CALIFORNIA STATE POLYTECHNIC UNIVERSITY, POMONA

ACADEMIC SENATE

GENERAL EDUCATION COMMITTEE

REPORT TO

THE ACADEMIC SENATE

GE-113-156

PHY 1050 – Physics of Musical Sounds (GE B1)

General Education Committee	**Date: 02/4/2016**
Executive Committee **Received and Forwarded**	**Date: 05/25/2016**
Academic Senate	**Date: 06/01/2016** **First Reading** **08/31/2016** **Second Reading**

BACKGROUND:

The Physics and Astronomy Department introduced a new course for Area B1

RESOURCES CONSULTED:
Faculty
Department Chairs
Associate Deans
Deans
Office of Academic Programs

DISCUSSION:

The GE Committee reviewed the ECO for this course and found it to satisfy the GE SLO's and other requirements for Area B1.

RECOMMENDATION:

The GE Committee recommends approval of GE-113-156: PHY 1050-Physics of Musical Sounds for Area B1

PHY - 1050 - The Physics of Musical Sound

C. Course - New General Education* Updated

General Catalog Information

- **College/Department**

  Physics and Astronomy

- **Semester Subject Area**

  PHY

  Semester Catalog Number

  1050

- **Quarter Subject Area**

  PHY

  Quarter Catalog Number

  105

- **Course Title**

  The Physics of Musical Sound

- **Units***
  (2)
- **C/S Classification***
  C-02 (Lecture Discussion)

- **To view C/S Classification Long Description click: http://www.cpp.edu/~academic-programs/scheduling/Documents/Curriculum%20Guide/Appendix_C_CS_Classification.pdf**
- **Component***
  Lecture
- **Instruction Mode***
  Face-to-Face
  Web-Assisted
- **Grading Basis***
  Graded Only
- **Repeat Basis***
  May be taken only once

- **If it may be taken multiple times, limit on number of enrollments**

  1

- **Cross Listed Course Subject Area and Catalog Nbr (if offered with another department)**

- **Dual Listed Course Subject Area and Catalog number (If offered as lower/upper division or ugrd/grad)**

- **Choose appropriate type(s) of course(s)***
  - ☐ **Major Course**
  - ☐ **Service Course**
  - ☑ **GE Course**
  - ☐ **None of the above**
- **General Education Area / Subarea***
  B1

- **To view the General Education SubArea definitions, click http://www.cpp.edu/~academic-programs/scheduling/Documents/Ch.3-GeneralEducationProposals.pdf.**
- **I. Catalog Description**
- **Catalog Description**

The fundamentals of acoustics and its application to music-vibrations, wave, hearing, pure tones, complex tones, resonance, scales, consonance, and the physics of musical instruments. Students must take 1050 and 1050L together to get credit for GE Area B1.

- **II. Required Coursework and Background**
- **Prerequisite(s)**

Prerequisite: None.

Corequisite: PHY 1050L

- **Corequisite(s)**
- **Pre or Corequisite(s)**
- **Concurrent**
- **III. Expected Outcomes**
- **List the knowledge, skills, or abilities which students should possess upon completing the course.***

On successful completion of this course, students will be able to:

1. Perform simple calculations, including relating the wavelength and frequency of a wave, relating intensity to power and distance, relating intensity to decibels, and determining the resonant frequencies of simple musical devices from their shapes.
2. Describe the physical principles underlying interference, resonance, reverberation, and damping, and how these principles determine the frequency of sound produced by a musical instrument and the quality of the sound perceived in a room.
3. Describe the physical and biological principles underlying the reception of sound by the ear, and their relationship to the perceived tone and pitch.
4. Explain the principle of superposition, its relationship to the spectrum of detected sound waves, and the physical means by which spectra can be measured.

- **If this is a course for the major, describe how these outcomes relate to the mission, goals and objectives of the major program.**
- **Explain how the course meets the description of the GE SubArea(s). Please select appropriate outcomes according to the GE Area/SLO mapping.**

Acoustics is a branch of physics that combines fundamental principles (wave propagation, energy, interference, etc.) with technological applications, and biological relevance (hearing in most animals, echolocation in bats and whales), while being intrinsic to music and the performing arts. While the emphasis in this course will be on the artistic applications of sound, all key aspects of the physical theory of sound will be examined, and the biology of hearing will, by necessity, be covered, as the ears are the means by which the musical arts are experienced. As a course that presents fundamental physical science principles in a

context of wide relevance to students' development of broader cultural appreciation, this course is fully in keeping with the objectives of general education.

