PCSE 503 Dr. Edward J. Brash
Fall 2020 edward.brash@cnu.edu
Office: Luter 304, and online using Google Meet 594-7451
Office Hours: Mon/Wed/Fri 11:00am-12:00pm, and by appointment – online using Google Meet

**System Design Laboratory/Advanced Analysis and Simulation Course**

**Texts:** There is not a required text for this course.

**Course Overview:**

This course has two principal overarching goals:

1. To provide an introduction to the methodology of investigating physics in an experimental laboratory, with a particular focus on advanced data analysis techniques.

2. To provide an introduction to the advanced simulation techniques used by physicists in graduate research and industry.

*Laboratory Component**:***

Because of the online format of this course, necessitated due to COVID-19, we will not be performing actual experiments in the laboratory. Instead, we will employ two alternate approachs:

1. Data from specific experimental setups will be provided to you for detailed analysis.
2. We will make use of online physics laboratory experiments.

Instead of formal (typed up) lab reports, analysis results from these experiments will be presented to the class as a whole via online presentations.

*Analysis and Simulation Component:*

The main sub-goals for this portion of the course are:

A) To study and understand some of the most basic and useful techniques in numerical analysis.

B) To develop a suite of useful programs, methods, and libraries which you will be able to apply to a host of problems going forward.

C) To develop an appreciation for and understanding of some of the applications of numerical analysis, in particular in modeling and simulation of non-linear physical processes.

We will be using the Python and Jupyter Notebooks, together with many very useful Python modules, including SciPy, NumPy, Matplotlib, Seaborn, Statsmodels, Scikit-Learn, and SimPy, for the data analysis and simulation frameworks, for the development of analysis scripts and programs, and also importantly for visualization. Over the last several years, I have developed a lot of useful pieces of analysis and simulation code in Python. I will make at least some of these programs available to you at points throughout the course, as a starting point for the assignments.

I have found that Anaconda (http://www.anaconda.com) is an incredibly use and easy to install data science platform.

There will be assignments given periodically, and in most cases will be due one week later. Homework is due by 11:59 pm on the due date. No extensions will be given, except in the case of a valid DOCUMENTED reason.

**Lab Notebook:**

Keeping a detailed and organized lab notebook is critical skill for both engineers and scientists. Even though this course is being offered in an online format, you will be expected to keep a lab notebook that records all of the work that you will do throughout the semester. There are a number of ways to do this; you may opt to keep a physical handwritten notebook, or you may decide that an electronic format works better for you. Personally, I find Jupyter Notebooks to be an IDEAL format for the lab notebook.

A working lab book evolves as your work progresses; you can move backward in the book to fill in details or augment explanations as you go, and forward to lay out a logical plan of work to be done, and how, and what mode of display of results you will use. If you record things in your book which you later decide to be wrong or otherwise to be ignored, that's OK — indicate this, and leave it there. Data and analysis in the logbook need to have a date associated with them, particularly if parts of the report are out of sequence.

Your notebook should be understandable in the absence of any other material. You don't need to reproduce derivations of equations, but the important equations should be presented with references. A diagram of the experimental set-up that includes details like model numbers of equipment is essential. At any time, a colleague (or especially one of your group members!!!) should be able to pick up your notebook and understand what you've done so far.

You will only be writing a formal report for one of the four experiments, but your lab book should contain most of the elements of a formal report within it: every experiment in your book should contain some statement of objective, what you are doing and why. It should explain clearly how the experiment was done and should have some discussion of the results and should clearly state your conclusions.

I would also like you to get experience in writing scientific abstracts, and so I ask you to write an abstract in your book when you have completed the experiment and

analysis.

Computer data files: Every raw data file you create in an experiment should be noted in your lab book with some explanation of what data are in it, and other relevant experimental details. Imagine coming back to your notebook two years from now – make it easy to figure out what data you have, and how to find it. In a working lab, you will eventually find that trying to encode all the details about the file in the file name is a losing proposition when you start repeating measurements with slightly different combinations of parameters. You are much better to give files names according to some simple scheme, e.g. ejb20140920-1 [my initials, followed by the date and a sequence number]. Then the contents of the file are described fully in your lab notebook. This protocol makes it easy to find the information about the file because the file points to the date which can be quickly located in the lab book.

| **Grading:** | Scientific communications/reports | 25% |
|---|---|---|
| | Homework Assignments | 25% |
| | Lab Notebook | 10% |
| | Advanced Simulation Project | 15% |
| | Overall performance/attendance/effort | 25% |

Scientific communications/reports, at each stage, will be due at the beginning of class on the specified due date. No extensions will be given, except in the case of a valid DOCUMENTED reason.

