Phys 311: Instrumentation

Fall 2021

Section ID:	Phys 311 - 202
Instructor:	Dr. Gabriele Belle
Office:	Planetary Hall, Room 201B;
Email:	gbelle@gmu.edu ***Please note:*** *All communication via email to your instructor must be through your GMU email account. Your instructor may send information to you via Blackboard email. Make sure you check your email account regularly.*
Office Hours:	Friday 10:00 am to 11:00 am and online by appointment
Course Material:	The lab handouts are made available on Blackboard as a set of handouts and released weekly.
Meeting Room:	Planetary Hall, Room 320
Meeting Time:	Lecture: Friday, 1:30 pm to 2:45 pm, Lab from 3:00 pm to 5:40 pm

Course Description

Physics 311 is a laboratory course intended to provide students with practical experience in instrumentation and electronics. This course introduces students to basic electronics – the elements of instrumentation as well as LabVIEW and Multisim, a PSpice based circuit simulation software. Students will learn to design build and analyze filter circuits, transistor amplifiers, operational amplifier circuits, digital circuits and virtual instruments with LabVIEW. The goals and learning outcomes are listed below.

Course Goals

In this course students will –

- Become familiar with circuit CAD and simulation
- Become familiar with virtual instrumentation software
- Understand basic analog and digital electronics
- Become proficient at keeping a laboratory notebook and producing technical notes.

Required Textbooks

John Essick: Hands-on introduction to LabView for Scientists and Engineers, ISBN: 978-0-19-085306-8, 4th Edition, Oxford University Press.

Paul Horowitz, Winfield Hill: The Art of Electronics, ISBN-13: 978-0521809269, 3rd Edition, Cambridge University Press.

Technology Requirements

Software: This course uses Blackboard as the learning management system. You will need a browser and operating system that are listed compatible or certified with the Blackboard version available on the myMason Portal. See supported browsers and operating systems.

Students owning Macs or Linux should be aware that LabVIEW runs on Windows. You can set up a Mac computer with Boot Camp or virtualization software so Windows will also run on it. Watch this video about using Windows on a Mac. Computers running Linux can also be configured with virtualization software or configured to dual boot with Windows. Note: If you are using an employer-provided computer or corporate office for class attendance, please verify with your systems administrators that you will be able to install the necessary applications and that system or corporate firewalls do not block access to any sites or media types.

Course-specific Hardware/Software

LabVIEW: This is a system design platform and development environment for visual programming. The download information and license key is posted on Blackboard. This information is not to be shared with anyone outside this course. The license is valid for one year until July 2022.

Multisim: This is a circuit simulation software and you will need it to complete your assignments. You can download it together with LabVIEW and activate it with the same license key.

MS Excel or equivalent spreadsheet software: Spreadsheet software is essential for data analysis.

Grading:

Grading Scale:

A+	96.7%---100%	A	93.3%---96.7%	A-	90%---93.3%
B+	86.7%---90%	B	83.3%---86.7%	B-	80%---83.3%
C+	76.7%---80%	C	73.3%---76.7%	C-	70%---73.3%
D	60%---70%				
F	Below 60%				

Grade Determination:

Assignment	Total
Laboratory Notebook Checks and Pre-Lab	50%
Technical Notes	50%

General Information:

Projects will be performed as shown on the lab syllabus but it may be necessary to modify the schedule. Project handouts will be made available on a weekly basis. All labs will include an introductory lecture followed by completion of the laboratory project.

Assignments:

All technical work for this lab course must be kept and maintained in a bound notebook with numbered pages. **Notebooks will be checked at the end of each lab session.** Students are required to **write a full report in form of a short technical note** for most of the labs. The due dates are listed in the schedule. Students are expected to follow the report guide attached to this syllabus.

1) ***Prelab (Homework):***
   a) Type your answers to the questions into a word document and submit it into the pre-lab drop box. Not every lab requires a pre-lab. Pre-labs can also include simulation of circuits.

2) ***Results (Lab notebook): In your lab notebook you must record:***
   a) Title of the project and date.
   b) Purpose of the project
   c) Circuit diagram.
   d) The results from the simulation with correct units in a table.
   e) Graphs, if applicable
   f) Summarized data, including correct units, tables
   g) Calculations with clear results
   h) A brief statement about the results and a conclusion summarizing what was done in the project as well as its outcome. In the conclusion, a comparison of the results to the simulation is required.

Table 1: *point distribution for each assignment (notebook – does not include the technical note)*

Prelab	20 points
Results	80 points
Total:	**100 points**

Course Policies:

Lecture:

There will be an introductory lecture before each lab session. **It is expected that all students arrive on time and not miss any portion of this lecture.** After the lecture, students work on their project. Since the introductory lecture is a necessary part of the lab session, students are expected to be on time. Lab attendance is mandatory.

Make-Up Laboratory: If you missed one lab, you can attend the make-up lab at the end of the course. If you miss more than one lab your grade will be reduced appropriately.

Late Submission of Assignments: Assignment due dates are listed in the schedule. Assignments must be submitted on or before the due date. Only one submission is possible. Re-Work will not be accepted. A late penalty of 10% will be applied to assignments that are submitted more than 48 hours after the due date.

