Department of Biosystems Engineering
Faculty of Engineering
Course outline – BIOE 4412, Winter 2020

Course identification	
Course name:	**Design of Light-Frame Building Systems, 3 credit hrs.**
Prerequisites:	BIOE 2110, BIOE 3590
Lecture hours:	Tuesday and Thursdays 8:30 am - 9:45 am
Lab hours:	Mondays 2:30 pm - 5:20 pm
Lecture location:	EITC E2 360
Lab Location:	105 Ag/Eng Building
Department Office Phone No.	(204) 474 - 6033

Instructor	
Instructor:	**Farhoud Delijani,** PhD, PEng
Contact information:	Office: E3-374, EITC Phone: (204) 474 - 8613 Email: Farhoud.Delijani@umanitoba.ca
Office hours:	Open door policy. Also by appointment and email.

Teaching assistant (TA)	
Contact Information:	**Daly Penner** Email: penner43@myumanitoba.ca Office Hours: Mon. 08:30AM-9:30AM Also by appointment and email

Course description and learning objectives

To provide students with an understanding of building system design from foundations to roofs. Students will gain experience in designing structures and built-environment of light-frame buildings.

Who should take this course?

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

Intended Learning Outcomes:

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

- Demonstrate an understanding of various light-frame structural systems and their application.
- Complete a set of calculations to evaluate building envelope performance related to heat and moisture management.
- Complete a set of calculations to determine environmental and structural loading on a building.
- 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.

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.

How this course fits into the curriculum?

This course is intended for students in their latter years in Biosystems 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.

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, tablets, cell phones, etc.) 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.

Course web site

UM Learn (https://universityofmanitoba.desire2learn.com/d2l/login)

Optional Textbook and Important References

- Environment Control for Animals and Plants, with Computer Applications
- ASHRAE Handbook of Fundamentals
- ASABE Standards
- National Building Code of Canada
- Wood Design Manual – 2017, Canadian Wood Council

Course Content and Scope

The following is a basic list of topics to be covered during this course. The order in which they have been presented does not, however, necessarily imply the order in which they will be encountered.

1. Introduction to Building Systems and design requirements
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. Air barriers and thermal insulation of building envelopes
4. Ventilation for residential buildings (*By Dr. Qiang Zhang*)
    4.1. Ventilation for agricultural and light commercial buildings (*By Dr. Qiang Zhang*)
5. Energy Efficient Buildings
    5.1. Energy saving strategies
    5.2. Building Rating Systems
6. Alternative Building Systems
    6.1. Strawbale
    6.2. Cob and light clay
    6.3. Insulated concrete forms (ICF's)
    6.4. Living/Green roofs
    6.5. Stackwall / cordwood masonry
    6.6. Rainwater harvesting
    6.7. Site location considerations
    6.8. Structural Insulated Panels
7. Occupant Safety

Where applicable computer design software may be used in conjunction with topics above. For example: HOT2000 for thermal performance, modeling tools for ventilation design.

Laboratory: two hours per week for one term

1. Hands-on lab: construction of small-scale structures (building)
2. Facility tours
3. Guest speakers

Assignments and Lab reports Policy

- All assignments are due by the beginning of the lab session (on their due date).
- A **term declaration form** must be filled, signed and attached to each assignment or group lab report.
- Only single-sided assignments and lab reports are accepted. Use engineering paper only when

needed.

- Late assignments will be accepted up to 3 days following their due date. Late assignments will receive a mark deduction of 30, 40 and 50% **no exceptions**.
- Assignments must be completed individually: you are required to only consult with the TAs or course instructor if you need help. All sources of information (paper and/or electronic documents) used in the assignments must be referenced.
- All unclaimed assignments and mid-term exams become the property of the faculty and will be destructed right after the end of the term.

Assignment Descriptions

- **Design Assignments** (15%) 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** (15%) 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.

Midterm exam

- Midterm exam is a 120 minute exam and will take place on **February 24th (TBC)** during the lab period (2:30-5:30 PM)
- Midterm exam will cover material taught in lectures and included in lecture notes since the start of the term.
- Midterm exam cannot be made up, **no exceptions**. Missing the exam for excused documented medical, compassionate or travel reasons will entail adding the weight of the exam to the weight of the final exam.
- Travel request should be pre-approved by the Dean's office or the instructor prior to any test.
- Only pens, pencils, rulers, erasers, and calculators are allowed in the exam. Personal devices such as IPods, IPads, cell phones and laptops are not allowed.

