ARCH 4/591 Environmental Control Systems 1

Course: ARCH 491 [CRN 21217]; ARCH 591 [CRN 21308] 4 credit hours
One of two required ECS courses for architecture students

Instructors: Alison G. Kwok, Ph.D., AIA, LEED AP, CPHC, akwok@uoregon.edu
office hours: sign up on door, 100PA
Tom Hahn, RA, tomh@uoregon.edu; office hours by appointment

Lectures: Tuesdays and Thursdays: 12:00 – 1:20 pm, 177 Lawrence

Sections: Undergraduate and graduate discussion sections will be held separately but during concurrent time periods on various days and locations as noted below

GEs: Chelsey Effinger, Julia May, Nick McGuire
TAs: Aaryn Gray, Elliot Hogan, Yue-ching Leung, Bentley Rager, Kelly Schoenborn

Pilkington Sun Angle Calculator
Thermal Delight in Architecture (Heschong)
The Green Studio Handbook, 3rd edition, 2018
iClicker (from the UO Bookstore)

Suggested: HOBO Datalogger (Onset Computer: http://www.onsetcomp.com) just to geek out!

Prerequisites: None; course is open to non-majors

DISCUSSION SECTIONS
491: 21218 T 1400-1550 278 Lawrence  GE: Chelsey Effinger; TA: Aaryn Gray
591: 21309 T 1600-1750 279 Lawrence  GE: Nick McGuire
491: 21220 W 800-950 104 Pacific  GE: Chelsea Effinger; TA: Yue-Ching Leung
491: 21219 W 1100-1250 104 Pacific  GE: Julia May; TA: Bentley Rager
491: 21221 Th 1400-1550 104 Pacific  GE: Nick McGuire; TA: Kelly Schoenborn, Elliot Hogan
591: 21310 Th 1400-1550 278 Lawrence  GE: Julia May

Edith Green Wendell Wyatt Federal building, SERA Architects with Cutler Anderson Architects, Portland, OR

FINAL PROJECT PRESENTATION OR EXAM
Case Study due: Thursday, March 14, 5:00pm
Final Poster Presentation on Monday, March 18, 2019, 12:30–2:30 pm
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BACKGROUND
Scope: This course will focus on building design strategies that are generally described as climate control systems and will give foundational information for you to understand and apply at schematic design level. Passive (architectural) solutions will also be emphasized, yet active (mechanical/electrical) solutions will also be covered. Major topics surrounding the environmental design of buildings and communities with regard to energy use, conservation, thermal comfort, cognizant codes and standards, renewable energy, measurement and verification, and the tools needed to understand an ecological approach to design. The instructors of this course are enthusiastic, committed, and critical about the pedagogy of this course and have carefully choreographed your participation and learning that will prepare you to be the future stewards of the built environment. Our philosophy is: We believe that it is the professional, ethical, and moral responsibility of the architect to ensure the comfort, safety, and health of occupants of buildings she/he designs AND to design in a way that dramatically reduces or eliminates the use of fossil fuels on building design, construction, operation, and decommissioning.

Objectives: The systems discussed in this course play an important role in all types of buildings. They substantially affect building costs (both first and life-cycle costs), building performance, and occupant health, safety, comfort, and productivity. Ultimately, climate control performance may be a primary determinant of owner and occupant perceptions of building success. It is ethically imperative that every architect have a sufficient understanding of climate control systems to permit their proper implementation and integration into the building design process. Providing such a fundamental understanding is the main objective of this course.

Outcomes: This course intends to develop a basic understanding of building climate control systems that will permit you to actively participate in decision making regarding such systems during the design process and that will facilitate further study leading to the ability to design such systems.

With respect to climate control and mechanized circulation systems, students can expect to:
• be able to communicate with the client and other members of the design team through an understanding of basic terminology and measurement units,
• be able to make early design decisions regarding the appropriateness of various systems and design concepts through an understanding of system functions (what the systems can and cannot do),
• be able to participate in project coordination and collaboration through an understanding of the role and character of these systems in typical building applications and contexts,
• understand the basics of system selection, placement, components, sizing, and integration,
• spend approximately 30 hours of effort for each credit earned,
• understand how to design for carbon neutrality, passive design, and renewable energy,
• prepare a building performance case study as a collaborative team investigation of a nearby building/space that reflects design intention and actual outcome.

