UNIVERSITY OF CALGARY
FACULTY OF SCIENCE
DEPARTMENT OF PHYSICS AND ASTRONOMY
COURSE OUTLINE

1. **Course:** Physics 497, Applied Physics Laboratory II Winter 2017

   Instructor: Dr. Christopher Cully | SB 631 | 403.220.6088 | cmcully@ucalgary.ca |
   Office hours: WF 13:00-14:00, SB 631 or by appointment

   Lecture Sections: L01: WF | 12:00-12:50 | KNB 131

   Course website: Desire 2 Learn (D2L) site is PHYS 497 L01 – W2017PHYS497L01

   Departmental Office: SB 605, 403-220-5385, phasugrd@ucalgary.ca

2. **Prerequisites:** Physics 397, Applied Physics Laboratory I
   See calendar: http://www.ucalgary.ca/pubs/calendar/current/physics.html

3. **Grading:** The University policy on grading and related matters is described sections F.1 and F.2 of the online University Calendar. In determining the overall grade in the course the following weights will be used:

Laboratory (13 weeks, 2 sessions per week)	50%
Midterm tests (2 in-class tests, dates below)	20%
Assignments (6)	30%

   Percentage grades will be given for all elements of term work and examinations in Physics 497. A weighted course percentage will be calculated for each student after the course ends. The weighted course percentage will be converted to a letter grade using the following scheme:

> = 95 %	A +	> = 80 %	B +	> = 65 %	C +	> = 50 %	D +
> = 90 %	A	> = 75 %	B	> = 60 %	C	> = 45 %	D
> = 85 %	A -	> = 70 %	B -	> = 55 %	C -	< 40 %	F

4. **Missed Components of Term Work:** The regulations of the Faculty of Science pertaining to this matter are found in the Faculty of Science area of the Calendar in Section 3.6. It is the student's responsibility to familiarize himself/herself with these regulations. See also Section E.6 of the University Calendar

5. **Scheduled out-of-class activities:** There are no scheduled activities outside of class time.

6. **Course Materials:** *Physics 497 Course Notes*, R.B. Hicks, available on D2L.
   Useful reference books:
   Electronics: Circuits Amplifiers and Gates, 2nd Edition, D.V. Bugg, CRC Press.
   The Art of Electronics, Paul Horowitz and Winfield Hill, Cambridge University Press.
   The Fast Fourier transform and its applications, E. Oran Brigham, Prentice-Hall.
   Schaum's Outline of Electric Circuits, M. Nahvi and J.A. Edminster, McGraw-Hill.
   Building Scientific Apparatus, John H. Moore, C.C. Davis and M.A. Coplan, Cambridge University Press.

7. **Examination Policy**: The two term tests in Phys 497 are closed-book 50 minute tests. They are tentatively scheduled for February 10th and March 29th during regularly scheduled lecture time. Calculators and a one-sided single-page "crib sheet" are permitted. There will be no final exam in this course. Students should also read the Calendar, Section G, on Examinations.

8. **Course fees:** none

9. **Writing across the curriculum:** In this course, the quality of the student's writing in laboratory reports will be a factor in the evaluation of those reports. See also Section E.2 of the University Calendar.

10. **Human studies statement**: Students in this course are not expected to participate as subjects or researchers. See also Section E.5 of the University Calendar.

11. OTHER IMPORTANT INFORMATION FOR STUDENTS:

(a) **Academic Misconduct:** Academic misconduct (cheating, plagiarism, or any other form) is a very serious offence that will be dealt with rigorously in all cases. A single offence may lead to disciplinary probation or suspension or expulsion. The Faculty of Science follows a zero tolerance policy regarding dishonesty. Please read the sections of the University Calendar under **Section K**. Student Misconduct to inform yourself of definitions, processes and penalties.

(b) **Assembly Points:** In case of emergency during class time, be sure to FAMILIARIZE YOURSELF with the information on assembly points.

(c) **Student Accommodations:** Students needing an Accommodation because of a Disability or medical condition should contact Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities available at http://www.ucalgary.ca/policies/files/policies/procedure-for-accommodations-for-students-with-disabilities_0.pdf. Students needing an Accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a Protected Ground other than Disability, should communicate this need, preferably in writing, to the Associate Head of the Department of Physics and Astronomy, Dr. Michael Wieser, by email (mwieser@ucalgary.ca) or by phone (403.220.3641).

(d) **Safewalk:** Campus Security will escort individuals day or night (http://www.ucalgary.ca/security/safewalk/). Call 220-5333 for assistance. Use any campus phone, emergency phone or the yellow phones located at most parking lot pay booths.

(e) **Freedom of Information and Privacy:** This course is conducted in accordance with the Freedom of Information and Protection of Privacy Act (FOIPP). As one consequence, students should identify themselves on all written work by placing their name on the front page and their ID number on each subsequent page. For more information see also http://www.ucalgary.ca/secretariat/privacy.

