

NUCL 563
Direct Energy Conversion

Spring, 2018

8 January 2018

Course Objectives: Review energy sources and study the basic processes of direct energy conversion and their applications to energy utilization, based on both conventional and nuclear energy conversion schemes. Conventional schemes include thermoelectric, photovoltaic, thermionic, magneto-hydrodynamic (MHD) generators, fuel cell systems, etc.; and nuclear energy conversion schemes corresponds to nuclear radiation and fusion energy conversions.

Prerequisites: Thermodynamics, fluid mechanics, electromagnetism, and modern physics.

Course Syllabus:

1. Reviews of energy sources and direct energy conversion
2. Uses of energy storage
3. Physical principles (thermodynamics, quantum mechanics, solid state physics, and plasma physics as needed)
4. Thermoelectric generators
5. Photovoltaic generators
6. Thermionic generators
7. Magneto-hydrodynamic (MHD) power generator
8. Fuel cell
9. Nuclear energy conversion (radiation and fusion energy conversion)
10. Other direct energy conversion schemes, e.g., electrohydrodynamic (EHD) power generator, piezoelectric power generator, ferroelectric and ferromagnetic power generators, etc.

Textbooks: R. Decher, *Direct Energy Conversion*, Oxford Univ. Press (1997).
S. Angrist, *Direct Energy Conversion*, 4/ed., Allyn & Bacon (1982).

References:

1. M. El-Wakil, *Nuclear Energy Conversion*, American Nuclear Society (1982).
2. G. H. Miley, *Fusion Energy Conversion*, American Nuclear Society (1976).
3. G. H. Miley, *Direct Conversion of Nuclear Radiation Energy*, American Nucl. Soc. (1970).
4. F. Chen, *An Indispensable Truth: How Fusion Power Can Save the Planet*, Springer (2011).
5. M. Prelas, et al., *Nuclear Batteries and Radioisotopes*, Springer Nature/Science (2016).

Instructor: Prof. Chan K. Choi, choi@purdue.edu
Office hours: MWF 2:30 –3:20 PM @NUCL 112B, or by Appointment

Course Grading: Attendance = 10%; homework = 50%; project report and presentation = 40%
 $85\% \leq A \leq 100\%$, $70\% \leq B < 85\%$, $55\% \leq C < 70\%$, $40\% \leq D < 55\%$,
and not passing below 40%; unexcused absences over 2 weeks = not passing.

Emergency Preparedness –A Message from Purdue:

To report an emergency, **call 911**. To obtain updates regarding an ongoing emergency, sign up for Purdue Alert text messages, www.purdue.edu/ea.

There are nearly 300 **Emergency Telephones** outdoors across campus and in parking garages that connect directly to the PUPD. If you feel threatened or need help, push the button and you will be connected immediately.

If you hear a **fire alarm** during class, we will immediately suspend the class, evacuate the building, and proceed outdoors. Do not use the elevator.

If we are notified during class of a **Shelter in Place requirement for a tornado** warning, we will suspend the class and shelter in [the basement].

If we are notified during class of a **Shelter in Place requirement for a hazardous materials release, or a civil disturbance**, including a shooting or other use of weapons, we will suspend the class and shelter in the classroom, shutting the door and turning off the lights.

Please review the Emergency Preparedness website for additional information. http://www.purdue.edu/epps/emergency_preparedness/index.html.

Campus Emergency: In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. Information about the changes in this course in such emergencies would be obtainable from the course instructor and/or the university provost office.

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