COURSE MEETING TIMES  
Fridays, 9:00 AM to 11:45 AM

COURSE LOCATION  
NORTH CLASSROOM 1608

COURSE START DATE  
Friday, August 25, 2017

LECTURE END DATE  
Friday, December 8, 2017

COURSE END DATE  
Friday, December 15, 2017 (non-negotiable)

FINAL EXAM DATE  
Friday, December 15, 2017 (non-negotiable)

INSTRUCTOR  
Joseph “Joe” Wujek, M.A.

INSTRUCTOR OFFICE  
CU BLDG Room 502

INSTRUCTOR PHONE  
303.933.1300 (Advanced Building Consultants, LLC)

E-MAIL ADDRESS  
JOSEPH.WUJEK@UCDENVER.EDU

INSTRUCTOR OFFICE HOURS  
Fridays, 8:30 to 9:00 AM (North Classroom 1608)  
Fridays, 11:45 AM to 12:00 PM (North Classroom 1608)  
Fridays, 3:15 to 3:30 PM (North Classroom 1535)

CONTACTING THE INSTRUCTOR  
The best ways to contact me are to see me before/after class or by email.

TEACHING ASSISTANT (TA)  
TBD – check Canvas

TA E-MAIL ADDRESS  

TA OFFICE/HOURS  

COURSE CATALOG DESCRIPTIONS  
The second course in the sustainable systems sequence introduces concepts and design methods of plumbing, power distribution, renewable electricity, artificial illumination, daylighting, acoustics, vertical transportation, fire protection, and telecommunication systems in buildings with a focus on energy and resource efficiency.  
3 Credits; Prereq: ARCH 5330

In building design and construction, architects, MEP engineers and constructors integrate low resource consumption strategies to address environmental challenges. The primary incentive is to save energy and ensure occupant health, safety and comfort. This requires that all design professionals -- architects and engineers -- have a solid comprehension of the environmental performance characteristics of buildings. For the architect, such strategies offer overt and inconspicuous opportunities for architectural expression.

Architects are typically the quarterback or conductor of the design team. As the principal design leader, architects must understand the interrelationship between a building and its subsystems, and need sufficient knowledge of building systems and design alternatives to recommend appropriate solutions that suit the site, climate, building type, and occupants. Architects must coordinate the work of the engineering disciplines that carry the sustainability concept forward through building design, construction, commissioning, operation and, ultimately, demolition, recycling and reuse. Thus, it is crucial that architects understand MEP systems. It is hopeful that the sustainable systems course sequence develops a base understanding of these systems.
COURSE INTRODUCTION
ARCH 5340 is one of two graduate-level 'systems' courses entitled Sustainable Systems. This course covers engineering concepts in plumbing systems, electrical systems, lighting systems, life safety, acoustical systems, and conveying systems in buildings. Photovoltaic (PV), wind energy and micro-hydro power electricity-generating systems, rain-water harvesting systems, and other sustainable systems are also explored.

The other Sustainable Systems course (ARCH 5330) covers concepts in the operation and design of building systems for providing a healthy, comfortable and productive thermal indoor environment. Major topics include thermal comfort; heat and moisture flow in buildings; and mechanical systems for environmental control in building spaces (heating, ventilating and air conditioning), with a focus on strategies used to solve interesting and challenging human comfort and energy related problems in sustainable buildings.

COURSE COMPETENCIES
Following are the course competencies for this course:

   a. Name, describe and distinguish between sources of potable water.
   b. Name, describe and distinguish between key types of and components in a plumbing supply/distribution system.
   c. Identify, describe and distinguish between types of and uses for water heaters.
   d. Name and explain basic properties of fluid flow of a building plumbing system (i.e. flow rate, velocity, pressure, pressure drop, etc.).
   e. Calculate maximum probable flow rate of a building plumbing system.
   f. Calculate pressure drop in lines of a building plumbing system.
   g. Compute the minimum required size of distribution lines of a building plumbing system.
   h. Name, describe and distinguish between methods of waste disposal in buildings.
   i. Identify, describe and distinguish between key components of a drain, west and vent (DWV) system.
   j. Compute the minimum required size of drainage and vent lines of a building plumbing system.
   k. Interpret plumbing supply and DWV system design and detailing information.