Graduate/Undergraduate Student Differential: Graduate students are expected to perform work of higher quantity and more in-depth than undergraduate students, typically with forty hours of student engagement for each student credit hour (compared to thirty hours of undergraduate student engagement for each student credit hour). Therefore, for this 4-credit course a graduate student should expect to commit approximately 160 while it is expected that an undergraduate student should expect to commit approximately 120 hours to this course over the duration of the term. Specific requirements that reflect this higher level of engagement for Graduate students will be provided on projects. Graduate students will also complete an analysis and summary of a scholarly article from an architectural research journal on building performance and comment on its relevance to the principles and concepts of this course. This is intended to give students a unique and important experience for practice but challenges students to dig more deeply into how architectural information is conveyed to the public.

Format:
ARCH 4/591 is a lecture/lab course involving hands-on experience. Though much of the information will be exchanged in lecture, the lab sections will be used to develop and discuss issues and concepts beyond what is possible in lecture. Hands-on application of selected concepts will be explored through projects and section activities by the GE who will conduct lab sections work under the direct supervision of the professors. The required readings will provide a background to facilitate such exchanges. These sections will be conducted according to the protocols that have been approved by the professor and that are common to all sections of the course.

Expenses: In addition to typical University tuition, fees, and book expenses, additional expenses will likely be incurred for materials and supplies required for the completion of course projects and potential travel related to the case study.
Instructors: All students are encouraged to attend office hours of the instructors and GEs should there be any questions regarding the course curriculum, assignments, or activities.

GRADING

Multiple measures will be used to assess your performance. A grasp of information will be tested via quizzes. The ability to apply information in design situations will be assessed via projects. Active participation in the learning process will be assessed via weekly questions and section attendance and participation. A case study assignment will span several weeks of the term. Regular class attendance and participation (including sections) and timely assignment submission are minimum expectations for successful course completion.

GE Role: The Department of Architecture maintains a long and successful tradition of peer teaching that benefits both students and GEs. Graduate Teaching Fellows will conduct both graduate and undergraduate labs under the direct supervision of the instructor. These sessions will be conducted according to protocols that have been approved by the instructors and that are common to all sections of the course. GEs will lead labs and may occasionally provide supplementary lessons on certain topics. However, the instructor will meet with the GEs on a weekly basis at least, to coordinate material and ensure that sections are being run consistently and according to the instructors’ specifications. GEs will work under the direct supervision of the instructor(s), who will have ultimate responsibility for determining and entering grades. All grading will be done according to clear criteria that are used by the course instructors and all GEs assisting in the course. The course instructors will regularly monitor the grading activities of GEs with respect to accuracy and fairness. All graduate students have the option of having their work evaluated solely by the course instructors and should request in writing by the first week of the term.

Lectures are designed to offers an expansion of the systems and concepts covered in the required readings. The instructors provide their expertise and connections (through invited experts) to the broad arena of architecture and require that you reflect upon potential applications for such systems in the buildings that you design. You are strongly encouraged to engage and make contextual sense of the concepts presented in class—as opposed to simply listening to the lectures and mechanically completing the projects. Design is a complex endeavor. We expect you to be fully engaged in lecture. Use of laptops and cell phones are not permitted in class; research has shown that students who sketch and take notes by hand, have longer retention and understanding of the material. If you have a Kindle version or library e-book of MEEB, you may use your Kindle reader or laptop in the front row of the lecture hall with instructor approval.

Project assignments will be described in writing and will have a specific due date. Projects will be discussed in class at the time they are assigned. Work must be submitted in a professional format reflective of your status as a student in a professional program. We expect typed work, checked for grammar and spelling. Specific data sources and/or other documentation used to complete assignments must be clearly noted (this is a valuable habit for practice). Presentation quality will affect grading—as will content accuracy and completeness. “Taking it Further” of each project is optional and will act as a “bonus points.” There will be 4 of these options.

