THE PHYSICS OF SOLAR AND RENEWABLE ENERGY (PHYSICS 162)	
WINTER 2024	PROFESSOR RAGHUVEER PARTHASARATHY DEPARTMENT OF PHYSICS THE UNIVERSITY OF OREGON

SYLLABUS

Welcome to "The Physics of Solar and Renewable Energy!" This syllabus contains a lot of information, especially about different components of the course. I'm fond of having a variety of assignments and activities, which makes the class livelier and also helps people learn. This has gone well in the past – students like it, as do I – but it requires a good amount of organization on everyone's part. – *Prof. Parthasarathy*

Please note that aspects of the syllabus may change. If so, I'll inform everyone in class and through Canvas.

Time and Place

Tuesday and Thursday 12:00 - 1:50 pm, Willamette Hall Room 100

The Tuesday period and the first half of the Thursday period will be "normal" classes – lecture, activities, etc. The second half of the Thursday period (approximately 1:00-1:50 pm) will be an open question/discussion time, similar to office hours. Feel free to attend this part or not, as you prefer, but keep in mind that it will likely be helpful.

Instructors and Contact Information

Professor Raghuveer Parthasarathy (pronounced **Par**-tha-**sa**-ra-thē)

Email: raghu@uoregon.edu

Office: Willamette 362

Office hours: W 2:00-2:50 pm, Th 2:00-2:50 pm, Willamette 362

Graduate Teaching Assistant: Lance Blagg

Email: lblagg@uoregon.edu

Office hours: Wednesday 12:00-12:50 pm, Friday 12:00-12:50 pm in Willamette 315

Make use of office hours! Even if you don't have specific questions, feel free to drop by. *Office hour times may change*, both by request (if particular times are not good for many students) and due to scheduling conflicts that arise.

Email: You can certainly ask questions by email or through Canvas! Please address me as "Prof. Parthasarathy" in communications. *Recommended:* Copy the graduate teaching assistant on emails.

Course Description and Learning Goals

Modern civilization uses vast amounts of energy in forms that are unsustainable and environmentally damaging. What are our alternatives? How do alternative energy sources work, and how much of our needs can they satisfy?

We'll explore these questions, investigating the science behind alternative energy and putting "real numbers" into our characterization of it. Why? It's easy to have good intentions about energy and the environment, but good intentions without quantitative analysis isn't enough to guide important decisions, and it can often do real harm.

Who are you? Being in this course, it's likely that you care about energy issues. Being university students, it's likely that you'll be the decision-makers of the future – businesspeople, policy makers, or at least voters – who will be faced with complex choices having to do with energy and society. The course is designed for **non-science majors**, and we'll develop the ability to make deep insights with simple math.

We'll examine a variety of topics:

1. Present Energy Usage and Sources
2. The Physics of Energy, Power, and Energy Conversion
3. Hydroelectric Power
4. Wind Power
5. Generating and Transporting Electricity
6. Solar Photovoltaics

7. Geothermal and Solar Thermal Energy

8. Biofuels

9. Nuclear Power

10. Batteries and Storage

We'll very briefly comment on fossil fuels and climate change, which are discussed at length in **Physics 161** (*Physics of Energy and the Environment*). Physics 161 **is not** a prerequisite for 162.

Other goals: We will develop our abilities to think critically and quantitatively about scientific issues. Science, contrary to what you may have been mis-taught in the past, is not about "learning facts" but rather about learning how to investigate and draw logical conclusions. We'll practice this!

Students completing the course will have improved their abilities to:

- Understand how physical principles underlie how we use energy.
- Assess and interpret graphs and quantitative data.
- Understand the process by which science generates knowledge.

Prerequisites. There are no scientific prerequisites, and mathematics will be at the level of basic algebra.

Canvas

We'll use Canvas to distribute materials, post links, submit assignments, etc. https://canvas.uoregon.edu/ . If you have questions about accessing and using Canvas, visit the Canvas support page. Canvas and Technology Support also is available by phone or live chat: 541-346-4357 | livehelp.uoregon.edu

Textbook

There is no required textbook. The lectures plus readings and videos that will be assigned throughout the term will be sufficient. (See also "Reading Quizzes.") Possibly useful:

- *Energy and Human Ambitions on a Finite Planet.* Tom Murphy. eScholarship, University of California, 2021. It's available **free** online at https://escholarship.org/uc/item/9js5291m. A broad and up-to-date book on energy issues. Part I isn't really necessary and has several parts that many people (myself included) would disagree with; I strongly recommend reading this review of the book: https://aapt.scitation.org/doi/full/10.1119/5.0062183 .

