University of Manitoba | Price Faculty of Engineering
Department of Biosystems Engineering

Course Outline

# BIOE 4420 Crop Preservation
## Winter 2025

### Instruction Team


- Dr. Fuji Jian, P.Eng. (he/him)

  Associate Professor
  E1-352 EITC

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### Student Hours

- Individual assistance is available by appointment – stop by!

### Location

- **R213 Russell Bldg**
  MWF 11:30 - 12:20 pm
- **E2-399 EITC**
  R 2:30-4:30 pm

### Contact Hours

- 4 credit hours
- Lectures:
  3 hours x 12.3 weeks = 37 hours
- Labs/Tutorials:
  2 hours x 12 weeks = 24 hours

### Prerequisites:

- BIOE 3110

### Course Website:

http://umanitoba.ca/umlearn

### Traditional Territories Acknowledgement

The University of Manitoba campuses are located on the original lands of Anishinaabeg, Ininiwak, Anisininewuk, Dakota Oyate and Dene, and on the National Homeland of the Red River Métis.

We respect the Treaties that were made on these territories, we acknowledge the harms and mistakes of the past, and we dedicate ourselves to move forward in partnership with Indigenous communities in a spirit of reconciliation and collaboration.

## Course Description

Biological and physical deterioration during storage. Methods of preserving and storing cereals, oilseeds, and other agricultural crops.

## Course Goals

Students are expected to gain an understanding of the physical (grain physical properties, temperature, moisture, and gas), chemical (chemical materials and chemical reaction such as grain respiration), biological (insects, mites, and microorganisms), and economic variables affecting the preservation and storage of cereal grains, oilseeds, and other agricultural products such as biomass and vegetables. The principles are applied to the design and operating criteria of storage systems. After the completion of the lectures, students should have the knowledge of industrial grain storage practice to maintain quality of grain and their products. The laboratory work will also provide students with an opportunity to collaborate equitably with group members in a team setting to manage an engineering testing project and write a technical report.

## Course Content

1. Introduction and overview of the postharvest grain industry in Canada. Grain storage in the world. Why storage is needed?
2. Grain physical properties: moisture contents, relative humidity, ERH-EMC curves, specific heat, thermal conductivity, thermal diffusivity, densities, angles of repose, distribution of dockage, and mass and funnel flow.
3. Ecosystem components: respiration of biological materials, pre- and post-harvest fungi, insects, and mites. Mycotoxin in stored grain and oil seeds. Characteristics of grain storage ecosystems. Example of hot spot and storage life.
4. Grain temperature: Initial temperatures, temperatures in stored grain bins. Effect of bin diameter and height, initial grain temperature, bin wall material, solar radiation, and geological location.
5. Grain moisture contents: change in moisture content. Moisture migration.
6. Controlled atmosphere storage.
7. Psychometric chart. Grain depth and air flow resistance, vertical vs horizontal air flow resistance.
8. Grain drying: Principles of drying.
9. Design of near-ambient drying systems.
10. Design of heated-air drying systems.
11. Advanced grain storage practice. Safety and health hazards. Monitoring of stored grain.

## Laboratories

1. Tour of grain storage facility, identification of insects, mites, and molds.
2. Physical property of grain bulk (angle of repose, friction of biomass materials, and density).
3. Experimental project: read publication related to deterioration of wheat and canola during storage. Conduct the experiments. Write a report.

## Recommended Reading

The instructor will supply materials through the course website (www.umlearn.com).


Muir, W.E. 1999. Grain Preservation Biosystems.

Jian, F., D.S. Jayas. 2022. Grains: Engineering Fundamentals of Drying and Storage. CRC Press, Boca Raton, London, New York. 477-pages.

## Accreditation Details

### Accreditation Units

- Mathematics: 0%
- Natural Science: 0%
- Complementary Studies: 0%
- Engineering Science: 75%
- Engineering Design: 25%

### 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

### Competency Levels

I - Introduced
D – Intermediate (Developing)
A - Advanced

## Grading Scale

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

| Letter | Mark |
|---|---|
| A+ | 90–100 |
| A | 85–89 |
| B+ | 80–84 |
| B | 75–79 |
| C+ | 65–74 |
| C | 60–64 |
| D | 50-59 |
| F | < 50 |

## Learning Outcomes

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

| No. | Learning Outcome |
|---|---|
| 1 | Understand fundamental concepts of grain and biomass storage and handling.<br>-Explain the physical, chemical, biological, and economic variables affecting the preservation and storage of cereal grains, oilseeds, and other agricultural products such as biomass and vegetables.<br>-Identify safety concerns during grain and biomass storage and handling. |
| 2 | Use principles and theories delivered in this course to solve problems.<br>-Evaluate existing storage scenarios to identify conditions likely to cause storage losses.<br>-Design storage systems to preserve the quality of grains, oilseeds, and other agricultural products such as biomass and vegetables.<br>-Design suitable drying and aerations systems to store biomaterials under safe storage conditions. |

