Old Dominion University
College: Science
Department: Physics
Course Title: Computational Physics

PHYS 420 Fall 2019

<table>
<thead>
<tr>
<th>Course</th>
<th>Computational Physics</th>
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<tr>
<td>Lecture Hours</td>
<td>Tuesday/Thursday 1:30-2:45</td>
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<tr>
<td>Location</td>
<td>Oceanography &amp; Physics Building, Room 140</td>
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<tr>
<td>Credits</td>
<td>3</td>
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Instructor Contact Information

<table>
<thead>
<tr>
<th>Name</th>
<th>Professor Colm Whelan</th>
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<tbody>
<tr>
<td>Office Location</td>
<td>Room 125 Oceanography &amp; Physics</td>
</tr>
<tr>
<td>Office Hours</td>
<td>Tuesdays 2:00 – 3:00pm or by appointment</td>
</tr>
<tr>
<td>Email Address</td>
<td><a href="mailto:cwhelan@odu.edu">cwhelan@odu.edu</a></td>
</tr>
<tr>
<td>Office Telephone Number</td>
<td>757-683-3483</td>
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</table>
2. Student Help Resources

2.3 Technical Support Center
http://occs.odu.edu/, occshelp@odu.edu, 757-683-3192

2.4 Study Guides Strategies
http://www.studygs.net/

3. Required Text
None. A set of detailed notes will be uploaded on Blackboard.

Recommended texts:

CT Whelan, *A First Course in Mathematical Physics*, Wiley-VCH

CT Whelan: *Atomic Structure, Institute of Physics*, e-book available from ODU library

4 Course Description:

4.1 Instructor Course Description
This is first and foremost a Physics course. It provides an introduction to numerical methods and techniques useful for the numerical solution of classical and quantum mechanical problems. The lectures present the underlying mathematics, physical basis and the numerical concepts needed for the resolution of problems of genuine physical interest.
You will be expected to develop computer codes to solve a series of model problems based on the material presented in lectures
You will learn the skills needed to program efficiently in order to apply computational methods.

4.2 Recommendations for Success
Your success depends on regular class attendance, individual study and timely submission of the project reports. The requirements are simple, but it is essential that you will complete them. I am always available to help you will any problems you might have. You can either come to see me at my office hours, make an appointment or just drop by. Give me a call at my office phone 757 683 3483 to see if I am in and you are always most welcome. **ALL EMAILS ARE ANSWERED PROMPTLY.**

5 Course Objectives and Expectations

5.1 Topics Covered

2. Sturm-Liouville Theory and Eigenvalue Problems, the Quantum Oscillator
3. Variational methods. Rayleigh-Ritz theorem. The Hartree Fock approximation
4. Special functions, quantum scattering
5. Monte-Carlo Methods

5.2 Course Expectations

- You should be able to write self-contained programs in a high-level scientific language—FORTRAN or C/C++
- You should be to apply computational techniques to a series of important physics problems

6 Teaching and Learning Methods

6.1 Delivery Method
Lectures will involve PowerPoint presentations.

6.2 Computational Projects
There will be five computational projects:
1. Classical Scattering by a central potential
2. The Quantum Oscillator.
3. Atomic Structure in the Hartree-Fock approximation
4. Scattering from a potential: cross section, phase shifts, resonances, positron and electron elastic scattering
5. Quantum Monte Carlo for the H₂ molecule

6.3 Homework.
As well as the main projects there will be a number of shorter homeworks, designed to help you understand the basic concepts, mathematical and physical and develop some short pieces of code that will be useful later in the course.

7.1 Course Schedule:
- No lectures on the October 12th and November 28th. Lectures are scheduled to end December 5th.

8.1 Projects:
- Each computational project will be worth 16% of the grade. You will have two weeks for each project. Your report should include a brief summary of the physics and the methods used and the numerical output from your program. The actual code is not required.
• Additionally, there will be other homework, 4 sets, each worth 5% of the grade. You will have one week for each homework. Both projects and homework should be handed in in class. Emailed pdf’s will not be accepted.

8.2 Special Needs
In compliance with PL94-142 and more recent federal legislation affirming the rights of disabled individuals, provisions will be made for students with special needs on an individual basis. The student must have been identified as "special needs" by the University and an appropriate letter(s) must be provided to the course instructor. Provision will be made based upon written guidelines from the university "special needs students" resource office. All students are expected to fulfill all course requirements. Every effort is made to provide students with accommodations appropriate to their needs. Old Dominion University is committed to ensuring equal access to all qualified students with disabilities in accordance with the Americans with Disabilities Act. The Office of Educational Accessibility (OEA) is the campus office that works with students who have disabilities to provide and/or arrange reasonable accommodations.

If you experience a disability which will impact your ability to access any aspect of my class, please present me with an accommodation letter from OEA so that appropriate accommodations are available to you.
If you feel that you will experience barriers to your ability to learn and/or testing in my class but do not have an accommodation letter, please consider scheduling an appointment with OEA to determine if academic accommodations are necessary.
The Office of Educational Accessibility is located at 1021 Student Success Center and their phone number is (757) 683-4655. Additional information is available at the OEA website: http://www.odu.edu/educationalaccessibility/

9 Student Responsibilities
To attend all lectures and submit the write-ups of all 5 projects and the 4 homework sets.

9.2 Understanding the Syllabus Requirements

It is essential that you understand the requirements stated in the syllabus. Your success depends on fulfilling these requirements.

9.3 Utilizing Online Components

You will find the Blackboard information very useful. I will add supplementary material on a regular basis.

