

Millersville University
Department of Applied Engineering, Safety & Technology

AENG 120 ENERGY & POWER SYSTEMS
3 s.h.

Dr. John Wright
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Rm 111, Osburn Hall

Spring 2023 Office Hours:
Monday 1-3pm
Tuesday 1-3pm
Wednesday 1-3pm

Course Meeting Location/Times:
Rm 119/122/123
Monday/Wednesday 10am-12:05pm

CATALOG DESCRIPTION

An introduction to energy and power systems. Principles of conventional and alternative energy resources and energy conservation, and electrical, fluid & mechanical power will be studied along with environmental concerns associated with power production. 2 hours lecture, 3 hours lab.

<u>COURSE OBJECTIVES</u>	<u>ASSESSMENTS</u>			<u>PROGRAM OUTCOMES</u>
<i>Upon successful course completion, students will be able to:</i>	<i>Students' achievement of course objectives will be assessed based on the following*:</i>			<i>Program learning competencies for the AET(M), ARET, & MFET programs:</i>
	LA	EX	HW	
1. Identify advantages and disadvantages of at least ten conventional or alternative energy sources.		x		A. Disciplinary Knowledge An ability to select and apply the knowledge, techniques, skills , and modern tools of the discipline to broadly defined applied engineering activities.
2. Explain how various devices convert energy into power.		x		
3. Describe the impacts that various energy and power systems have on the environment.		x		
4. Accurately measure and calculate the effort, rate, opposition, power, and horsepower of mechanical, fluid, and electrical power systems using appropriate instruments and formulas.	x	x		
5. Test and evaluate the operating efficiency of energy and power converters.	x	x		
6. Describe conceptual similarities within mechanical, fluid, and electrical power systems.	x	x		
7. Utilize written technical specifications and procedures, precision measurement, and analytical skill to disassemble, evaluate and reassemble a small power converter so that it meets all manufacturer's specifications.	x	x		
8. Describe the interaction of technological, economic, social, environmental and political factors on the development and use of energy and power systems.	x	x		

7. Design, construct, program, and evaluate mechanical systems utilizing simple machines.	x	x	B. Design An ability to design systems, components, or processes for broadly defined applied engineering problems appropriate to program educational objectives.	
8. Design, construct, and evaluate electrical power circuits/systems.	x	x		
9. Design, construct, and evaluate fluid systems including electrical control.	x	x		
10. Design, construct, and evaluate a computer control system.	x	x		
12. Accurately conduct a comprehensive residential energy audit including calculation of payback period as a cost/benefit analysis.			x	E. Written Communication An ability to apply written communication in both technical and non-technical environments.

* LA = Lab Experiment/Design Challenge; EX = Exam; HW = Homework/Papers.

CONTENT OUTLINE

I. Energy

A. Forms of Energy

1. Radiant
2. Chemical
3. Thermal
4. Mechanical
5. Electrical
6. Nuclear

B. Energy Conversion

1. First law of thermodynamics
2. Second law of thermodynamics
3. Efficiency

C. Energy Production and Methods

1. Renewable
 - a. Solar
 - b. Wind
 - c. Hydro
 - d. OTEC
 - e. Geothermal
2. Nonrenewable
 - a. Coal
 - b. Oil
 - c. Natural Gas
 - d. Nuclear
3. Other
 - a. Wood
 - b. Hydrogen
 - c. Biomass
4. Doubling time
5. Supply and demand
6. Energy units
 - a. Btu
 - b. Quad
 - c. Therm
 - d. Heating unit
 - e. Barrel
 - f. CCF
 - g. Cord
7. Environmental impacts
8. Energy conservation

