

Physics 104 Physics of Sound and Music
Gustavus Adolphus College
Spring 2009

Instructor: Dr. Dennis C. Henry Office: Olin 213

Textbooks: The Physics of Sound (3rd Ed.) by Berg and Stork (Prentice-Hall, 2005). Required.

The Science of Hi-Fidelity (Selective reprint of Third Edition) by Johnson, Walker, and Cutnell (Kendall-Hunt, 1994). Available in the Book Mark. Required.

COURSE CATALOG DESCRIPTION

PHY-104 Physics of Sound and Music (1 course) An exploration of the physical principles of sound and its production and reproduction as music. The course will use the science and technology of sound reproduction as a vehicle for studying basic principles of acoustics, electricity and magnetism, waves, and telecommunications. The laboratory involves the use of stereo music equipment and scientific instrumentation in demonstrating and measuring acoustical phenomena. Lecture and laboratory. Does not count toward Physics major. NASP. Offered occasionally. [Most recently in 2006, 2003, 2000, and 1998]

COURSE POLICY AND EVALUATION

1. **LECTURE:** The class will meet at 9:00-9:50 AM four times each week (MTWF) for lecture, discussion, demonstrations, homework review and exams. Announcements and updates will be communicated via e-mail as necessary. Pay attention to them.
2. **LABORATORY:** The lab meets Thursday 2:30-4:20 PM in Olin 219 or nearby rooms. Refer to the lab schedule. Students will normally work in teams of two.
3. **HOMEWORK:** Exercises and problems from the texts and other sources will be assigned on a chapter basis. These assignments are due at the **beginning** of the class period, and will then be discussed. They will be graded by the instructor and returned to the student. Late homework due to circumstances beyond the control of the student may be accepted at the discretion of the instructor and with some reduction in credit.
4. **LABORATORY REPORTS:** Laboratory results and analysis will be reported using the data sheets supplied with the lab manual and these will be due at the end of each lab period. In most cases each student in the team will submit a separate report.
5. **ATTENDANCE:** Students are expected to attend all lectures and all laboratories during the scheduled hours. Students are responsible for informing themselves of material and assignments covered during absences. **Students must advise the instructor in writing during the first week of class of any scheduled athletic, music, or other college activities that will require their absence during the semester. Such written notice does not imply a waiver of course requirements or an agreement to reschedule exams.**

(over)

6. **EXAMS AND LABS:** There will be three one-hour exams and a two-hour comprehensive final exam. There will be no separate mid-term exam. *Requests to reschedule or make up exams or labs for non-emergency personal reasons will be declined. Do not make advance travel commitments with the expectation that such requests will be granted.* Permission to take an exam or lab at other than the scheduled time to accommodate college activities will be at the discretion of the instructor. Such reschedulings are often impractical.

7. **EVALUATION:**

Hour exams	35%	Homework	20%
Final exam	25%	Lab	20%

Assignment of the final letter grades will also take into account the instructor's subjective evaluation of the student's attendance, initiative, laboratory engagement, and quality of independent and cooperative work.

8. **DECORUM:** Except for specific lab exercises, the use of laptop computers, cell phones, "Blackberrys", cameras, personal audio devices, and other such equipment is prohibited in the classroom and laboratory of this course. Please set cell phones to ring silently.

9. **INCOMPLETES:** A grade of Incomplete will only be given when course requirements are not completed due to circumstances beyond the control of the student. [College policy]

10. **ACADEMIC HONESTY POLICY:** Full descriptions of the Academic Honesty Policy and the Honor Code can be found in the catalogue on the web at:

http://gustavus.edu/academics/general_catalog/current/index.cfm?pr=acainfo

At the November, 2006, Faculty Meeting, the faculty approved the following changes to Handbook Section 2.2.9:

“Through information provided in syllabi and/or other means, faculty members will explain to students how the Honor Code will operate in their respective courses. The following statement is suggested as a pledge for students to sign on all graded assignments and projects:

On my honor, I pledge that I have not given, received, or tolerated others' use of unauthorized aid in completing this work.

A similar statement may be signed by students at the beginning of a course, indicating that their work for that course will comply with the academic honest policy and the Honor Code.”

Your instructor will discuss the application of the academic honesty policy and the Honor Code and will provide a statement that each student will be requested to sign as confirmation of understanding and acceptance of the policy.

