PHYS/MUSC 166 - Spring 2016
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SAN JOSE STATE UNIVERSITY
PHYS/MUSC 166: PHYSICS OF MUSIC
Spring 2016 – TTh 10:30

Brian Holmes
Office: SCI-315 OFFICE HOURS: TTh 1-2PM
Class: usually, SCI 242; sometimes other locations
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Catalogue description: Physical, mathematical and perceptual foundations of music. Includes musical instruments, hearing, harmony, room acoustics, sound analysis, synthesis and reproduction. Prerequisite: Completion of core GE Area: R. Prerequisite: Passage of the Writing Skills Test (WST) or ENGL/LLD 110A with a C or better (C– not accepted), completion of Core General Educations, and upper division standing are prerequisites to all SJSU studies courses. Completion of, or co-registration in, 100 W is strongly recommended.

The catalog description has been changed without my permission. I also expect students to have a level of musical proficiency equivalent to the ability to play a musical instrument.

PHYS/MUSC 166 explores the scientific background of music. Topics covered include motion, force and energy; vibrating systems; waves; resonance; sound; hearing; the mathematics of harmony and tuning; musical instruments; voice; room acoustics; reproduction and synthesis of sound.

PHYS/MUSC 166 is a San Jose Studies course in area R, Earth & Environment. The home department for this course is Physics and Astronomy, even if you take the course with the MUSC 166 designation.

Background: No physics background is assumed. Completion of lower division GE science and math is assumed. A musical background equivalent to the ability to play a musical instrument is assumed. You should be able to read musical notation, and you should know about scales and chords. An ability to deal with college-level mathematics (algebra, exponents, and logarithms) is assumed. However, the course emphasizes ideas, not calculations.

Location: The class is scheduled for SCI-242. However, we will sometimes meet in the Music building, at the Beethoven Center (in the King Library), and at other locations to be announced. Shifts in location will be announced in advance; they will also be announced via email. You are
responsible for knowing where classes will be held.

**Text, Readings, and Reading Quizzes:**
I will provide you with lecture notes at no cost. They are available online through the course’s Canvas site. I expect you to read the lecture notes in advance of each lecture. I hope you will let me know of any mistakes in the lecture notes, or of any places that would benefit from better writing. *I will give you extra credit on homework for any valid corrections and improvements you suggest.* Send such corrections and improvements to me via email or through the Canvas page.

You will take online Reading Quizzes to show me that you have read the material. Reading Quizzes will appear on the course’s Canvas page. Typically, the deadline for completing the Reading Quiz is 7:00AM the day the material is covered in class. (See the Schedule on this greensheet for details.) Your Reading Quiz grade will be A if you answer 75% of the questions correctly over the semester; B if your average is between 60% and 75%; C if your average is between 50% and 60%; F if your average is below 50%. *Late Reading Quizzes receive no credit.*

**Grades:** Grades are determined according to the following Recipe:
- Three Tests 30%
- Paper & Presentation 30%
- Reading Quizzes 10%
- Homework 10%
- Final 20%

Grades are calculated using the 4-point system, where 4.0 is A, 3.7 is A−, 3.3 is B+, and so forth. Hence it is the letter grade you get on an activity that matters, not the number of points.

**Changes:** If you want to use a different Recipe for your grade, you may propose a change. (For example, you might propose to do no Homework, transferring its weight to the Tests instead. Or you might choose to do an in-class demonstration worth 5% of the course grade, reducing the weight of the tests). I will agree to any reasonable proposal. Proposals reducing the weight of the Paper/Presentation are not reasonable. Proposals reducing the weight of the Reading Quizzes are not reasonable. You may not propose to change the weight of work already submitted. When you make a proposal, submit two copies in writing. I will return one copy to you; the second copy is for my records.
Cell Phones and laptop computers: You will turn off and refrain from using any cell phone or smart phone. (The only exception is if you are expecting an important phone call; you will inform me of this at the beginning of class, and you will sit where you can leave the class if you receive such a call.) You may use a laptop computer only for taking notes. If I detect you using a laptop computer for any other purpose, I will not allow you to use it in class ever again, on penalty of failure. You may not use a cell phone as a calculator in class.