- II. Power
 - A. Types of power
 - 1. Electrical
 - 2. Fluid
 - a. Pneumatic
 - b. Hydraulic
 - 3. Mechanical
 - a. Linear
 - b. Rotary
 - B. Measurements and Characteristics of Power
 - 1. Effort
 - a. Voltage
 - b. Pressure
 - c. Force
 - 2. Rate
 - a. Amperage
 - b. Flow/time
 - c. Distance/time
 - 3. Opposition
 - a. Resistance
 - b. Turbulence
 - c. Friction
 - 4. Power
 - a. Wattage
 - b. Torque
 - c. Horsepower
 - 5. Instrumentation
 - a. Voltmeters
 - b. Ammeters
 - c. Ohmmeters
 - d. Wattmeters
 - e. Pressure gauges
 - f. Flowmeters
 - C. Control of Power
 - 1. Theorems and laws
 - a. Ohm's law
 - b. Watt's law
 - c. Kirchoff's law
 - d. Pascal's law
 - e. Boyle's law
 - f. Charles's law
 - g. Bernoullis' theorem
 - h. Newton's laws
 - 2. Other
 - a. Work
 - b. Efficiency
 - c. Torque
 - d. Horsepower
 - e. Mechanical advantage
 - f. Torque multiplication
 - D. Programming / Robotic Control
 - a. Microcontrollers
 - b. Mobile Robots
 - c. High-Level Language Introduction
 - d. Flowcharting
 - e. Real-time Inputs/Outputs

TEXT AND REQUIRED MATERIALS

Litowitz, L. & Brown, R. (2012). *Energy, Power, and Transportation Technology*. Tinley Park, IL: Goodheart-Willcox.

Litowitz, L. *Energy & Power Technology Coursepack*. Akademos.

A standard calculator

ANSI-approved eye protection

COURSE REQUIREMENTS

Students are expected to participate in or complete the following activities:

1. Obtain the specified text.
2. Participate in class discussions.
3. Complete and submit all required exams, experiments and assignments
4. Participate in all assigned clean-up activities at the end of each class session and the close of the semester.
5. Regularly attend all lecture and laboratory sessions in their entirety. An attendance record will be maintained by the instructor during both lecture and laboratory segments. The attendance policy adopted by the Department of Applied Engineering, Safety & Technology will be in effect; unauthorized absences exceeding the number permitted in the departmental policy (3) will result in removal from the course, and a grade of "F" will be assigned. A copy of the departmental policy concerning attendance is posted on the bulletin boards in both the laboratory and the lecture room. Attendance will be a factor in "letters of recommendation" requested by the student from the course instructor.

EVALUATION

Exams* (2 @ 20% each)	40%
Laboratory Exercises (8 @ 5% each)	40%
Energy Audit Team Assignment	20%
	100%

Lab 1 Solar & Wind (Activities 1-3)
Lab 2 Infiltration & Thermographic Imaging (Activities 4-5)
Lab 3 DC Electronic Circuits (Activities 7-8)
Lab 4 Control Logic (Activity 9)
Lab 5 AC Electrical Circuits (Activities 11-12)
Lab 6 Mechanical Advantage (Activities 18-19 & 13)
Lab 7 Fluid Power (Activities 20-21)
Lab 8 Programming & Robotics

*Each student is allowed to use a single page (8.5"x11") hand-written reference sheet. This sheet must be unique and original to the student – it may not be copied or reduced (size) with a copier. Reference sheets will be inspected by the instructor prior to taking the quiz.

Scale:

93 - 100	A	80 – 82.9	B-	67 – 69.9	D+
90 – 92.9	A-	77 – 79.9	C+	63 – 66.9	D
87 – 89.9	B+	73 – 76.9	C	60 – 62.9	D-
83 – 86.9	B	70 – 72.9	C-	below 60	F

Should the end-of-semester mean score for the class fall below 75%, each student will receive a curve to fit the mean of 75%.

Grades will not be based upon criteria such as need, appearance, race, age, sex, or social status. Once determined, grades will not be changed except in the case of clerical errors that cause the student's true level of ability to be underestimated. Course grades may only be determined by the instructor of record.

NOTES

The instructor reserves the right to alter this syllabus as required.

Late work (less than 1 week) will be subject to a 25% reduction in the student's earned grade. All work submitted more than 1 week late will not be accepted and will result in a zero for the assignment.

