

**EE40448 Electrical Energy Extraction**  
Syllabus

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**Prerequisites:** Phys 20330 or equivalent

**Credit Hours:** 3

**Time/Location:** MWF 12:50 – 1:40 pm, DeBartolo Room 306

**Description:** This course will teach the physics and engineering of energy conversion devices with a focus on devices that convert energy from renewable energy sources. Special consideration will be given to ways to recycle energy now wasted in the form of heat, vibrations, electromagnetic radiation, or available from biological activity. Four primary classes of conversion devices will be considered: electromagnetic generators, solar cells, and thermoelectric devices. The laws of electromagnetism and the physics of solids will be applied to energy conversion devices with particular attention to the factors that determine conversion efficiency. Charge storage and energy conversion circuits will also be covered.

**Course Content:**

- |                                |                                 |
|--------------------------------|---------------------------------|
| 1. Introduction                | 5. Inverters                    |
| 2. Generators                  | DC to AC and AC to DC           |
| Physics to efficiency          | Efficiency                      |
| Hydroelectric, wind, wave, etc | 6. Thermoelectrics              |
| 3. Solar Cells                 | Physics to efficiency           |
| Physics to efficiency          | Converters approaches           |
| Converter approaches           | 7. Piezoelectrics               |
| 4. Energy storage              | 8. Biological energy extraction |
| Batteries                      | 9. Student Presentations        |

**Homework:** Discussion of problems with other students is encouraged, but solutions must be your own. Homework is due at the beginning of class – no late homework.

**Presentation:** Students will select and present a paper on an energy conversion technology

**Concourse:** Log into concourse for homework assignments, solutions, grades, and readings not held on library reserve.

**Readings:** <https://www.library.nd.edu/reserves/ereserves/>

**Grading:** Homework (10%), Midterm exam (30% each), Presentation (30%), Final Exam (30%).

**Office Hours:** By appointment through Heidi Deethardt, [hdeethar@nd.edu](mailto:hdeethar@nd.edu) or 631-0279, or stop by my office as needed, Fitzpatrick 230A.

**Objectives:** Students will develop a quantitative understanding of: (1) the energy density of renewable sources, (2) the physics of energy conversion devices including generators (hydroelectric, wind, wave, steam, and biodriven), solar cells, thermoelectrics, and piezoelectrics, (3) energy storage devices (capacitors and batteries), DC-to-AC and AC-to-DC conversion, and (4) principles underlying energy-efficient design and energy recycling.