Quizzes will be given each Thursday in class (timing at the instructor’s discretion). Notes may be used in class for the quizzes, unless otherwise noted. iClickers are used for quizzes only (no pieces of paper substitutes. A missed quiz may be made up ONLY in the case of a verified emergency situation or a pre-excused absence approved prior to the time of the quiz. We do not drop the lowest quiz grade.

Question/Response: Each week we will give you a “question of the week” to respond to. This will be due on Tuesday at the beginning of lecture. You can also submit a question or observation about materials recently covered in class. The question or observation must be submitted to Canvas in your own handwriting (take a photo, upload jpg). The instructor will use these Q/R sheets to look at learning trends in the class, though they may be responded to on occasion in class or by email.

Section meeting attendance is required. Assessment will be based upon attendance and active and constructive participation in discussion and successful completion of in-section activities. For certain approved circumstances, students attend another section, with pre-approval from both GEs for those sections.

A final case study project represents the final, 5-week project of the course. The case study is a group assignment, will involve interim reviews, requires the development a paper and poster, and presentation of the case study by the group during the scheduled final exam period for the course. We seek case studies of actual building performance, materials, visualizations, etc.

iClickers will be used for activities and evaluation throughout the class. You will register your iClicker through Canvas. iClickers may only be used by you. Submitting responses for another person, or allowing others use your iClicker, is grounds for a failing grade and the basis for referral to the Office of the Dean of Students. Clickers must be brought to each lecture. Extra clickers will not be available.
The course may be taken on either a graded or P/N basis. A “pass” requires a minimum equivalent grade of C-(undergraduates); B-(graduates). Students should check the deadlines for change of grade options by the end of the first week. The overall course grade will be based upon a cumulative tabulation of the various elements described above, weighted as follows:

<table>
<thead>
<tr>
<th>Element</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Projects</td>
<td>30 %</td>
</tr>
<tr>
<td>Quizzes</td>
<td>15 %</td>
</tr>
<tr>
<td>Questions/Observations</td>
<td>5 %</td>
</tr>
<tr>
<td>Section Attendance/Participation</td>
<td>15 %</td>
</tr>
<tr>
<td>Case Study</td>
<td>35 %</td>
</tr>
</tbody>
</table>

Your course grade will be based on the following weights (and not curved which tends to unfairly penalize those who do well). Grading will be as follows:

\[
A+ = 97.5-100+\%, \quad A = 92.5-97.4\%, \quad A- = 89.5-92.4\% \\
B+ = 87.5-89.4\%, \quad B = 82.5-87.4\%, \quad B- = 79.5-82.4\% \\
C+ = 77.5-79.4\%, \quad C = 72.5-77.4\%, \quad C- = 69.5-72.4\% \\
D+ = 67.5-69.4\%, \quad D = 62.5-67.4\%, \quad D- = 59.5-62.4\%
\]

Due Dates: All projects are due, in print, in the boxes outside Lawrence 177 at the start of class on Tuesdays prior to the start of class, unless otherwise announced (If turned in after the start of class on the due date, this constitutes 5% per day late penalty up to one week). We are able to provide better feedback on print copies of your work and Canvas will not be used to upload the Projects or Case Studies. Any project turned in later than one week after it was due will not receive any credit. Arrangements should be made with your GE to turn in a late project. Case studies must be submitted as scheduled. Final case study presentations are scheduled during the University's designated final examination period. Failure to attend the case study presentations will result in a 50% case study grade penalty.

Incompletes: A grade of Incomplete will be given ONLY for medical emergencies and requires written pre-approval from the instructor. The instructor reserves the right to withhold a final course grade if equipment on loan is not returned in working order by the time of the final case study presentations. Requests for extra-credit or compensatory work to make up for missing assignments or quizzes will not be considered.

