STATE UNIVERSITY COLLEGE AT BUFFALO

Department of Physics Course Syllabus

PHY 522: Energy, Sustainability and Renewability for HS Teachers

Course by Contract Fall2022 CRN4062

**Professor:** Dr. Dan MacIsaac, SAMC278 (by appmt; Zoom is STRONGLY preferred)
**E-mail:** macisadl@buffalostate.edu (within 48h)

**Phone:** (716) 878-3802 (Office voicemail; email is STRONGLY preferred)
**Course** **BlackBoard Web:** https://buffalostate.open.suny.edu/

**Office hours:** M 3:00-4:00pm and 7:30-8:00pm; F 2:00-3:00pm; and by appointment (live, phone or Zoom).

**Course Particulars:** This is a 3 credit-hour online course by contract meeting online via Zoom Wednesdays nights from 4:30-7:30pm with an optional attendance self-organized weekly help/study session via Zoom (e.g. -- past semesters students organized HW sessions on Sun evenings). Students are expected to attend several evening sessions, and must attend the course session which includes final project presentations.

**Pre-requisites:** An introductory course sequence in college or university physics, plus ***either*** enrollment in a STEM Masters’ degree program for science teachers, ***or*** instructor’s permission.

**Textbook and Materials:** The required text is available from several sources (including electronic versions): **Jaffe, R.L. & Taylor, J.R (2018). *The Physics of Energy, First Edition*. Cambridge University Press**. ISBN-13 978-1107016651. The first few chapters are fully available for free from the text Amazon webpage. In addition, you will be submitting online homework and documents by e-mail and/or blackboard. Computer videoconferencing access, printer access and a high quality cellphone camera (I suggest free *CamScanner* software from the Apple App or Google Play store) OR a document scanner will be required to submit assignments.

We will follow the textbook skimming at a high rate of speed covering 25 (most specified, some of your choice) of the 38 textbook chapters:
Ch1-12 reviews physics energy concepts for: mechanics, E&M, waves and optics, thermodynamics, modern physics;
Ch17-19 analyzes nuclear power generation physics;
Ch22-26 examines physics underlying solar energy and biofuels production and conversion;
Ch28-30 examines fluid physics particularly underlying wind energy production:
Ch34-38 examines physics impacts of energy use and conservation on the Earth’s climate; and the physics of large scale energy generation, storage, distribution systems.

**Course Description and Objectives:** A survey review of the introductory physics of energy, with a deeper analysis of the physics underlying nuclear, solar, and wind energy production, and including an overview of energy systems related to the Earth’s climate, conservation and energy generation distribution and storage systems.

A survey of the major conceptual ideas underlying "energy physics" appropriate for physics teachers. This course will be taught using a collection of techniques including reading logs, take home exams, homework and a project. We will act as an online community to develop understandings of powerful scientific ideas underlying the physics of energy. You will have reading logs and/or homework sets due most weeks.

**Course Schedule:** You are expected roughly read and complete several homework problems from two to three chapters per week of the textbook (MIT students use this text in a writing intensive course, covering one chapter per class or three chapters per week). Every second week you will have a homework set of < 10 chapter problems (expect 2-3 hours of homework weekly). *Tentative due dates for some homework and exams are set in a separately available course schedule; I reserve the right to modify topics and pacing to suit needs.*

**Grading and Evaluation:** Overview as above, details given below and in class as required.
Below is the guaranteed grading scale. I reserve the right to lower grade cutoffs but will not raise them.
 ≥ 90% A ≥ 80% B ≥ 70% C ≥ 60% D

**Reflective Writing via Reading Logs (25% of grade):** A conscientiously completed one page (two faces) Reading Log for each chapter on the provided paper form is due roughly weekly. Expect to spend at least 2 hours per chapter reading the chapters. READ AHEAD! Blank forms and examples will be provided via download. You are expected to do these the old fashioned way with pencil or ink on paper, then scan or photograph and submit them via a drop folder on Blackboard. Reading Logs are ordinarily due before midnight on the Tuesday before class, as indicated on the schedule. You will actually image and .pdf your work, and upload the .pdf to Blackboard (examples will be given).

**Homework (15% of grade):** roughly biweekly there will be homework due (plan on 2-3 hours/week). This will include about 5-10 conceptual and numeric questions, and may include brief online tutorials. **While you are strongly encouraged to communicate and work with others, homework is expected to represent your own individual efforts, thoughts and language.** Homework is ordinarily due before midnight on the Sunday of the week, indicated on Blackboard. You will actually photograph or scan your work, and upload the .pdf file to Blackboard (examples will be given). Late homework will not be accepted due to the restrictive nature of the online submission system, though homework will be made available in advance. Solutions will be posted on Blackboard, and used to construct midterm and final exams. There will also be one written midcourse evaluation given after the first exam that will be graded for completeness only and counted with the homework. Some conceptual and attitudinal assessments graded on completeness only may also be counted in this category.

**Exams (30% of grade):** there will be one midterm exam and one final exam. These will be take home, open-book and open-notes exams built from homework. Midterm exams are not deliberately cumulative, the final will be only partially cumulative. Exams will include 1-2 short problems you will present on 2-3 min Flip.com videos.

**Final Project and Presentation Video (30% of grade):** You will individually negotiate and then complete a project related to a course topic of your choice, and present that via Skype. This project will include an appropriate artifact with a video report presenting a constructed device, or documenting an experiment, or producing software simulation code. You will make a 10 minute presentation upon your project to your peers during the final weeks of class. You will also submit a brief 5-10 page double spaced word processed reflective report submitted both on paper and as an electronic attachment at the end of the course reflecting on your project and including at least five appropriate scholarly references. You must use reviewed literature (journals) and can also use the web as references. More details will be forthcoming, and previous course examples are found on the instructor’s YouTube channel, ***danmacvids***.

**Statement On Plagiarism And Cheating:** Anyone caught cheating, verbatim copying or presenting the intellectual work of another (including quotations, images and music) without appropriate fair use attribution and citation may receive a failing grade in the course, and/or a recommendation to leave a teacher preparation program if applicable. Solo effort is particularly expected for the take home exams. Working with other people on homework and project activities is not considered cheating, and is in fact encouraged, though your submitted work must reflect your own choice of words and interpretation.

**Official SUNY Course Description Particulars (SLOs and Content):**

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| **Student Learning Outcomes** |
| 1. Students will be able to describe and analyze issues and science related to energy production and use.
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| 1. Students will be able to conduct literature searches, evaluate literature sources and cite sources in a format consistent with a peer reviewed journal.
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| 1. Students will able to apply course content to solve qualitative and quantitative problems.
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| 1. Students will be able to measure the power output and efficiency of energy conversion devices (e.g. batteries, motors).
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| 1. Students will be able to make and evaluate scientific presentations.
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| **Course Content:** I.   Overview: Availability and Nature of Fossil and Other Fuels II.   Basic Physics and Chemistry behind Energy Transformations 1. Mechanical energy in gravity, kinetic energy and work
2. Electrical energy in batteries, simple electrical circuits and electrical current
3. Chemical energy in fossil fuel
4. Ideal gas laws for pressure and temperature of a gas
5. Electrical energy generation by using the Faraday effect

III. Sources for Energy 1. Energy from wind and turbines
2. Thermal energy from heat engines, Carnot engines, thermometers, thermal energy dependence, heat flow and the First and Second law of Thermodynamics, pressure and temperature of an ideal gas, work
3. Fuel cells
4. Solar cells
5. Nuclear Reactors and E = mc2
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