ENGG*2230 Fluid Mechanics

Fall 2019
Section(s): C01

School of Engineering
Credit Weight: 0.50
Version 1.00 - September 04, 2019

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1 Course Details

1.1 Calendar Description

Analysis of steady ideal and viscous fluid flow systems using the Continuity, Bernoulli and Momentum equations. Boundary layer theory is treated in terms of viscous and pressure drag, lift and its importance in heat and mass transfer. Dimensional analysis and dynamic similitude are studied to provide an understanding of flow systems analysis and modeling. Introduction to pipe flow and open channel flow.

Pre-Requisites: ENGG*1210, MATH*1210

1.2 Timetable

Lectures:

Tuesday		2:30PM – 3:50PM	MACN 113
Thursday		2:30PM – 3:50PM	MACN 113

Seminars/Tutorials:

Friday	#1	8:30AM – 10:20AM	THRN 1002
Thursday	#2	8:30AM – 10:20AM	THRN 1002
Wednesday	#3	9:30PM – 11:20AM	THRN 1002

Laboratory:

Friday	#1	8:30AM – 10:20AM	THRN 1125
Thursday	#2	8:30AM – 10:20AM	THRN 1125
Wednesday	#3	9:30PM – 11:20AM	THRN 1125

1.3 Final Exam

Tuesday December 10th, 2:30PM to 4:30PM, room TBA.

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2 Instructional Support

2.1 Instructional Support Team

Instructor: Rafael Santos
Email: santosr@uoguelph.ca
Telephone: +1-519-824-4120 x52902
Office: THRN 2342
Office Hours: TBA on CourseLink or by appointment

Lab Technician: Ryan Smith
Email: rsmith17@uoguelph.ca
Telephone: +1-519-824-4120 x53278
Office: THRN 1114

2.2 Teaching Assistants

Teaching Assistant: Mohammad Khodabakhshisoureshjani
Email: mkhodaba@uoguelph.ca

Teaching Assistant: Arash Yoosefdoost
Email: arashyd@uoguelph.ca

Teaching Assistant: Trishan Deb Abhi
Email: tabhi@uoguelph.ca

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3 Learning Resources

3.1 Required Resources

Course Website (Website)

https://courselink.uoguelph.ca/

Course material, news, announcements, and grades will be regularly posted to the ENGG*2230 CourseLink site. You are responsible for checking the site regularly. **As per University regulations, all students are required to check their <mail.uoguelph.ca> e-mail account regularly**; e-mail is the official route of communication between the University and students.

Fluid Mechanics (Textbook)

https://www.mheducation.com/highered/product/fluid-mechanics-white/M9780073398273.html

"**Fluid Mechanics**", by Frank M. White , 8th Edition, McGraw-Hill, 2016, ISBN 978-0-07-339827-3.

Available from the publisher as Hardcopy and as eBook.

Hardcopies of the 8th, 7th and 6th editions have been placed on reserve at the McLaughlin Library.

3.2 Recommended Resources

Engineering Peer Helpers (Voluntary) (Other)

The peer helper program, staffed by upper year engineering students, offers regular workshops aimed at developing problem solving skills and new learning tools specific to core engineering courses such as Fluid Mechanics. For more information on the Peer Helper program, visit:

https://www.uoguelph.ca/engineering/content/current/peer-helper

Recommended readings (Textbook)

These are other textbooks that students may find helpful when in need of additional readings and practice problems (note: not all available, or not in latest editions, in the McLaughlin Library):

"**Marks' Standard Handbook for Mechanical Engineers**", by E.A. Avallone, T. Baumeister III, A. Sadegh. 11th Edition.

"**Schaum's Outline of Fluid Mechanics and Hydraulics**", by R.V. Giles, J.B. Evett, C. Liu. 4th Edition.

"**Perry's Chemical Engineers' Handbook**", by D.W. Green, R.H. Perry. 8th Edition.

"**Mechanics of Fluids**", by M.C. Potter, D.C. Wiggert, B.H. Ramadan. 5th Edition.

3.3 Additional Resources

Lecture Information (Notes)

Lectures will be presented through a combination of PowerPoint slides, Chalkboard notes, and Document Camera notes. The slides for the lectures will be posted on the course website (CourseLink). These slides are augmented with in-class notes and detailed example solutions. You are thus expected to **take notes** during class, which includes theory, the example solutions, and supplementary information the professor provides while lecturing.

Lab Manual (Lab Manual)

The lab manual is available on CourseLink. You are responsible for reviewing this and having an electronic or hard copy with you during your laboratory sessions. You must read the laboratory manual to prepare for each experiment **prior** to your scheduled laboratory.