Significant Difference Statement:

This course is cross-listed with PHYS421, and differs from that course in the following ways:

1. There will be an advanced simulation project that will be assigned to the graduate students in the course, i.e. only those students enrolled in PCSE503.

2. As graduate students, the expectation is that you should take on a leadership role for group projects that you will be working on (with students in PHYS421).

Final grades will be assigned as follows:

A = 87-100%; $A^-$ = 80-86 %
$B^+$ = 77-89 %; B = 73 –77 %; $B^-$ = 70 – 73 %
$C^+$ = 67-79%; C = 63 –67 %; $C^-$ = 60 – 63 %
$D^+$ = 57-69%; D = 53 –57 %; $D^-$ = 50 – 53 %: F < 50%

**Honor Code, Plagiarism, and All That:**

Students are encouraged to talk with each other and help each other where appropriate, but copying from current or pre-existing lab reports, marked or unmarked, is strictly prohibited. If you are thinking about it, don't. I can tell.

While it is obvious what constitutes academic misconduct during exams, in the past there has been some confusion regarding misconduct when working on lab reports and other presentation formats. In the interest of being crystal clear on this topic below I have provided some specific examples detailing what is and what isn't acceptable behavior. This list is meant only as a guide and it is by no means exhaustive. Moreover, the final determination of what is and isn't academic misconduct shall always follow official CNU policy.

Examples of academic misconduct in the context of laboratory work:

1. Directly copying any portion of another student's presentation/report/poster/lab notebook (whether in final form or not) and hands them is as his/her own solutions.

2. Copying from current or pre-existing lab reports whether they are marked or unmarked.

3. Using data taken by anyone other than yourself without acknowledging it and giving credit as appropriate.

4. Presenting the work of another student (such as a computer program, etc.) as your own work.

Examples of acceptable conduct in the context of laboratory work:

1. Two or more students sit down and discuss a laboratory analysis to see if their understanding of the problem(s) and/or their solution(s) are consistent and then SEPERATELY go their own way and write their own solutions WITHOUT reference to a either a common document or another student's solutions (whether the latter is in final form or not).

2. Using a computer program or other utility written by another student to analyze your data, and giving appropriate credit to that student in the final presentation product.

**Additional Information, provided by the CNU Administration, which you may find useful (and with which I happen to agree):**

**University Statement on Diversity and Inclusion:**
The Christopher Newport University community engages and respects different viewpoints, understands the cultural and structural context in which those viewpoints emerge, and questions the development of our own perspectives and values, as these are among the fundamental tenets of a liberal arts education.

Accordingly, we affirm our commitment to a campus culture that embraces the full spectrum of human attributes, perspectives, and disciplines, and offers every member of the University the opportunity to become their best self.

Understanding and respecting differences can best develop in a community where members learn, live, work, and serve among individuals with diverse worldviews, identities, and values. We are dedicated to upholding the dignity and worth of all members of this academic community such that all may engage effectively and compassionately in a pluralistic society.

If you have specific questions, suggestions or concerns regarding diversity on campus please contact Diversity.Inclusion@CNU.edu

**Disabilities:**
In order for a student to receive an accommodation for a disability, that disability must be on record in the Office of Student Affairs, 3rd Floor, David Student Union (DSU). If you believe that you have a disability, please contact Jacquelyn Barnes, Student Disability Support Specialist in Student Affairs (594-7160) to discuss your needs.

Students with documented disabilities are to notify the instructor at least seven days prior to the point at which they require an accommodation (the first day of class is recommended), in private, if accommodation is needed. The instructor will provide students with disabilities with the reasonable accommodations approved and directed by the Office of Student Affairs. Work completed before the student notifies the instructor of his/her disability may be counted toward the final grade at the sole discretion of the instructor.

