



# ENGG\*2660 Biological Engineering Systems I

01

Winter 2023

Section(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - January 03, 2023

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## 1 Course Details

### 1.1 Calendar Description

This course deals with the mathematical description and identification of biological systems through: mass and energy balances; reactions in biological systems; and applications in biomedicine, food and bioprocessing.

**Pre-Requisites:** ENGG\*2400, MATH\*2270, (1 of BIOL\*1070, BIOL\*1080, BIOL\*1090)

**Restrictions:** This is a Priority Access Course. Enrolment may be restricted to the BIOE specialization in the BENG and BENG:C programs. See department for more information.

### 1.2 Course Description

Bioengineering is a broad discipline that integrates engineering principles with biological sciences. Applications include biochemical and food engineering bioresource engineering and biomedical engineering. Systems identification and analysis are common to all of these areas and form the foundation for engineering design. We will focus on systems containing biological catalysts (e.g. cells, enzymes) and/or other reacting species. A range of bio-system examples will be studied including those pertaining to food and bioprocessing industries.

### 1.3 Timetable

#### Lectures

Monday, Wednesday, Friday  
8:30 AM-9:20 AM, CRSC 403

#### Tutorial/Quiz

Wednesday  
Sec 01 11:30 AM-12:20 PM, CRSC 403

## 1.4 Final Exam

Final Exam:

EXAM Tues

08:30AM - 10:30AM (2023/04/25)

Room TBA

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## 2 Instructional Support

### 2.1 Instructional Support Team

<b>Instructor:</b>	Guneet Kaur PhD
<b>Email:</b>	gkaur41@uoguelph.ca
<b>Telephone:</b>	519-824-4120
<b>Office:</b>	RICH 1503

### 2.2 Teaching Assistants

<b>Teaching Assistant (GTA):</b>	Dayna McNeill
<b>Email:</b>	dmcnei02@uoguelph.ca

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## 3 Learning Resources

### 3.1 Required Resources

#### Course Website (Website)

Course material, news, announcements, and grades will be regularly posted to the ENGG\*2660 Courselink site. You are responsible for checking the site regularly.

#### Basic Principles and Calculations in Chemical Engineering, 8th Edition, David M. Himmelblau & James B. Riggs, Prentice-Hall. (Textbook)

Basic Principles and Calculations in Chemical Engineering, 8<sup>th</sup> Edition, David M. Himmelblau & James B. Riggs, Prentice Hall.

### 3.2 Additional Resources

**Lecture Information:** All the lecture notes will be posted on Courselink prior to the lecture. During the lecture, additional notes and examples will be provided. It is expected that you will

have a copy of the posted lecture notes for each class.

**Tutorial Information:** The tutorial notes will also be posted on the Courselink.

**Miscellaneous Information:** Other information related to this course may also be posted on the web page.

## 4 Learning Outcomes

### 4.1 Course Learning Outcomes

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

1. Identify and analyse mass and energy transformations in biological systems.
2. Develop mathematical models for biological systems and analyse their dynamic behaviour.
3. Integrate fundamental principles of microbiology and biochemistry with quantitative analysis to solve engineering problems.

### 4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome	Learning Outcome
1	Knowledge Base	1, 2, 3
1.1	Recall, describe and apply fundamental mathematical principles and concepts	1, 2, 3
1.3	Recall, describe and apply fundamental engineering principles and concepts	1, 2
1.4	Recall, describe and apply program-specific engineering principles and concepts	1, 2, 3
2	Problem Analysis	1, 2, 3
2.1	Formulate a problem statement in engineering and non-engineering terminology	1, 2, 3
2.2	Identify, organize and justify appropriate information, including assumptions	1, 2, 3
2.3	Construct a conceptual framework and select an appropriate solution approach	2

#	Outcome	Learning Outcome
2.4	Execute an engineering solution	2

## 5 Teaching and Learning Activities

### 5.1 Lecture

#### Week 1

**Topics:** - Introduction to Chemical Engineering and Bioengineering. (Week 1)

- Dimensional analysis. (Week 1)

