



CE 437 – Sec: 001

Engineering Materials for Sustainability

The Pennsylvania State University
Department of Civil and Environmental Engineering
Fall 2014

Hours

Lecture	TR	9:45-11am	203 Sackett
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Instructor

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Office Hours: F 2-4pm

Textbooks

M.F. Ashby (2012) “Materials and the Environment: Eco-Informed Material Choice”, 2nd Ed., Elsevier, Burlington, MA (available online at PSU library)

M.F. Ashby (2011) “Materials Selection in Mechanical Design”, 4th Ed., Elsevier, Burlington, MA (available online at PSU library)

Course Objectives

Our industrialized world is producing materials in tens of billions of tons. Much of these materials are used in construction (with concrete being the dominant man-made material). Material production is resource/energy intensive and has negative eco-impacts (e.g., CO₂, waste production). As engineers, we are responsible to design, build, and maintain structures that are not only safe, but also energy efficient, environmentally benign, and economically viable over their entire life-cycle. This course introduces students to simple scientific techniques for optimum design of materials to improve their performance while minimize their cost and environmental impact. These principles are further expanded to infrastructure maintenance and asset management.

By the end of semester, students will be able to predict criticality/exhaustion of a resource (e.g., crude oil), identify different phases in the life of a structure or product, perform life-cycle cost and environmental assessments for a product, element, or simplified infrastructure system, calculate material indices and select the best materials (with optimum mechanical, durability, and eco-performance) for a project, design efficient cross sections for structural members, and explain various techniques for designing green concrete materials. The course is developed to emphasize active learning through interactive classroom discussions, as well as computer and laboratory exercises.

Prerequisites: “CE 336 – Materials Science for CE” or equivalent

Class Attendance

Students are encouraged to attend all classes to make sure they learn the most from this course and will perform well on assignments and exams. **Exception:** If you are not feeling well, I ask that you do not attend class to safeguard the health of your classmates. No doctor's note is required; however, if there is homework due on the day of your absence, you are still required to submit the homework by email or through a classmate.

Exam Attendance

There will be two exams in this course. A mid-term exam will be given during class on **10/14/14**, and a final exam will be given on during finals week. Exam attendance is required and **THERE WILL BE NO MAKE UP EXAMS**. If you feel flu-like symptoms or other illness before an exam day, I ask that you inform me at least 24 hours in advance. I will make proper arrangements for you to take the exam in quarantine at the same date and time as other students.

If you are absent during an exam, you will receive a score of "zero" for the exam; unless your absence was related to a substantive personal or family health emergency. The dates of the exams are indicated on the syllabus. Therefore, all travel plans associated within or outside the university functions shall be made with this policy in mind. **Any student missing an exam due to a substantive personal or family health emergency shall provide a written letter from a physician or a recognized individual authenticating the seriousness of the emergency** and how it led to the student's absence from the exam. The letter should state the specific reason for the absence and the date and duration of the incident. The letter shall include the name, title, relationship to the student, address, and telephone number of the letter's author. In such case, the instructor reserves the right to accept or decline the excuse.

Quizzes

There will be a number of quizzes during the semester. Most quizzes will be announced in advance but there may be few unannounced quizzes. If you miss a quiz due to an excused absence, you will be given a chance to take the quiz at a later date.

Grading

Exams (2 exams)	60%
Homeworks	20%
Presentations	14%
Quizzes	6%
Participation	Ext. 5%

The course is **NOT** graded on a CURVE. Final letter grades are assigned based on the total number of percentage points accumulated as follows:

93 – 100	A	76 – 79	C+
89 – 93	A-	69 – 76	C
86 – 89	B+	60 – 69	D
83 – 86	B	below 60	F
79 – 83	B-		

You are welcome to discuss any grade with me. You should submit a WRITTEN request for grade review within 2 days after the graded homework or exam is returned.

Homeworks

There will be 5 or 6 homework assignments in this course. Homework is due at the beginning of each class (e.g., 9:45am on the due date). No late submissions will be accepted; however, in extreme circumstances, the instructor may consider a late submission and assign a penalty for not meeting the due date/time. Homework solutions will be made available on ANGEL Course Management system within few days of the due date.

All homeworks should be submitted in a format that is consistent with professional engineering practice. Solutions must be prepared using word processing software (e.g., MS Word, LaTeX) or legibly hand written on either plain (i.e., unlined paper) or engineering paper. Graphs should be prepared using Excel, Grapher, SigmaPlot, or similar software. No hand-drawn graph will be accepted. You can use both sides of paper to prepare homework solutions; however, each sheet/side of paper must not include more than one problem. Multiple short answer problems can be included on the same side of a paper provided that sufficient space is included between adjacent problems to avoid any confusion during grading. All sheets should contain your name and assignment number. All pages must be stapled together. The student will be responsible for missing pages if sheets are not stapled.