11. **DISABILITY SERVICES:** The Academic Operations Committee has recommended that faculty incorporate catalog language about Disability Accommodations into course syllabi:

“Section 504 of the Rehabilitation Act of 1973 and the Americans With Disabilities Act (1990) work together to ensure ‘reasonable accommodation’ and non-discrimination for students with disabilities in higher education. A student who has a physical, psychiatric/emotional, medical, learning, or attentional disability that may have an effect on the student’s ability to complete assigned course work should contact the Disability Services Coordinator in the Advising Center, who will review the concerns and decide with the student what accommodations are necessary.”

Disability Services Coordinator Laurie Bickett (x6286) can provide further information.

Physics 104 Physics of Sound and Music
Class Schedule for Spring 2009 - Version of January 5, 2009

<u>Lecture</u>	<u>Topics</u>
1	Course objectives and organization; sound and music sampler
2	Historical introduction to sound reproduction and communication
3	The anatomy of sound reproduction systems
4	Oscillations and vibrating systems
5	The physics of waves
6	The physics of sound waves
7	Interference of waves
8	Standing waves
9	Standing waves
10	Resonance and beats
11	Hearing and loudness
12	Sound pressure, power and loudness
13	Decibels
14	Pitch, timbre and harmonics
15	First Hour Exam
16	Introduction to electricity
17	Electrical relationships in DC circuits
18	Common electrical applications and devices, electric power & energy
19	Capacitors, inductors, filters and crossovers
20	Amplifier basics
21	Negative feedback and its applications
22	The photographic analogy for amplifier performance
23	Measuring amplifier performance and understanding specifications
24	Loudspeaker principles and characteristics
25	Loudspeaker systems and measurements
26	Second Hour Exam
27	Electromagnetism-Ampere's Law
28	Electromagnetic induction-Faraday's Law
29	Applications of electromagnetic induction
30	Historical introduction to E&M waves and radio (Hertz, Marconi and others)
31	Evolution of radio and television technology and content
32	FM as a high fidelity medium and battleground - Edwin Howard Armstrong
33	Principles of radio transmission and reception, AM & FM
34	Radio measurements and specifications
35	Historic recording methods
36	The physics of analog media I
37	The physics of analog media II
38	Demonstrations and review
39	Third Hour Exam
40	Fourier analysis and synthesis
41	Basics of how we hear
42	Musical instruments - Guest Lecturers
43	Musical instruments - Guest Lecturers
44	Musical instruments - Guest Lecturers
45	Musical instruments - Guest Lecturers
46	Digital representation of sound, analog-digital conversions
47	Digital signal generating, processing and recording techniques
48	Auditorium acoustics
49	Calculation of the reverberation time in a room
50	Noise in the environment and its effects on people
51	History and examples of electronic music
52	TBA
53	Review and bonus music quiz
	Comprehensive Final Exam

Physics 104 Physics of Sound and Music Laboratory
Spring 2009

Instructor: Dr. Dennis C. Henry

Laboratory Assistant: TBA

Required Laboratory Manual: Available in the Book Mark (three-ring sheet style)

LABORATORY SCHEDULE

Feb. 12	No Lab
Feb. 19	Introduction to Audio Equipment
Feb. 26	Standing Waves on a String
March 5	Standing Waves in an Air Column
March 12	Basic Electricity - DC Circuits
March 19	Measurements with Oscilloscopes
	SPRING BREAK (March 21- 29)
April 2	Audio Amplifier Measurements I
April 9	Audio Amplifier Measurements II and Crossover Networks
April 16	Measurements with the KORG AT-12 Chromatic Electronic Tuner
April 23	Tests of AM Radio Reception and Transmission using RF Generators
April 30	Lab under development
May 7	Fourier Synthesis and Analysis with Lab Computers
May 14	TBA

PREPARATION FOR LABORATORY

Students are expected to be thoroughly familiar with the purpose and general procedures of the laboratory experiment before coming to lab. Advance preparation is an absolute requirement for team participation and for the efficient use of the 110-minute lab period. Students who arrive at the lab late or without adequate preparation (i.e. no idea what they are going to be doing) will receive a reduction in the grade for that lab.

Bring the scheduled experiment and data sheets and a calculator to lab. Most labs take place in Olin 219, but a few experiments will be carried out in Olin 221, as announced in class. Report sheets from each student are due at the end of the lab period.