

<b>THE PHYSICS OF SOLAR AND RENEWABLE ENERGY (PHYSICS 161)</b>  SPRING 2022	<b>PROFESSOR RAGHUVeer PARTHASARATHY</b> (Par-tha-sa-ra-thē)  Office: 362 Willamette Hall EMAIL: <a href="mailto:raghu@uoregon.edu">raghu@uoregon.edu</a>
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## 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 more lively 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*

### INSTRUCTORS AND LOGISTICAL INFORMATION

<b>CLASS TIMES</b>	TuTh 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., and I expect everyone to attend (barring health issues, of course!). The second half of the Thursday period (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 note that it will likely be helpful.
<b>INSTRUCTOR</b>	<b>Professor Raghuveer Parthasarathy (Par-tha-sa-ra-thē)</b> <i>Email:</i> <a href="mailto:raghu@uoregon.edu">raghu@uoregon.edu</a> Office: 362 Willamette Hall, and Zoom
<b>TEACHING ASSISTANTS</b>	This course has one graduate student teaching fellow (GTF): <b>Piyush Amitabh</b> – <i>Email:</i> <a href="mailto:pamitabh@uoregon.edu">pamitabh@uoregon.edu</a>
<b>OFFICE HOURS</b>	Professor Parthasarathy and the GTF will have weekly office hours: <b>Prof. Parthasarathy:</b> W 1:00-1:50 pm, Th 2:00-2:50 pm, Willamette 362 <b>Piyush Amitabh:</b> Monday 1:00 -2:00 pm Science Library B010 (PSC B010); Thursday 5:15-6:15 pm (Willamette 149, by the atrium) <b>Make use of office hours!</b> Even if you don’t have specific questions, feel free to drop by and chat. <i>Office hour times may change</i> , both by request (if particular times are not good for many students) and due to scheduling conflicts that arise.
<b>EMAIL</b>	<b>Email:</b> You can certainly ask questions of me and the GTF by email! I almost always respond within 24 hours. I might not respond to emails that begin “Hey...” or are otherwise poorly constructed. Please call me “Prof.

	Parthasarathy” in communications.
	<p>As part of the <b>Science Literacy Program (SLP)</b>, we will pay special attention to connections between science, societal issues, and “big ideas.” SLP courses include courses for non-science majors and science majors taught by teams of faculty, graduate fellows, and undergraduate scholars, who will include opportunities to engage with topics through a variety of activities. For more information about the program see <a href="http://scilit.uoregon.edu">scilit.uoregon.edu</a></p>

## ***COURSE DESCRIPTION***

### **TOPICS AND AIMS**

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!

<b>LEARNING OUTCOMES</b>	<p>Students completing the course will have enhanced their abilities to:</p> <ul style="list-style-type: none"> <li>• Understand how physical principles underlie how we use energy.</li> <li>• Assess and interpret graphs and quantitative data.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Understand the process by which science generates knowledge.</li> </ul>
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### ***COURSE MATERIALS AND COMPONENTS***

<b>CANVAS</b>	<p>We will be using Canvas in this course extensively to distribute and collect course materials. Log on to <a href="https://canvas.uoregon.edu">canvas.uoregon.edu</a> using your DuckID to access our class. If you have questions about accessing and using Canvas, visit the <a href="#">Canvas support page</a>. Canvas and Technology Support also is available by phone or live chat: <a href="tel:541-346-4357">541-346-4357</a>   <a href="https://livehelp.uoregon.edu">livehelp.uoregon.edu</a></p>
<b>TEXTBOOK</b>	<p><b>There is no required textbook.</b> The lectures plus supplemental readings will be sufficient. (See also “Reading Quizzes.”) Possibly useful:</p> <ul style="list-style-type: none"> <li>• <i>Energy and Human Ambitions on a Finite Planet</i>. Tom Murphy. eScholarship, University of California, 2021. It’s available <b>free</b> online: <a href="https://escholarship.org/uc/item/9js5291m">https://escholarship.org/uc/item/9js5291m</a> . <i>Note:</i> This is a remarkable and up-to-date book on understanding 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: <a href="https://aapt.scitation.org/doi/full/10.1119/5.0062183">https://aapt.scitation.org/doi/full/10.1119/5.0062183</a> .</li> <li>• <i>Sustainable Energy – Without the Hot Air</i> by David MacKay, a remarkable book that quantifies a lot of energy-related issues. It’s available <b>free</b> online, at <a href="http://www.withouthotair.com/">http://www.withouthotair.com/</a> .</li> </ul>
<b>SLIDES AND RECORDINGS</b>	<p>Powerpoint slides will be posted after each class. As will be discussed, the slides are rather minimal and aren’t a substitute for taking notes in class. Also, to facilitate keeping up with the course despite rare absences, I intend to record the audio + computer display for each class and to make these accessible <i>by request</i>. Please note that this is not a hybrid course, and recording quality may be poor. Still, the combination of the recordings and slides, along with asking questions at office hours, should help you keep up if unforeseen events prevent attendance.</p>

