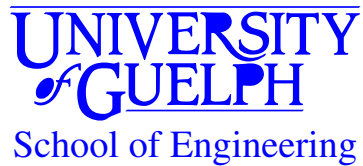


# ENGG\*3140 Mechanical Vibrations

## Fall 2016



(Revision 02: August 18, 2016)

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## 1 INSTRUCTIONAL SUPPORT

### 1.1 Instructor

Instructor: Marwan Hassan, Ph.D., P.Eng.  
Office: THRN 2405, ext. 52429  
Email: [mahassan@uoguelph.ca](mailto:mahassan@uoguelph.ca)  
Office hours: TBA on Courselink or by appointment

### 1.2 Lab Technician

Technician: Barry Verspagen  
Office: THRN 1138, ext. 58821  
Email: [baverspa@uoguelph.ca](mailto:baverspa@uoguelph.ca)

### 1.3 Teaching Assistants

GTA	Email	Office Hours
Amro Elhelaly	<a href="mailto:amro@uoguelph.ca">amro@uoguelph.ca</a>	TBA - Thornbrough GTA room
Olufemi Bamidele	<a href="mailto:obamid@uoguelph.ca">obamid@uoguelph.ca</a>	TBA - Thornbrough GTA room
Nihad Oleiwi	<a href="mailto:noleiwi@uoguelph.ca">noleiwi@uoguelph.ca</a>	TBA - Thornbrough GTA room
Kelechukwu Ezike	<a href="mailto:kezike@uoguelph.ca">kezike@uoguelph.ca</a>	TBA - Thornbrough GTA room

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## 2 LEARNING RESOURCES

### 2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG\*3140 [Courselink](#) site. You are responsible for checking the site regularly.

## 2.2 Required Resources

1. Theory of Vibrations with Applications (5e), W. T. Thomson and M. D. Dahleh

## 2.3 Recommended Resources

1. Engineering Vibration, Daniel J. Inman, (8th Edition in SI Units)

## 2.4 Additional Resources

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

**Assignments:** Download the assignments according to the schedule given in this handout. All the solutions will be posted as indicated.

**Miscellaneous Information:** 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.

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# 3 ASSESSMENT

## 3.1 Dates and Distribution

**Quizzes:** 50%

Quiz	Date	Weight
1	Friday Sep 30	12.5%
2	Friday Oct 14	12.5%
3	Friday Oct 28	12.5%
4	Friday Nov 11	12.5%
5	Friday Nov 25	12.5%

The lowest quiz mark will be dropped.

**Laboratory:** 20%

The week of	Weight	Description
Week 1	Lab 0	Safety, Lab equipment
Week 2-3	Lab 1	Mass-spring system - Free Vibrations
Week 5-6	Lab 2	Rotational SDOF - Free Vibrations
Week 7-8	Lab 3	Rotational SDOF - Forced Vibrations
Week 9-10	Lab 4	Two SDOF - Forced Vibrations
Week 11-12	Lab 5	Modal Analysis

**Note:** 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. Each student will write a lab quiz in the week following the experiment in the beginning of the lab time. 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.

**Final Exam:** 30%

Thur 02:30PM - 04:30PM (2016/12/08), Room TBA Room TBA

### 3.2 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 exam portion (4 quizzes + Final Exam) accounts for 80% of the total mark of the course. The Lab portion accounts for 20% of the total mark of the course. In order to pass the course, you must meet the following criteria:

- score 40% or higher out of the 80% allocated to the exam + quizzes portion of the course.
- score 10% or higher out of the 20% allocated to the Lab portion of the course.
- Attending all Laboratory sessions.

Failure to meet the above criteria will result in a failure grade (your total mark or 49%, whichever is less).

**Missed quizzes:** If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of any missed quiz will be added to the final exam weight. There will be no make-up quiz.

**Lab Work:** 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.

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## 4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

### 4.1 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.

*Prerequisite(s):* ENGG\*2340, MATH\*2270

*Corequisite(s):* None

## **4.2 Course Aims**

This course aims at:

- Introducing basic aspects of vibrational analysis, considering both single and multi-degree-of- freedom systems.
- Developing the ability to use the exact and approximate methods in the analysis of complex systems.
- Developing the ability to integrate the knowledge gained in designing structures.
- Developing the ability to utilize numerical techniques including MATLAB toward analyzing vibration problems.

## **4.3 Learning Objectives**

At the successful completion of this course, the student will have demonstrated the ability 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. Determine the overall response based upon the initial conditions and/or steady forcing input.
4. Design a passive vibration absorber to ameliorate vibrations in a forced system.
5. Utilize modern experimental and numerical techniques to analyze and investigate structures,

## **4.4 Graduate Attributes**

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

<b>Graduate Attribute</b>	<b>Learning Objectives</b>	<b>Assessment</b>
1. Knowledge Base for Engineering	1	Quizzes, Exams
2. Problem Analysis	1-4	Quizzes, Exams, Lab
3. Investigation	5	Lab
4. Design	-	-
5. Use of Engineering Tools	4,5	Quizzes, Lab
6. Communication	-	Lab
7. Individual and Teamwork	-	Lab
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Life-Long Learning	-	-

#### **4.5 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/D2L but these are not intended to be stand-alone course notes. 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 quizzes.

#### **4.6 Students' Learning Responsibilities**

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. 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.

#### **4.7 Relationships with other Courses & Labs**

##### **Previous Courses:**

**ENGG\*1210:** Mechanical system fundamentals such as force, torques, friction, moments, free body diagrams

**ENGG\*1500:** Solving systems of linear equations, matrix algebra, complex numbers

**MATH\*1200 & MATH\*1210:** Limits, differentiation, integration, series expansion

**MATH\*2270:** Applied Differential Equations

**ENGG\*2120:** Mean, standard deviation, normal distribution

**ENGG\*2340:** Kinematics, Dynamics, and gear analysis

**ENGG\*2400:** Second order system, natural frequency

**Follow-on Courses:**

**ENGG\*4160:** Application of mechanical design principles

**ENGG\*4220:** Application of mechanical design principles

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## 5 TEACHING AND LEARNING ACTIVITIES

### 5.1 Timetable

**Lectures:**

Monday	02:30AM - 03:20AM	ALEX, Room 100
Wednesday	02:30AM - 03:20AM	ALEX, Room 100
Friday	02:30AM - 03:20AM	ALEX, Room 100

### 5.2 Lecture Schedule

<b>Lectures</b>	<b>Lecture Topics</b>	<b>References</b>	<b>Learning Objectives</b>
2	Introduction, review of DE and Harmonic Motion	Chapter 1	1
5	Free Vibrations	Chapter 2,7	1, 2
5	Harmonically Excited Vibrations	Chapter 3	1, 3
4	Transient Vibrations	Chapter 4	3
8	Multiple Degrees of Freedom	Chapter 5	1, 2, 3
4	Properties of Vibrating Systems	Chapter 6	1, 2, 3
3	Review	Notes	4

### 5.3 Other Important Dates

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## 6 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.

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## 7 ACADEMIC MISCONDUCT

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 discourages misconduct. 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.

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## 8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email [csd@uoguelph.ca](mailto:csd@uoguelph.ca) or see the website: <http://www.uoguelph.ca/csd/>

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## 9 RECORDING OF MATERIALS

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

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## 10 RESOURCES

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:

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

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:

<http://www.academicintegrity.uoguelph.ca/>

Please also review the section on Academic Misconduct in your [Engineering Program Guide](#).

The School of Engineering has adopted a Code of Ethics that can be found at:

<http://www.uoguelph.ca/engineering/undergrad-counselling-ethics>