Final exam

- The final exam is **3:00 hours**
- Only allowed documents, pens, pencils, rulers, erasers, and calculators are allowed in the exam. Personal devices such as IPods, IPads, cell phones and laptops are not allowed.
- **Please note: You must pass the final exam in order to pass the course.**

Assessment method and scale

Letter Grade	Percentage
A+	92-100
A	85-91.99
B+	78-84.99
B	72-77.99
C+	66-71.99
C	60-65.99
D	50-59.99
F	Less than 49.99

Other course policies

- Attendance of lectures is **mandatory**. An attendance sheet will be circulated at the beginning of every lecture. To confirm attendance, please sign next to your printed name. Do not write your name down or initial. Only a **signature** is accepted as confirmation of attendance.
- Lecture notes will not necessarily cover everything discussed in lectures. Similarly, lectures will not necessarily cover everything included in the notes. You should take your own notes to avoid missing any critical information.
- Lectures notes will be posted on UM Learn before the lectures.
- Dr. F. Delijani, and the University of Manitoba hold copyright over the course materials, presentations and lectures that form part of this course. No audio or video recording of lectures or presentations is allowed in any format, openly or surreptitiously, in whole or in part without permission from Dr. Farhoud Delijani. Course materials (both paper and digital) are for the participant's private study and research.

University policies

- The Faculty of Engineering expects regular attendance of all students at lectures, laboratories, and tutorials. Attendance will be taken to monitor this information. If the number of unexcused absences recorded against a student in any one course exceeds 10 percent of the number of course hours (including mandatory lectures, laboratories, and tutorials), the course instructor may report the case to the Dean of Engineering and inform the student of potential debarment. If the student's attendance or work continues to be unsatisfactory, the instructor has the authority to initiate procedures to debar the student from attending classes, handing in assignments, and from final examinations and/or from receiving credit. Such cases shall be reported to the Faculty Council of Engineering at the first opportunity. Students so debarred will have failed that course and will have to repeat the course in the case that the course is compulsory. (University of Manitoba General Academic Regulations 7.1 & Faculty of Engineering Academic Regulations 3.2).

- The undergraduate calendar defines plagiarism as taking ideas or words of another person and passing them off as one's own. In short, it is stealing something intangible rather than an object. It will be considered plagiarism and/or cheating if you copy the answers of another student in any examination or take-home assignment. Plagiarism or any other form of cheating in tests,

examinations or take-home assignments is subject to severe academic penalty (e.g. suspension or expulsion). A student found guilty of contributing to cheating is also subject to serious academic penalties.
- All unclaimed assignments become property of the Faculty of Engineering and are subject to destruction.

Communications

- Some course announcements will be made via email. You are responsible to ensure that you are officially registered for the course, that you have access to it through UM Learn, that your university email account sends and receives email messages, and that you regularly check your inbox and UM Learn for relevant notices and updates.
- All correspondence by email to myself or the TAs must be done using your university email accounts and not your personal accounts.
- TAs are available to meet during posted office hours. To meet outside office hours, please email them for an appointment.
- Email messages will be answered within 48 hours.
- Please be polite when emailing. Professional behaviour is expected from all of you as future professional engineers.

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/

  520 University Centre
  (204) 474 7423
  Email: Student_accessibility@umanitoba.ca

Supplemental Course Information for BIOE4412

All engineering courses are expected to contribute, in some way, to the development of one or more of the 12 graduate attributes that have been identified by the Canadian Engineering Accreditation Board. The 12 graduate attributes have been defined below for your information.

Graduate Attributes

1. **A Knowledge Base for Engineering:** Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.
2. **Problem Analysis:** An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.
3. **Investigation:** An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.
4. **Design:** An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, and economic, environmental, cultural and societal considerations.
5. **Use of Engineering Tools:** An ability to create, select, apply, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.
6. **Individual and Team Work:** An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.
7. **Communication Skills:** An ability to communicate complex engineering concepts within the profession and with society at large. Such ability includes reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.
8. **Professionalism:** An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.
9. **Impact of Engineering on Society and the Environment:** An ability to analyze social and environmental aspects of engineering activities. Such ability includes an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society, the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.
10. **Ethics and Equity:** An ability to apply professional ethics, accountability, and equity.
11. **Economics and Project Management:** An ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations.
12. **Life-long Learning:** An ability to identify and address their own educational needs in a changing world in ways sufficient to maintain their competence and to allow them to contribute to the advancement of knowledge.

Expected Competency Level

Learning Outcome	Attribute*											
	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	D	D		D	D							
2	D	D		D	D							
3	D	D		D	D							
4						D	D					

Graduate Attribute Allocation for BIOE4412

Assessment Element	Value	Attributes Covered	Indicators Assessed	Level Note 1
Mid Term Exam	15%	Problem Analysis Knowledge Base	PA.3 Analyzes and solves complex engineering problems KB.4 Specialized Engineering science	D
Assignments	15%	Design Communication Skills Engineering Tools Knowledge Base	DE.2 Uses an appropriate design process DE.3 Develops possible solutions CS.2 Produces appropriate engineering documents ET.1 Uses tools to complete engineering activities KB.3 Fundamental Engineering science KB.4 Specialized Engineering science	D
Project	20%	Design Communication Skills Individual & Team	DE.1 Understands open-ended engineering design DE.2 Uses an appropriate design process DE.3 Develops possible solutions CS.1 Applies principles for effective engineering communication CS.3 Delivers effective technical presentations IT.1 Participates in group activities IT.2 Contributes equitably to group work IT.3 Exhibits appropriate interpersonal skills	D
Final Exam	50%	Knowledge Base Design	KB.3 Fundamental Engineering science KB.4 Specialized Engineering science DE.2 Use appropriate design process	D