



MUSC\*1090/PHYS\*1810 W'21

**PHYSICS OF MUSIC**

**Lecturer:** E.J. Nicol  
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**Text:** *Musical Acoustics* (Third Edition) by D.E. Hall (Brooks/Cole, 2002)

**Lecture Times & Location:** Mon., Wed., Fri., 10:30-11:20am (online with Zoom)

**Calendar Description:**

A course designed for arts and social science students with an interest or background in music. The fundamentals of vibrations and waves will be introduced and applied to a study of archetypal instruments. The psychoacoustic basis of pitch and loudness will be discussed.

**Restrictions:**

Students who have standing in any other 1000 level physics course (except PHYS\*1020 and PHYS\*1600) may not enrol in this course unless they are completing an honours or general B.A. program in Music. In this case, permission of the instructor is required.

**OUTLINE OF MATERIAL TO BE COVERED  
(As Time Permits)**

Chapter 1	The Nature of Sound 1.1 Introduction 1.2 Acoustics and Music 1.3 Organizing Our Study of Sound 1.4 The Physical Nature of Sound 1.5 The Speed of Sound 1.6 Pressure and Sound Amplitude	All
Chapter 2	Waves and Vibrations 2.1 The Time Element in Sound 2.2 Waveforms 2.4 Simple Harmonic Oscillation 2.5 Work, Energy, and Resonance	All except section 3

Chapter 3	Sources of Sound 3.1 Classifying Sources of Sound 3.2 Percussion Instruments 3.3 String Instruments 3.4 Wind Instruments 3.5 Source Size	All except section 6
Chapter 4	Sound Propagation 4.1 Reflection and Refraction 4.2 Diffraction 4.4 The Doppler Effect 4.5 Interference and Beats	All except section 3
Chapter 5	Sound Intensity and Its Measurement 5.1 Amplitude, Energy, and Intensity 5.2 Sound Level and the Decibel Scale 5.3 The Inverse-Square Law 5.5 Combined Sound Levels and Interference	All except section 4
Chapter 6	The Human Ear and Its Response 6.1 The Mechanism of the Human Ear 6.2 Limits of Audibility and Discrimination 6.3 Characteristics of Steady Single Tones 6.4 Loudness and Intensity 6.5 Pitch and Frequency 6.6 Pitch and Loudness Together 6.7 Timbre and Instrumental Recognition	All
Chapter 7	Elemental Ingredients of Music 7.3 Scales and Intervals 7.4 The Harmonic Series	Sections 3 and 4 only
Chapter 8	Sound Spectra and Electronic Synthesis 8.1 Prototype Steady Tones 8.2 Periodic Waves and Fourier Spectra 8.3 Modulated Tones	All except section 4
Chapter 9	Percussion Instruments and Natural Modes 9.1 Searching for Simplicity 9.2 Coupled Pendulums 9.3 Natural Modes and Their Frequencies 9.4 Tuning Forks and Xylophone Bars 9.5 Drums, Cymbals, and Bells 9.6 Striking Points and Vibration Recipes 9.7 Damped Vibrations	All

Chapter 10	Piano and Guitar Strings 10.1 Natural Modes of a Thin String 10.2 Vibration Recipes for Plucked Strings 10.3 Vibration Recipes for the Piano 10.4 Piano Scaling and Tuning	All
Chapter 11	The Bowed String 11.1 Violin Construction 11.2 Bowing and String Vibrations 11.3 Resonance 11.4 Sound Radiation from String Instruments	All
Chapter 12	Blown Pipes and Flutes 12.1 Air Column Vibrations 12.2 Fluid Jets and Edgetones 12.3 Organ Flue Pipes 12.5 Fingerholes and Recorders 12.6 The Transverse Flute	All except section 4
Chapter 13	Blown Reed Instruments 13.1 Organ Reed Pipes 13.2 The Reed Woodwinds 13.3 The Brass Family 13.4 Playable Notes and Harmonic spectra 13.5 Radiation	All
Chapter 14	The Human Voice 14.1 The Vocal Apparatus 14.2 Sound Production 14.3 Formants 14.4 Special Characteristics of the Singing Voice	All
Chapter 15	Room Acoustics 15.1 General Characteristics for Room Acoustics 15.2 Reverberation Time 15.3 Reverberation Calculation	Sections 1-3 only
Chapter 16	Sound Reproduction	None
Chapter 17	The Ear Revisited	None
Chapter 18	Harmonic Intervals and Tuning	None
Chapter 19	Structure in Music	None
Chapter 20	Epilogue: Science and Esthetics	None

<b>Evaluation:</b>	Quizzes	10%
	Test #1	15%
	Test #2	15%
	Test #3 (Final Exam)	15%
	Essay (due last week of class)	<u>45%</u>
		<u>100%</u>

**Quizzes:** Multiple choice quizzes will be administered through Courselink. These are meant to keep students up-to-date on the basics of the course material. Details will be provided on the first day of classes. It is anticipated that there will be weekly quizzes with ten multiple choice questions each.

