UNIVERSITY OF MANITOBA  
DEPARTMENT OF BIOSYSTEMS ENGINEERING  
COURSE OUTLINE  
BIOE 4412 DESIGN OF LIGHT-FRAME BUILDING SYSTEMS

Basic Course Information

Course No. BIOE 4412  
Course Title Design of Light Frame Building Systems  
Academic Session Winter Term  
Credit Hours 4

Prerequisite(s) and how they relate to this course
To provide students with an understanding of building system design from foundations to roofs. Students will gain and understanding of structural systems, ventilation and building envelope systems. BIOE 2110 Transport Phenomena, BIOE 3590 Mechanics of Materials in Biosystems

Classroom Location E2-164 EITC  
Class Schedule Tuesday, Thursday 8:30 to 9:45  
Lab Location E2 310 EITC, Biosystems Fabrication Shop, Alternative Village  
Lab Schedule Friday 2:30 to 5:30

Department Office Location E2-376 EITC  
Department Office Phone No. 474-6033

Instructor Information

Dr. Kris Dick, P.Eng.  
E1-344 EITC  
T: 474-6457  
Kristopher.Dick@umanitoba.ca  
Office hours: by appointment

Teaching Assistant(s) (if applicable) TBA  
TA Office Hours and Location TBA

Course Philosophy

Student’s Learning Responsibilities:
Attendance and punctuality are expected, primarily as this is a team-based course, requiring students to maximize opportunities to work effectively with their teammates in class. If you must be absent, please notify the instructor beforehand through email. Also, while the importance of technology is recognized in our daily lives (laptops, cell phones, blackberries) please exercise discretion. When we are engaged in class discussion and interaction, your full attention is requested. There is no technological substitute for the development of communication skills. In accordance with university policy all email communication for this course shall be conducted using your University of Manitoba email address only. Please ensure that you are monitoring your university account for this course.
**Why is this course useful?**

This course provides students with an understanding of structural design concepts as related to light-frame buildings combined with heating and ventilation fundamentals. An understanding of how structures manage loads is important to overall design. This course provides students with strategies to determine structural and environmental loads used in the design of light frame building systems.

**Who should take this course?**

This is a design elective for students in the Biosystems and Civil Engineering program.

**How this course fits into the curriculum.**

This course is intended for students in their latter years in Biosystems/Civil Engineering. This course will provide the student with the opportunity to gain an understanding of structural behaviour, and heating, ventilation, and energy efficient strategies for light-frame buildings. The relationship between various components within a building envelope is fundamental to how we as design engineers can integrate this knowledge into the design of light frame buildings.

**Engineering-Related Objectives**

By the end of the term students will have an understanding of light-frame building systems. This includes structural, heating, ventilation and energy-efficient design of envelope systems.

**Intended Learning Outcomes:**

By the end of the term BIOE 4412 students should be able to:

1. Demonstrate an understanding of various light-frame structural systems and their application
2. Complete a set of calculations to evaluate building envelope performance related to heat and moisture management
3. Complete a set of calculations to determine environmental and structural loading on a building.
4. Prepare a report that summarizes design concept to construction of a hands-on project. Report shall include a cost analysis. Students will present their results and project design in an oral presentation.

**Expected Level of Development in Course**

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Attribute*</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>KB PA IN DE ET IT CS PR IE EE EP LL</td>
</tr>
<tr>
<td>1</td>
<td>D D D D</td>
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<tr>
<td>2</td>
<td>D D D D</td>
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<td>3</td>
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<td>4</td>
<td>D D D D</td>
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</table>
**CEAB Graduate Attributes**

- **KB** A knowledge base for engineering
- **PA** Problem analysis
- **IN** Investigation
- **DE** Design
- **ET** Use of engineering tools
- **IT** Individual and team work
- **CS** Communication skills
- **PR** Professionalism
- **IE** Impact of engineering on society/environment
- **EE** Ethics and equity
- **EP** Economics and project management
- **LL** Life-long learning

**Expected Level of Development**

- **I** - Introductory
- **D** - Developing
- **A** - Advanced

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**Course Evaluation:**

The basis of evaluation is established by agreement at the beginning of each term. Weights assigned to various components of the work are:

- Final Examination: 50%
- Mid Term Examination: 10%
- Project: 20%
- Assignments: 20%

In general late submission is penalized by 10% per day. PRIOR Notice is required for consideration of late assignments. Once assignments/labs have been returned to class, they will not be accepted. Some evaluative feedback will be provided before the VW date.

