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

1. **Course:** PHYS 497, Applied Physics Laboratory II -- Winter 2018

   Lecture 01: (WF, 12:00-12:50 in SS006)

Instructor Name	Email	Phone	Office	Hours
Michael Wieser	mwieser@ucalgary.ca	403 220 3641	SB 131	TBA

   Course Site:

   D2L: PHYS 497 L01-(Winter 2018)-Applied Physics Laboratory II

   Department of Physics & Astronomy: Science B 605, 403 220-5385, office@phas.ucalgary.ca

   Students must use their U of C account for all course correspondence.

2. **Prerequisites:**

   See section 3.5.C in the Faculty of Science section of the online Calendar.

   Physics 397.

3. **Grading:**

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

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

   Each of the above components will be given a letter grade using the official university grading system. The final grade will be calculated using the grade point equivalents weighted by the percentages given above and then converted to a final letter grade using the official university grade point equivalents.

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.3 of the University Calendar

5. **Scheduled out-of-class activities:**

   There are no out-of-class activities scheduled for this course.

   REGULARLY SCHEDULED CLASSES HAVE PRECEDENCE OVER ANY OUT-OF-CLASS-TIME-ACTIVITY. If you have a conflict with the out-of-class-time-activity, please contact your course coordinator/instructor no later than **14 days prior** to the date of the out-of-class activity so that alternative arrangements may be made.

6. **Course Materials:**

   Physics 497 Course Notes, R.B. Hicks, available on D2L

Other useful reference books include:

- 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 7th and March 28th during regularly scheduled lecture time. Calculators and a one-sided single-page â€œcrib sheetâ€ are permitted. There will be no final exam in this course.

   Students should also read the Calendar, Section G, on Examinations.

8. **Approved Mandatory and Optional Course Supplemental Fees:**

   There are no mandatory or optional course supplemental fees for this course

9. **Writing across the Curriculum Statement:**

   For all components of the course, in any written work, the quality of the student's writing (language, spelling, grammar, presentation etc.) can be a factor in the evaluation of those reports. See also Section E.2 of the University Calendar.

10. **Human studies statement:**

    Students will not participate as subjects or researchers in human studies.

11. **Reappraisal of Grades:**

    A student wishing a reappraisal, should first attempt to review the graded work with the Course coordinator/instructor or department offering the course. Students with sufficient academic grounds may request a reappraisal. Non-academic grounds are not relevant for grade reappraisals. Students should be aware that the grade being reappraised may be raised, lowered or remain the same. See Section I.3 of the University Calendar.

    1. **Term Work:** The student should present their rationale as effectively and as fully as possible to the Course coordinator/instructor within **15 days** of either being notified about the mark, or of the item's return to the class. If the student is not satisfied with the outcome, the student shall immediately submit the Reappraisal of Graded Term work form to the department in which the course is offered. The department will arrange for a re-assessment of the work if, and only if, the student has sufficient academic grounds. See sections I.1 and I.2 of the University Calendar
    2. **Final Exam:** The student shall submit the request to Enrolment Services. See Section I.3 of the University Calendar.

12. **OTHER IMPORTANT INFORMATION FOR STUDENTS:**

    a. **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. Examples of academic misconduct may include: submitting or presenting work as if it were the student's own work when it is not; submitting or presenting work in one course which has also been submitted in another course without the instructor's permission; collaborating in whole or in part without prior agreement of the instructor; borrowing experimental values from others without the instructor's approval; falsification/ fabrication of experimental values in a report. **These are only examples**.

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

    c. **Academic Accommodation Policy:** 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 procedure-for-accomodations-for-students-with-disabilities_0.pdf.

       Students needing an accommodation in relation to their coursework or to fulfill 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 & Astronomy, Dr. David Feder by email dfeder@ucalgary.ca or phone 403-220-3638. Religious accommodation requests relating to class, test or

exam scheduling or absences must be submitted no later than **14 days** prior to the date in question: http://www.ucalgary.ca/pubs/calendar/current/e-4.html

d. **Safewalk:** Campus Security will escort individuals day or night (www.ucalgary.ca/security/safewalk/) . Call 403-220-5333 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). 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 www.ucalgary.ca/legalservices/foip.