- *Sustainable Energy – Without the Hot Air* by David MacKay, a remarkable book that quantifies a lot of energy-related issues. It's available **free** online at http://www.withouthotair.com/ .

In class

I'll lecture, but not exhaustively. We'll spend quite a bit of time in class on discussions and problem-solving. To have fruitful discussions, it is important for people to have read the pre-class readings and be ready to participate.

Powerpoint slides will be posted after each class on Canvas. As will be discussed, the slides are rather minimal and aren't a substitute for taking notes in class.

Participation. ~~I'll make an announcement about in-class participation at the end of Class #1~~ As announced in class #1: An abundance of research, and my own experience teaching, confirms that active engagement in class enhances student learning. As an added bonus, it makes the class sessions more enjoyable. Of course, it is each student's decision whether or not to actively participate – asking and answering questions, taking part in discussions, etc. However, non-participating students can stifle the mood around them and detract from others' learning experience. Therefore, I've decided to allow students to self-segregate, making use of our large classroom:

- If you want an interactive, hopefully fun, class experience, please sit in the middle section of Willamette 100, in the front half. Be ready to ask and answer questions, talk to your neighbors, etc. (Wrong answers are welcome!)
- If you prefer not to participate, please sit in the side sections of Willamette 100, or in the back half of the middle.

You can make your choice at each class session, moving wherever you like.There are no consequences for your grade, other than that active participation will likely help you!

Absences

This course follows the university's policies on absences, described at https://provost.uoregon.edu/course-attendance-and-engagement-policy. Please note the "reason neutral" policy: **instructors "shall not ask for reasons for absences and shall not distinguish between 'excused' and 'unexcused' absences."** Attendance is not mandatory but succeeding in the class without consistent attendance will be very difficult.

I realize that it is unavoidable that people will have to miss a few classes, for example due to illness. I will therefore **drop certain scores and rescale various grade components** as described below.

Course structure and grade components

I'm fond of having a variety of tools for fostering and assessing student learning, rather than just high-stakes exams. (There's a lot of educational research literature that supports this approach.) There are therefore a lot of components to the coursework. These are listed below along with their weight toward the overall course grade.

Reading assignments and Reading Quizzes (~~7~~ 9%). Reading assignments will precede most classes and will usually have "reading quizzes" associated with them, administered through Canvas and due 30 minutes before the start of class. The reading quizzes are intended to be straightforward, with the aim of providing a bit of feedback to facilitate your reading. More comprehensive questions will appear on regular quizzes and exams. Each student's **lowest two reading quiz scores will be dropped** from the overall total.

Post-class notes (~~5~~ 6%). Briefly reviewing what one learned from a class session helps cement one's understanding. Within 24 hours of the end of each class, submit a short (less than 300 words) summary of what the key points of that day's class were. You can also describe things that were unclear or that need further explanation. These will be submitted on-line, via Canvas. The notes will be graded on content (i.e. that they capture something important about the day's lessons) and clarity. We'll give examples of good and bad notes. I will **rescale the grades** of the post-class notes such that 90% becomes 100%. (In other words, I will divide each student's percentage by 0.9, with a ceiling of 100%. If your original score were 75%, the rescaled score would be 83%.)

Poll Questions (~~3%~~). There will be in-class poll questions scored by participation only, not the accuracy of the response. We will use "iClicker cloud," which I will discuss in class. You'll need a phone or computer to respond. If you don't have a device like this, please let me know; I am happy to help with alternatives. Like the post-class notes, I will **rescale the scores** so that 90% counts as 100%; i.e. you can miss 10% of the questions without penalty. **Updated:** Because of technical problems, I'm not going to count participation points. I have moved the 3% of the overall grade to Reading Quizzes (2%) and Post-Class Notes (1%).

Quizzes (20%). There will be several short in-class quizzes. They won't be surprises; you'll get advance notice of at least one class. We'll use these to assess understanding of key points without the heavy weight of an exam. Each student's **lowest quiz score will be dropped** from the total. There won't be any make-up quizzes; if you miss one, this will be the dropped quiz.

