The Physics of Sound and Music (PH 102) Syllabus

Spring 2025 ∘ Northern Michigan University

Instructor: Dr. P.W. Mengyan ("men-gin") **Office**: Science 2513; Cohodas 402 **Phone**: x2183

Email: pmengyan@nmu.edu [preferred comm. method]. Begin subject line with "*PH 102:*"

Office Hours: T 14:00 – 15:00 [402 Cohodas], W 08:30 – 09:30 [Science 2513];
(other times available, email for appointment)

Class Meetings: (CRN 10212): Mon & Wed 18:00 to 19:50 in *The Science Building 2603*

Webpage: https://educat.nmu.edu ; http://physics.nmu.edu/~pmengyan

Required Text: Hartmann, Principles of Musical Acoustics, Springer 2013,
DOI 10.1007/978-1-4614-6786-1 (free download via NMU library: here)

Required item: An approved scientific calculator such as the *Texas Instruments TI-30XS* MultiView (available for less than $20; if you have a calculator, check with me before you buy another one; cell phones will not be not approved calculators)

Course Description (outline and expected outcomes): This general education lecture and lab combination course will take a diverse look at the analysis of sound and its production, wave properties, resonance, musical instruments, concert hall acoustics, electronics, recording, speech, and hearing. Hands on exercises will supplement many of the ideas. A student who is successful in this class will, for each topic, be able to (i) explain the fundamental principles to a peer and (ii) apply a general problem-solving strategy to interpret and write a solution to basic questions. Progress towards these outcomes will be assessed through activities such as in-class exams, homework assignments, quizzes, laboratory and discussion exercises.
More information is available via the teaching section of the instructor's webpage.

General Education Requirements: PH 102 satisfies the Laboratory Science University Requirement (LAB) and Quantitative Reasoning and Analysis (QUAR).

Homework: May be assigned periodically via EduCat or prescribed during class and may include suggested questions, readings and other activities to supplement lecture. Due date, time and assignment description will be indicated on each assignment. Late assignments are *not* typically accepted; however, should you find yourself in a situation where you do not foresee being able to complete the assignment on time, contact your instructor as soon as reasonably possible. Once solutions are posted or discussed in class, assignment due dates cannot be extended.

Quizzes: May be administered during the regularly scheduled class time and may include content from lecture, homework, exams, labs or any other relevant course related information. Please note that quizzes may or may not be announced during lecture. **Make up quizzes will *not* be administered**. These will be designed with a few goals in mind (1) provide students the opportunity to check their understanding of relevant material and receive feedback from the instructor (2) provide the instructor with feedback as to how well students are understanding the material (3) encourage students to continue to stay on top of the material, develop sound study habits, regularly attend class, etc

Exams: There will be up to two (2) scheduled exams during the semester plus a final exam. Each in-class exam is equally weighted. If the final exam score is higher than the lowest in-class exam score, the final exam score will replace this lowest in-class exam score. Exams 1 and 2 will typically be administered in the normal lecture room and during the normal meeting time. The final exam will be administered in the same room as lecture and at a time pre-determined by NMU. **Make up exams will not be administered**. If an exam is to be missed due to extenuating circumstances or official university-related business,

contact me via email BEFORE the scheduled exam time to see about making the appropriate arrangements.
Use of notes, books or electronic gizmos of any sort will not be permitted on the exams unless otherwise specified by the instructor.

TENTATIVE[**] Exam Schedule:

Exam 1:	Normal class time	Mon	~19 Feb 2025	
Exam 2:	Normal class time	Wed	~09 Apr 2025	
Final Exam	18:00 – 19:50	Mon	28 Apr 2025	All course material

[**]Exam *format*, *times* and *content* will be adjusted appropriately to accommodate the course schedule. Deviations from this tentative schedule will be discussed, *in class*, as they become relevant. Exam dates will typically be finalized a minimum of one week before the exam is administered.

The final exam time is predetermined by NMU and will *not* be modified by the instructor.
University Closure During Exam Week (as per the NMU Registrar):

> *"Students should be prepared for the possibility of in-class [final] exams being postponed and held later in the week than originally scheduled due to unforeseen circumstances, such as inclement weather, causing the University to close. If the University were to close one day during the first four days final exam week, that day's exams would be moved to Friday of exam week. Should the University close a second day or on the Friday of exam week, the exams scheduled for that day would be moved to Saturday afternoon of exam week. Exams scheduled to be taken on-line outside of the classroom will be administered on the originally scheduled date, regardless of changes to the in-class exam schedule due to unexpected University closures."*

Grades:

Lab***, Quizes, Homework, Attendance/participation etc:	40%	A: ≥ 90%; B: ≥ 80%
Exams[◊] (1, 2, Final, Final; Best 3 of 4):	60%	C: ≥ 70%; D: ≥ 60%
Total:	100%	F: < 60%

'+' and '–' grades are typically assigned when a grade is within ± ~2.0% of the letter grade cutoff.
***Minimum grade of 60% on the laboratory component, in addition to appropriate performance in the rest of the course, is *required* to earn an overall passing grade in this course.
[◊] If an exam is missed the resulting zero may not be dropped and instead each exam may be equally weighted.

Lab:
Lab is built in to the 4-hour class, as scheduled. A minimum score of 60% on lab related activities is *required* in order to qualify for a passing score in the course. To be clear, that means if your lab-related score is any less than 60.0%, you will have earned a FAILING grade in the course regardless of your other scores. The final grade from the laboratory course part of your lecture score and likely to be weighted at ~20%. The laboratory portions of this course is designed to provide hands on experience with the topics discussed in lecture.