Problem Sets (Other)

There will be **weekly unmarked** problem sets posted on CourseLink during the term. You are expected to complete each problem set on a timely basis. Most students find that practice problems are the best way to stay engaged in the course. The solutions will be posted on CourseLink approximately one week after the unmarked problem set is posted.

Tutorials - Cooperative Learning Exercises (Other)

There will be 5 tutorials in which cooperative learning exercises will take place. During these tutorials, you will work in groups to solve problems on the white boards in the tutorial room. Peer and self evaluations on your problem analysis skills as well as instructor and GTA evaluations on the solution process will be used to determine an individual grade for the cooperative learning exercise. Your **best 4 out of 5** grades will be considered for your final grade assessment.

Miscellaneous Information (Other)

Supporting information will also be occasionally posted on the CourseLink site.

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4 Learning Outcomes

4.1 Course Learning Outcomes

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

1. Describe the physical and flow properties of fluids, and their impact on engineered systems and structures.
2. Characterize and analyze fluid mechanics problems through the use of the appropriate tools, including conservation of mass, conservation of momentum, and the conservation of energy, and using the appropriate approaches, including integral (control volume), differential, or dimensional approaches.
3. Estimate head loss, required power, conduit sizing, and flow rates in internal and open flow systems, and lift and drag forces on submerged bodies.

4. Model fluid engineering systems, with stated assumptions, systematically solved and clearly communicated, including the use of correct accuracy, precision, significant digits, and dimensional homogeneity.
5. Use appropriate apparatus, sensors and instruments to analyze fluid flow, test fluid flow hypotheses, and collect data, by conducting laboratory experiments.
6. Write clear, concise and professional laboratory reports for the biweekly fluid mechanics laboratories.
7. Demonstrate effective skills in teamwork during group activities (cooperative exercises and biweekly laboratories), and respectful interactions with peers, lab technicians, graduate teaching assistants, and instructor during lectures, tutorials and laboratories.

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
1.2	Recall, describe and apply fundamental principles and concepts in natural science	1, 2, 3
1.3	Recall, describe and apply fundamental engineering principles and concepts	1, 2, 3
2	Problem Analysis	2, 3, 4
2.2	Identify, organize and justify appropriate information, including assumptions	2, 3, 4
2.3	Construct a conceptual framework and select an appropriate solution approach	2, 3, 4
2.4	Execute an engineering solution	2
2.5	Critique and appraise solution approach and results	2, 3, 4
3	Investigation	5
3.3	Analyze and interpret experimental data	5
3.4	Assess validity of conclusions within limitations of data and methodologies	5
5	Use of Engineering Tools	5
5.2	Demonstrate proficiency in the application of selected engineering tools	5

#	Outcome	Learning Outcome
5.3	Recognize limitations of selected engineering tools	5
6	Individual & Teamwork	7
6.2	Understand all members' roles and responsibilities within a team	7
6.3	Execute and adapt individual role to promote team success through, for example, timeliness, respect, positive attitude	7
6.4	Apply strategies to mitigate and/or resolve conflicts	7
6.5	Demonstrate leadership through, for example, influencing team vision and process, promoting a positive team culture, and inspiring team members to excel	7
7	Communication Skills	6
7.1	Identify key message(s) and intended audience in verbal or written communication as both sender and receiver	6
7.2	Interpret technical documentation such as device specification sheets, drawings, diagrams, flowcharts, and pseudocode	6
7.3	Construct the finished elements using accepted norms in English, graphical standards, and engineering conventions, as appropriate for the message and audience	6
7.4	Substantiate claims by building evidence-based arguments and integrating effective figures, tables, equations, and/or references	6
7.5	Demonstrate ability to process oral and written communication by following instructions, actively listening, incorporating feedback, and formulating meaningful questions	6
8	Professionalism	7
8.3	Demonstrate professional behaviour	7

5 Teaching and Learning Activities

Students are responsible for all information presented in the lectures, tutorials, and labs, and student participation is encouraged. The dynamics of each learning activity should be based on professionalism and mutual respect. Cell phones are to be turned off during the class, ear buds are to be put away, and the use of laptops and tablets in class is restricted to taking

class notes. Everyone in the classroom has the right to participate and contribute.

