Arc461d/561d: Computer Energy Analysis
School of Architecture, CAPLA
The University of Arizona
Fall 2004

Prerequisites: Graduate standing and upper division undergraduate students

COURSE DESCRIPTION
A comprehensive course that teaches students about energy conservation and passive solar architecture, and up-to-date computer energy simulation techniques. The course promotes students learning through field investigation of existing buildings and/or new design projects.

Teaching Format: Three teaching modules with lectures, Computer laboratory sessions and field survey of buildings

INSTRUCTOR:
Dr. Nader Chalfoun, Ph.D.
Contact: School of Architecture Rm. 218, 621-6740, Arch. Annex II, 621-3755, e-mail: chalfoun@u.arizona.edu
Office Hours: Tuesday 11:00-12:00 Room 218.

COURSE OBJECTIVES
This course will enable the students to:
1. Understand the major environmental systems that emphasize energy conservation and passive solar techniques including explanation of human factors, climate/microclimate and building envelope.
2. Enable the students to acquire the necessary skills to conduct site survey techniques, the use of tools and site instruments, and data acquisition systems.
3. Enable the students to conduct computer energy simulation programs as tools to analyze the energy performance of existing residential and commercial buildings and/or new design projects.

NAAB PERFORMANCE CRITERIA:
The National Architectural Accrediting Board identifies 37 performance criteria it determines to "constitute the minimum requirements for meeting the demands of an internship leading to registration for practice". The criteria, which this course addresses, are indicated in the box at the upper right corner of page one of this syllabus. More information on accreditation and a list of the performance criteria can be found on NAAB’s web site at: http://www.naab.org.

COURSE TOPICS AND STRUCTURE
Lectures will be presented to deliver general knowledge, to explain concepts through slides and demonstrations and to give detailed explanations of specific issues. Attendance is mandatory and will be recorded.

Module I: Six major energy and solar fundamentals
- Lectures will provide basic knowledge, review and explanation of 6 major environmental fundamentals: 1) solar geometry and astronomical relationships, 2) solar radiation measurements and physics, 3) Human thermal comfort principles, indices and design, 4) climatic analysis and bioclimatic evaluation, 5) microclimate analysis and site planning and design, and 6) building envelope heat transfer, ventilation and mechanical systems.
- Laboratory sessions focused on calculation of sun angles, solar radiation, solar obstruction charts, daylighting simulation and modeling and thermal load calculations.

Module II: Computer simulation and site survey techniques
- Computer laboratory sessions that explain site survey methods and instrumentations while using up-to-date site survey forms.
- Site visits to survey existing buildings.

Module III: Computer parametric energy analysis and optimization
- Lecture and computer lab. Sessions that explains parametric analysis and cost effective optimizations. A final presentation by team students is given to home/building owners or design clients.

ASSIGNMENTS
- In class and take home skill development exercises and experiments that deal with the subject matter. Graduate students will be writing short essays on each development exercise. There will be assigned readings and writing of short reports.
- In laboratory computer exercises emphasizing performance prediction, optimization, cost analysis, final presentation and team’s final report. Graduate students teamed with undergraduates in the same group will present simple payback and lifecycle cost analysis on their respective projects.

READING
There is no single source book for this course except the class handouts and the computer software manuals. Reading assignments are chosen from different books representing a wide variety of attitudes and approaches to the subject matter (see list below). Assigned books will be placed on reserve in the Architecture Library. In-class notes are greatly recommended.

2. Climatic Design, Donald Watson TJ163.5.B84 W38
3. Design with Climate, Victor Olgyay NA2540 .044 C.3
5. Microclimate, the Biological Environment, Norman J. Rosenberg QH543 .R6 1983
13. At Home in the Sun, Norah Deakin and Linda Lindsey TH7414 D39 1979
14. CalPas3 Manual and Energy-10 Manual (see instructor)

**REQUIREMENTS**

Students must complete all skill development exercises and one mid-term report and one final presentation and final report. Graduate students will submit additional reports and simple payback and life cycle cost estimates.

**POLICIES**

**Attendance:**

Attendance is required. In class response cards will be collected as a record of attendance.

**Grading:**

Each module will be assessed separately and weighted as follows:

<table>
<thead>
<tr>
<th>Activity</th>
<th>% of final grade</th>
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<tbody>
<tr>
<td>Solar fundamentals skill development exercises (6)</td>
<td>18%</td>
</tr>
<tr>
<td>Conservation and passive solar simulation exercises (6)</td>
<td>18%</td>
</tr>
<tr>
<td>Mid-term (Basecase) Report</td>
<td>14%</td>
</tr>
<tr>
<td>Final Exam (Finalcase report 30% &amp; reviews 15%)</td>
<td>45%</td>
</tr>
<tr>
<td>Attendance</td>
<td>5%</td>
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</tbody>
</table>

Total 100%

Final grades will be based on the following:

<table>
<thead>
<tr>
<th>Grade</th>
<th>points</th>
</tr>
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<tbody>
<tr>
<td>A</td>
<td>90-100</td>
</tr>
<tr>
<td>B</td>
<td>80-89</td>
</tr>
<tr>
<td>C</td>
<td>70-79</td>
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<tr>
<td>D</td>
<td>60-69</td>
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<tr>
<td>F</td>
<td>59 or below</td>
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**Late Work**

Late work will not be accepted

**Incomplete Work**

Incomplete work will not be accepted without instructor’s prior approval and written agreement as to revised due dates and grading policy.

