**PHYS 155 – Physics Behind the Internet (CRN 17509)**

**SYLLABUS**

**INSTRUCTOR**
Professor Benjamin McMorran  
Email: mcmorran@uoregon.edu  
Office: 174 Willamette Hall  
Office hours: Mon 2-3, Tue 10-11, or by appointment

**CO-INSTRUCTORS**
Tyler Harvey (SLP Fellow)  
Email: trh@uoregon.edu  
Location: Willamette 220  
Office hours: Thurs 2-3, Fri 10-11  
Adrian Fraser (SLP Scholar)  
Email: afraser@uoregon.edu  
Location: Physics Reading Room  
Tutoring hours: Wed 2-4

**CLASS TIMES**
MWF 1:00-1:50 pm, 110 Willamette Hall  
Attendance is not required, but is strongly recommended. Note that there is a “clicker-based” participation grade as well as in-class reading quizzes – see the Grading section below.

**BLACKBOARD**
We will be using Blackboard in this course to distribute course materials.  
URL: https://blackboard.uoregon.edu/

**GRADER**
TBD

**OFFICE HOURS**
Listed above. *You’re encouraged to come to my or the co-instructors’ office hours, either with specific course-related questions, or just to chat about science or other general topics.*

**EMAIL**
You can certainly ask questions of me and the co-instructors by email.  
*You must use your uoregon.edu email address,* since I will be using email filters to sort messages.

**TOPICS AND AIMS**

“Any sufficiently advanced technology is indistinguishable from magic.” – Arthur C. Clarke

Is the internet magic? The internet allows us to communicate with people wherever they are, gives us access to vast stores of human knowledge, and lets us summon endless forms of entertainment, all instantaneously and with a few quick movements of our fingertips. The internet is complex, to be sure, but it is not magic. It is a feat of engineering, resulting from hundreds of years of scientific insights. Here we aim to gain a peak at just some of the key physical principles that underlays this technology.

Goals for the class include being able to discuss the following questions: How can information be quantified? How can it be stored? How do we transmit it? What exactly *is* the internet?
We’ll examine a variety of topics:
1. Digital information and logic
2. Electricity and magnetism (physics of computers)
3. Electromagnetic waves (physics of communications)
4. Energy and power (physics of data centers)

Other goals: Through readings and discussions, we will also use our knowledge of the physics underlying the internet to gain insight into important economic, social, and technological issues in internet technology.

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<tr>
<th>TEXTBOOK</th>
<th><em>The Silicon Web</em> by Michael Raymer</th>
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<td>MATERIALS</td>
<td>- We’ll use “i&gt;clickers,” personal response systems that allow real-time polling in class. Each enrolled student must bring one clicker to every class. Clickers can be purchased at the bookstore for about $36 new, with decent resell value. If you know someone not enrolled in this course, borrowing their clicker for this class will work fine. You will need to register your clicker following instructions on Blackboard in the Course Documents section for this course. <strong>Please register your clicker prior to the second class Wednesday.</strong></td>
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| HOMEWORK       | Weekly homework sets will be assigned on Blackboard about one week before they are due. Homework is due each Thursday by 5:00 pm; put into the designated In-Box (location: basement of Willamette - directly below our classroom, bottom of stairs and to the right). We will accept late homework no more than 24 hours late (5:00 pm Friday in the homework In-Box), but the score will be reduced by 50%. Feel free to discuss the questions with others, but of course, the work you submit should be your own. Solutions to all the problem sets will be posted – study these.  
**Homework grading:**  
(1) Each student’s lowest score will be dropped from the overall total.  
(2) Due to the large size of the class, we will not be able to comment in detail on your homework when grading it. Because of this, it is especially important to study the problem set solutions. |
| READING QUIZZES| Most of classes will begin with a very short reading quiz, using your clicker. The quizzes should add incentive to do the assigned reading before class, and the questions are designed to be easy if you’ve done the reading (they won’t test mastery of the material). Your responses are known only to you and the Instructors. Bring pencil, paper, and calculator to every class for these. |
| MIDTERM EXAMS  | There will be two in-class midterms, one on Friday, Oct 19, and the other on Friday, Nov 16. **There will be no makeup exams.** If there is a serious (e.g. involving illness) and well-documented (e.g. with a doctor's note) reason for missing the midterms, the final exam score will count extra, in place of the missed tests. |
| FINAL EXAM     | The final exam will be held from 3:15 pm - 5:15 pm on Wednesday, Dec. 5. You must take the exam at this time. (No exceptions.) You must bring
In general, vibrant class participation enhances all students’ learning experiences – one of the motivations for “clicker” usage. However, I consider it overly paternalistic to require attendance. Therefore there will be two possible weightings of the various grade components:

