Environmental Control Systems
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EVDA 615Q(1.5-0)
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Introduction

Comfortable indoor environment is a major goal in the design of buildings, and achieving this may be challenging in cold climate where several factors should be considered simultaneously. This course addresses design of buildings for cold climate to provide comfortable and productive environment while reducing the negative environmental effects at the global level by reducing demands for fossil fuels.

Course outcomes

By the end of this course, students will be able to:

1. Apply the basic principles of heat transfer mechanism and to perform simple heat loss /gain calculations.
2. Evaluate design decisions on heat loss/gain through envelope.
3. Apply basic passive design strategies to reduce operational energy requirements of the building.
4. Design mechanical control systems using approximate methods for sizing of ducts and other components.
5. Organize major mechanical system components in relation to other systems, including structure, enclosure, lighting, and fire safety.
6. Apply the principles of ventilation in cold climates (including natural ventilation, heat recovery, etc.).
7. Demonstrate awareness of issues related to energy efficiency and renewable energy applications for cold climate buildings.
8. Develop architectural designs that integrate mechanical systems together with other building systems (e.g. building envelop, lighting, structures).

Teaching Approach

The course will be presented in lecture and workshop mode. The course is connected with the comprehensive studio through the required development of building system concepts. Typical approaches to systems design will be reviewed in terms of air distribution approach and spatial organization. The assignment is conceptual design of a ventilation and thermal control system for the studio project, using rules of thumb for sizing.

Content: Topic Areas & Detailed Class Schedule

The course will introduce the overall concept of environmental control systems. This includes passive and active strategies to reduce heating and cooling loads of the buildings. The functions and characteristics of thermal and ventilation systems will be reviewed, together with their place in the development of design concepts. Components

and terminology will be discussed, as well as quantitative design methods and elementary sizing procedures. Factors in systems selection will be examined, including:

1. Thermal comfort and air quality.
2. Types of ventilation and thermal control systems.
3. Performance criteria for the evaluation of systems, (e.g., system capabilities, cost, energy efficiency, energy codes).
4. Visual treatment of systems.
5. Interrelationship of systems (e.g., envelope and active thermal control).
6. Heat transfer processes.
7. Other issues such as noise considerations and mechanical movement systems.

W1	M Jan 9 W Jan 11	Thermal comfort, impact of Building design (integrates design concept); Heat transfer and heating and cooling loads	
W2	M Jan 16 W Jan 18	Heating and cooling loads (ctd) - simple calculation methods (to compare design effects); Introducing the term Project; Introduction to passive design (heating, cooling, daylighting and ventilation); passive heating.	
W3	M Jan 23 W Jan 25	Passive design for cooling. Natural ventilation, Indoor air quality.	
W4	M Jan 30 W Feb 1	Passive design implementation in the Term project. (Students presentations)	
W5	M Feb 6 W Feb 8	Mid term exam (Feb 6th) HVAC for small buildings (residential and commercial)	Mid term exam
W6	M Feb 13 W Feb 15	HVAC for small buildings (ctd)- various systems and their combinations; Case studies. HVAC for Large buildings; Generic HVAC Systems (Air to air, air to water and all- water);	
W7	Feb 20 - 24	Block week	
W8	M Feb 27 W Mar 1	HVAC for large buildings (ctd) Rules of thumb for sizing HVAC equipment; Case studies	
W9	M Mar 6 W Mar 8	Distribution systems (Type of distribution, delivery systems, etc.). Air ducts and approximate sizing of ducts.	
W10	M Mar 13 W Mar 15	Students presentation: Mechanical systems preliminary selection and sizing	
W11	M Mar 20 W Mar 23	Crits	
W12	M Mar 27 W Mar 29	Crits	
W13	M Apr 3 W Apr 5	Crits	
W14	Apr 10	Final exam	

Means of Evaluation

Evaluation will be based on:	
Passive design presentation	10%
Mid term exam	15%
Mechanical system presentation	5%
Final exam	20%
Design Project	50%
Total	100%

- Passive design presentation will focus on the passive design strategies included in the conceptual design of the buildings to reduce its heating and cooling load (including building shape, orientation, preliminary selection of materials, window size, etc.) (Outcomes 1, 2 and 3)
- Mid term exam will be based on material covered in week 1-4 (outcomes 1, 2, 3, 4)
- Mechanical systems students presentation will focus on preliminary selection of mechanical systems (Outcomes 4-6)
- Final exam will cover all semester material (Outcomes 1-7)
- Design project (Outcomes1-8)

The exams will be closed book. Writing and the grading thereof is a factor in the evaluation of the project.