**Make up Exams**

No absences from the exam will be permitted except those of an extreme nature and then only if the instructor is notified BEFORE the scheduled exam. No special make-up exams will be given.

**STATEMENTS**

**Subject to Change**

With the exception of the grade and attendance policies, parts of this syllabus are subject to change with advance notice, as deemed appropriate by the instructor.

**Handicapped Accessibility**

Every effort will be made to accommodate students with diagnosed disabilities. Please contact the instructor to initiate a discussion about how we can best help you succeed in this class.

**Retention of Work**

The School of Architecture has the right to retain any student project whether it be for display, accreditation, documentation or any other educational or legal purpose.

**Required Supplies:**

1. Two 3-ring notebooks white with front cover insert and section dividers. One for keeping all handouts and exercises, and one for submission of final report.
2. Media storage materials such as zip disks, cds or others. A digital copy of your final report is required.
3. Scientific calculator
## HOUSE ENERGY DOCTOR AGENDA:

### Week 1
- **Thu** Aug 26
- Introduction to The Solar Program®, syllabus, calendar and the “House Energy Doctor®” program
- The Energy Problem: a computer presentation
- **Review of Six Major Fundamentals (2 weeks)**

### Week 2
- **Thu** Sep 02
- Fund I: Solar Geometry & Astronomical Relationships
- Fund II: Solar Radiation Measurements and Physics
- Fund III: Human Thermal Comfort Principles/Indices
- Fund IV: Climatic Analysis & Bioclimatic Evaluation
- Fund V: Microclimate Analysis & Site Design

### Week 3
- **Thu** Sep 09
- Fund VI: Building Envelope and Heat Transfer Principles
- Skill Development Exercise 1 (Review of all fundamentals)
- **Computer Energy Simulation (6 weeks)**

### Week 4
- **Thu** Sep 16 (Lab)
- Introduction to Code Compliance Requirements and tools
- Skill Development Exercise 2: Basecase compliance using MEC (in Lab)

### Week 5
- **Thu** Sep 23 (Lab)
- Introduction to Computer Energy Simulation “ENERGY10” (part 1)
- Skill Development Exercise 3: Lab: Input/output of the Basecase
- Home: Your Own Design

### Week 6
- **Thu** Sep 30 (Lab)
- Computer Energy Simulation “ENERGY10” strategies (part 2)
- Skill Development Exercise 4: Orientation, Roof reflectance, and roof insulation, Slab-edge insulation, bermed walls.
- **Sat** Oct 02 (Trip)
- Field trip to Phoenix: Green Building Expo + other important sites

### Week 7
- **Thu** Oct 07 (Lab)
- Computer Energy Simulation “ENERGY10” strategies (part 3)
- Skill Development Exercise 5: High-mass exterior walls, Dbl glazing, inside shutters, night insulation. (Start building ¼” models of own)

### Week 8
- **Thu** Oct 14 (Lab)
- Computer Energy Simulation “ENERGY10” strategies (part 4)
- Skill Development Exercise 6: Reflectors, trees shading, overhangs/fins. (make sure models are updated for shading)

### Week 9
- **Thu** Oct 21 (Heliodon)
- Testing efficiency of shading devices using the Heliodon sun simulator facility. Students use their own models

### Week 10
- **Thu** Oct 28
- Computer Energy Simulation “ENERGY10” strategies (part 5)
- Skill Development Exercise 7: Infiltration, Ventilation, and mechanical systems
- **Site Survey and Basecase Report (2 week)**

### Week 11
- **Thu** Nov 04
- Selection of test house(s), site survey forms and tools, video tape prepare for visit on weekend, basecase report explained
- **Sat** Nov 06 (Site)
- Site survey of selected building(s)

### Week 12
- **Thu** Nov 11
- Utility bills and code compliance investigation
- **Parametric Analysis & Final Report (3 weeks)**

### Week 13
- **Thu** Nov 18
- Submission of basecase report
- Final project development: Session 1: parametric analysis

### Week 14
- **Thu** Nov 25
- Thanksgiving: No classes 😊 😊

### Week 15
- **Thu** Dec 02
- Final project development: Session 2: Cost-effective analysis
- **Wed** Dec 08
- Last Day of Classes
- **Thu** Dec 09
- Dead Day
- **Thu** Dec 16
- Final Presentation

**NOTE:** All reading materials will be announced and/or distributed in class.