- **Reading quizzes (RQ):** Short, simple clicker questions occasionally at beginning of class
- **Participation (P):** In-class i>Clicker-based polls related to the present topic, scored by participation only, not the accuracy of the response.
- **Homework Assignments (HW)**
- **Midterm Exam 1 (MT1):** tentatively Friday, Feb. 10
- **Midterm Exam 2 (MT2):** tentatively Friday, Mar. 2
- **Final Exam (F):** Monday, March 19, 10:15 AM – 12:15 PM

Grading option 1: RQ/P/HW/MT1/MT2/F = 5/10/30/15/15/25%
Grading option 2: RQ/P/HW/MT1/MT2/F = 0/0/30/20/20/30%

I’ll grade each student using both options, keeping the higher overall score.

**Final Grade:**
- A=88-100%
- B=76-87.9%
- C=64-75.9%
- D=52-63.9%
- F<52%

If necessary, I may apply a curve to achieve a higher average final grade. However, you are guaranteed at least the grade listed here based on your course average. Pass/fail grading option: A passing grade requires at least the equivalent of a C- grade.

**Use of Math**
One of the main aspects of physics is that you can use mathematics to understand how things work. As such, you will need to employ some basic math skills—fractions, simple algebra (solve $2/x = 5$), square roots, exponents and scientific notation. Physicists use units to add meaning to math, and you will learn how to use units as a tool for problem-solving.

**Physics Drop-In Help Center**
Free help with any standard math or physics question can be obtained in 147 Willamette Hall. The Drop-In Help Center is staffed 5 days a week and most of the day (hours are posted on the door). Note: some of the computer-related topics in this course may be outside the expertise of the tutors there, but they can probably still help you.

**Laptops and Phones in Class (None)**
Ironically, the use of laptop computers and phones in class is not allowed. Why? Several studies show that students using laptops in class spend a great deal of time on non-class-related activities (FB, surfing the web, playing games,...) and that these distractions negatively impact both learning and grades. This alone isn’t a reason to ban laptops – you’re responsible for your own performance in class. In addition, however, studies have shown that non-class-related laptop use distracts and impacts the learning of other students nearby. (E.g. Fried, C. B. *Computers & Education* 50, 906-914 (2008).) Plus, students have complained about the environment created by their classmates’ laptop use. Taking notes by hand, by the way, is
more effective in cementing concepts in your mind – you can always take a quick photo of your notes if you want a digital copy.

In summary, laptops and phones are not allowed in class. The only exceptions will be for people with documented medical needs; please see me if this is the case.

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<th>HOW TO DO WELL IN THE COURSE</th>
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<td>• Attend class.</td>
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<td>• Participate in discussions (both talking and listening)</td>
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<td>• Do the homework, and study the solutions.</td>
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<td>• Work on understanding all the concepts and example questions discussed in the lectures and the homework. “Understanding” does not mean “it sounds like it makes sense to me,” but more deeply, “I could explain this concept to one of my classmates.”</td>
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<td>• Come to my or the teaching assistants’ office hours with questions!</td>
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<td>• Another suggestion: <strong>Sleep!</strong> Numerous studies show that sleeping helps both memory and understanding.</td>
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<td>• And another: Avoid low blood sugar during exams (and all class periods) by eating a healthy snack just beforehand.</td>
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<th>STUDENTS WITH DISABILITIES</th>
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<td>If there are aspects of the instruction or design of this course that result in barriers to your inclusion, please notify me as soon as possible. You are also welcome to contact Disability Services in 164 Oregon Hall, 346-1155.</td>
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