It is expected that the solution contain a clear description of the problem including what are the problem givens, nomenclature, and the unknowns. In addition, a sketch of the problem is needed as well as a free body diagram whenever applicable (use straight-edges in making these diagrams). The solution is to be worked in an organized manner with relevant calculations and notes as appropriate. The answer is to be placed in a box or underlined at the end of the problem containing units. The details of your calculations must be shown for all problems that involve calculations. A result may be graded as completely wrong if given without supporting calculations. Any numerical result or answer that requires a unit is incorrect, and will be counted as such, if that unit is omitted or given incorrectly. Example: 50 is not the same as 50 mph or 50 km/hr. You are expected to understand the concept of significant figures and to use the proper number of significant figures in the final statement of your results. These rules are also applied to the exams sheets.

Failure to follow these guidelines may result in loss of credit regardless of the correctness of your answers. Students are expected, even encouraged, to consult with one another on homework assignments. However, all work submitted by the student is expected to be his/her own effort. If there is a reason to believe that work has been copied from another student, university regulations may be invoked regarding punitive action. Furthermore, the instructor reserves the right to assign a failing grade for either the specific work or for the entire course.

Exams

Exams will be open book/notes. Calculators are permitted during exams. However, grading will be based solely on the information shown on the exam sheet. For this reason, all necessary steps, figures, and calculations are to be shown in order to obtain credit. All work that you submit must be strictly your own. If there is reason to believe that work has been copied or done in collaboration with another student, university regulations may be invoked regarding punitive action. Instances of cheating during exams will result in full loss of credit for that exam. Additional measures including the immediate failure of the course may be applied at the discretion of the instructor and/or university staff.

Academic Integrity

The University defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. All students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts (refer to [Senate Policy 49-20](#)). Dishonesty of any kind will not be tolerated in this course. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the University's Office of Student Conduct for possible further disciplinary sanctions (refer to [Senate Policy G-9](#)).

Disability-related Needs

Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Office for Disability Services (ODS) Web site provides contact information for every Penn State campus: <http://equity.psu.edu/ods/dcl>. For further information, please visit the Office for Disability Services Web site: <http://equity.psu.edu/ods>.

In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: <http://equity.psu.edu/ods/doc-guidelines>. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Tentative Schedule

	Date	Lecture Number	Day	Lecture Title	Ashby Green Book	Ashby Online Book	Handouts
Week 1:	8/26/14	1	T	Materials, Infrastructure and Sustainability	Ch. 1		√
	8/28/14	2	R	Economic Growth	Ch. 2		√
Week 2:	9/2/14	3	T	Reserves and Exhaustion Time	Ch. 2		√
	9/4/14	4	R	End of Life Options	Ch. 4		√
Week 3:	9/9/14	5	T	Life Cycle Assessment - Basics	Ch. 3		√
	9/11/14	6	R	Life Cycle Assessment - Basics	Ch. 3		√
Week 4:	9/16/14	7	T	Ecodata of Materials	Ch. 6		√
	9/18/14	8	R	Ecodata of Materials	Ch. 6		√
Week 5:	9/23/14	9	T	Eco-audits 1	Ch. 7		√
	9/25/14	10	R	Eco-audits 2	Ch. 7		√
Week 6:	9/30/14	11	T	Life Cycle Cost and Economic Analysis			√
	10/2/14	12	R	Eco-audits: Case Studies (student pres)	Ch. 7		√
Week 7:	10/7/14	13	T	Life Cycle Cost and Economic Analysis			√
	10/9/14	14	R	Review and exam prep			√
Week 8:	10/14/14	15	T	Midterm Exam			
	10/18/12	16	R	LCC of Civil Infrastructure			√
Week 9:	10/21/14	17	T	LCC of Civil Infrastructure			√
	10/23/14	18	R	Eco-selection of Materials	Ch. 8	Ch. 4	√
Week 10:	10/28/14	19	T	Review Solid Mechanics			√
	10/30/14	20	R	Material Indices 1	Ch. 8	Ch. 4	√
Week 11:	11/4/14	21	T	Material Indices 2	Ch. 9	Ch. 5	√
	11/6/14	22	R	Design of Efficient Shapes		Ch. 11, 12	√
Week 12:	11/11/14	23	T	Design of Efficient Shapes		Ch. 11, 12	√
	11/13/14	24	R	Design of Efficient Shapes		Ch. 11, 12	√
Week 13:	11/18/14	25	T	Intro to Composites			√
	11/20/14	26	R	Micro-Mechanics			√
Week 14:	11/25/14		T	Thanksgiving Break			√
	11/27/14		R	Thanksgiving Break			√
Week 15:	12/2/14	27	T	Recycled Concrete			√
	12/4/14	28	R	Non-Portland Cement Concretes			√
Week 16:	12/9/14	29	T	Sustainable Civil Infrastructure (student pres)			√
	12/11/14	30	R	Sustainable Civil Infrastructure (student pres)			√
Week 17:	Final Exam: During the exam week Dec 15-19						