2. Building Electrical Systems
   a. Name and define common electrical terminology (i.e. voltage, amperage, resistance, voltage drop, ampacity, etc.) and relate voltage, amperage, resistance, energy, and power.
   b. Calculate energy and cost of operation of electrical equipment.
   c. Name, describe and distinguish between types of electrical circuits and compute circuit loads.
   d. Identify, describe and distinguish between types of branch circuit components.
   e. Name, describe and distinguish between types building system voltage (e.g., 120/240V, 277/480V, etc.) and buildings in which they are used.
   f. Identify, describe and distinguish between types of building distribution equipment.
   g. Compute the minimum required size of branch circuit components.
   h. Interpret design information of building electrical system components.

3. Illumination and Daylighting
   a. Name, describe and distinguish between types of artificial and natural lighting sources.
   b. Identify the influence of color rendition.
   c. Identify appropriate lighting levels for a specific occupancy.
   d. Perform basic lighting analysis (single point, zonal cavity, and natural lighting methods)
   e. Interpret design and detailing information on artificial and natural lighting.

4. Building Telecommunication Systems
   a. Name, describe and distinguish between types of networks.
   b. Identify types of transmission media.
   c. Name and describe standards, devices, equipment and space requirements for a structured cabling and wireless systems.
   d. Interpret design and detailing information on building telecommunication systems.

5. Life Safety Systems
   a. Identify, describe, distinguish between passive and active fire protection.
   b. Identify, describe, distinguish and interpret fire resistance and spread fire ratings.
   c. Name, describe and distinguish between types and key components of building fire extinguishing, sprinkler, and standpipe systems, fire detection systems, and fire alarm systems.
   d. Interpret building fire protection system design and detailing information.

6. Conveying Systems
   a. Identify, describe and distinguish between types of conveying systems that move people and freight vertically and horizontally (escalators, elevators, ramps, lifts, walkways).
   b. Describe applications for building conveying systems that move people and freight.
   c. Interpret conveying system design and detailing information.

7. Acoustical Control Systems
   a. Identify, describe, and interpret ratings related to acoustical control (STC, NRC).
   b. Interpret acoustical control design and detailing information.

8. Sustainable Systems
   a. Identify, describe and distinguish between types of renewable power systems (e.g., PV, wind, hydropower, etc.).
   b. Interpret design and detailing information for renewable power systems.

COURSE ORGANIZATION AND MANAGEMENT
COURSE FORMAT: This course is delivered in a traditional lecture format, involving Power Point presentations, in-class activities, assigned readings, quizzes, exams, and out-of-class assignments/exercises.

LECTURES: The lectures provide primary access to the course content. They are intended to highlight and expand upon text material. Techniques for completing assignments are introduced in lecture.
**COURSE WEBSITE:** Course materials will be distributed online. Check the university course website weekly.

**ATTENDANCE:** Excellent attendance is essential to the student’s comprehension of material presented. Students bear responsibility for missed material. Unannounced quizzes will be given to ascertain commitment to attendance. Make-up quizzes will not be given. Poor participation in ‘attendance’ quizzes will be penalized.

Circumstances that cause a student to miss a one lecture -- a minor illness (e.g., cold, flu, and another ailment) or a minor unavoidable incident (e.g., oversleeping, missed bus, minor accident, personal, family or business commitment, etc.) -- will not receive excused attendance credit. A serious illness (e.g., hospitalization) or valid extenuating occurrence (e.g., relative death, athletic or academic travel) that causes a student to miss class will be considered for excused attendance credit; see the instructor.

**CLASSROOM ETIQUETTE:** The student is expected to practice good etiquette and respect for others. Disruptive behavior such as distractions (e.g., gestures and noises, etc.), talking between students (socializing), inattentiveness (i.e., snoozing), and disrespect (e.g., verbal abuse) will not be tolerated.

**ELECTRONIC DEVICE USE:** Phone, pager or similar mobile device should be switched to silent mode during class. Calls and text messaging should not be placed or received during class. Emergency conversations should be taken outside the classroom. Laptop and handheld computers may be used for class-related work only.

