Syllabus

ARCH 3231
Environmental Systems I
Spring 2012

Course Info.
3 credit hour lecture
T/Tr, 9:35a – 10:55a
Management (Tech Sq.) 300

Instructors
Jason Brown
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Office Hours: M/W 10a–noon and by appointment

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Office Hours: Th 11a–noon; F 10a–noon

Required text
Grondzik, et al., **Mechanical and Electrical Equipment for Buildings**, 11th ed. (2010), J. Wiley, Hoboken, NJ

Supplemental texts
Steven V. Szokolay, **Introduction to Architectural Science: The Basis of Sustainable Design**, 2nd ed. (2008), Architectural Press/Elsevier, Burlington, MA

Supplementary handouts will also be provided.

Overview, and Outcomes
This course is the first of a two-term sequence in environmental systems and constitutes part of the core curriculum in architecture. ARCH 3231 focuses on basic physical interactions between buildings, their surroundings, and occupants. Specifically: three key types of energy flows in buildings, their impact on building occupants, and their influence on design decisions. Toward that end, the following topics will be discussed:

I. **(Natural) light**
   i. Physics of light
   ii. Natural illumination (daylighting and some solar geometry)
II. **Acoustics in buildings**
III. **Heat**
   i. Basic thermodynamics and heat transfer
   ii. Psychrometrics and thermal comfort
   iii. Solar geometry and the control of direct solar radiation through shading devices
   iv. Load calculation
   v. A few special topics

Overview, and Outcomes

The learning outcomes of this course are:

1. **Develop the ability to reason through, model, and analyze a technical problem**
   We will investigate the fundamental laws and models describing the aforementioned topics/physical processes, and most importantly, what these laws and models *mean*. Using the knowledge and comprehension thus acquired, we will apply these models to particular situations. In some cases these basic, fundamental models will need to be adapted and/or combined to form an appropriate and useful model; this new model may be simpler or more complex. This modeling activity is distinctly different from the sort of modeling done in the architectural studio, but both are ultimately done in the service of design – although one is technical design and the other is 'Design', they can, and should, be complimentary.
2. **Apply models to interrogate the effects of physical processes on basic design parameters**
   The *use* of these models will allow you to make more informed design decisions regarding technical matters.
3. **The formation and use of a systems level model or view**
   The individual topics of this class do not exist in silos, isolated from one another. They are interrelated in several ways and impact not only each other, but also impact multiple facets of a building design. These interrelations are made explicit in the models. They may lead to conflict among the objectives of a design, or lead to a complimentary relationship among objectives. The ability to comprehend and manage these interrelations at the whole system level, i.e. make design tradeoffs, is something that any designer of a real system will need.

In addition I hope that you will develop intuition and a tough, skeptical habit of mind. The world does not always operate the way we might expect, and misleading information abounds. A sense of context, the programming of your intuitive sense, and an innate resistance to being fooled will serve you both in design practice and all other walks of life.

To achieve these outcomes, elementary mathematics will be used throughout the course, although math is not the object of the course. Math is a tool and a language to precisely develop and express concepts (i.e. to model), for making predictions about the outcomes of technical design decisions (i.e. to execute that model), and thereby to explore the space of possible technical design solutions.

Course Requirements, Evaluation, and Policies

Students will be evaluated on the basis of quizzes, homework assignments, and exams:

i. pop quizzes - 10%
ii. $\leq$ 10 homeworks - 50%
iii. 2 exams - 40%

Quizzes - Are unannounced, are of an indeterminate number, and are primarily intended to keep you current, although they also evaluate basic knowledge and comprehension. At the end of the semester I will drop your lowest quiz.

Homework Homework is the venue to exercise/apply knowledge gained in class and through readings. You don't really know something until you do it, and homework is where you will first 'do'. Homework also advances you toward achieving the course's learning outcomes.

Exams The exams will emphasize both analytical competency and conceptual understanding which you will build up through your effort in the homework and through class discussion. Exams will be of open books/open notes format.

You will be graded based on the correctness of quantitative answers where appropriate, although partial credit will be given if your work demonstrates some understanding of the material. Quizzes can be a special case in which an answer is either right or wrong with nothing in between. Note that a quantitative answer with a correct numerical value but incorrect or missing unit will be counted as incorrect. Five dollars is not five cents.

Submissions and makeup policies Homework is to be turned in at the beginning of class on the day it is due. If turned in between the time I begin the lecture and the end of class, it will be docked 10%. If it is turned in later that same due day, it will be docked 50%. No submissions will be accepted after the due day unless you have prior approval from me (emergencies excepted). If you are going to be absent for the midterm for a good reason, I will arrange a time for you to make up the exam or (preferably) take it early.

Office hours See above, but do not hesitate to ask for help: it's my job.

Preliminary Schedule

Environmental Systems I
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Week	Day	Date	Topic	Book Reading	Assignment
1	T	1/10	Introduction		
	Tr	1/12	Light & vision	MEEB 11.1–11.12, IAS *2.1*	
2	T	1/17	Light & vision, daylighting	MEEB 11.15–11.29, 11.34–11.36, IAS *2.2, 2.3*	
	Tr	1/19	Daylighting	MEEB 12.1–12.6, Ch. 14 IAS *2.4*	
3	T	1/24	Daylighting		
	Tr	1/26	Daylighting, thermal intro.	IAS *1.2*	
4	T	2/31	Heat/thermodynamics – basics	MEEB Ch. 7, IAS *1.1.1, 1.1.2*	
	Tr	2/02	Basic thermo & heat transfer		
5	T	2/07	Basic thermo & heat transfer		
	Tr	2/09	Basic thermo & heat transfer		
6	T	2/14	Psychrometrics, thermal comfort	IAS *1.1.3, 1.2*	
	Tr	2/16	Psychrometrics, thermal comfort		
7	T	2/21	Midterm exam		
	Tr	2/23	Building thermal behavior	IAS *1.4 (Intro), 1.4.3, 1.4.4*	

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Week	Day	Date	Topic	Book Reading	Assignment
8	T	2/28	Midterm review		
	Tr	3/01	Building thermal behavior		
	F	3/02	*Drop Day*		
9	T	3/06	Building thermal behavior		
	Tr	3/08	Building thermal behavior	IAS *1.4.1.3*	
10	T	3/13	Building thermal behavior	IAS *1.5*	
	Tr	3/15	Building thermal behavior		
11			Spring Break		
12	T	3/27	Climate, solar geometry	MEEB 6.1–6.4, IAS *1.3.1*	
	Tr	3/29	Climate, solar geometry	MEEB 6.5–6.6, IAS *1.4.1.1*	
13	T	4/03	Shading		
	Tr	4/05	Shading		
14	T	4/10	Acoustics	MEEB Ch. 17, IAS *Ch. 3*	
	Tr	4/12	Acoustics	MEEB Ch. 18 19.1–19.13	
15	T	4/17	Acoustics		
	Tr	4/19	Recap		
16			Final Reviews: No Class		
	M	4/30	Finals		
	T	5/01	Finals		
17	W	5/02	Finals		
	Tr	5/03	**Final Exam: 8:00a – 10:50a**		
	F	5/04	Finals		