## Evaluation

| Component | Value (%) | Assessor | Method of Feedback* | Learning Outcomes Evaluated | I/T** |
|---|---|---|---|---|---|
| Midterm Exams | 30 | FJ | S | 1, 2 | I |
| Term Assignments | 30 | FJ | F,S | 1, 2 | I |
| Final Exam | 40 | FJ | S | 1, 2 | I |

* Method of Feedback: **F** - Formative (written comments / oral discussion), **S** - summative (numerical grade)

** I/T: **I** – Individual effort, **T** – A team effort

Term Assignments include a design project and laboratory report. Questions will be assigned weekly or biweekly and will be evaluated for content (Total 6 assignments). The questions include the understanding of theories, principles, and design works. The reports should be presented in a neat and easy to read format (handwriting is acceptable but prefer printing). The mark of the lab report will be counted as two assignments. Students are expected to complete their assignments on an individual basis even though discussion with the instructor and classmates are encouraged.

The mid-term exam is scheduled before the reading break during lab time. The date of the final exam will be scheduled by the University of Manitoba. The examinations will be closed-book exams. The questions will be similar to those assignments plus descriptive questions on theory and design works. Material presented in class, in laboratories, and in the textbook will be covered.

**Late Submission Policy**: Assignments submitted after the due date will receive a zero grade unless the student has a valid medical or compassionate reason.

**Group Work Policies:** You will be required to share your laboratorial results with your classmates. If you could not provide your results on time, penalties deducted for late sharing will be 10% per day.

**Lab/Tutorial Attendance:** The tutorials are not optional.

## CEAB Graduate Attributes Assessed

This course will assess the following CEAB graduate attribute indicators shown below:

| Indicator (Level) | Indicator Description | Assessment Point |
|---|---|---|
| KB.4 (I, D, A) | Recalls and defines, and/or comprehends and applies, first principles and concepts in specialized engineering science. | Midterm exam, final exam |
| PA.3 (A) | Analyzes and solves complex engineering problems. | Midterm exam, final exam, assignments |
| DE.3 (D) | Develops possible solutions to an open-ended design problem, leading to an appropriate recommendation. | Assignments |
| ET.1A (D) | Uses analytical tools to complete engineering activities. | Assignments |

## Important Dates

| | |
|---|---|
| **Winter Term Break**<br>February 17-21, 2025 | **Midterm Exam**<br>February 13, 2025 |
| **Voluntary Withdrawal Date**<br>March 19, 2025 | **Final Exam**<br>Scheduled by Registrar's Office |
| **Last Day of Classes**<br>April 9, 2025 | |

## Academic Integrity

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the *General Academic Regulations* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g., suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

## Requirements/Regulations

- Please copy the Instruction Team in all emails (Instructors and Teaching Assistants). All email communication must conform to the Communicating with Students university policy.

*Communicating with Students*

- As the Instruction Team, we will do our best to respond to all emails **within 48 hours during working hours** (8:30 AM – 5:30 PM Monday thru Friday). Ex. A Friday night email may not be responded to until the following Tuesday.
- Self-declaration forms may be completed for missed tests, exams, or assignments during short-term absences (≤72 hours) for extenuating circumstances. This form cannot be used for planned absences like vacations. It is also not to be used for longer-term absences, or ongoing circumstances (e.g., Authorized Withdrawals, Leaves of Absence, or other accommodations), which will still require additional documentation.

*Self-Declaration Form for Brief or Temporary Absence*

*Self-Declaration Policy for Brief or Temporary Absences*

- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should familiarize themselves with the University's *General Academic Regulations*.

*General Academic Regulations*

*Engineering Academic Regulations*

- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g., Academic Integrity, Respectful Behaviour, Examinations, and related matters.
- *Supplemental Resources*

## Deferred Final Examinations

Students who miss the regularly scheduled writing of a final examination for valid medical or compassionate reasons will only be allowed to write a deferred exam if the Associate Dean (Undergraduate) approves the request. All requests for a deferred examination *must* be made within 48 hours of the missed exam and follow the procedure described on the Faculty website without exception. Course Instructors *do not have the discretion* to grant deferred final examinations.

*Deferred Exam Policy (student experience website)*

## Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e., assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the Instructor and the Department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.

## Copyright Notice



*Copyright Office*