5.1 Lecture

Weeks 1-2
Topics: Fluids and fluid properties
References: Chapter 1
Learning Outcome: 1, 4

Weeks 2-4
Topics: Fluid statics and pressure distribution
References: Chapter 2
Learning Outcome: 1, 4

Weeks 4-5
Topics: Fluid flow concepts: control volumes
References: Chapter 3
Learning Outcome: 1, 2

Weeks 6-7
Topics: Fluid flow concepts: differential analysis
References: Chapter 4
Learning Outcome: 1, 2

Weeks 7-8
Topics: Dimensional analysis
References: Chapter 5
Learning Outcome: 1, 2

Weeks 8-9

Topics: Internal viscous flow (pipe flow)

References: Chapter 6

Learning Outcome: 1, 2, 3, 4

Week 10
Topics: External flow and boundary layer theory
References: Chapter 7
Learning Outcome: 1, 2, 3, 4

Week 11
Topics: Pumps and turbomachinery
References: Chapter 11
Learning Outcome: 1, 3

Week 12
Topics: Open channel flow
References: Chapter 10
Learning Outcome: 1, 2, 3

5.2 Labs

The laboratory is a vital part of the course – material introduced in the lab may be a part of either exam. Labs will be done in groups of up to 3 students during your scheduled lab time.

You must attend your scheduled lab during the week of September 9th to 13th, 2019. At that time you will be introduced to the lab, including lab safety, and you will sign up for your lab groups. There will be sign-up sheets available in the Fluids Lab (THRN 1125) and posted on the wall outside of the Fluids Lab once completed.

Before arriving to the laboratory to perform an experiment, **each person must have read and understood the corresponding information in the lab manual** (available on CourseLink) and **must have watched the corresponding video** (also available on CourseLink). You are expected to do the intermediate calculations (and in some cases all of the calculations) before leaving the lab.

5.3 Lab Activities

Lab Activity	Topic
0	Intro to the fluids lab and lab safety
#1	Flow measurement
#2	Impact of a jet
#3	Pipe friction
#4	Minor losses
#5	Discharge over weirs

5.4 Due Dates

The lab reports are to be submitted electronically in dropboxes in CourseLink that will be created based on your lab teams. The due date will be one week after a lab is conducted, at 11:59PM. Due dates for each lab group will be posted on Courselink.

Each lab report is to include a scanned version of the raw data sheet used while doing the experiment. This sheet is to be signed and dated by either the lab technician or the GTA before you leave the lab.

Each team must submit a single electronic report for each experiment. The report is to be no

longer than 10 pages, which includes the title page and signed data sheet; that is: one page for the title page, one page for the signed data sheet, and up to 8 pages for the rest of the work. Additional report information is in the laboratory manual.

If you miss a laboratory **due to grounds for granting academic consideration** or **religious accommodation**, arrangements must be made with the teaching assistant to complete a makeup lab during open lab days (last week of classes).

5.5 Seminar/Tutorials

The labs and tutorials will be conducted in alternating weeks during the same two-hour time blocks (labs in THRN 1125, and tutorials in THRN 1002). **Everyone must attend your scheduled lab during the week of September 9th–13th, 2019 (in THRN 1125).** During this lab time, students will be familiarized with the Fluids Lab and the required safety procedures. In addition, the sections will be divided into two groups of students of approximately equal size (designated as “A” and “B” groups). This A and B group designation will indicate in which weeks you have a lab and in which weeks you have a tutorial, as per the schedule included in the course outline.

There is no scheduled lab or tutorial prior to September 9th, 2019.

5.6 Lab and Tutorial Schedule

	Wednesday	Thursday	Friday
Sept. 9th-13th	**Section 03** Groups A&B – THRN 1125: Intro to the Fluids Lab	**Section 02** Groups A&B – THRN 1125: Intro to the Fluids Lab	**Section 01** Groups A&B – THRN 1125: Intro to the Fluids Lab
Sept. 16th-20th	**Section 03** Group A – Lab #1 Group B – Tut #1	**Section 02** Group A – Lab #1 Group B – Tut #1	**Section 01** Group A – Lab #1 Group B – Tut #1
Sept. 23rd-27th	**Section 03**	**Section 02**	**Section 01**

	Group A – Tut #1 Group B – Lab #1	Group A – Tut #1 Group B – Lab #1	Group A – Tut #1 Group B – Lab #1
Sept. 30th-Oct. 4th	**Section 03** Group A – Lab #2 Group B – Tut #2	**Section 02** Group A – Lab #2 Group B – Tut #2	**Section 01** Group A – Lab #2 Group B – Tut #2
Oct. 7th-11th	**Section 03** Group A – Tut #2 Group B – Lab #2	**Section 02** Group A – Tut #2 Group B – Lab #2	**Section 01** Group A – Tut #2 Group B – Lab #2
Oct. 14th-18th	**Section 03** Group A – Lab #3 Group B – Tut #3	**Section 02** Group A – Lab #3 Group B – Tut #3	**Section 01** Group A – Lab #3 Group B – Tut #3
Oct. 21st-25th	**Section 03** Group A – Tut #3 Group B – Lab #3	**Section 02** Group A – Tut #3 Group B – Lab #3	**Section 01** Group A – Tut #3 Group B – Lab #3
Oct. 28th-Nov 1st	**Section 03** Group A – Lab #4 Group B – Tut #4	**Section 02** Group A – Lab #4 Group B – Tut #4	**Section 01** Group A – Lab #4 Group B – Tut #4
Nov. 4th-8th	**Section 03**	**Section 02**	**Section 01**