**Success**:
I want you to succeed in this course and at Christopher Newport. I encourage you to contact me during office hours or to schedule an appointment to discuss course content or to answer questions you have. During the Coronavirus pandemic, our conversations may need to be via electronic means. If I become concerned about your course performance, attendance, engagement, or well-being, I will contact you first. I also may submit a referral through our Captains Care Program. The referral will be received by the Center for Academic Success as well as other departments when appropriate (Counseling Services, Office of Student Engagement). If you are an athlete, the Athletic Academic Support Coordinator will be notified. Someone will contact you to help determine what will help you succeed. Please remember that this is a means for me to support you and help foster your success at Christopher Newport.

**Academic Support**:
The Center for Academic Success offers free tutoring assistance for Christopher Newport students in several academic areas. Center staff offer individual assistance and/or workshops on various study strategies to help you perform your best in your courses. The center also houses the Alice F. Randall Writing Center. Writing consultants can help you at any stage of the writing process, from invention, to development of ideas, to polishing a final draft. The Center is not a proofreading service, but consultants can help you to recognize and find grammar and punctuation errors in your work as well as provide assistance with global tasks. Contact them as early in the writing process as you can!

You may contact the Center for Academic Success to request a tutor, confer with a writing consultant, obtain a schedule of workshops, or make an appointment to talk with a staff member about study skills and strategies. The Center is located in Christopher Newport Hall, first floor, room 123. You may email academicsuccess@cnu.edu or call (757) 594-7684.

**Safety Protocols Specific to COVID-19 and Academic Instruction:**
Offering in-person instruction on campus requires everyone to take individual responsibility for reducing the risk of exposure for all campus community members both inside and outside the classroom.

Irresponsible behavior jeopardizes not only your own health, but also that of your fellow students, friends, professors and advisors, and members of our staff. Therefore, you are expected to learn and diligently follow the safety protocols required by the University at all times. The following protocols apply specifically to instructional spaces and academic buildings.

Prior to leaving their residence hall room or home, students should:
- conduct daily health screenings; and
- pack cloth face covering(s), personal cleaning supplies, and related items for campus use.

Students cannot enter instructional spaces or academic buildings if they:
- are experiencing symptoms of any illness, regardless of whether they believe the illness to be COVID-19;
- have been exposed to someone with COVID-19;
- are in isolation while waiting for COVID–19 test results;
- have been directed to quarantine by a University or health department official; or
- have been diagnosed with COVID-19 and have not been approved to return to campus by a healthcare provider.

All students must adhere to the following requirements while inside instructional spaces, common areas and offices:
- attend only the classes and sections in which they are officially enrolled;
- sit in their assigned seats or work at their assigned stations every class period;
- wear a face covering at all times* (face coverings should cover the nose and mouth, be secured under the chin, and fit snugly against the sides of the face);
- use additional personal protective equipment as required for specific classes;
- maintain physical distancing of at least six feet from other people;
- disinfect their own work areas upon arrival in and prior to departure from the instructional space;
- refrain from sharing personal materials, such as pens, textbooks, etc., with others;
- refrain from bringing food and drinks into the instructional space;
- follow all directional signs; and
- follow directives regarding office hours and advising appointments.

**Students who have received an exemption from the face covering requirement for health reasons must present the proof of the exemption provided by the Office of Student Affairs to the instructor upon entering the instructional space.*

Because non-compliance potentially endangers others, faculty members:
- are authorized to instruct anyone in non-compliance with safety protocols to correct the non-compliance or immediately leave the instructional space; and
- may submit referrals to CHECS to report non-compliance with safety protocols.

Faculty should immediately notify the Vice President for Student Affairs, Kevin Hughes (dosa@cnu.edu or kmhughes@cnu.edu), if they become aware of a student who has sought a diagnostic test or who has been exposed. In addition, faculty members may submit referrals through the Captain's Care Program to report absences as a way of identifying students who may have become ill. It would be appropriate to do so when students have not attended class or communicated with the faculty member in any way for a period of one week or longer.