**Learning Outcome:** 2, 3  
Textbook Chapter 1&2 and slides

#### Week 2

**Topics:** Fundamentals of Material Balances; Material Balances for Single Units Without Reactions.

**Learning Outcome:** 1, 2  
Chapters 3 & 4

#### Week 3

**Topics:** Material Balances for Multiple Units Without Reactions; Material Balances for Reactive Processes.

**Learning Outcome:** 1, 2, 3  
Chapters 4, 5 & 6

#### Week 4

**Topics:** Material Balances for Reactive Processes.

**Learning Outcome:** 1, 2  
Chapter 5

#### Week 5

**Topics:** Material Balances for Recycle Systems, Bypass and Purge.

**Learning Outcome:** 1, 2  
Chapter 6

**Week 6**

**Topics:** Fundamentals of Energy Balance.

**Learning Outcome:** 1, 2  
Chapter 9

**Week 7**

**Topics:** Energy Balances on Nonreactive Processes without Phase Change.

**Learning Outcome:** 1, 2, 3  
Chapter 10

**Week 8**

**Topics:** Energy Balances on Nonreactive Processes with Phase Change.

**Learning Outcome:** 1, 2, 3  
Chapters 10 & 11

**Week 9**

**Topics:** Mixing and Solutions; Fundamentals for Energy Balances on Reactive Processes.

**Learning Outcome:** 1, 2  
Chapters 10 & 13

**Week 10**

**Topics:** Energy Balances on Reactive Processes.

**References:** Chapter 10

**Learning Outcome:** 1, 2, 3

**Week 11**

**Topics:** The Mechanical Energy Balance.

**Learning Outcome:** 1  
Chapter 14

**Week 12**

**Topics:** Unsteady-State Material and Energy Balances.

**Learning Outcome:** 1  
Chapter 17

## 5.2 Other Important Dates

Monday, January 09, 2023 – Classes commence  
 Monday, February 20-Friday, February 24, 2023 – Winter Break  
 Monday, April 10, 2023 – Classes conclude  
 Thursday, April 13-Tuesday, April 25, 2023, Examinations

## 5.3 Disclaimer

The instructor reserves the right to change any or all of the above in the event of appropriate circumstances, subject to the University of Guelph Academic Regulations.

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# 6 Assessments

## 6.1 Assessment Details

### Quizzes (in Tutorials) (15%)

11 tutorial & quiz sessions (Week 2-12). Each tutorial will cover two parts. In the first part, your GTA will solve and discuss 1 problem and in the second part, you will be asked to solve a problem. At the end of the tutorial, you will submit your solution to the GTA for grading. You are encouraged to attend the tutorial section regularly. If you miss a tutorial, you won't be allowed to write it in any other section and you will receive a Zero for that quiz.

### Midterm Exam 1 (Open Book) (17.5%)

**Date:** Fri, Feb 10, 8:30 AM - 9:15 AM, CRSC 403

**Learning Outcome:** 1, 2, 3

Note: An Open Book exam means that you are allowed to bring the course textbook but not your notes and problem set solutions (If you copy solutions to the problem sets into your textbook, your textbook will be confiscated by the instructor or TA and returned to you after you hand in your exam). You are also allowed to use a non-programmable calculator during the exams.

### Midterm Exam 2 (Open Book) (17.5%)

**Date:** Fri, Mar 24, 08:30 AM - 9:15 AM, CRSC 403

**Learning Outcome:** 1, 2, 3

Note: An Open Book exam means that you are allowed to bring the course textbook but not your notes and problem set solutions (If you copy solutions to the problem sets into your textbook, your textbook will be confiscated by the instructor or TA and returned to you after you hand in your exam). You are also allowed to use a non-programmable calculator during the exams.

### Final Examination (Open Book) (50%)

**Date:** TBD, TBD

**Learning Outcome:** 1, 2, 3

Note: An Open Book exam means that you are allowed to bring the course textbook but not your notes and problem set solutions (If you copy solutions to the problem sets into your textbook, you will not be allowed to use it during the exams). You are also allowed to use a non-programmable calculator during the exams.

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## 7 Course Statements

### 7.1 Course Grading Policies

**Missed Assessments:** If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

**Accommodation of Religious Obligations:** If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:

<http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml>

**Missed Midterm Exam:** If you miss the midterm due to grounds for granting academic consideration or religious accommodation, the weight of the missed midterm will be added to the final exam. **There will be no makeup midterm tests.**

**Passing grade:** The overall passing grade of this course is 50% and every student must obtain a grade of 50% or higher in the Midterm and Final Exam portion of the course in order for the Quizzes portion of the course to count towards the final grade.

**Tutorial Work:** You must attend and complete all tutorials. If you miss a tutorial due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup tutorial.

### 7.2 Relationships with other Courses & Labs

**Previous Courses:**

ENGG\*2120: Materials Science: Fundamentals of materials science are reviewed in this class.

ENGG\*2400: Engineering Systems Analysis: This course uses techniques and tools developed in ENGG\*2400 to analyse mass, energy and momentum components of biological systems.

BIOL\*1070, BIOL\*1080, BIOL\*1090, MICR\*2420: Concepts of biodiversity, cell and molecular biology and microbiology are covered that are helpful for fundamental understanding of this course.

**Follow on courses:**

ENGG\*3160: Biological Engineering Systems II: Fundamental learning from ENGG\*2660 course is essential to understand mass transfer processes of biological importance.

ENGG\*41X: Fourth year engineering design IV projects will integrate bioprocess principles used in ENGG\*2660 course.

## **8 School of Engineering Statements**

### **8.1 Instructor's Role and Responsibility to Students**

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

### **8.2 Students' Learning Responsibilities**

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

### **8.3 Lab Safety**

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

## **9 University Statements**

### **9.1 Email Communication**

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

### **9.2 When You Cannot Meet a Course Requirement**

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.



Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

### 9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

### 9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

### 9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or

changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website  
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website  
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

## 9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct  
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct  
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

## 9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

## 9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars  
<https://www.uoguelph.ca/academics/calendars>

## 9.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

## 9.10 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).

## 9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- <https://news.uoguelph.ca/return-to-campus/how-u-of-g-is-preparing-for-your-safe-return/>
- <https://news.uoguelph.ca/return-to-campus/spaces/#ClassroomSpaces>

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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