University of Manitoba

Faculty of Agricultural & Food Sciences
Department of Biosystems Engineering

Course Outline

Instruction Team
Fuji Jian (He, his),
PhD, P.Eng.
Associate Professor
Room E1-352
Tel: 204-294-1295
E-mail:
fuji.jian@umanitoba.ca

Student Hours
Individual assistance is available by appointment.

Location
St. John Rm:113
Tues 11:30 - 12:45 PM
Thurs 11:30 - 12:45 PM

Contact Hours
- 3 credit hours
- Lectures:
  3 hours x 12 weeks = 36 hours

Prerequisites:
BSc in Biosystems Engineering or equivalent

Course Website:
http://umanitoba.ca/umlearn

The Department of Biosystems Engineering has devised a plan so that there is minimal impact on the delivery and content of the course, should the instructor fall sick and be unable to continue lectures in-person. Please be assured that the alternative plan outlining any deviation from the normal mode of instruction will be communicated to you as quickly as possible if/when the need arises.

BIOE 7360 Biological Systems: Behavior, Modelling and Simulation, Winter term, 2026

Course Description

Course materials will analyze critical elements of mathematical models; provide principles and techniques of modelling biological systems, modeling process, estimation of model parameters, and model analysis and validation. Applications of engineering principles and mathematical methods to model and simulate biological ecosystems will be also presented. Examples of existing models will be discussed and used to simulate various biological systems**.**

General Course Information

A biological system is a system of living organisms that can directly or indirectly interact with others and within their environments. This course provides students with an overview of biological systems in terms of their fundamental attributes, processes, and interactions. The emphasis will be placed on the principles and applications in the development of basic mathematical modelling of biological systems. Procedures for development of qualitative and quantitative models, estimation of model parameters, and model calibration and validation will be demonstrated by presenting examples of biological systems that have been modelled.

Course Objectives

- To provide students with an overview of mathematical models.
- To teach students the principles and techniques of mathematical modelling of biological systems.
- To train students to use specific mathematical modelling techniques and software to model different biological systems.

Intended Learning Outcomes

At the conclusion of the course, the students should:
1) Become familiar with common modelling principles for biological systems.
2) Gain the knowledge and skills to formulate models for biological systems.
3) Be able to model basic biological systems in his/her research area.

Textbook

Lecture notes (pdf files) will be posted on UM Learn for download.
Required textbook: None

Important Dates

First day if classes
Jan. 6, 2026

Last Day of Classes
April 9, 2026

Early Withdrawal Deadline
Jan. 19, 2026

Voluntary Withdrawal Deadline
Mar. 19, 2026

Winter Term Break
Feb. 16 -20, 2026
No classes or examinations

Grading Scale

Letter Grade	Percentage out of 100
A+	90-100
A	85-89
B+	80-84
B	71-79
C+	65-70
C	60-64
D	50-59
F	Less than 50

Assignment Feedback

Students can expect to receive graded assignments within two weeks of their submission.

Course Policies:

If you miss lecture(s), it is your responsibility to obtain information on material covered and any announcements made during the lecture.
Submission after the due date will be docked 10% per school day for the first three days, and submission after three days will receive a zero grade. However, each student is allowed to have one late submission (no later than 3 days). Students need to contact me at the time you wish to use the late submission allowance. Missed submission will receive a zero grade for that submission.

Supplementary Reading materails will be provided.

Course Content

1. Introduction
1.1. Example of a biological system: grain storage ecosystems
1.2. Regression model and application in mathematical modelling
1.3 Introduction of modelling and process of modeling
1.4. Examples of basic models
2. Concept model formulation
3. Quantitative model formulation
4. Matrix model
5. Simulation
6. Numerical model
7. Sensitivity analysis
8. Examples of models for biological systems (materials will be offered based on students' interests which will be surveyed at the beginning of the course)

Assignments

- There will be 5 to 6 assignments and one project (model developemtn and presenation). Almost all the assignments require the use of computer software, such as Sigmaplot, MatLab, visual studio, and Oprnfoam.
- The objectives of each assignment are stated in the assignment handouts. Large assignments will be due after 2 to 3 weeks.
- For evaluations, points/marks will be assigned to each question, and steps within a question.
- You are required to complete your assignments independently. You may be allowed to discuss the assignment topics with others. However, you need to ensure that your discussion complies with the academic integrity regulations. Either copying from another student or letting other students to copy from you works will receive zero grade and academic penalty.

Your assignments should be submitted in physical paper format.

- Dr. Jian will mark your assignments and note comment on your assignments. If you need more feedback, please email them.

Course Evaluation

Assignments: 30%
Project: 20%
Final exam 50%

Expectation

You are expected to learn the materials covered in lectures and assignments. Attendance for lectures is strongly expected. To benefit the most from this course, you must be willing to review the course materials and participate in discussions about the material preferably during class or tutorial. While it is the instructor's responsibility to inform you changes in due dates, assignment material, etc…, it is your responsibility to read your university email regularly at least daily. Please also respect your fellow students during class, such as mute your cell phone.

You are required to obtain and use your UM email account for all communication between yourself and the university. All communication must comply with the Electronic Communication with Student Policy: http://umanitoba.ca/admin/governance/governing_documents/community/electronic_communication_with_students_policy.html.

Academic Integrity

- Each student in this course is expected to abide by the University of Manitoba Academic Integrity principles. Always remember to reference the work of others that you have used.
- You must do your own work individually during assignment and exams.
- Inappropriate collaborative behavior and violation of other Academic Integrity principles, will lead to the serious disciplinary action. Please visit the Academic Calendar, Student Advocacy, and Academic Integrity web pages for more information and support.
- University policy states that plagiarism or any form of cheating in examinations, term tests or academic work is subject to serious academic penalty. Penalties range from a grade of zero for the assignment or examination, failure in the course, to expulsion from the faculty or university. Cheating in assignments or project works may take the form of copying from another student or let other students to copy from you.

Requirements/Regulations

- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, smart watches, wireless communication, or data storage devices) are allowed in examinations unless approved by the course instructor.
- All email communication must conform to the Communicating with Students university policy.

  Communicating with Students
- Attending lectures and laboratories is essential for the successful completion of this course.
- Self-declaration forms may be completed for missed tests, exams, or assignments during short-term absences (≤72 hours) for extenuating circumstances. Students don't need to share personal information about their situation beyond declaring the nature of the extenuating circumstance on the self-declaration form.

  Self-Declaration Form for Brief or Temporary Absence
- 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 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
- 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

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/or the department for the purpose of student assessment and grading. 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