**Tests:** There will be three tests. Two tests will be given during the semester (dates to be announced) and a third test will be given during the final exam time slot for the course. It is anticipated that the tests will be no more than one hour each and will test both conceptual understanding and the ability to do simple numerical problems related to the course material. Each test will cover about one third of the course material. The tests will be administered through Courselink.

**Final Exam:** The date for the final exam is to be announced. The final exam will be the third test for the course and cover the material since Test #2. Policies and procedures for final exams and missed final exams will hold. Students are responsible for ensuring that they have no conflicts with other exams scheduled at the same time.

**Essay:** The essay should be between 2000 and 5000 words in length. Part of the grade for the essay will be for grammar, spelling, style, and general compositional competence. The topic of the essay must be chosen and approved by Monday, February 1. The deadline for submitting the essay is the last day of classes Monday, April 12. Students are encouraged, however, not to wait until the last minute to finish the essay, and to that end, any essay handed in by Tuesday, April 6 will be marked promptly and receive an early bird bonus. More information and a list of possible topics for the essay will be made available on the first day of classes. Some examples of topics are: the Modern Piano, the Modern Violin, the Acoustics of the Human Voice, Concert Hall Design, the Doppler Effect, the Production and Use of Ultrasound, Sonar, Echolocation, Underwater Sound, Pitch Resolution by the Human Ear, and the Perception of Loudness. A student may write an essay on a topic of their own choice as long as permission is received from the instructor.

## **Absence due to Illness or for Compassionate Reasons:**

If either one of the first two tests is missed because of illness or for compassionate reasons, the student should consult the instructor. If the final examination (Test #3) is missed for any reason, the regulations in the current undergraduate calendar should be consulted.

### Course Statements

#### 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 or faculty advisor. The Academic Misconduct Policy is detailed in the Undergraduate Calendar - [Academic Misconduct](#). A helpful resource in understanding academic misconduct and plagiarism can be found at: [plagiarism.org](http://plagiarism.org)

#### Turnitin

In this course, your instructor will use Turnitin, integrated with the CourseLink Dropbox tool, to detect possible plagiarism, unauthorized collaboration or copying as part of the ongoing efforts to maintain academic integrity at the University of Guelph. All submitted essays will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. Use of the Turnitin.com service is subject to the Usage Policy posted on the Turnitin.com site.

A major benefit of using Turnitin is that students will be able to educate and empower themselves in preventing academic misconduct. In this course, you may screen your own essay through Turnitin as many times as you wish before the due date. You will be able to see and print reports that show you exactly where you have properly and improperly referenced the outside sources and materials in your essay.

#### Copyright Protections of Intellectual Property

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

Classroom teaching and learning activities, including lectures, discussions, presentations, etc., by both instructors and students, are copyright protected and remain the intellectual property of their respective author(s). All course materials, including PowerPoint presentations, outlines, lecture notes, quizzes, assignments, assessments and other materials, are also protected by copyright and remain the intellectual property of their respective author(s). Students registered in the course may take notes and make copies of course materials for their own educational use only. Students are not permitted to reproduce or distribute lecture notes and course materials publicly for commercial or non-commercial purposes without express written consent from the copyright holder(s).

#### Course Assessment

The Department of Physics requires student assessment of all courses taught by the Department. These assessments provide essential feedback to faculty on their teaching by identifying both strengths and possible areas of improvement. In addition, annual student assessment of teaching provides part of the information used by the Department Tenure and Promotion Committee in evaluating the faculty member's contribution in the area of teaching.

The Department's teaching evaluation questionnaire invites student response both through numerically quantifiable data and written student comments. In conformity with University of Guelph Faculty Policy, the Department Tenure and Promotions Committee only considers comments signed by students (choosing "I agree" in question 14). Your instructor will see all signed and unsigned comments after final grades are submitted. Written student comments may also be used in support of a nomination for internal and external teaching awards.

NOTE: No information will be passed on to the instructor until after the final grades have been submitted.

#### University Statements

##### COVID-19 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](#) and circulated by email.

##### Illness

The University will not require verification of illness (doctor's notes) for the fall 2020 or winter 2021 semesters.

##### 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.

##### 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.

#### 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](#)

#### 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.

#### 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.

#### 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](#).