Describe how these outcomes relate to the associated GE Learning Outcomes listed below.*

Ia. Write effectively for various audiences.Students will produce written explanations of their reasoning in homework problems involving calculations, and will provide short (paragraph-long) answers to conceptual questions about physical situations. Questions requiring written explanations of reasoning, or written interpretation of physical situations, will be included on graded homework assignments as well as tests.

Additionally, the corequisite for PHY 1050 will be PHY 1050L, a laboratory course with weekly written report assignments. The topics in PHY 1050 and 1050L are intended to be mutually reinforcing, so that although the lab reports in 1050L are not formally a component of 1050, all of the students in 1050 will be part of an integrated pair of courses with significant writing throughout this instructional experience.

Id. Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.

Students will produce problem solutions that not only give a correct numerical result, but also correct reasoning leading to the result. Students will explain why they used a particular principle for each step of the calculation, why they translated a verbal description of a physical situation into a particular geometrical model or equation, or why they chose a particular physical principle or phenomenon as being the relevant one to the situation described in the problem or question.

Ie. Apply and communicate quantitative arguments using equations and graphical representations of data.

Students will solve quantitative problems using simple equations (e.g. relationship between wavelength and frequency, or relationship between intensity, power, and distance) explaining in their solutions how the principle underlying the equation applies to the physical situation in the problem, and how using the equation will yield a physically meaningful answer to the problem that was posed to the student. Additionally, students will answer questions that require them to produce a graph that represents physical phenomena such as sound waves in air, the vibrations of strings, or the spectrum of sound received by a microphone. (See particularly Course SLO 1)

IIa. Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.

Students will solve simple quantitative problems, and answer conceptual questions, in which they apply physical principles to predict such things as the frequency of sound produced by a given instrument, or the magnitude of a signal received by a microphone, or the magnitude of the neural signal produced by an ear in response to a sound.

- **General Education Outcomes***

  Ia. Write effectively for various audiences
  Id. Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.
  Ie. Apply and communicate quantitative arguments using equations and graphical representations of data.
  IIa. Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.

- **To view the mapping, click https://www.cpp.edu/~academic-programs/Documents/GE%20SLO%20Mapping.pdf**

- **IV. Instructional Materials**

- **Provide bibliography that includes texts that may be used as the primary source for instruction, and other appropriate reference materials to be used in instruction. The reference list should be current, arranged alphabetically by author and the materials should be listed in accepted bibliographic form.**

- **Instructional Materials***

Texts may vary with instructor and over time, but will typically be at the level of*Physics of Sound* by Berg and Stork (Pearson, 3rd edition, 2005).

Additional notes and current papers on the diverse topics may also be made available on BlackBoard by the instructor.

- **Faculty are encouraged to make all materials accessible. Indicate with an asterisk those items that have had accessibility (ATI/Section 508) reviewed. For more information,http://www.cpp.edu/~accessibility**
- **V. Minimum Student Material**
- **List any materials, supplies, equipment, etc., which students must provide, such as notebooks, computers, internet access, special clothing or uniforms, safety equipment, lockers, sports equipment, etc. Note that materials that require the assessment of a fee may not be included unless the fee has been approved according to University procedures.**
- **Minimum Student Material***

Acccess to a computer (as needed)
Internet access
e-mail
Clicker
calculator
Notebook

- **VI. Minimum College Facilities**
- **List the university facilities/equipment that will be required in order to offer this class, such as gymnastic equipment, special classroom, technological equipment, laboratories, etc.**
- **Minimum College Facilities***

External Support

Library Services
Stockroom
Graphic Services
Information Technology (IT) Services
Classroom Management System (e.g. BB)
Copier

Physical Space & Major Equipment

Lecture room with seating for 50 students
Smart classroom (computer/projector)
Demonstration equipment
Overhead screen
White board/dry erase markers
Adjustable lighting

VII. Course Outline

Describe specifically what will be included in the course content. This should not be a repetition of the course description but an expansion that provides information on specific material to be included in the class, e.g. lecture topics, skills to be taught, etc. This should not be a week-by-week guide unless all instructors are expected to follow that schedule.

Course Outline*

The course topics will typically be organized into 9 units of roughly 1-2 weeks each.