Lab Safety: Students must comply with lab safety rules. The lab safety handout is posted on blackboard in the Lab safety content folder.

Cell phones: Cell phones must be turned off and stored away from the lab table. Students who are caught texting, emailing, or checking emails on their cell phone during class time, will be asked to leave the laboratory room and will receive a grade of "zero" for the lab.

Computer use: The computers in the lab room are to be used for class work only. Computers may not be used to work on assignments for other classes. To be able to access all software installed for this course, students must log on with the given username and password. Students should never use their Mason Net ID. You may use your laptop or tablet for note taking **only if the instructor gives permission to do so.**

Lab-computers may not be used for any purpose until the lecture is over. At no time may they be used for reading e-mail or web surfing. After the lab session, you may email your results to your account or save them on a memory stick.

Classroom courtesy: Use the lab time to work on physics only. Students who disrupt the classroom with loud, inappropriate, or off-topic conversations may be asked to leave the lab after a warning. Show courtesy to your fellow students and to your instructor by giving whole-hearted attention to the topic at hand.

Food and drink: Food and drink are not permitted in the lab room**.**

Visitors: You may not bring visitors to the lab with you, even if they are students enrolled in other sections of the course. Students may not complete their work or make up missed labs for other courses during class time.

Withdrawal: If you need to withdraw from this course you must do it within the University established time frame. For fall 2021 the last day to withdraw with no tuition penalty is September 7. From then on tuition penalties apply. https://registrar.gmu.edu/calendars/fall_2021/ See the GMU academic calendar for other important dates.

University Policies and Resources

a. Academic Honesty: You are expected to be familiar with and abide by the University's Honor Code. The Code can be found here. It is your responsibility to see me if you have questions about these policies. George Mason University has an honor code that states the following:

   To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University community and with the desire for greater academic and personal achievement, we, the student members of the University Community have set forth this: Student Members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.

   The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Plagiarism is a violation of the honor code. All work done outside the lab must be completed individually. Any two reports that have identical sentences or have paragraphs with identical structure will be considered plagiarism.

b. Students must follow the university policy for **Responsible Use of Computing**

c. Student services: The University provides range of services to help you succeed academically and you should make use of these if you think they could benefit you.

d. Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account.

e. **The George Mason University Counseling and Psychological Services (CAPS)** staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance. Counseling Center: Student Union I, Room 3129, 703-993-2380.

f. Students with disabilities who seek accommodations in a course must be registered with **the George Mason University Office of Disability Services (ODS)** and inform their instructor, in writing, at the beginning of the semester. All academic accommodations must be arranged through that office. Please note that accommodations MUST BE MADE BEFORE assignments or exams are due. I cannot adjust your grade after the fact.

g. Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.

h. **The George Mason University Writing Center** staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. University Writing Center: Johnson Center, Room 227E, 703-993-1200. The writing center includes assistance for students for whom English is a second language.

i. **Diversity**: George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

j. **Withdrawal:** If you need to withdraw from this course you must do it within the University established time frame. For Fall 2021 the last day to withdraw with no tuition penalty is September 7. From then on tuition penalties apply.

k. **Privacy Statement**: Nothing posted in this course is to be posted outside the Blackboard course or passed on to a third party or anyone who is not enrolled in this course. The material posted in this course is copyright protected. Re-posting it on a third-party website is a violation of the copyright act. This includes lab handouts and any video recordings, power points etc.

l. **COVID-19 Safety:** All students taking courses with a face-to-face component are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus webpage (https://www2.gmu.edu/safe-return-campus). Similarly, all students in face-to-face and hybrid courses must also complete the Mason COVID Health Check daily, seven days a week. The COVID Health Check system uses a color code system and students will receive either a Green, Yellow, or Red email response. **Only students who receive a "green" notification are permitted to attend courses with a face-to-face component.** If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. Faculty are allowed to ask you to show them that you have received a Green email and are thereby permitted to be in class.

m. **Face Masks**: Students are required to follow Mason's current policy about facemask-wearing. As of August 11, 2021, **all community members are required to wear a facemask in all indoor settings**, including classrooms. An appropriate facemask must cover your nose and mouth at all times in our classroom. If this policy changes, you will be informed; however, students who prefer to wear masks either temporarily or consistently will always be welcome in the classroom.

Tentative Course Schedule

The schedule could change.