Homework (13%). There will be homework assignments approximately every week. Feel free to discuss the questions with others, but of course, *the work you submit should be your own*. Assignments will be submitted online, via Canvas. Solutions will be posted; **study these.** No late homework will be accepted. Each student's **lowest score will be dropped** from the overall total. We will not comment in detail on your homework when grading it. It is therefore important to study the homework solutions.

Projects (12%). There will be three small "projects" that involve assessing the recent history, current usage, and physics-related potential of an alternative energy source: hydroelectric power, wind power, and solar power. These can be done in groups of up to three students.

Exams (20% and 20%). There will be one midterm exam, scheduled for Tuesday, May 7 ~~Thursday, May 2~~, and a final exam on Thursday, June 13 at 8:00 am. (Final exam times are set by the Registrar's office; see https://registrar.uoregon.edu/calendars/examinations.) Exams will have a combination of multiple-choice and short-answer questions

OVERALL GRADE: A: score ≥ 90.0%; B: 90 > score ≥ 80.0%; C: 80 > score ≥ 70.0%; D: 70 > score ≥ 60.0%; F: score < 60.0 %, where "score" is the overall weighted course score. Note that these are minimum guarantees, which I may choose to loosen.

Math Diagnostic Quiz

The mathematics in this course will be elementary, as discussed in class, but it is important to be comfortable with these basic numerical skills. Therefore, there will be a diagnostic "quiz" to be taken on Canvas on basic mathematics. Re-taking the quiz **is** allowed – you are encouraged to learn from your mistakes, and to see the GTF or me for help! Scoring 75% or higher by the Friday of Week 3 is **required** for continuing in the course. (A score of <75% will automatically result in a failing grade for the course.)

Generative Artificial Intelligence (GenAI) Use

Students in this class can use GenAI tools such as ChatGPT to help with certain aspects of course work. This includes asking GenAI tools for explanations of terms or concepts, keeping in mind that the explanations might be incorrect. GenAI will probably be able to answer reading quiz questions or possibly homework questions correctly, and you can use this to assess your answers, but you should **not** use this as a substitute for answering questions yourself – the aim of these tasks is to develop your own skills, and you will be assessed on this in-class quizzes and exams. For assignments that involve writing, you might find it useful to bounce ideas off of GenAI tools. However, you cannot use content such as text or graphics created by GenAI tools in your work; rather, you must be the author/creator of your work submissions. Be advised, in accordance with UO policy, if I believe you've handed in work created whole or in part by GenAI tools, I may submit a report of suspected academic misconduct to the Office of Student Conduct and Community Standards for that office to make a determination of responsibility and, if warranted, assess a grade penalty. So, if you are in doubt or have questions about a particular GenAI tool and if its use is okay, check in with me and let's discuss!

How to do well in the course

Plan ahead and start early! This applies to everything in the course – homework, reading assignments, and general studying. It will be crucial to keep up with the course and not fall behind; later topics build on earlier ones. For a 4 credit course, the University's expectation is that you'll spend about 10 hours per week outside of class on coursework. [1].

Make use of resources. If you have questions about anything, come to office hours! Communication by email is also welcome, though it's often more effective to chat in person.

Sleep! Many studies show that sleeping helps memory and understanding.

University Policies

Some of this text is quoted from https://provost.uoregon.edu/standard-university-syllabus-language:

Academic Disruption due to Campus Emergency

In the event of a campus emergency that disrupts academic activities, course requirements, deadlines, and grading percentages are subject to change. Information about changes in this course will be communicated as soon as possible by email, and on Canvas. If we are not able to meet face-to-face, students should immediately log onto Canvas and read any announcements and/or access alternative assignments. Students are also expected to continue coursework as outlined in this syllabus or other instructions on Canvas.

Academic Integrity

The University Student Conduct Code (available at conduct.uoregon.edu) defines academic misconduct. Students are prohibited from committing or attempting to commit any act that constitutes academic misconduct. By way of example, students should not give or receive (or attempt to give or receive) unauthorized help on assignments or examinations without express permission from the instructor. Students should properly acknowledge and document all sources of information (e.g. quotations, paraphrases, ideas) and use only the sources and resources authorized by the instructor. If there is any question about whether an act constitutes academic misconduct, it is the students' obligation to clarify the question with the instructor before committing or attempting to commit the act. Additional information about a common form of academic misconduct, plagiarism, is available at https://researchguides.uoregon.edu/citing-plagiarism .