**DELIVERABLES:** In the professions of engineering and architecture, deliverables are submittals of work. In class, these include homework, project work, etc. All deliverables must meet professional standards; substandard work will be penalized. Deliverables must be neat. Multiple-page submittals must be stapled. Electronic submittals are acceptable only when specified.

Practicing professionals must meet deadlines; as should university students. Work submitted after a deadline is universally unacceptable: it is contrary to practices in the profession and is unfair to the punctual individual. Deliverables shall be submitted on time -- on the assigned date and at the start of lecture. Work submitted after the start of lecture will be deemed late and the student’s grade for that deliverable will be penalized by 25% (25% of the maximum score will be deducted). Work submitted after the due date will be deemed excessively late, and penalized by 50%. Work will not be accepted after the start of the next lecture.

**ACADEMIC HONESTY:** Academic dishonesty includes cheating, plagiarism (claiming another person’s work as your own), fabrication (falsification of information), and deception (providing false information such as providing a false excuse for missing a deadline). Academia takes a very negative view of academic dishonesty and has instituted severe consequences for this act. Any incident of academic dishonesty will lead to a failing grade for the assignment; possible failure for the course; and, possible expulsion from the University.

**STUDY GROUPS/WORKING TOGETHER:** Study groups are encouraged to discuss class concepts only. Studying as a group differs from completing assigned work as a group. All assignments (except projects specifically defined as team/group projects) must be completed individually. Computations, writings, and drawings (including CAD work) associated with individual assignments (homework and most THPs) should be completed by the individual student; it is unethical to claim another person’s work as your own.

**EXTRA CREDIT:** As a university-level course, extra credit work is not available to improve a student’s grade.

**EXTRA ASSISTANCE:** If you are worried about your grade, see me as soon as possible. If you wait until the end of the semester there is not much that I can do. A student in danger of a substandard course grade should:

1. Discuss the situation with the instructor as early as possible. The instructor will be open to options – I will do what I can to help you achieve your academic goals.
2. Consider withdrawing from the course before the drop deadline, so your student record is not tainted.

**GRIEVANCE PROCEDURE:** If you feel an awarded grade is not correct, you may dispute it by submitting a written explanation stapled with the marked material to the instructor within two weeks of receiving the graded material.

**SPECIAL ACCOMMODATIONS:** The University and the instructor will make reasonable accommodations for persons with disabilities (including physical, psychiatric, and learning disabilities), military personal with schedule conflicts, and students who have schedule conflicts between religious observance dates and course examinations or assignment due dates. Students eligible for special accommodations must contact the instructor by the first two weeks of the semester.

**COURSE SYLLABUS:** This syllabus provides information about the policies and procedures of this course and an outline for students to plan their semester. It is tentative and may change to meet the needs of the class. The instructor reserves the right to make changes to this syllabus. On occasion, new assignments can be issued or existing assignments amended. Any changes to assignments will be announced in lecture. It is a student’s responsibility to attend lecture and record amendments to requirements and deliverable due dates.

**INTELLECTUAL PROPERTY:** Materials created for this course -- the syllabus, PowerPoints, projects, exams, etc. -- are the intellectual property of the instructor. Use, distribution or sale of such materials requires permission of the instructor. No component of the course may be recorded (audio or video), broadcast or re-published without written consent of the instructor. Reproduction, distribution or sale of class materials is not permitted, unless the faculty member has explicitly waived the copyright.
GRADING SCALE