Important Notes:

- **ADA Statement**
  In compliance with the ADA and university policy: *"If you have a need for disability-related accommodations or services, please inform the Coordinator of Disability Services in the Dean of Students Office at 2001 C. B. Hedgcock Building (227-1737 or disserv@nmu.edu). Reasonable and effective accommodations and services will be provided to students if requests are made in a timely manner, with appropriate documentation, in accordance with federal, state, and University guidelines."*
- **Religious and spiritual obligations**
  Consistent with university recommendations, a student whose religious or spiritual obligation(s) conflict with a class-related activity (e.g. exam, lab, homework, etc) will make their conflict known, in writing, to the instructor a minimum of 5 business days prior to the conflict. The student is not exempt from meeting course requirements or completing assignments in a timely manner as determined by the instructor.
- **Academic Integrity**
  Section 2.3.1 of the NMU Student Handbook discusses scholastic dishonesty; all of which will be upheld in all aspects of this course. Academic dishonesty will not be tolerated.
  Link to student handbook https://nmu.edu/policies/1070
- **Appropriate behavior**
  Students will behave in a respectful, considerate and courteous fashion in any activity related to this course (e.g. Lecture, lab, discussion, office hours etc).
  Rude, disrespectful or disruptive behavior will *never* be tolerated.
- **Attendance** and **participation**
  - Attendance and participation in every class is required. You are expected to be on time. Absences will be excused for officially sanctioned university events, illness (documentation *may* be required), court appearance (plaintiff, defendant, witness, juror – documentation is required), family emergencies (at the discretion of the instructor and may require appropriate documentation).
  - An excused absence does not necessarily excuse you from completing the work. Arrangements for a planned excused absence, if possible, should be finalized (with written confirmation between student and instructor) no later than one business day before the planned absence, if possible. Otherwise, establish contact with the instructor as soon as reasonably possible.
  - *Bottom line: Communicate with your instructor if you need to miss class for any reason*
  - Changes to the in-person attendance policy may occur to comply with updates in university, local, state or federal guidelines or CDC-based recommendations.
  - *Any questions or concerns should be discussed with your professor as soon as possible*

Final Notes and Suggestions to Succeed:

- **Course Assistance**: A plethora of options are available to support your success in this course (e.g. Lecture [Dr. Mengyan], lab and discussion via class, office hours, email or special appointment), your textbook, the library, and other text books. Take advantage of the available resources. DO NOT HESTIATE TO ASK QUESTIONS AS THEY ARISE!
- Preparation is the key!
    - Read the recommended material before AND after we discuss it in class
    - Take good notes during lecture
    - Study your notes
    - Take advantage of available resources (e.g. *actually* attend class, read the book)
    - If something is unclear during lecture or your own studying, ASK ABOUT IT!
- Homework and supplemental work:
    - Work each question using the problem-solving process. Getting the 'correct' numerical answer is *meaningless* if you do not understand the process used to arrive there.
    - Start your homework assignments as early as possible
    - Read the homework questions when they are available before the related material is presented in class; familiarity with the questions will help you associate the relevant concepts as they are introduced in lecture, lab and while you read the material
    - Give yourself plenty of time to complete the assignments as you will likely need to think carefully about the questions, review the relevant sections of the text or your notes and then work towards a solution
    - Use a dedicated notebook to *fully* work out homework and supplemental questions
- Studying for any exam should be an ongoing exercise. Structured reviews of material built into your schedule promotes better long-term retention and higher understanding of the material
- I cannot stress enough: ASK QUESTIONS WHEN YOU HAVE THEM!

TENTATIVE outline of Course Topics

In this course, we may work in the following topic areas (a course calendar will be completed as we go so as to stay true to topics covered and enable appropriate planning and review)

- Simple harmonic motion, vibrations and applications
- Instrumentation
- Waves and sound
- Standing waves, overtone series
- Analysis and synthesis of complex waves, tone quality, resonance curves
- Human ear and voice, sound intensity scales, pitch
- Sound localization and environments
- Sound recording and production
- Room and auditorium acoustics
- Electronic music and synthesizers; distortion and noise; audio systems; speakers
- Digital vs analog audio; broadcasting
- Speech
- Brass instruments
- Woodwind instruments
- Stringed instruments
- Piano
- Percussion instruments
- Musical temperament and pitch

Course Content (blank provided to allow for students to track chapters and topics covered each week)

Week	Start Date	Chapter[s]	Content / Additional Detail
1	13 Jan 25		
2	20 Jan 25		Mon – No class (MLK)
3	27 Jan 25		
4	03 Feb 25		
5	10 Feb 25		
6	17 Feb 25		**Exam 1** (~19 Feb 2025)
7	24 Feb 25		
8	03 Mar 25	** **No class** 03 or 05 Mar 2025 (Spring break)	
9	10 Mar 25		
10	17 Mar 25		
11	24 Mar 25		
12	31 Mar 25		
13	07 Apr 25		**Exam 2** (09 Apr 2025)
14	14 Apr 25		
15	21 Apr 25		
☺	**28 Apr 25**		**Final exam (18:00 Monday 28 Apr 2025)**

Notable dates

13 Jan 2025	First official day of class
20 Jan 2025	Martin Luther King Day (observance; no class)
01 to 09 Mar 2025	Spring break (no classes)
09 Mar 2025	Daylight savings time ends ('spring' forward)
26 Apr 2025	Last day of class
28 Apr 2025	Final exam at 18:00
06 May 2025	Final grades due from faculty
08 May 2025	Grades available on MyNMU