(f) **Student Union Information:** VP Academic Phone: 220-3911 Email: suvpaca@ucagary.ca.
SU Faculty Rep: Phone: 220-3913
Email: science1@su.ucalgary.ca, science2@su.ucalgary.ca and science3@su.ucalgary.ca
Student Ombuds Office: 403 220-6420 Email: ombuds@ucalgary.ca; http://ucalgary.ca/provost/students/ombuds

(g) **Internet and Electronic Device Information:** You can assume that in all classes that you attend, your cell phone should be turned off unless instructed otherwise. Also, communication with other individuals, via laptop computers, Blackberries or other devices connectable to the Internet is not allowed in class time unless specifically permitted by the instructor. If you violate this policy you may be asked to leave the classroom. Repeated abuse may result in a charge of misconduct.

(h) U.S.R.I.: At the University of Calgary, feedback provided by students through the Universal Student Ratings of Instruction (USRI) survey provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses (www.ucalgary.ca/usri). Your responses make a difference - please participate in USRI Surveys.

12. OTHER COURSE RELATED INFORMATION:

(a) Course Description

Intermediate laboratory electronics. AC circuit theory and semiconductor devices, including operational amplifiers. Digital sampling theory and frequency-domain signal processing. Computer automation of experimental control, data collection, and analysis, including error analysis and error propagation.

(b) Course Learning Outcomes

At the end of this course, students should be able to:

- Proficiently use standard electronic lab equipment (oscilloscope, multimeter, etc.) to test and troubleshoot electrical circuits in an individual (non-group) laboratory setting.
- Build functional electrical circuits incorporating passive components, operational amplifiers, digital components and discrete semiconductor devices.
- Predict the behavior of networks of passive electrical components (resistors, capacitors, inductors, power supplies) and operational amplifiers (including limited non-ideal effects) using AC phasor analysis.
- Explain how discrete semiconductor devices operate and demonstrate their use in simple circuits.
- Describe and design digital signal acquisition chains.
- Analyze digital data using frequency-domain (Fourier) methods and convolution.

(c) Course Learning Incomes

Before beginning this course, students should be able to:

- Manipulate complex algebraic expressions
- Solve second-order linear ordinary differential equations
- Analyze DC circuits using Ohm's law and Kirchhoff's laws
- Use Fourier series to represent analytic functions
- Set up and conduct university-level physics experiments

(d) Syllabus & Lab Schedule

Tentative lecture and lab outline

The lab part of the course involves six hours per week in the laboratory (ES02). Each lab exercise involves preliminary work and a detailed in-lab presentation by the lab instructor, Pat Irwin. These will provide the specific background needed for each lab exercise. The two lecture hours per week are intended to provide a more in-depth theoretical treatment to complement the practical lab experience. You will find that, as the term proceeds, the topics of the practical lab exercises will quickly outpace the lectures.

The table below details the tentative schedule as currently planned. Lectures may be shifted and/or topics altered as the course progresses. Lecture topics refer to chapters in the online course notes.

Week	Date	Lecture Topics	Labs
1	Jan 11 Jan 13	Introduction, DC circuits DC Equivalent circuits (Norton and Thévenin)	(No lab Jan 9-10) Orientation/briefing
2	Jan 18 Jan 20	AC circuits chapter 1: AC sources and waveforms AC circuits chapter 2: Phasor analysis	DC circuits AC circuits
3	Jan 25 Jan 27	AC circuits ch 3,6: Impedance in series, AC equivalent circuits AC circuits chapter 4,5: RLC circuits	RC circuits RLC circuits
4	Feb 1 Feb 3	AC circuits chapter 7: Power dissipation, transformers Op-amps chapter 1: Introduction to op-amps	Transformers Transistors
5	Feb 8 Feb 10	Op-amps chapter 1: Operational amplifier (op-amp) circuits Term test #1 on DC and AC circuit theory	Op-amps Op-amp integrator
6	Feb 15 Feb 17	Op-amps chapter 1: Differential amplifiers Op-amps chapter 1: Filters and op-amp bandwidth limitations	Op-amp bandwidth Comparator
Reading week Feb 20-24. No lectures or labs.			
7	Mar 1 Mar 3	Op-amps chapter 4.5: Sampling and aliasing Op-amps ch 2.3,2.4: Transfer functions, Fourier transforms	Difference Amp Active filters
8	Mar 8 Mar 10	Op-amps chapter 3: Fourier transform applications and filtering Spectral estimation and wavelets	Linearity Swept generator DFT
9	Mar 15 Mar 17	Op-amps chapter 4.5.7: Narrow-band signals and modulation Op-amps chapter 4.1-4.4: Digitization	Phase detection Intro to digital
10	Mar 22 Mar 24	Circuit simulation Semiconductors ch. 1.1-1.2:Semiconductor basics	Digital instruments Intro to PLL
11	Mar 29 Mar31	Term test #2 on weeks 1-9 Semiconductors chapter 1.2: Junctions and diodes	PLL synthesis Soldering/Mechanical
12	April 5 April 7	Semiconductors chapter 1.3: Transistors Semiconductors chapter 1.5: Transistor applications	Make-up for missed labs
13	April 12	Field Effect Transistors	No labs

Department Approval_____Date_____