Collaboration vs Own Work: Group discussion of projects is acceptable and encouraged. Collaborative work (which can be very educational) has limits, however. Copying another’s work, or a portion of work, for submission as your own, or allowing others to copy your work, is grounds for a failing grade and the basis for potential referral to the Director of Student Judicial Affairs. All students are expected to know and understand the Oregon Student Conduct Code. Any project submitted for grading is—by the act of submission—certified to be the true work product of the individual who submits the work. This means that the work reflects a personal exercise of judgment regarding accuracy, quality, and completeness.

Extenuating Circumstances: If unforeseen and uncontrollable circumstances during the term make it impossible for you to fully participate in course activities as scheduled, such a situation must be brought to the instructor’s attention immediately—delayed requests for compassionate consideration will not be accepted. Any request for deviation from published and/or assigned course requirements must be made in a timely manner and be agreed to in writing.

Disabilities: The University of Oregon is working to create inclusive learning environments. Please notify me if there are aspects of the instruction or the design of this course that result in disability barriers to your participation. You are also encouraged to contact the Accessible Education in 164 Oregon Hall at 541-346-1155 or uoaec@uoregon.edu. Ideally, I would like to receive a notification letter before the end of the first week of classes so that we can discuss ways to provide accommodations within the classroom and department.

Equipment: Equipment checked out from the Baker Lab or NetZed Lab in accordance with the tool lending policy. Equipment used for team projects are the team’s responsibility, even if a representative checked it out. In the case of missing or damaged equipment, the team is expected to order and replace the equipment with a new equivalent specified by the lab. Unresolved equipment issues may result in an “I” incomplete grade for each member of the team.

Homework Presentation: On all project pages, include your name, date, the number of the project, and your GE’s name. Any project without a name will receive no credit. All questions requiring a short response should be answered with a concise, well-crafted paragraph. Answers should be typed, unless otherwise noted. If you are to fill in answers on the project sheets themselves, please turn in a clean, legible copy. Illegible answers will not receive credit. Successful presentations of projects include, but is not limited to: spelling, clarity of thought, following instructions, and design. Points are awarded at the instructor’s discretion. Show all calculations and include all units (e.g. Kilowatts = kW). Calculations may be handwritten, if presented legibly.
REQUIRED READINGS

Required readings (see course schedule) are generally from *Mechanical and Electrical Equipment for Buildings*, 12th ed.: Grondzik, Kwok, John Wiley, Hoboken, NJ, 2015; *The Green Studio Handbook*, 3rd ed.: Kwok, Grondzik, Routledge, 2018; *Thermal Delight in Architecture*: Heschong, The MIT Press, Cambridge, MA, 1979. Additional required readings are derived from a number of sources as noted on the course schedule—are either on physical or electronic library reserve or on Canvas. Specific reading assignments are noted by page, section, or chapter numbers and are to be read prior to the class meeting to which they are linked in the schedule. We expect our students to use legal copies of materials.

LEARNING OUTCOMES and NAAB CRITERIA

This course addresses the following 2014 NAAB Student Performance Criteria (bold are addressed explicitly). U=understanding, A=ability: Understanding addressed through interactive lectures, readings, quizzes, section activities. Criteria in bold, are tied to specific demonstrations through quizzes, section activities, project homework, and a case study assignment.

**Realm A: Critical Thinking and Representation**


**Realm B: Building Practices, Technical Skills and Knowledge**

B.1 Pre-Design: B.6 Environmental Systems: *Ability* to demonstrate the principles of environmental systems’ design, how design criteria can vary by geographic region, and the tools used for performance assessment. This demonstration must include active and passive heating and cooling, solar geometry, daylighting, natural ventilation, indoor air quality, solar systems, lighting systems, and acoustics; B.7 Building Envelope Systems and Assemblies: *Understanding* of the basic principles involved in the appropriate selection and application of building envelope systems relative to fundamental performance, aesthetics, moisture transfer, durability, and energy and material resources; B.8 Building Materials and Assemblies: *Understanding* of the basic principles used in the appropriate selection of interior and exterior construction materials, finishes, products, components, and assemblies based on their inherent performance, including environmental impact and reuse.

**Realm C: Integrated Architectural Solutions**

C.1 Research: *Understanding* of the theoretical and applied research methodologies and practices used during the design process.