	Group A – Tut #4 Group B – Lab #4	Group A – Tut #4 Group B – Lab #4	Group A – Tut #4 Group B – Lab #4
Nov. 11th-15th	**Section 03** Group A – Lab #5 Group B – Tut #5	**Section 02** Group A – Lab #5 Group B – Tut #5	**Section 01** Group A – Lab #5 Group B – Tut #5
Nov. 18th-22nd	**Section 03** Group A – Tut #5 Group B – Lab #5	**Section 02** Group A – Tut #5 Group B – Lab #5	**Section 01** Group A – Tut #5 Group B – Lab #5
Nov. 25th-29th	**Open lab day for makeup labs (all sections)**		

***It is critical that you sign up in a slot during your scheduled lab time.**
Pick your lab group wisely as you will work with the same lab group during the entire semester. If you sign up for “Group A” you will always conduct your lab during the first week the experiment is offered, and if you sign up for “Group B” you will always do it during the second week it is offered.

5.7 Other Important Dates

Thursday, September 5th, 2019: First day of class (lecture).

Tuesday, October 15th, 2019: Fall Study Break Day - No classes scheduled.

Thursday, November 28th, 2019: Last day of class (Tuesday schedule in effect).

Friday, November 29th, 2019: Last day to drop F19 one semester courses.

6 Assessments

6.1 Marking Schemes & Distributions

Assessment of your final grade will be evaluated against four different assessment schemes as described in the table below with your **final grade assigned being the maximum calculated by the four schemes**. Scheme A uses the assessment weights aforementioned in the Assessments section of this outline. Schemes B and D allows students who performed poorly on the midterm to diminish the weight of the midterm by putting more weight on the final exam. Schemes C and D allows students not to participate in the Tutorial Cooperative Learning Exercises by assigning more weight to the final exam.

If you fail (< 50%) both the midterm and the final, you will receive a failing grade in the course equal to the highest of your midterm or final assessment.

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

Name	Scheme A (%)	Scheme B (%)	Scheme C (%)	Scheme D (%)
Unmarked Assignments	0	0	0	0
Labs	20	20	20	20
Tutorial Cooperative Learning Exercises	10	10	0	0
Midterm Exam	25	10	25	10

Name	Scheme A (%)	Scheme B (%)	Scheme C (%)	Scheme D (%)
Final Exam	45	60	55	70
Total	100	100	100	100

6.2 Assessment Details

Unmarked Problem Sets (0%)
Date: Mon, Sep 9 - Thu, Nov 28, 10 problem sets posted weekly on Courselink
Learning Outcome: 1, 2, 3, 4

Labs (20%)
Date: Wed, Sep 18 - Fri, Nov 22
Learning Outcome: 5, 6, 7
Due dates will be one week after the day the lab is conducted, and will be posted on CourseLink for each group. A grade of zero will be issued to any team member who is not in attendance when the team completes the lab.

You must attend and complete all laboratories. If you miss a laboratory due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to complete a makeup lab (i.e. during open lab days).

Tutorial Cooperative Learning Exercises (10%)
Date: Wed, Sep 18 - Fri, Nov 22
Learning Outcome: 1, 2, 3, 4, 7
4 out of 5 exercises will be considered the final grade assessment for this component.

Midterm Exam (25%)
Date: Tue, Oct 22, 2:30 PM - 3:50 PM, In Class
Learning Outcome: 1, 2, 4
Closed book; covers material up to last lecture prior to exam.

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

Final Exam (45%)
Date: Tue, Dec 10, 2:30 PM - 4:30 PM, TBA
Learning Outcome: 1, 2, 3, 4
Closed book; covers entire course.

6.3 Midterm and Final Exams: Note

The midterm and final exams will be closed book tests. Necessary equations and information (e.g. graphs, tables, unit conversions) will be provided or announced prior to each exam.

Calculators are permitted, but they must be non-communicating devices.

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7 Course Statements

7.1 Fluid Mechanics Lab

You must familiarize yourself with the lab equipment by reading the manual and watching the accompanying video prior to your lab, in addition to attending the safety orientation during your first scheduled lab session (see lab schedule in this outline). There is to be no food or drinks in the Fluids Lab. Pay especial attention to the labs rules for appropriate attire as **no open toed shoes (e.g. sandals) are allowed**.

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