f. **Student Union Information:** VP Academic, Phone: 403-220-3911 Email: suvpaca@ucalgary.ca. SU Faculty Rep., Phone: 403-220-3913 Email: sciencerep@su.ucalgary.ca. Student Ombudsman, Email: suvpaca@ucalgary.ca.

g. **Internet and Electronic Device Information:** Unless instructed otherwise, cell phones should be turned off during class. All communication with other individuals via laptop, tablet, smart phone or other device is prohibited during class unless specifically permitted by the instructor. Students that violate this policy may be asked to leave the classroom. Repeated violations may result in a charge of misconduct.

h. **Surveys:** At the University of Calgary, feedback through the Universal Student Ratings of Instruction (USRI) survey and the Faculty of Science Teaching Feedback form provides valuable information to help with evaluating instruction, enhancing learning and teaching, and selecting courses. Your responses make a difference - please participate in these surveys.

i. **SU Wellness Center:** The Students Union Wellness Centre provides health and wellness support for students including information and counselling on physical health, mental health and nutrition. For more information, see www.ucalgary.ca/wellnesscentre or call 403-210-9355.

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.

Tentative lecture and laboratory schedule

The laboratory component of the course involves two laboratory exercises (three hours each) per week in the laboratory (ES02). Each 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	Lecture Topics	Laboratory	Date
1	Introduction, DC circuits DC Equivalent circuits (Norton and ThÃ©venin)	(No lab Jan 8-9) Orientation/briefing	Jan 08 Jan 10
2	AC circuits chapter 1: AC sources and waveforms AC circuits chapter 2: Phasor analysis	DC circuits AC circuits	Jan 15 Jan 17
3	AC circuits chapter 3,6: Impedance in series; AC equivalent circuits AC circuits chapter 4,5: RLC circuits	RC circuits RLC circuits	Jan 22 Jan 24
4	AC circuits chapter 7: Power dissipation, transformers Op-amps chapter 1: Introduction to op-amps	Transformers Transistors	Jan 29 Jan 31
5	**Term test #1 on DC and AC circuit theory on February 7** Op-amps chapter 1: Operational amplifier (op-amp) circuits	Op-amps Integrator	Feb 05 Feb 07

6	Op-amps chapter 1: Differential amplifiers Op-amps chapter 1: Filters and op-amp bandwidth limitations	Bandwidth Comparator	Feb 12 Feb 14
	Reading week Feb 19-23 â€“ No lectures or labs		
7	Op-amps chapter 4.5: Sampling and aliasing Op-amps chapter 2.3,2.4: Transfer functions, Fourier transforms	Difference Amp Active filters	Feb 26 Feb 28
8	Op-amps chapter 3: Fourier transform applications and filtering, Spectral estimation and wavelets	Linearity Swept generator DFT	Mar 05 Mar 07
9	Op-amps chapter 4.5 - 4.7: Narrow-band signals and modulation Op-amps chapter 4.1-4.4: Digitization	Phase detection Intro to digital	Mar 12 Mar 14
10	Circuit simulation Semiconductors chapter 1.1-1.2: Semiconductor basics	Digital instruments Intro to PLL	Mar 19 Mar 21
11	**Term test #2 on March 28 covers weeks 1-9**	PLL synthesis Soldering/Mechanical	Mar 26 Mar 28
	Good Friday March 30 â€“ No Lecture		
12	Semiconductors chapter 1.2: Junctions and diodes Semiconductors chapter 1.3: Transistors	Make-up for missed labs	Apr 02 Apr 04
13	Semiconductors chapter 1.5: Transistor applications Field Effect Transistors	No labs	Apr 09 Apr 11

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 Ohmâ€™s law and Kirchhoffâ€™s laws
- Use Fourier series to represent analytic functions
- Set up and conduct university-level physics experiments

Department Approval: Electronically Approved **Date:** 2018-01-04 19:19

Course Outcomes

1. Proficiently use standard electronic lab equipment (oscilloscope, multimeter, etc.) to test and troubleshoot electrical circuits in an individual (non-group) laboratory setting
2. Build functional electrical circuits incorporating passive components, operational amplifiers, digital components and discrete semiconductor devices
3. 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
4. Explain how discrete semiconductor devices operate and demonstrate their use in simple circuits
5. Describe and design digital signal acquisition chains
6. Analyze digital data using frequency-domain (Fourier) methods and convolution