ENGG*2660 Biological Engineering Systems I

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Winter 2021
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 2.00 - January 08, 2021

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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
12:30 PM-01:20 PM, Virtual

Tutorial/Quiz

Monday
Sec 01 02:30 PM-03:20 PM, Virtual

Tuesday

Sec 02 08:30 AM-09:20 AM, Virtual

1.4 Final Exam

Final Exam: 02:30 PM - 04:30 PM (2021/04/26) Room TBA

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2 Instructional Support

2.1 Instructional Support Team

Instructor: Ashutosh Singh PhD, PEng
Email: asingh47@uoguelph.ca
Telephone: 519-824-4120, ex:53048
Office: RICH3525

2.2 Teaching Assistants

Teaching Assistant: Prabhjot Kaur
Email: pkaur07@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^{th} 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.

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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
1.4	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
3	Investigation	1, 2, 3
3.1	Propose a working hypothesis	1, 2, 3
3.2	Design and apply an experimental plan/investigative approach (for example, to characterize, test or troubleshoot a system)	1, 2, 3
5	Use of Engineering Tools	1, 2, 3
5.1	Select appropriate engineering tools from various alternatives	1, 2, 3
6	Individual & Teamwork	1, 2, 3

#	Outcome	Learning Outcome
6.1	Describe principles of team dynamics and leadership	1, 2, 3
6.2	Understand all members' roles and responsibilities within a team	1, 2
12	Life Long Learning	1
12.1	Identify personal career goals and opportunities for professional development	1

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 11, 2021 – Classes commence
Monday, February 15-19, 2021 – Winter Break
Friday, April 12, 2021 – Classes conclude
Thursday, April 15-27, 2021, 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

Tutorial & Quizzes (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 (in the Dropbox Folder for the respective Quiz) 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 an immediate Zero as the grade.

Midterm Exam 1 (Open Book) (17.5%)
Date: Fri, Feb 12, 12:30 PM - 1:15 PM, Zoom
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.

Midterm Exam 2 (Open Book) (17.5%)
Date: Fri, Mar 19, 12:30 PM - 1:15 PM, Zoom
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.

Final Examination (Open Book) (50%)
Date: Mon, Apr 26, 2:30 PM - 4:30 PM, Zoom
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 book their exams at least 7 days in advance and not later than the 40th Class Day.

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 and academic schedules. Any such changes will be announced via CourseLink and/or class email. 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

The University will not normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.