Tests: There will be three tests. The dates of these tests will be

Test 1: Thursday, March 3.
Test 2: Tuesday, April 7
Test 3: Tuesday, May 5

I drop your worst test before calculating your test average. Tests will consist about 80% of questions requiring written answers, and 20% involving calculations. I will make sample tests available in advance. Review sessions will be based on the sample tests.

Final: The Final Exam is 0945-1200 on Tuesday, May 24. The final exam is comprehensive and open book.

Optional Final and Offered Grades: I plan to offer you a grade no later than the last day of class, Thursday, May 12. If the offered grade is acceptable, you do not need to take the Final. If you choose to take the Final anyway, it cannot lower your grade below the offered grade. My grade offer will include information about what grade you need on the Final to raise your course grade above the offered grade. Whether I am able to offer grades the last day of the semester depends on how busy I am. I will keep you informed. However, I will not be able to offer a grade to anyone whose work in the course is incomplete.

The offered grade will be based on all the work performed in the course. I will drop your worst test only after you take the final. So if you get A's on your first two tests, you still need to get a good grade on the third test if you wish to avoid the final.

Canvas: I will use the course’s Canvas page to communicate with members of the class. You are responsible for any announcements I make through Canvas. I will record grades on the Canvas page as well. Please inform me of any mistakes I make in recording your grades. Please ignore any percentages Canvas calculates; course grades are not based on these percentages.
Office Hours: I will be available for regular office hours TTh 1-2PM. I am glad to consult with you at other times as well. (I am not normally on campus Mondays and Fridays.) You might drop in on my office during the two hours before class, but please be understanding if I am too busy to help you at that time. Please feel free to call or email me and set up another time if you wish. Please give your name and a way to contact you when you leave messages.

Paper: As you write your paper, you will submit
• a Topic Proposal (Tuesday, February 16),
• a Topic Report (due Tuesday, March 15), and finally
• a Paper (due Tuesday, April 19).

You will also give a brief Presentation, typically based on your paper. Dates of Presentations will be determined later. Details appear later (pages 7-11) in this greensheet.

Homework: Weekly, I will assign exercises from the lecture notes, or on handout sheets. Tests will contain questions similar to those used in homework, so homework offers you a chance to get feedback on how well you are doing. Most of the homework will be graded by Stephen Morgan. His email contact is Stephen.morgan@svsu.edu; his phone number is 408-924-5266. I will post homework solutions on Canvas. Late homework will not be accepted; homework is late if I have already made solutions available.

Calendar: A Calendar for the course, including readings, due dates of assignments, and tests, is given on the last page of the Greensheet. It will be updated from time to time.

Calculator: You need a scientific calculator capable of handling scientific notation (93,000,000 = 9.3 x 10^6, logarithms (log (75) = 1.8751) and exponents (10^{1.8751} = 75). Maybe you are not too familiar with logarithms, but pianos, your ears, and harmony depend on them! Always bring your calculator to class. Please do not use a cell phone as a calculator.

Demonstrations: I use demonstrations to illustrate the content of the course. I get tired of doing demonstrations all the time, so please consider doing one yourself. I would be glad to give you extra credit toward your course grade if you do a Demonstration.

Attendance, Late Work, Missed Tests: You are responsible for any work announced in class, even if you did not attend. Homework will not be accepted after I have made solutions available. I generally post
homework answers the day homework assignments are submitted. Let me know in advance if you have difficulty attending on a test day, and I will attempt to arrange a makeup.

**Learning Objectives:** While taking PHY/MUS 166, you will
1. Gain an understanding of the physical nature of sound.
2. Distinguish factors influencing oscillating systems.
3. Relate the perception of sound to the structure of the ear and to the listener’s environment.
4. Consider and observe the effects of noise and loud sounds on hearing.
5. Study the physical basis of harmony.
6. Investigate the production of musical sound.
Along the way, you will also
7. Contrast scientific and non-scientific approaches to music.
8. Strengthen your awareness of the methods and limits of science.
   (Area R LO 1)
9. Distinguish science from pseudoscience. (Area R LO 2)
10. Communicate how the course content relates to your particular musical expertise.
11. Apply a scientific approach to answer questions about the earth and environment (Area R LO 3).