10. Course Policies

10.1 Attendance
Regular attendance is mandatory.

10.2 Course Disclaimer
Every attempt is made to provide a syllabus that is complete and that provides an accurate overview of the course. However, circumstances and events may make it necessary for the instructor to modify the syllabus during the semester. This may depend, in part, on the progress, needs, and experiences of the students.

11 University Policies

11.1 College Classroom Conduct

The following standards are intended to define acceptable classroom behavior that preserves academic integrity and ensures that students have optimum environmental conditions for effective learning.

1. Students must turn off cell phones and pagers during class or have them set to vibrate mode.
2. Classes are expected to begin on time, and students will respect the time boundaries established by the professor. The classroom door will be locked at the start of each lecture.
3. Students should notify instructors in advance when a class will be missed. In the event of an emergency that causes a class to be missed, instructors must be notified as soon as possible.
4. Instructors will require that cell phones and other electronic devices be left on their desks during tests or examinations.
5. Students must not engage in extraneous conversations during classes. Such acts are considered to be violations of the Code of Student Conduct.
6. Students will activate their Old Dominion email accounts and check them before each class. If the student chooses to have his/her messages forwarded to another account, it is the student's responsibility to take the necessary steps to have them forwarded.
7. Consumption of food and drink during class is prohibited, except when the professor has specifically approved such acts.
8. Offensive language, gestures and the like are disrespectful and disruptive to the teaching-learning process.

[http://studentservices.odu.edu/osja/ccc_pamphlet.pdf]

11.2 Honor Pledge

I pledge to support the honor system of Old Dominion University. I will refrain from any form of academic dishonesty or deception, such as cheating or plagiarism. I am aware that as a member of the academic community, it is my responsibility to turn in all suspected violators of the honor system. I will report to Honor Council hearings if summoned." By attending Old Dominion University you have accepted the responsibility to abide by this code. This is an institutional policy approved by the Board of Visitors. Refer to Student Honor Council
11.3 University Email Policy
The Old Dominion University email system is the official electronic mail system for distributing course-related Communications, policies, Announcements and other information. In addition, the University email user ID and password are necessary for authentication and access to numerous electronic resources (online courses, faculty webpages, etc.). All student accounts utilize MIDAS passwords. [https://midas.odu.edu]
http://occs.odu.edu/accounts/studemail/index.shtml

11.4 Withdrawal
A syllabus constitutes a contract between the student and the course instructor. Participation in this course indicates your acceptance of its teaching focus, requirements, and policies. Please review the syllabus and the course requirements as soon as possible. If you believe that the nature of this course does not meet your interests, needs or expectations, if you are not prepared for the amount of work involved or if you anticipate that the class meetings, assignment deadlines or abiding by the course policies will constitute an unacceptable hardship for you, you should drop the class by the drop/add deadline, which is located in the ODU Schedule of Classes.

About Plagiarism:
Plagiarism is a serious offense, and it will not be overlooked in this or in other classes.

What is plagiarism?
The ODU Catalog defines plagiarism as follows: “A student will have committed plagiarism if he or she reproduces someone else’s work without acknowledging its source; or if a source is cited which the student has not cited or used. Examples of plagiarism include: submitting a research paper obtained from a commercial research service, the Internet, or from another student as if it were original work; making simple changes to borrowed materials while leaving the organization, content, or phraseology intact; or copying material from a source, supplying proper documentation, but leaving out quotation marks”.

Avoiding Plagiarism:
Your homework should be your own unaided work. Copying solutions from another student or from an external source such as the internet constitutes plagiarism, don’t do it. If you need help come to me.
The High Cost of Plagiarism

Plagiarism can ruin your reputation and cost you your professional career, along with the respect of your peers and family. Plagiarism at Old Dominion University is an act of academic dishonesty that has serious consequences. Note that plagiarism is specifically covered in the ODU Honor Pledge. Refer to your course syllabus and the Student Handbook and the Office of Student Affairs for details about sanctions and penalties for this behavior.

Health advice:

There may be students in class with underlying health conditions, such as asthma, diabetes, or heart and lung disease, for whom a flu can be more serious. Pregnant women are also at risk for more serious illness. With that in mind, here is additional important information for ODU students:

- The university has a Campus Health Alerts web site on the ODU home page (www.odu.edu) with up-to-date information and helpful links.
- For persons with flu, the current CDC recommendation is to stay home from work and school until at least 24 hours after free of fever (100 F/37.8 C) without the use of fever-reducing medication. This means staying home for 3 to 5 days in most cases. This is very important for preventing the spread of flu to others.

Additionally, here are general guidelines for students to help prevent the spread of influenza:

- Stay home if you are sick. If you have symptoms of influenza-like illness (fever, cough, sore throat, headache, chills, fatigue and body aches), notify your supervisor and stay home for at least 24 hours after your fever is gone except to get medical care or necessary supplies.
- Cover your nose and mouth when coughing or sneezing and throw the tissue in the trash.
- Wash your hands often with soap and water, especially after coughing or sneezing. The use of alcohol-based hand cleaners also is effective.
- Limit close contact with sick people.
- Prevent the spread of germs by not touching your eyes, nose or mouth.
- Call your health care provider if you have questions or concerns, especially if you have an underlying medical condition or are pregnant and have flu symptoms or have been exposed to the flu.

Antiviral medication may shorten the duration and severity of illness, and is also sometimes used to prevent illness in individuals with underlying medical conditions or those who may be at risk for more severe illness.

For additional information and resources, visit the following web sites:

http://www.cdc.gov/h1n1flu/sick.htm
http://www.cdc.gov/h1n1flu/guidance_homecare.htm
http://www.cdc.gov/h1n1flu/guidance/workplace.htm
http://www.cdc.gov.h1n1flu/pregnant.htm