**Table 1: Graduate Attribute Allocation for BIOE4412**

<table>
<thead>
<tr>
<th>Assessment Element</th>
<th>Value</th>
<th>Attributes Covered</th>
<th>Indicators Assessed</th>
<th>Level Note 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mid Term Exam</td>
<td>10%</td>
<td>Problem Analysis</td>
<td>PA.3</td>
<td>D</td>
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<tr>
<td></td>
<td></td>
<td>Knowledge Base</td>
<td>KB.4 Specialized Engineering science</td>
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<tr>
<td>Assignments</td>
<td>20%</td>
<td>Design</td>
<td>DE.2</td>
<td>D</td>
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<tr>
<td></td>
<td></td>
<td>Communication Skills</td>
<td>CS.2 Educates appropriate engineering documents</td>
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<tr>
<td></td>
<td></td>
<td>Engineering Tools</td>
<td>ET.1</td>
<td>D</td>
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<tr>
<td></td>
<td></td>
<td>Knowledge Base</td>
<td>KB.3 Fundamental Engineering science</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>KB.4 Specialized Engineering science</td>
<td></td>
</tr>
<tr>
<td>Project</td>
<td>20%</td>
<td>Design</td>
<td>DE.1</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communication Skills</td>
<td>CS.1 Applies principles for effective engineering communication</td>
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<td></td>
<td></td>
<td>Individual &amp; Team</td>
<td>CS.3 Delivers effective technical presentations</td>
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<tr>
<td>Final Exam</td>
<td>50%</td>
<td>Knowledge Base</td>
<td>KB.3 Fundamental Engineering science</td>
<td>D</td>
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<tr>
<td></td>
<td></td>
<td>Design</td>
<td>KB.4 Specialized Engineering science</td>
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<td></td>
<td></td>
<td></td>
<td>DE.2 Use appropriate design process</td>
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Assignment Descriptions
The basis of this course is to provide students with a fundamental understanding of light-frame structures from both a structural and building envelope perspectives.

Design Assignments (20%) Students will be expected to complete a design assignments that will provide experience with determining environmental loads, load flow through structures, building envelope design and basic member sizing.

Mid-Test Exam (10%) Students will be evaluated on the concepts presented in class and will be based on assignments and in-class discussions.

Term Project (20%) Students will work in design teams on a project related to light-frame building construction. The details of the project will be presented in class. Students will identify design solutions, complete a hands-on project and present their results to the class.

Final Exam (50%) Students will be evaluated on the entire term, including labs and guest presentations. There will be an emphasis on material presented after the mid-term.

Important Dates /Schedule
The following are milestone dates for the Winter 2018 term:

<table>
<thead>
<tr>
<th>Item</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading Week</td>
<td>February 19-23</td>
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<tr>
<td>Mid-Term Exam</td>
<td>March 2</td>
</tr>
<tr>
<td>Voluntary Withdrawal</td>
<td>March 16</td>
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<tr>
<td>Project Presentation</td>
<td>March 30</td>
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<tr>
<td>Report Due</td>
<td>April 5</td>
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<tr>
<td>Final Exam</td>
<td>Scheduled by others</td>
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</tbody>
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Course Content Guideline
Lectures/Theory: three hours per week for one term
1. Introduction to Light Frame Building Systems
2. Building System Components –Design Considerations
   2.1. Overview of light-frame buildings
   2.2. Review of selected structural analysis methods
   2.3. Load flow in structures
   2.4. Roof systems
   2.5. Wall systems
   2.6. Floor systems
   2.7. Foundation systems
3. Building Envelope Considerations –Insulation, Vapour Barrier, Thermal Performance
   3.1. Moisture and condensation
3.2. Vapour movement through building envelopes
3.3. Vapour barriers and thermal insulation of building envelopes
3.4. Air barriers
4. Ventilation for residential, agricultural and light commercial buildings
5. Energy Efficient Buildings
   5.1. Energy saving strategies
   5.2. Building Rating Systems

**Laboratories:** two hours per week for one term
   1. Hands-on labs: (design and construction of building components/systems)
   2. Facility tours
   3. Guest speakers

**Term Project**
Design teams will be formed to design, construct and test a heat-recovery system for use in a residential or light commercial building. Details will be provided in a separate handout

**Textbook:** None – notes provided by instructor

**References:**
1. Environment Control for Animals and Plants, with Computer Applications
2. ASHRAE Handbook of Fundamentals
3. ASABE Standards

**Academic Dishonesty**
Assignments and laboratory reports are expected to be the independent work of each student. The General Academic Regulations and Policy, as outlined in the General Calendar, will be followed in case of academic dishonesty.

**Student Accessibility Services**
If you are a student with a disability, please contact SAS for academic accommodation supports and services such as note-taking, interpreting, assistive technology and exam accommodations. Students who have, or think they may have, a disability (e.g. mental illness, learning, medical, hearing, injury-related, visual) are invited to contact SAS to arrange a confidential consultation.

*Student Accessibility Services* [http://umanitoba.ca/student/saa/accessibility/](http://umanitoba.ca/student/saa/accessibility/)
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204 474 7423
Student_accessibility@umanitoba.ca