Lab	Date	Lab Activity	Assignment	Due Date
1	08/27	The Basics	Lab notebook check; no full report	08/27
2	09/03	LabVIEW and MultiSim	Lab notebook check; no full report	09/03
3	09/10	Voltage Divider	Lab notebook check; Full report	09/10; 09/17
4	09/17	Passive Filter Circuits	Lab notebook check; Full report	09/17; 09/24
5	09/24	Semiconductors: Diodes	Lab notebook check; Full report	09/24; 10/01
6	10/01	LabVIEW Virtual Instrument (VI)	Lab notebook check; no full report	10/01
7	10/08	Transistor Circuits	Lab notebook check; Full report	10/08; 10/15
8	10/15	Operational Amplifiers	Lab notebook check; Full report	10/15; 10/22
9	10/22	Active Filters	Lab notebook check; Full report	10/22; 10/29
10	10/29	Combinational Logic	Lab notebook check; no full report	10/29
11	11/05	Sequential Logic	Lab notebook check; Full report	11/05; 11/12
12	11/12	Data Acquisition with LabVIEW VI	Lab notebook check; Full report	11/12; 11/19
13	11/19	Data Acquisition with SR-860	Lab notebook check; no full report	11/19
14	11/26	Thanksgiving Recess		
15	12/03	Make-up lab		

Report Guide

Title of Experiment

Name of Author

Date

Abstract: A brief statement summarizing what was done, why it was done, and giving the key results. It should be complete enough so that one need not read the paper to understand the abstract. Nothing in the abstract should require referencing the body of the paper. Everything in the abstract is repeated, but with more elaboration, in the paper. All data result values may not be included in this section but some statement as to the conclusiveness of the data is required. The purpose of the abstract is to allow the reader to determine whether or not it will be worth the while to read the entire paper. The abstract is written after the report is completed.

Introduction

The introduction provides the background and theory motivating the experiment. Important physical principles that may be used later in the paper should be explained in a general way. Key derivations that lead the predictions should be referenced and included in appendices. Equations used in the body of the report must be introduced in this section, if the equation is part of the theory. Equations must be numbered and the numbering must be used to later reference that particular equation.

Experiment

The experiment must be described thoroughly but concisely. The description should cover all apparatus used (including circuit diagrams) and a short discussion of techniques and procedures. This latter discussion only needs to be sufficiently detailed to reveal both strengths and weaknesses of the work.

Data and Analysis

Present data, observations, and results in tabular and or graphical form. Graphs and tables should be labeled and captioned and referred to in the text. Include a description of any mathematical manipulations of the data. If it might help to show sample calculations, they should be referenced and included as appendices. Do not copy bullet points from the lab manual, the section must be your own work. This section should be a formal paragraph.

Results

Final results include limits of uncertainty and a comparison of experiment with theory. Graphs comparing data points with theoretical curves belong here, but judgements as to the significance of the results do not. Results stand or fall as supported by the data and analysis, irrespective of your opinion.

Discussion

Draw conclusions about the results. While speculations are sometimes appropriate in this section, opinion must be carefully distinguished from conclusions that are supported completely by evidence.

References

This is a bibliography or list of footnotes, you will always have at least one (the lab write-up provided by the instructor), the book could be another one. It is highly encouraged to explore online to better learn theories – if this is done include those references if you end up using their explanations in the report. Please note that copying a picture from a website or from the online manual requires a citation. Please make sure to include all URL addresses used as sources either of content or images during the report writing procedure. The actual style of the bibliography may be either APA or MLA.

Appendix

Contains material, if any, that elaborates on or supplements what is in the body of the paper, such as derivatives of important relationships and sample calculations.
Everything in the appendices needs to be referenced in your report.

Lab Notebook Grading Rubric

Category	Proficient (max. 80)	Developing (max. 60)	Basic (max. 40)
Organization	• Each experiment contains title, purpose, brief procedure. • Takes a planned approach to the experiment. • All recorded data and calculations are present. • The presented information is well organized. • All information is recorded in pen not pencil. • Experiments are listed in the table of contents.	• One or two of the following are missing: title, purpose, brief procedure. • Takes a planned approach to the experiment. • Provided data are not complete. • The presented information is organized • Not all the information is recorded in pen • Experiments are not recorded in the table of contents.	• Several of the following are missing: title, purpose, brief procedure. • No planned approach to the experiment. • Provided data are not complete • The presented information is chaotic and disorganized. • All the information is recorded in pencil. • Experiments are not recorded in the table of contents.
Content	• Circuit diagram provided • All experiments are complete • All data is recorded and neatly presented with units in tabular form • All calculations with clear results and units	• Circuit diagram provided • Not all experiments have been completed • Data is not neatly presented in tabular form • Units are missing. • Calculations are incomplete	• Circuit diagram is not provided • Not all experiments are complete • Not all data is recorded and what is recorded is not neatly presented. • Units are missing • Calculations are not presented
Analysis	• Data is analyzed and methods of analysis are clearly described • Uncertainty calculations are provided • Graphs, if applicable, are included • Predicted and simulated results hardly deviate from the measured values • Sources of uncertainties are considered	• Data is analyzed but methods are not described • Calculations are incomplete • Graphs if applicable, are incorrect • Predicted and simulated results hardly deviate from the measured values • Sources of uncertainties are explored but they are inadequate.	• Data is not analyzed • Calculations are incomplete or missing • Graphs, if applicable, are missing • Predicted and simulated results significantly deviate from the measured values • Sources of uncertainties were not explored
Conclusion	• A comparison of predicted data with actual results is provided • Written in coherent manner with proper English syntax	• Results are interpreted but interpretation is not adequate. • Written incoherently with spelling and grammar errors.	• The interpretation of the data is not logical and does not agree with the results. • Incoherent with many errors