Cell phones, PCs, and any type data storage devices or devices with cameras are **not** allowed for use on examinations.

SAFETY PROCEDURES

- ANSI-approved eye protection shall be worn by all individuals in the laboratory whenever lab activity is in progress.
- No smoking is permitted in the laboratory area or throughout the building.
- Loose or dangling attire shall not be worn while working in the laboratory.
- Individuals shall not operate equipment unless they have been authorized by the instructor to do so.
- Tools and equipment shall not be removed from the laboratory.
- Flammable liquids are to be located in a specified area.

- G. Rags which contain flammable substances will be disposed of in the proper container.
- H. Be familiar with the location of all fire extinguishers, power disconnect buttons, and other safety equipment contained within the power laboratory.
- I. ALL accidents must be reported to the instructor immediately.

STUDENTS WITH SPECIAL NEEDS

if you have a disability that requires accommodations under the Americans with Disabilities Act, please present your letter of accommodations and meet with me as soon as possible so that I can support your success in an informed manner. Accommodations cannot be granted retroactively. If you would like to know more about the Millersville University Office of Learning Services-please contact the office at 717-871-5554) ADA Program (Office of Learning Services) <https://www.millersville.edu/hr/ada/index.php>

OTHER MILLERSVILLE UNIVERSITY POLICIES AND LINKS

Academic Honesty Policy link:

<https://www.millersville.edu/about/administration/policies/pdf/academics/academic-policyacademic-honesty-and-dishonesty.pdf> ; for additional information please see the following:
<https://www.millersville.edu/cae/teaching-and-learning/academic-integrity.php>

Attendance Policy link: <https://www.millersville.edu/registrar/faculty/attendance-policy.php>

Inclusion Statement: <https://www.millersville.edu/dsj/inclusionstatement/>

Land Acknowledgement: <https://www.millersville.edu/dsj/land-acknowledgement/index.php>

Policy on Delays and Cancellations link: <https://www.millersville.edu/delays.php>

Preferred Name FAQs link: <https://www.millersville.edu/dsj/inclusionstatement/preferredname-faqs.php>

Privacy Rights under FERPA link: <https://www.millersville.edu/registrar/ferpaforstudents.php>

Student Conduct and Community Standards Handbook link:

<https://www.millersville.edu/studentconduct/files/studentcodeofconduct.pdf>

Title IX Reporting Requirements and the Faculty member: Millersville University is committed to maintaining a safe education environment for all students. In compliance with Title IX of the Education Amendments of 1972 and guidance from the Office for Civil Rights, the University requires faculty members to report incidents of sexual violence shared by students to the University's Title IX Coordinator. The only exceptions to the faculty member's reporting obligation are when incidents of sexual violence are communicated by a student during a classroom discussion, in a writing assignment for a class, or as part of a University-approved research project. Faculty members are obligated to report sexual violence or any other abuse of a student who was, or is, a child (under 18 years of age) when the abuse allegedly occurred to the person. Information about Title IX, resources and reporting can be found at:
<https://www.millersville.edu/titleix/index.php>

ATTENDANCE

MILLERSVILLE UNIVERSITY ATTENDANCE POLICY

EFFECTIVE SPRING 2003

Approved by Faculty Senate 12/4/02; Administrative approval 1/10/03

The University supports departmental and faculty class attendance policies that are reflective of and consistent with University approved guidelines. Faculty will include their class attendance policy in their syllabi given to all students in their classes at the start of the semester.