### ***ASSIGNMENTS AND ASSESSMENTS***

<b>PHILOSOPHY</b>	<p>I’m fond of having a variety of tools for fostering and assessing student learning, rather than just one or two 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.</p>
<b>READING QUIZZES</b>	<p>Reading assignments will <b>precede</b> most classes and will often have required “reading quizzes” associated with them, to be taken via Canvas. Some of these “reading” assignments will be videos. Each student’s <b>lowest reading quiz score will be dropped</b> from the overall total.</p>
<b>QUIZZES</b>	<p>There will be several short quizzes. (They won’t be surprises; you’ll get</p>

	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 <b>lowest quiz score will be dropped</b> from the total. There won't be any make-up quizzes; if you miss one, this will be the dropped quiz.
<b>HOMEWORK</b>	<p>There will be homework assignments approximately every week. Feel free to discuss the questions with others, but of course, <i>the work you submit should be your own</i>. Assignments will be submitted online, via Canvas. Solutions will be posted – study these! <u>No late homework will be accepted.</u></p> <p>Some assignments will involve finding and analyzing data. You should be able to navigate the internet and make graphs (e.g. with Excel).</p> <p><i>Homework grading:</i></p> <p>(1) Each student's <b>lowest score will be dropped</b> from the overall total.</p> <p>(2) We will not comment in detail on your homework when grading it. It is especially important to study the problem set solutions.</p>
<b>POST-CLASS NOTES</b>	<p>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.</p> <p>I realize that it is unavoidable that people will have to miss a few classes (for example, due to illness). Therefore, I will <b>rescale the grades</b> 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%.)</p>
<b>PROJECTS</b>	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.
<b>POLL QUESTIONS</b>	<p>There will be in-class poll questions scored by participation only, not the accuracy of the response. We will use "Poll Everywhere," which I will discuss in class. The URL will always be the same, and I suggest bookmarking it: <a href="https://pollev.com/raghuveerparthasarathy489">https://pollev.com/raghuveerparthasarathy489</a> . You'll need a phone or computer to respond to the polls. If you don't have a device like this, please let me know; I am happy to help with alternatives.</p> <p>Like the post-class notes, I will <b>rescale the scores</b> so that 90% counts as 100%; i.e. you can miss 10% of the questions without penalty.</p>
<b>EXAMS</b>	There will be one midterm exam, tentatively scheduled for April 28, and a final exam on 8:00 am on Tuesday, June 7. (The final exam time is set by UO.) Exams will have a mix of multiple-choice and short-answer questions.

<b>GRADING</b>	<p>The various grade components and their weights for the final grade are:</p> <ul style="list-style-type: none"> <li>• <i>Quizzes: 14%</i></li> <li>• <i>Reading Quizzes: 14%</i></li> <li>• <i>Homework Assignments: 14%</i></li> <li>• <i>Projects: 12%</i></li> <li>• <i>Post-class summaries: 6%</i></li> <li>• <i>Poll questions (participation): 3%</i></li> <li>• <i>Midterm Exam: 18%</i></li> <li>• <i>Final Exam: 19%</i></li> </ul> <p><b>Overall Grade:</b> A=90-100%; B=80-89.9%; C=70-79.9%; D=60-69.9%; F&lt;60%.</p>
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### **OTHER POLICIES**