How you will meet GE learning objectives:
1. To demonstrate an understanding of the methods and limits of scientific investigation, you will
   a. distinguish between how scientists and musicians approach topics such as harmony and room acoustics;
   b. describe the historical development of various theories of hearing.
2. To distinguish science from pseudo-science, you will
   a. Listen to a lecture on the distinction between science and pseudo-science,
   b. Choose a pseudo-science, investigate it, and write a one-page page on what you have learned.
   c. Participate in a class discussion based on your paper and those of other students, and d. Answer one or more test questions on this topic.
3. To apply a scientific approach to questions about the Earth and environment, you will
   a. Keep a log of your daily activities while monitoring your environment with a sound level meter, to see whether you are exposed to unsafe levels of sound;
   b. Describe the acoustics of some space familiar to you; explain how
the architectural features give rise to the acoustics; and explain what modifications would produce what changes in the acoustics.

**Writing requirements:** For a San Jose Studies (alias Advanced GE) course, a minimum of 3000 words is required. This requirement is met by the term paper (2000 words) and by other assignments (homework, tests, and, if taken, the Final.) 25% of the grade for the paper is based on the writing style. Students receive feedback (on both content and style) during and after the writing of the paper.

**Special Needs:** If you have any special needs for me to consider, please let me know.

Your own commitment to learning, as evidenced by your enrollment at San José State University, and the University’s Academic Integrity Policy requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the Office of Student Conduct and Ethical Development. The policy on academic integrity can be found at [http://sa.sjsu.edu/student_conduct](http://sa.sjsu.edu/student_conduct).

If you need course adaptations or accommodations because of a disability, or if you need special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with DRC to establish a record of their disability.

You are responsible for understanding the policies and procedures about add/drops, academic renewal, withdrawal, etc. found at [http://sa.sjsu.edu/student_conduct](http://sa.sjsu.edu/student_conduct).

**Library:** The Physics contact is Christina Mune, phone 408-808-2046, email Christina.mune@sjsu.edu. The Music contact is Patricia Stroh Music and Dance Librarian - Curator, Beethoven Center (408) 808-2059 pstroh@email.sjsu.edu Additional research information associated with the MLK Library is available through [http://www.sjllibrary.org/gateways/academic/](http://www.sjllibrary.org/gateways/academic/)
Paper/Presentation: You will write a paper of 2000 words on a topic chosen in consultation with me. In general, I expect that the topic you choose will be closely related to your background in music; i.e. if you are a trumpet player, you will probably choose to write about the physics of brass instruments. You will also give an in-class presentation based on your paper (or on some other topic, if you prefer.) I have designed the paper-writing process so that you can receive significant feedback from me as you research and write it.

Please read the following descriptions of how to write your topic proposal, topic report, and paper. I will not have time in class to remind you of these details.

A Topic Proposal will be submitted by Tuesday, February 16. The purpose of the Topic Proposal is to let me know the topic of your paper, and what sources you have found on the topic. Here are the specifications for the Topic Proposal:

- Give the title and topic of the proposed paper. (One paragraph should be fine).
- The Topic Proposal will be typed, double-spaced, using standard fonts.
- Submit two copies.
- Cite at least two references in standard bibliographic format. You may not use my lecture notes as a reference. You may not use Wikipedia as a reference.
- Use at least one non-online source as a reference.
- If you use an online source, you will include (as part of your standard bibliographic citation) the URL of the source, and a hard copy of one page of this source.

If you have trouble coming up with a topic, please consult with me. If you have difficulty finding suitable references, please consult with me.

The Topic Proposal is worth 5% of the paper grade.
A Topic Report will be submitted Tuesday, March 15. The purpose of the Topic Report is to let me know what progress you have made on the Paper since submitting the Topic Proposal. Here are the specifications for the Topic Report:

- Give the title of your paper, state the topic (if it isn't obvious from the title), and describe how you will treat it. (For example, you might give a brief outline of the paper.) If you have begun writing the paper, include what you have written.

- The Topic Report will be typed/printed, single-sided, double-spaced, using standard fonts.

- Submit two copies.

- Cite at least three references in standard bibliographic format not including the lecture notes.

- Use at least one non-online source as a reference. You may not use Wikipedia as a reference.

- Present any online sources you use in standard bibliographic format (including the web address) and include hardcopy of a sample page. Include a sentence or two explaining how you determined that the online source was reliable. Sources I consider unreliable are papers written by high school students, or by manufacturers of musical instruments. There is a lot of material available online, but much of it is unrefereed, so you need to be cautious.