University approved guidelines:

1. **Students are expected to attend all classes.** It is the student's responsibility to complete all course requirements even if a class is missed. If a student misses class for an officially excused reason, then he/she is entitled to make up the missed work but only at the convenience of the faculty member. Responsibility for materials presented in, assignments made for, and tests/quizzes given in regularly scheduled classes lies solely with the student.
2. **The University policy is that faculty will excuse absences for the following reasons:**
 - a. personal illness,
 - b. death or critical illness in the family,
 - c. participation in a university-sponsored activity,
 - d. jury duty,
 - e. military duties, or
 - f. religious holidays
3. **Faculty judge the validity of student absences from class within the University's approved guidelines and may require documentation for excused absences.** Faculty will evaluate any reason, other than those listed above, for a student missing class and determine whether the absence is justified. In these circumstances, a student may make up missed work at the discretion of the instructor.
4. **In the case of foreseeable absences, students are encouraged to notify the faculty member in advance.** A student who will miss class due to participation in an official University activity must notify the instructor well in advance of the activity to assure that the absence is excused.

Appeals:

As with any academic issue, students may exercise their right to appeal adverse attendance decisions. Please refer to the current undergraduate catalog for the complete Academic Appeal procedure.

**DEPARTMENT OF APPLIED ENGINEERING, SAFETY & TECHNOLOGY ATTENDANCE POLICY
Adopted May 4, 1998**

Students are expected to attend all scheduled classes in accordance with the above policy. To the extent that this does not happen, the following shall apply:

1. The limit of unauthorized absences depends upon the number of scheduled days per week as follows:
 - Fall and spring semesters
 - three per semester for a course scheduled three days per week
 - two per semester for a course scheduled one or two days per week
 - Winter and summer sessions
 - two per session
2. Each late arrival and early departure will count as one-half of an unauthorized absence.
3. Participation in outside-of-the-classroom educational activities and intercollegiate contests shall be communicated to the instructor prior to the absence. Failure to do so will convert these authorized absences to "unauthorized absences."
4. Students whose "unauthorized" absences exceed the policy stated in item #1 are liable to dismissal from the course with a grade of 'F' or 'Z.'

Web References

Alternative Energy Institute: www.altenergy.org
Electric Power & Utilities: www.eia.doe.gov/fuelelectric.html
Energy Information Administration: www.eia.doe.gov
Energy Star Homepage: www.energystar.gov
Home Energy: www.homeenergy.org
Home Energy Saver: <https://hes.lbl.gov/consumer/>
International Institute for Energy Conservation: www.iiec.org
Mechanisms & Movement: www.flying-pig.co.uk/mechanisms
Power Technology: www.power-technology.com
Solar Energy: www.eere.energy.gov/re/solar.html
Solar Energy: www.fsec.ucf.edu
Transportation: www.transportation.com
United States Department of Energy: www.energy.gov

AENG 120 Tentative Spring 2023 Schedule
Ver. A
Wright

Week of	M/W 10:00am-12:05pm
1 1/16	Monday: No Class - Holiday Course Introduction Safety Review
2 1/23	Intro to Energy Lecture Fossil Fuels Lecture
3 1/30	Renewable Energy Lecture Solar Energy Lecture
4 2/6	<i>Lab 1 Solar & Wind</i>
5 2/13	Monday: Lab 1 Due Nuclear Energy Lecture Energy Conservation Lecture
6 2/20	<i>Lab 2 Infiltration & Thermographic Imaging</i>
7 2/27	Monday: Lab 2 Due Wednesday: Exam I
8 3/6	No Class – Spring Break Residential Energy Audit Assigned
9 3/13	Intro to Electronic/Electrical Power Lecture <i>Lab 3 DC Electronic Circuits</i>
10 3/20	Monday: Residential Energy Audit is Due <i>Lab 4 Control Logic</i> Wednesday: Lab 3 Due
11 3/27	<i>Lab 5 AC Electrical Circuits</i>
12 4/3	Mechanical Advantage & Efficiency Lecture <i>Lab 6 Mechanical Advantage</i>
13 4/10	Intro to Fluidics Lecture <i>Lab 7 Fluid Power</i>
14 4/17	Intro to Programming & Robotics Lecture <i>Lab 8 Mobile Robots</i> Wednesday: Lab 4-7 Due
15 4/24	<i>Lab 8 Mobile Robots</i> Wednesday: Lab 8 Due
Finals Week	Thursday 5/4 8-10:00am: Exam II