I will report misconduct to the Office of Student Conduct and Community Standards—consequences can include failure in the course.

Access and Accommodations

[1] https://blogs.uoregon.edu/uocc/files/2016/10/Credit-Hour-and-Student-Workload-Policies-2afl3yr.pdf

The University of Oregon and I are dedicated to fostering inclusive, equitable, and accessible learning environments for all students. The Accessible Education Center (AEC) assists students with disabilities in reducing barriers in the educational experience. You may be eligible for accommodations for a variety of disabilities – apparent disabilities, such as a mobility or physical disability, or non-apparent disabilities, such as chronic illnesses or psychological disabilities. If you have or think you have a disability and experience academic barriers, please contact the Accessible Education Center (Location: 360 Oregon Hall; 541-346-1155; uoaec@uoregon.edu) to discuss appropriate accommodations or support. The details of your disability will be kept confidential with the AEC and you are not expected to share this information with others. However, I invite you to discuss any approved accommodations or access needs at any time with me.

INCLEMENT WEATHER

It is generally expected that class will meet unless the University is officially closed for inclement weather. If it becomes necessary to cancel class while the University remains open, this will be announced on Canvas and by email. Updates on inclement weather and closure are also communicated in other ways described here: https://hr.uoregon.edu/about-hr/campus-notifications/inclement-weather/inclement-weather-immediate-updates

REPORTING OBLIGATIONS

I am a designated reporter. For information about my reporting obligations as an employee, please see Employee Reporting Obligations on the Office of Investigations and Civil Rights Compliance (OICRC) website. Students experiencing sex or gender-based discrimination, harassment or violence should call the 24-7 hotline 541-346-SAFE [7244] or visit safe.uoregon.edu for help. Students experiencing all forms of prohibited discrimination or harassment may contact the Dean of Students Office at 5411-346-3216 or the non-confidential Title IX Coordinator/OICRC at 541-346-3123. Additional resources are available at investigations.uoregon.edu/how-get-support. I am also a mandatory reporter of child abuse. Please find more information at Mandatory Reporting of Child Abuse and Neglect.

MENTAL HEALTH AND WELLNESS

Life at college can be very complicated. Students often feel overwhelmed or stressed, experience anxiety or depression, struggle with relationships, or just need help navigating challenges in their life. If you're facing such challenges, you don't need to handle them on your own--there's help and support on campus. As your instructor if I believe you may need additional support, I will express my concerns, the reasons for them, and refer you to resources that might be helpful. It is not my intention to know the details of what might be bothering you, but simply to let you know I care and that help is available. Getting help is a courageous thing to do—for yourself and those you care about.

University Health Services help students cope with difficult emotions and life stressors. If you need general resources on coping with stress or want to talk with another student who has been in the same place as you, visit the Duck Nest (located in the EMU on the ground

floor) and get help from one of the specially trained Peer Wellness Advocates. Find out more at health.uoregon.edu/ducknest.

University Counseling Services (UCS) has a team of dedicated staff members to support you with your concerns, many of whom can provide identity-based support. All clinical services are free and confidential. Find out more at counseling.uoregon.edu or by calling 541-346-3227 (anytime UCS is closed, the After-Hours Support and Crisis Line is available by calling this same number).

Basic Needs

Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live and believes this may affect their performance in the course is urged to contact the Dean of Students Office (346-3216, 164 Oregon Hall) for support.

This UO webpage includes resources for food, housing, healthcare, childcare, transportation, technology, finances, and legal support: https://blogs.uoregon.edu/basicneeds/food/

Accommodation for Religious Observances

The university makes reasonable accommodations, upon request, for students who are unable to attend a class for religious obligations or observance reasons, in accordance with the university discrimination policy which says "Any student who, because of religious beliefs, is unable to attend classes on a particular day shall be excused from attendance requirements and from any examination or other assignment on that day. The student shall make up the examination or other assignment missed because of the absence." To request accommodations for this course for religious observance, visit the Office of the Registrar's website (https://registrar.uoregon.edu/calendars/religious-observances) and complete and submit to the instructor the "Student Religious Accommodation Request" form prior to the end of the second week of the term.