**Course Materials:**
All content created and assembled by the faculty member and used in this course is to be considered intellectual property owned by the faculty member and Christopher Newport University. It is provided solely for the private use of the students currently enrolled in this course. To ensure the free and open discussion of ideas, students may not make available any of the original course content, including but not limited to lectures, discussions, videos, handouts, and/or activities, to anyone not currently enrolled in the course without the advance written permission of the instructor. This means that students may not record, download, screenshot, or in any way copy original course material for the purpose of distribution beyond this course. A violation may be considered theft. It is the student's responsibility to protect course material when accessing it outside of the physical classroom space.

Code of Conduct

We can feel anonymous in online formats, but you are expected to handle yourself professionally during online courses, just as you would with an in-person class. You are expected to arrive on time and not leave early. You also are expected to abide by CNU's community guidelines and honor code.

Guidelines for attending online courses:

- Do your best to be in a low-distraction area.
- Please keep your camera on throughout the class.
- Make sure there is a light source close to your camera. Otherwise, your face might be blurry.
- Mute your microphone until you have an idea to share.
- If you would like to speak, you are welcome to indicate so by clicking on the raised hand icon at the bottom of your screen or by turning on your microphone and asking to make a comment.
- Refrain from posting comments on the chat forum that are not directly related to the topic being discussed

Conduct during online courses (adapted from https://wiki.creativecommons.org/wiki/Slack/Code_of_Conduct)

The following behaviors are expected and requested of all community members:

- Be friendly, patient, and welcoming. We strive to be a community that welcomes and supports people of all backgrounds and identities. This includes, but is not limited to members of any race, ethnicity, culture, national origin, color, immigration status, social and economic class, educational level, sex, sexual orientation, gender identity and expression, age, size, family status, political belief, religion, and mental and physical ability.
- Be considerate and respectful of others' ideas. We will not all agree all the time, but disagreement is no excuse for poor behavior and poor manners. Your point of view is valid, but it is not the only one.
- Be careful in the words that you choose. We are a community of professionals, and we conduct ourselves professionally. Do not insult or put down other participants.
- Harassment and other exclusionary behaviors are unacceptable. This includes, but is not limited to:
    - Violent threats or language directed against another person or group.
    - Discriminatory jokes and language.
    - Posting sexually explicit or violent material.
    - Posting (or threatening to post) other people's personally identifying information ("doxing").
    - Personal insults of any kind, but especially those using racist or sexist terms.
    - Unwelcome sexual attention.
    - Advocating for, or encouraging, any of the above behavior.
    - In general, if someone asks you to stop, then stop.

- Remember that we are different. The strength of CNU comes from its varied community, people from a range of backgrounds. Different people have different perspectives on problems, learn in different ways, and may be able to explain in different ways that will be helpful to you or someone else. Being unable to understand why someone holds a viewpoint does not mean that they are wrong. Do not forget that it is human to err and blaming each other does not get us anywhere. Instead, focus on helping to resolve issues and learning from mistakes.
- Any abuse of the forum privilege will warrant a CHECS report, and banning from the forums.

## Textbook and Reference List

### Data Analysis and Error Propagation

Bevington, Phillip, and D. Keith Robinson. Data Reduction and Error Analysis for the Physical Sciences.: The McGraw-Hill Companies, 2002. ISBN: 9780072472271

Taylor, John R. Introduction to Error Analysis: The Study of Uncertainties in Physical Measurements.: University Science Press, 1997. ISBN: 9780935702750

### Design of Experiments

Montgomery, Douglas C. Design and Analysis of Experiments, 6th Edition.: John Wiley & Sons, Incorporated, 2004. ISBN: 9780471487357

Baird, D.C. Experimentation: An Introduction to Measurement Theory and Experiment Design, 3rd Edition.: Prentice Hall, 1995. ISBN: 0133032981

Canavos, George C., and Koutrouvelis, Ioannis A. An Introduction to the Design and Analysis of Experiments.: Prentice Hall, 2008. ISBN: 9780136158639

Cobb, George W. Introduction to Design and Analysis of Experiments.: Key College Publishing, 2002. ISBN: 9781931914079

### Probability and Statistics

Devore, Jay L. Probability and Statistics for Engineering and the Sciences.: Duxbury Resource Center, 2008. ISBN: 9780495557449