1. The physical nature of sound
2. The nature of waves and vibrations: Wavelength, frequency, speed, superposition, resonance.
3. Wave propagation: Reflection, refraction, inverse square law, interference.
4. Standing waves: Fundamental, harmonics, overtones, applications to musical instruments.
5. Spectra of sounds: Principles of Fourier analysis, relationship between measured spectrum and auditory perception.
6. The biological basis of speaking, singing, and hearing: Form and function of the vocal cords and ear.
7. Electronic instruments: Mechanical basis, simple electronic principles.
8. Room acoustics: Reverberation, room design, and related principles.
9. Analysis of selected musical instruments.

VIII. Instructional Methods

Describe the type(s) of method(s) that are required or recommended for the instruction of this course (lectures, demonstrations, etc.). Include any method that is essential to the course, such as the use of particular tools or software.

Instructional Methods*

Lecture
Problem-solving

Discussion
Demonstrations

- **IX. Evaluation of Outcomes**
- **Describe the methods to be used to evaluate students' learning, i.e. written exams, term papers, projects, participation, quizzes, attendance, etc.***

Students will be evaluated by three methods:**1) Homework assignments, done weekly outside of class**: In these assignments, students will produce written solutions to problems, including numerical calculations, justifications of each step in the calculations, diagrams (with written explanations), and graphs illustrating the qualitative and quantitative behavior of sound waves, the objects producing the waves, or the objects receiving the waves. These assignments will be graded both for the correctness of the result, the validity of the process, and the clarity of the justification given for the process.

2) Quizzes, done either individually either in-class or online before class: Quizzes will be shorter than homework assignments, given at regular intervals to incentivize practice of what was covered previously and preparation for what is to be covered next. Although shorter than the weekly homework assignments, over the course of the semester the quiz questions will assess the full span of topics and skills covered in the homework assignments.

3) Exams, including 2 in-class written exams, and an in-class final exam: Exam questions will require students to perform a variety of calculations and answer a variety of conceptual questions similar to those on homework, and provide written justifications for their reasoning. These written tests will be graded and returned to students with useful feedback on the clarity and correctness of their reasoning.

- **Describe the meaningful writing assignments to be included.***

Students will provide justification for their reasoning and (when appropriate) calculation steps in weekly written homework assignments, which will be graded and critiqued both for clarity and correctness. Calculation problems will typically require just short explanations (a sentence or two) to clarify steps, while conceptual questions on physical principles will require longer explanations (short paragraphs). Graded work will be returned with comments. On exams, given after students have completed several written assignments and received comments, students will be expected to provide more detailed justifications for problem solutions, and the expectations for the depth and clarity of written justifications will increase on each subsequent exam, after students have received feedback on the previous exam.

Additionally, in the corequisite laboratory course, students will produce weekly written reports (typically 2-3 pages) summarizing experimental methods, results, and interpretations of results.

- **Discuss how these methods may be used to address the course and program outcomes, as appropriate. Include or attach a matrix to align the evaluation methods to the outcomes.***

Student Learning Outcomes	Written Homework	Quizzes	Exams

Course SLO 1: Perform simple calculations, including relating the wavelength and frequency of a wave, relating intensity to power and distance, relating intensity to decibels, and determining the resonant frequencies of simple musical devices from their shapes.	X	X	X
Course SLO 2: Describe the physical principles underlying interference, resonance, reverberation, and damping, and how these principles determine the frequency of sound produced by a musical instrument and the quality of the sound perceived in a room.	X	X	X
Course SLO 3: Describe the physical and biological principles underlying the reception of sound by the ear, and their relationship to the perceived tone and pitch.	X	X	X
Course SLO 4: Explain the principle of superposition, its relationship to the spectrum of detected sound waves, and the physical means by which spectra can be measured.	X	X	X

- **If this is a general education course, discuss how these methods may be used to address the associated GE Learning Outcomes listed below. Include or attach a matrix to align the evaluation methods to the outcomes.***

Student Learning Outcomes	Written Homework	Quizzes	Exams
GE SLO Ia: Write effectively for various audiences.	X	X	X
GE SLO Id: Construct arguments based on sound evidence and reasoning to support an opinion or conclusion.	X	X	X
GE SLO Ie: Apply and communicate quantitative arguments using equations and graphical representations of data.	X	X	X
GE SLO IIa: Apply scientific methods and models to draw quantitative and qualitative conclusions about the physical and natural world.	X	X	X