Grades are earned by the student and are awarded on the basis of the following grading scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Scale</th>
<th>Description of Grade</th>
<th>Instructor Interpretation of Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100 to 93</td>
<td>Distinguished grade and superior mastery of subject/skills</td>
<td>Extraordinary understanding and insight of subject matter, complete work and excellent attendance.</td>
</tr>
<tr>
<td>A-</td>
<td>92.9 to 90</td>
<td>Average grade and acceptable mastery of subject/skills</td>
<td>Very good understanding and insight of subject matter, complete work and very good attendance.</td>
</tr>
<tr>
<td>B+</td>
<td>89.9 to 87</td>
<td>Average grade and acceptable mastery of subject/skills</td>
<td>Essential understanding and limited insight of subject matter, some incomplete/poor work or fair attendance.</td>
</tr>
<tr>
<td>B</td>
<td>85.9 to 83</td>
<td>Below average grade and less-than-acceptable mastery of subject/skills</td>
<td>Minimal understanding and weak insight of subject matter, mostly incomplete work or poor attendance.</td>
</tr>
<tr>
<td>B-</td>
<td>82.9 to 80</td>
<td>Below average grade and less-than-acceptable mastery of subject/skills</td>
<td>Inadequate understanding or insight of subject matter, incomplete work or poor attendance.</td>
</tr>
<tr>
<td>C+</td>
<td>79.9 to 77</td>
<td>Failing grade and failure to master subject/skills</td>
<td>Inadequate understanding or insight of subject matter, incomplete work or poor attendance.</td>
</tr>
<tr>
<td>C</td>
<td>76.9 to 73</td>
<td>Failing grade and failure to master subject/skills</td>
<td>Inadequate understanding or insight of subject matter, incomplete work or poor attendance.</td>
</tr>
<tr>
<td>C-</td>
<td>72.9 to 70</td>
<td>Failing grade and failure to master subject/skills</td>
<td>Inadequate understanding or insight of subject matter, incomplete work or poor attendance.</td>
</tr>
<tr>
<td>D</td>
<td>69.9 to 60</td>
<td>Failing grade and failure to master subject/skills</td>
<td>Inadequate understanding or insight of subject matter, incomplete work or poor attendance.</td>
</tr>
<tr>
<td>F</td>
<td>Below 60</td>
<td>Failing grade and failure to master subject/skills</td>
<td>Failing grade and failure to master subject/skills</td>
</tr>
</tbody>
</table>

STUDENT ASSESSMENT

Student evaluation is based upon the following criteria and percentage of overall course grade:

OBSERVED PERFORMANCE (10% of grade)

This assessment component is based upon the instructor's observation of the student's commitment to learning. It includes periodic unannounced 'attendance' quizzes. Make-up quizzes will not be given.

EXAMS (40% of grade)

Three exams and a cumulative final exam will be given (see Course Outline and Assignment List). Make-up exams will not be given unless special arrangements are made in advance or a written excuse is provided.

HOMEWORK (15% of grade)

Homework exercise sets will be assigned (see Course Outline and Assignment List). These exercises should be completed on engineering paper in the appropriate format, unless directed otherwise. Exercises will be collected at the start of lecture on the assigned date. A late penalty will be assessed after that time. Exercises will be evaluated on completeness/technical accuracy (80%) and neatness (20%).

TAKE HOME PROJECTS (25% of grade)

THPs involving real world investigation and analysis of building systems will be assigned. Exercises are evaluated on technical completeness and accuracy (80%) and neatness (20%). THPs are collected at the start of lecture on the assigned date. A penalty will be assessed after that time.

SPECIAL PROJECT (10% of grade)

This project is an assignment that involves investigating the engineering systems in a building. It can involve a group case study analysis and report writing, or individual technical research of a unique project. A supplemental handout will be provided.

TEXTBOOK

Required Textbook:

The following book is required reading for this course:


Optional Readings:

The following books are optional supplementary reading for this course:


Pertinent Codes (Most recent edition):


DELIVERABLE (SUBMITTAL) FORMAT

Standards are used in industry to maintain and improve efficiency and accuracy. In this course, a submittal format for deliverables -- Homework (HW) and Take Home Projects (THPs) -- ensures efficiency, accuracy and fairness in grading. Student work that fails to comply with this standard format will be penalized.

1. Availability: THPs and HWs are available online.
2. Completion: THPs and HWs should be fully completed as directed. Use of CAD or spreadsheet (Excel) is only as per instructions. Only submit those pages requested.
3. Neatness: Work should be neat. Hand lettering and sketches shall be legible.
4. Multiple Sheets: Staple multiple page submittals in upper left-hand corner. Use of a paper clip, binder clip, tape or another method is unacceptable, and will be penalized.
COURSE SCHEDULE