Grading

Final grades will be reported as letter grades, with the final grade calculated according to the 4-point range. Grading will be based on the following scale:

Grade	Grade Point Value	4-Point Range	Percent	Description
A+	4.00	4.00	95-100	Outstanding - evaluated by instructor
A	4.00	3.85-4.00	90-94.99	Excellent - superior performance showing comprehensive understanding of the subject matter
A-	3.70	3.50-3.84	85-89.99	Very good performance
B+	3.30	3.15-3.49	80-84.99	Good performance
B	3.00	2.85-3.14	75-79.99	Satisfactory performance
B-	2.70	2.50-2.84	70-74.99	Minimum pass for students in the Faculty of Graduate Studies
C+	2.30	2.15-2.49	65-69.99	All final grades below B- are indicative of failure at the graduate level and cannot be counted toward Faculty of Graduate Studies course requirements.
C	2.00	1.85-2.14	60-64.99	
C-	1.70	1.50-1.84	55-59.99	
D+	1.30	1.15-1.49	50-54.99	
D	1.00	0.50-1.14	45-49.99	
F	0.00	0-0.49	0-44.99	

Notes: A student who receives a "C+" or lower in any one course will be required to withdraw regardless of their grade point average (GPA) unless the program recommends otherwise. If the program permits the student to retake a failed course, the second grade will replace the initial grade in the calculation of the GPA, and both grades will appear on the transcript.

Readings

The course texts are

- The Architect's Studio Companion: Rules of Thumb for Preliminary Design, 5th ed. 2007 E. Allen and J. Iano Wiley ISBN-13: 9780470641910
- W.T. Grondzik, A.G. Kwok, B. Stein, J. S. Reynolds, Electrical and Mechanical Equipment for Buildings (11th Edition), 2010 (selected chapters) Wiley, ISBN 978-0-470-19565-9
- Additional materials will be posted on the course website.

Canadian Architectural Certification Board - Performance Criteria Met by Course

The following CACB Student Performance Criteria will be covered in this course at a primary level: B8 Environmental Systems, C2 Building Systems Integration, B10 Building Service Systems
The following CACB Student Performance Criteria will be covered in this course at a secondary level: B4 Sustainable Design, C1 Detailed Design Development, C4 Comprehensive Design.

Notes:

As a quarter course, the class will run about 50% of the weeks of the term, plus time for the test.

1. Written work, term assignments and other course related work may only be submitted by e-mail if prior permission to do so has been obtained from the course instructor. Submissions must come from an official University of Calgary (ucalgary) email account.

2. Academic Accommodations. Students who require an accommodation in relation to their coursework or to fulfil requirements for a graduate degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to their Instructor or the designated contact person in EVDS, Jennifer Taillefer (jtaillef@ucalgary.ca). Students who require an accommodation unrelated to their coursework or the requirements for a graduate degree, based on a protected ground other than disability, should communicate this need, preferably in writing, to the Vice-Provost (Student Experience). For additional information on support services and accommodations for students with disabilities, visit www.ucalgary.ca/access/

3. The instructor may reduce grades for assignments and components thereof when submitted after deadlines.

4. Plagiarism - Plagiarism involves submitting or presenting work in a course as if it were the student's own work done expressly for that particular course when, in fact, it is not. Most commonly plagiarism exists when:(a) the work submitted or presented was done, in whole or in part, by an individual other than the one submitting or presenting the work (this includes having another impersonate the student or otherwise substituting the work of another for one's own in an examination or test),(b) parts of the work are taken from another source without reference to the original author,(c) the whole work (e.g., an essay) is copied from another source, and/or,(d) a student submits or presents work in one course which has also been submitted in another course(although it may be completely original with that student) without the knowledge of or prior agreement of the instructor involved. While it is recognized that scholarly work often involves reference to the ideas, data and conclusions of other scholars, intellectual honesty requires that such references be explicitly and clearly noted. Plagiarism is an extremely serious academic offence. It is recognized that clause (d) does not prevent a graduate student incorporating work previously done by him or her in a thesis. Any suspicion of plagiarism will be reported to the Dean, and dealt with as per the regulations in the University of Calgary Graduate Calendar.

5. Information regarding the Freedom of Information and Protection of Privacy Act (http://www.ucalgary.ca/secretariat/privacy) and how this impacts the receipt and delivery of course material

6. Emergency Evacuation/Assembly Points (http://www.ucalgary.ca/emergencyplan/assemblypoints)

7. Safewalk information (http://www.ucalgary.ca/security/safewalk)

8. Contact Info for: Student Union (https://www.su.ucalgary.ca/contact/) Graduate Student representative (http://www.ucalgary.ca/gsa/) and Student Ombudsman's Office (http://www.ucalgary.ca/ombuds/).