Your Topic Report is worth 5% of the paper grade.
Your **Paper** will be submitted **Tuesday, April 19**. Here are the specifications for the Paper:

- The Paper will be typed/printed, single-sided, double-spaced, using standard fonts.
- Submit two copies.
- Submit an additional digital copy via email. I will screen your paper using www.turnitin.com or some similar service to verify the originality of your writing. Quotes or any other writing which is not your own should be properly referenced and should be easy to distinguish from what you have written yourself. Illustrations that are not original should also be properly referenced. **Submitting a plagiarized paper will result in failing the course.** It is possible that I will ask you to have your paper screened by turnitin.com, rather than me doing it. If this happens, I will give instructions later.
- The paper will be at least 2000 words long. This is approximately seven pages, not counting illustrations.
- Cite at least three references (in standard bibliographic format) not including the text/lecture notes.
- Use at least one non-online source as a reference. You may not use Wikipedia as a reference.
- All illustrations will have captions. All illustrations will be referred to in the text. If an illustration is not original, you will give the source of the illustration in the caption.
- Present any online sources you use in standard bibliographic format (with the web address) and include hardcopy of a sample page. Include a sentence or two describing how you determined that the online source was reliable.
- Papers will be graded 75% on content and 25% on style. **See page 11 of this Greensheet for a listing of my goals for the content and style of the paper.**

**Papers submitted on time may be resubmitted later for a higher grade.** (Papers must be resubmitted within a week of being returned. Include the original graded paper with your resubmission.) Late papers may not be resubmitted. I insist that your paper be as polished as possible when
it is submitted; those who submit incomplete papers, hoping to complete them on resubmission, will be penalized.

- *Papers submitted late will be reduced in grade.* Even if your paper is late, you must submit it to avoid getting an incomplete in the course.

- The Paper counts for 20% of your course grade.

- A date for your Presentation will be chosen when you turn in your paper. (It is possible that Presentation dates will be chosen earlier. A Presentation will consist of a 5-10 minute talk to the class. The Presentation will include a one-page written Summary to be handed out to all the students in the class. The Summary will be complete enough to convey the content of the Presentation to any class member who is so unfortunate as to miss your Presentation. Get the Summary to me in advance of your talk so that I can duplicate it for you. Let me know at that time of any equipment or materials you require for your Presentation.

- If you choose to do a project emphasizing experimental work rather than library research, please consult with me as early in the semester as possible. (Note that some library research will still be necessary.) I am particularly interested in projects that result in demonstrations that I can use in class in future years.

- The Presentation counts for 10% of your course grade. There will be a full class (25 students) this semester, so it may not be possible to accommodate everyone’s presentation. If you don’t give one, I will include the weight of the presentation in your paper grade. If you wish to give one, even though no class time is available, let me know.
Paper: Goals for style.

Two copies are submitted.  
The pages are single-sided, double-spaced, with standard margins, fonts, and font sizes.  
The title clearly states the topic.  
The organization of the paper is clear and suitable. Ideally, the paper’s organization is clear to anyone who reads the first paragraph.  
Illustrations have captions and are integrated into the paper. They are referred to in the text. The sources of illustrations are cited.  
Paragraphs develop one idea, and the sentences in them have logical connections to the topic and to each other. Long paragraphs are avoided.  
The writing is free of grammatical errors.  
The writing uses precise expressions and omits unnecessary words.  
The bibliography lists all sources in standard format. It includes at least one non-online source.  
Online sources listed in the bibliography include the web address. In addition, a description of how you judged that the source is reliable is included, along with one sample page of the source.  
All or most of the writing is in your own words. Any writing from some other source is clearly indicated. Using the words of others as if they are your own is plagiarism and will result in failing the paper.

Paper: Goals for content.

The topic is suitable. It relates to music and/or sound, and it will include a significant amount of physics.  
The paper is written to be understandable by a classmate. Even better, it is written to be interesting to a classmate.  
The paper is free of factual errors.  
The paper does not include very much content already covered in the course. Instead, the paper covers its topic in greater depth than the course. Equations are omitted unless they are actually used.
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<th>Topic</th>
<th>Read</th>
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<td>Science versus pseudoscience</td>
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<td>Pseudoscience; Elementary Physics</td>
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<td>Structure of the Ear</td>
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<td>T May 10</td>
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<td>Modern and Historical Instruments</td>
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