Following is the course schedule. Deliverable due dates are listed. This schedule is tentative, and subject to revision. Any changes will be announced in lecture and posted on the course website.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Chapter</th>
<th>Tentative Lecture/Exam Schedule</th>
<th>Deliverable Due Date – Due at Class Start</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Homework Exercise Set</td>
</tr>
<tr>
<td>1</td>
<td>Fr: 8/25</td>
<td>-</td>
<td>Course Introduction</td>
<td>-</td>
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<tr>
<td></td>
<td></td>
<td>12</td>
<td>Plumbing Materials, Fittings, Fixtures</td>
<td>-</td>
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<tr>
<td>2</td>
<td>Fr: 9/1</td>
<td>13</td>
<td>Building Water Systems and Design</td>
<td>-</td>
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<tr>
<td></td>
<td></td>
<td>13</td>
<td>Domestic Water Heating Systems and Design</td>
<td>-</td>
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<tr>
<td>3</td>
<td>Fr: 9/8</td>
<td>14</td>
<td>Sanitary Drainage Systems and Design</td>
<td>HW 1</td>
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<tr>
<td></td>
<td></td>
<td>-</td>
<td>Plumbing/Water Systems and Design</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>Fr: 9/15</td>
<td>-</td>
<td>Plumbing/Water Systems Project</td>
<td>-</td>
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<tr>
<td>5</td>
<td>Fr: 9/22</td>
<td>15</td>
<td>OSST/Alternative Waste Systems</td>
<td>HW 2</td>
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<tr>
<td></td>
<td></td>
<td>17</td>
<td>Electrical Theory</td>
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<tr>
<td>6</td>
<td>Fr: 9/29</td>
<td>18</td>
<td>Electrical Materials</td>
<td>HW 3</td>
</tr>
<tr>
<td>7</td>
<td>Fr: 10/6</td>
<td>-</td>
<td>EXAM 1 (Chapters 12-15)</td>
<td>HW 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>19</td>
<td>Electrical Systems</td>
<td></td>
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<tr>
<td>8</td>
<td>Fr: 10/13</td>
<td>19</td>
<td>Electrical Design Principles</td>
<td>HW 5</td>
</tr>
<tr>
<td>9</td>
<td>Fr: 10/20</td>
<td>25</td>
<td>Sustainable/Renewable Systems</td>
<td>THP 7</td>
</tr>
<tr>
<td>10</td>
<td>Fr: 10/27</td>
<td>-</td>
<td>EXAM 2 (Chapters 17-19)</td>
<td>HW 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
<td>Sustainable/Future Systems</td>
<td></td>
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<tr>
<td>11</td>
<td>Fr: 11/3</td>
<td>20</td>
<td>Light and Architectural Lamps</td>
<td>HW 7</td>
</tr>
<tr>
<td>12</td>
<td>Fr: 11/10</td>
<td>20</td>
<td>Lighting Design Principles</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>Fr: 11/17</td>
<td>-</td>
<td>Acoustical Control in Buildings</td>
<td>HW 8</td>
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<tr>
<td></td>
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<td>23</td>
<td>-</td>
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<tr>
<td>Break</td>
<td>Fr: 11/24</td>
<td>No Class – Assignment: Turkey purchasing, preparation, carving and eating until full.</td>
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<tr>
<td>14</td>
<td>Fr: 12/1</td>
<td>21</td>
<td>Life Safety Systems in Buildings</td>
<td>HW 9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22</td>
<td>Building Telecommunication Systems</td>
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<td></td>
<td>24</td>
<td>Building Conveying Systems</td>
<td></td>
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<tr>
<td>15</td>
<td>Fr: 12/8</td>
<td>-</td>
<td>Quiet Week -- attendance not required)</td>
<td>-</td>
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<tr>
<td>-</td>
<td>Fr: 12/15</td>
<td>Final Exam (Cumulative) - As scheduled by university.</td>
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<table>
<thead>
<tr>
<th>THP</th>
<th>Description</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Restroom Inventory and Layout Study</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>Water Supply System Analysis</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>Domestic Water Heater Analysis</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>Drain, Waste and Vent System Analysis</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>OSST System Analysis</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Electrical Energy Consumption and Cost Analysis</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>Electrical Circuit Layout and Analysis</td>
<td>10</td>
</tr>
<tr>
<td>8</td>
<td>Renewable Energy Analysis</td>
<td>10</td>
</tr>
<tr>
<td>9</td>
<td>Lighting Design and Energy Cost Analysis</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>Acoustical Analysis</td>
<td>10</td>
</tr>
<tr>
<td>Total:</td>
<td></td>
<td>100</td>
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</table>