits of PLNU programs and activities. After the student files the required documentation, the DRC, in conjunction with the student, will develop an AP to meet that student's specific learning needs. The DRC will thereafter email the student's AP to all faculty who teach courses in which the student is enrolled each semester. The AP must be implemented in all such courses.

If students do not wish to avail themselves of some or all of the elements of their AP in a particular course, it is the responsibility of those students to notify their professor in that course. PLNU highly recommends that DRC students speak with their professors during the first two weeks of each semester about the applicability of their AP in that particular course and/or if they do not desire to take advantage of some or all of the elements of their AP in that course.

Credit Hour:
In the interest of providing sufficient time to accomplish the stated course learning outcomes, this class meets the PLNU credit hour policy for an 2 unit class delivered over 15 weeks. Specific details about how the class meets the credit hour requirements can be provided upon request.

FINAL EXAM: Date and Time:
The final exam date and time is set by the university at the beginning of the semester and may not be changed by the instructor. This schedule can be found on the university website and in th course calendar. No requests for early examinations will be approved. Only in the case that a student is required to take three exams during the same day of finals week, is an instructor authorized to consider changing the exam date and time for that particular student. EGR 3053 will have a mandatory final exam on 12/18/2019 on **Wednesday** from 1:30 – 4:00 p.m.

COPYRIGHT POLICY
Point Loma Nazarene University, as a non-profit educational institution, is entitled by law to use materials protected by the US Copyright Act for classroom education. Any use of those materials outside the class may violate the law.
FERPA Policy: In compliance with federal law, neither PLNU student ID nor social security number should be used in publicly posted grades or returned sets of assignments without the student's written permission.

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This class will meet the federal requirements by (Note: each faculty member should choose one strategy to use: distributing all grades and papers individually;

requesting and filing written student permission; or assigning each student a unique class ID number not identifiable on the alphabetic roster.).
Also in compliance with FERPA, you will be the only person given information about your progress in this class unless you have designated others to receive it in the "Information Release" section of the student portal. See Policy Statements in the (undergrad/ graduate as appropriate) academic catalog.

Questions are always welcome and encouraged. The best way to learn is to ask questions and challenge what you are being taught. Feel free to talk to me after class or via email if you have any questions. I hope you enjoy my course!

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EGR 3053 Class Schedule (Tentative Fall Schedule)

Week 1	09/02	***Labor Day Holiday: No Classes***	
1st Day	09/04	Introduction: Electrical Elements Circuits, Definitions and abstractions	Ch 1, Pages 1-15 Agarwal
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	09/06	Passive, active elements Batteries, resistors, current sources	Pages 15 - 36 1.1 – 1.5
Week 2	09/11	2-terminal elements, Analog vs Digital signals, linearity	Ch 1, Pages 15-32 sections 1.5 – 1.8
	09/13	Resistive networks, Ohm's Law Types of circuits	Ch 2, 53-71
Week 3	09/18	Kirchhoff KVL, KCL, Voltage Current dividers, resistive circuits	Section 2.2: 56-75
	09/20	Series and Parallel Circuits	Section 2.4, Page 89
Week 4	09/25	Node Voltage analysis Loop method of circuits	Ch 3 , 3.1 – 3.3 3.4
	09/27	Node voltage vs Loop	Ch 3, 3.7
Week 5	10/02	**EXAM #1**	**Ch 1 – 3**
	10/04	Non-linear elements Non-linear resistors, diodes Exponential, power laws	Ch 4, 4.1 – 4.2
Week 6	10/09	Energy storage elements Capacitors, inductors Parallel and series connections Sinusoidal, Step, Impulse Inputs	Ch 9, 9.1 9.2 9.4
	10/11	Electrical circuits Series and Parallel RC, RL First-Order Transients in Linear RL series circuit, step input	 10.1 Ch 10, 10.1

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Week 7	10/16	RC Step, discharge, square wave output, RL series circuit, step input	10.1 – 10.2
	10/18	RL decaying exponential	
Week 8	10/23	Series RL Circuit with Sinewave Input, Transients in 2nd -Order Circuits	10.6 Ch. 12, 12.1
	10/25	***Fall Break Holiday – No Classes***	
Week 9	10/30	RLC circuits, Undriven LC Circuit Series RLC Circuit	12.2 12.3
	11/01	Damping, under, over in RLC Undriven parallel RLC, damping levels	12.4
Week 10	11/06	**EXAM #2**	Ch 4, 9, 10
	11/08	Driven series RLC Step and impulse response	Ch 12, 12.5-10.11
Week 11	11/13	Parallel RLC, step and impulse response	12.6
	11/15	Sinusoidal Steady State Impedance and frequency response	Ch 13, 13.1-13.2
Week 12	11/20	Complex exponential drive Impedance, RL, RC circuits	13.3
	11/22	Filters (Hi-pass, lo-pass) RLC, Series, parallel config. Resonance	13.5 14.1-14.2
Week 13	11/27	***Thanksgiving Holiday – No Classes***	
	11/29	***Thanksgiving Holiday – No Classes***	

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Week

14	12/04	**EXAM #3**	
	12/06	Semiconductors- Diodes, transistors (MOSFET, BJT)	Ch 16, 16.1-16.2
Week 15	12/11	Operational Amplifiers and uses Basic Models, inverters, Non-inverters, Basic circuit rules of Op amps	Ch 15, 15.1 – 15.2
	12/13	Operational Amplifiers voltage followers Adders, subtractors, integrators differentiators, applications	Ch 15, 15.3-15.4 15.5 – 15.6
Week 16		Finals Week – December 16 – 20, 2019	
	12/18	**Wednesday - FINAL EXAM** 1:30 – 4:00 p.m.	

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