<b>ABSENCES</b>	<p>I will not give “makeup” quizzes, etc. As described above for each course component, absences are unavoidable, and so I’ll drop the lowest quiz score, etc., and rescale participation scores to allow missing 10%. These policies help offset any short-term absences, while avoiding the unsatisfying and time-consuming messes created by attempting to give “makeups,” which are never really equivalent to the originals.</p> <p><b>Exams.</b> Students with a serious and well-documented reason for missing an exam should contact Prof. Parthasarathy.</p>
<b>ACADEMIC INTEGRITY</b>	<p>Students are expected to abide by university policies on academic honesty, avoiding unauthorized help on assignments and examinations, the use of sources without acknowledgment plagiarism, fabrication, and cheating of all types. The Student Conduct Code (<a href="https://dos.uoregon.edu/conduct">https://dos.uoregon.edu/conduct</a>) provides definitions of these terms and explanations of the university policy on the subject. I take academic misconduct very seriously, as it is disrespectful to your fellow students, your instructor, and society. I will report misconduct to the Office of Student Conduct and Community Standards—consequences can include failure of the course. On exams, if a technological glitch disrupts your performance, don’t panic. Take a photo to document the error message you’re receiving and then email Prof. Parthasarathy.</p>
<b>HOW TO DO WELL IN THE COURSE</b>	<p><b>Plan ahead and start early!</b> 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 <b>10 hours per week</b> outside of class on coursework. <sup>1</sup></p> <p><b>Make use of resources.</b> If you have questions about lectures, assignments,</p>

<sup>1</sup> <https://blogs.uoregon.edu/uocc/files/2016/10/Credit-Hour-and-Student-Workload-Policies-2af13yr.pdf>

	<p>readings, or other matters, come to Prof. Parthasarathy's or the GTFs' office hours with questions! Also, we encourage communication by phone or email, though we may often reply that it's more effective to chat in person, at office hours.</p> <p>The University's Tutoring and Learning Center (TLC) provides math and writing support in addition to tutoring, study skills support, workshops, and more. For more information, see <a href="http://tlc.uoregon.edu/">http://tlc.uoregon.edu/</a>.</p> <p><i>Also: <b>Sleep!</b> Many studies show that sleeping helps memory and understanding.</i></p>
<p><b>POLICY ON MISSED DEADLINES, SIGNIFICANT ABSENCES &amp; INCOMPLETES</b></p>	<p>Only the following unforeseen and uncontrollable emergency situations are acceptable excuses for missed deadlines:</p> <ul style="list-style-type: none"> <li>• Documented serious illness/injury;</li> <li>• Documented death in the <i>immediate</i> family.</li> </ul> <p>All of the following are <b>unacceptable</b> – note that they include “personal” as well as “technological” excuses:</p> <ul style="list-style-type: none"> <li>• Special occasions (e.g. weddings, birthdays, anniversaries etc.).</li> <li>• Work and school conflicts: “I had to work extra hours,” “I have a huge midterm tomorrow in another class...”</li> <li>• Couldn't get to campus (alarm didn't ring; missed the bus; etc.).</li> <li>• Being generally “busy” or having “a lot going on right now...”</li> <li>• Forgot or “mixed up” the assignment or due date.</li> <li>• Assignment completed on computer is “missing,” was accidentally erased, or is inaccessible.</li> </ul>
<p><b>STUDENTS WITH DISABILITIES</b></p>	<p>All of us at the University of Oregon are working to create inclusive learning environments. Please notify me if there are aspects of the instruction or design of this course that result in disability-related barriers to your participation. You are also encouraged to contact the Accessible Education Center at 541-346-1155 or <a href="mailto:uoaec@uoregon.edu">uoaec@uoregon.edu</a>.</p>
<p><b>CHANGES TO THE SYLLABUS</b></p>	<p>As the university community adjusts to consequences of the COVID-19 pandemic, <b>course requirements, deadlines, and grading percentages are subject to change</b>. I will be mindful of the many impacts the events related to COVID-19 may be having on you. I encourage you to talk with me about what you are experiencing so we can work together to help you succeed in this course.</p>