



ENGG*3140 Mechanical Vibration

Fall 2019

Section(s): C01

School of Engineering

Credit Weight: 0.50

Version 1.00 - September 04, 2019

1 Course Details

1.1 Calendar Description

This course will provide students with an introduction to the fundamental concepts of vibration engineering using both single and multiple degrees of freedom concepts. The free and forced response of these systems will be covered. Emphasis will be placed on the design of vibration suppression and isolation of mechanical systems. Concepts of natural frequencies and mode shapes and their significance in the solution of multiple degrees of freedom problems will be covered. Vibration of rotating machinery, balancing, condition monitoring, and predictive vs. preventative maintenance philosophies will be introduced.

Pre-Requisites: ENGG*2340, MATH*2270

1.2 Timetable

Lectures: Mon, Wed, Fri
01:30PM - 02:20PM
MCLN, Room 102

1.3 Final Exam

TBA

2 Instructional Support

2.1 Instructional Support Team

Instructor: Marwan Hassan
Email: mahassan@uoguelph.ca
Telephone: +1-519-824-4120 x52429
Office: THRN 1393
Office Hours: Friday 11:30 am-1:30 pm or by appointment

Lab Technician: Barry Verspagen
Email: baverspa@uoguelph.ca
Telephone: +1-519-824-4120 x58821
Office: THRN 1138

2.2 Teaching Assistants

Teaching Assistant: TBAAndrew TBA BSc, MSc
Email: TBA@uoguelph.ca
Office Hours: TBA - Thornbrough GTA room

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*3140 Courselink site. You are responsible for checking the site regularly.

3.2 Recommended Resources

Theory of Vibration with Applications (Textbook)

William T. Thomson and Marie D. Dahleh (5th Edition)

Fundamentals of Mechanical Vibrations (Textbook)

Graham Kelly

3.3 Additional Resources

Lecture Information (Notes)

Some of the lecture notes are posted on the web page (week #1-#12).

Assignments (Other)

Download the assignments according to the schedule given in this handout. Partial solutions will be posted as indicated.

Miscellaneous Information (Other)

Lectures are the main source of material which includes important discussions and worked examples that might not be found elsewhere. Therefore, attendance is very important and relying on the book and posted material only might not be enough for passing the course. Other information related to Mechanical Vibrations will 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. Derive the equations of motion for vibratory systems.
2. Compute the natural frequency (or frequencies) of vibratory systems and determine the system's modal response.
3. Design a passive vibration absorber to ameliorate vibrations in a forced system.
4. Determine the overall response based upon the initial conditions and/or steady forcing input.
5. Use modern experimental techniques, appropriate apparatus, sensors and instruments to collect data and analyze a system by conducting laboratory tests.
6. Write clear and concise laboratory reports for the labs.
7. Demonstrate effective skills in teamwork during group activities (tutorials and laboratories) and respectful interactions with peers, lab technicians, graduate teaching assistants, and instructor during lectures, weekly 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
1.1	Recall, describe and apply fundamental mathematical principles and concepts	1, 2
1.2	Recall, describe and apply fundamental principles and concepts in natural science	1, 2
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
2	Problem Analysis	1, 2, 3, 4, 5
2.1	Formulate a problem statement in engineering and non-engineering terminology	1, 2, 3, 4
2.2	Identify, organize and justify appropriate information, including assumptions	1, 2, 3, 4, 5

#	Outcome	Learning Outcome
2.3	Construct a conceptual framework and select an appropriate solution approach	1, 2, 3, 4
2.4	Execute an engineering solution	1, 2, 3, 4
2.5	Critique and appraise solution approach and results	1, 3
3	Investigation	1, 5
3.1	Propose a working hypothesis	1, 5
3.2	Design and apply an experimental plan/investigative approach (for example, to characterize, test or troubleshoot a system)	1, 5
3.3	Analyze and interpret experimental data	1, 5
3.4	Assess validity of conclusions within limitations of data and methodologies	1, 5
5	Use of Engineering Tools	1, 3, 5
5.1	Select appropriate engineering tools from various alternatives	1, 3, 5
5.2	Demonstrate proficiency in the application of selected engineering tools	1, 3, 5
5.3	Recognize limitations of selected engineering tools	1, 3, 5
6	Individual & Teamwork	7
6.1	Describe principles of team dynamics and leadership	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
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

#	Outcome	Learning Outcome
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

5 Teaching and Learning Activities

5.1 Lecture

Lectures 1-2

Topics: Introduction, review of DE and Harmonic Motion
References: Chapter 1

Lectures 3-8

Topics: Free Vibrations
References: Chapter 2

Lectures 9-14

Topics: Harmonically Excited Vibrations
References: Chapter 3

Lectures 15-19

Topics: Transient Vibrations
References: Chapter 4

Lectures 20-28

Topics: Two Degrees of Freedom
References: Chapter 5

Lectures 29-33

Topics: Properties of Vibrating Systems
References: Chapter 6

Lectures 34-36

Topics: Review
References: Notes

5.2 Lab

Week 1

Topics: Safety, Lab equipment and Matlab introduction

In case of unsafe lab conditions, a computation labs will be will replace the physical labs.

Week 2-3

Topics: Mass-spring system - Free Vibrations

Week 4-6

Topics: Rotational SDOF - Free Vibrations

Week 7-8

Topics: Rotational SDOF - Forced Vibrations

Week 9-10

Topics: Two SDOF - Forced Vibrations

Week 11-12

Topics: Modal Analysis

5.3 Quizzes

Quiz 1: Friday Sep 27

Quiz 2: Friday Oct 11

Quiz 3: Friday Oct 25

Quiz 4: Friday Nov 8

Quiz 5: Friday Nov 22

The lowest quiz mark will be dropped.

6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Labs	20
Quizzes	50
Final Exam	30
Total	100

6.2 Assessment Details

Labs (20%)

Learning Outcome: 1, 2, 3, 4, 5

Each Lab spans over two weeks. The first week of each lab will include an introduction to the experiment and discussion of the theoretical background. The second week of the lab, the experiment will be conducted and data is collected. Lab report is due the beginning of the next lab after the lab is completed. Thus the lab report for lab 1 is due at the beginning of the lab 2. The lab report is to be submitted through the courselink. Failure to attend any lab period will result in an automatic zero grade for this lab. Although the labs are conducted in groups and one lab report will be submitted per group, different grades may be assigned to each member of the group depending on their performance, participation, etc.

You must attend all Labs and submit all Lab reports. If you miss a Lab due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to submit the missed report. Late submissions of reports will not be accepted.

Quizzes (50%)

Learning Outcome: 1, 2, 3, 4, 5

5 Quizzes, each worth 12.5%; lowest quiz mark will be dropped. There will be no make-up quiz.

Final Exam (30%)

Date: TBA, TBD

Learning Outcome: 1, 2, 3, 4, 5

6.3 Course Grading Policies

Missed Assessments: If you are unable to meet a course requirement due to medical, psychological, or compassionate reasons, please contact the course instructor with the supporting documents. 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 a 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 Consideration of Religious Obligations: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08->

accomrelig.shtml

Passing grade: The passing grade for the course is 50%.

7 School of Engineering Statements

7.1 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.

7.2 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.

7.3 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.

8 University Statements

8.1 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.

8.2 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>

8.3 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>

8.4 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.

8.5 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>

8.6 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>

8.7 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.

8.8 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>