CALIFORNIA STATE UNIVERSITY CHANNEL ISLANDS

NEW COURSE PROPOSAL

PROGRAM AREA ___ BIOLOGICAL AND PHYSICAL SCIENCES, ART (MUSIC)

1. **Catalog Description of the Course.** *[Include the course prefix, number, full title, and units. Provide a course narrative including prerequisites and corequisites. If any of the following apply, include in the description: Repeatability (May be repeated to a maximum of ___ units); time distribution (Lecture ___ hours, laboratory ___ hours); non-traditional grading system (Graded CR/NC, ABC/NC). Follow accepted catalog format.]*

   PHYS 335. THE PHYSICS OF MUSIC (3)
   Two hours of lecture and two hours of lab activity per week.
   Provides an understanding of music and sound for students interested in music, speech, and language. Extensive use of demonstrations and sound analysis computer programs will be used. The format will include lectures, demonstrations, and hands-on use of the computer programs.
   Same as MUS 335.
   GenEd-ID: B1, C1 and Interdisciplinary

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2. **Mode of Instruction.**

	Units	**Hours per Unit**	**Benchmark Enrollment**
Lecture	____2____	___1_____	___20_____
Seminar	_____	_____	_____
Laboratory	_____	_____	_____
Activity	____1____	____2____	___20_____

3. **Justification and Learning Objectives for the Course.** (Indicate whether required or elective, and whether it meets University Writing, and/or Language requirements) *[Use as much space as necessary]*
   Elective in Art

   This course attempts to satisfy a basic deficiency in the understanding of music and language students in the physical basis of their disciplines. In the past few years, there has been a great proliferation of sound analysis programs which are not always easy to understand or use. This course bridges that gap and primarily puts the student on a level with research workers in the field. In addition, for those students interested in an introductory science course this course gives them an easy to understand and exciting glimpse at experimental research.

   Through this course, students will be able to
   - learn the graphical approach to sound as a function of time
   - discuss the language of sound waves and waves in general
   - describe the physical basis of musical harmony
   - describe the meaning of pure tones and complex tones with many harmonics
   - discuss beauty and utility of Fourier analysis
   - record a musical sound and carry out a sophisticated analysis of that sound
   - quantify the difference in sound of most instruments, including the human voice
   - describe quantitatively how we distinguish vowels
   - demonstrate an understanding of acoustics in a quantitative manner

   A major part of this course is the term project. Students pick their own projects and these vary from analysis of the beat frequencies produced by a gong to a study of the sounds made by the door closings of automobiles.

4. Is this a General Education Course **YES** **NO**
If Yes, indicate GE category:

A (English Language, Communication, Critical Thinking)	
B (Mathematics & Sciences)	**X**
C (Fine Arts, Literature, Languages & Cultures)	
D (Social Perspectives)	
E (Human Psychological and Physiological Perspectives)	

5. Course Content in Outline Form. *[Be as brief as possible, but use as much space as necessary]*

1. Properties of Sound Waves - Define and relate wavelength, frequency (pitch), and sound speed. Distinguish amplitude, intensity, and power.
Describe absorption, diffraction, refraction, reflection, phase and interference. Sound as longitudinal waves.
2. Wave Shapes - Complicated wave shapes and pure tones compared. Introduce the concept of the frequency spectrum.
3. The Fourier Theorem. Non-mathematical description in terms of analysis and synthesis of waves.
4. Musical Scales - The development of Western musical scales and harmony based on harmonics. Introduce other scales.
5. Pipes as Instruments - Flute, clarinet, oboe, trumpet etc. Describe instrument as a resonant cavity (or filter). Define resonance and standing waves.
6. Percussive Instruments - Piano, drums, bells, etc.
7. The Strings - Violin, viola, cello, bass etc. Emphasis on the physics - cavity, body resonance, action of bridge, etc.
8. The Human Voice - The vocal tract as a resonant filter. Definition of filter. Use of spectrometry for comparing voices and instruments. Real time spectrograms and vocal feedback studies.
9. Refinements of Spectral Analysis - Uncertainty principle for music. Use computer programs (SE16, SpectraFoo, Syd, Armadillo, SpectraPlus Canary) for individual projects.
10. Acoustics - How to make sound measurements in a scaled-down room.

6. References. *[Provide 3 - 5 references on which this course is based and/or support it.]*

Ian Johnston, Measured Tones – **The Interplay of Physics and Music**, Institute of Physics Publishing, 2002

- N. H. Fletcher and T. D. Rossing, **The Physics of Musical Instruments**, Springer-Verlag, 1988
- J. R. Pierce, **The Science of Musical Sound**, Scientific American Books, 1992
- R. E. Berg and David G. Stork, **The Physics of Sound**, Prentice-Hall, 1982
- A.H. Benade, **Fundamentals of Musical Acoustics**, Dover, 1990
- J. Sundberg, **The Science of the Singing Voice**, Northern Illinois University Press, 1987
- R. Miller, **Training Tenor Voices**, Schirmer Books, 1993

7. List Faculty Qualified to Teach This Course.

Dr. Geoff Dougherty

8. Frequency.

a. Projected semesters to be offered: Fall _ Spring _x____ Summer _____

9. New Resources Required.

a. Computer (data processing), audio visual, broadcasting needs, other equipment.

Computer classroom licenses for SoundEdit 16 (MAC) and Canary (Mac). A licence for these costs around $90 and $50 resp. per student, but these are once-only costs, not annual costs.

b. Library needs

One copy each of the books listed in para.6.

c. Facility/space needs

Use of Mac G3 Lab in Technology Center

10. Consultation.
Attach consultation sheet from all program areas, Library, and others (if necessary)

Consulted: Ted Lucas, PHD

11. If this new course will alter any degree, credential, certificate, or minor in your program, attach a program modification.

Geoff Dougherty, PHD, Professor of Physics

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Proposer of Course Date

GE CRITERIA APPROVAL FORM

Course Number and Title:

• PHYS 335 The Physics of Music
• MUS 335 The Physics of Music

Faculty Member(s) Proposing Course: Geoff Dougherty, (David Bach)

Indicate which of the following categories would be satisfied by this course by marking an "X" on the appropriate lines. Courses may be placed in up to two GE categories as appropriate. Upper Division Interdisciplinary GE courses may be placed in two categories plus the UDIGE category.

	A1: Oral Communication
	A2: English Writing
	A3: Critical Thinking
X	B1: Physical Sciences
	B2: Life Sciences
	B3: Mathematics
	B4: Computers and Technology
X	C1: Fine Arts
	C2: Literature
	C3: Languages & Cultures
	D: Social Perspectives
	E: Human Psychological & Physiological Perspectives
X	Upper Division Interdisciplinary GE

Lab Included? Yes _____ No __X____

Please provide a brief explanation of how the proposed course meets <u>each</u> of the criteria for the selected General Education categories.

This course is **GE** because of its breadth and applicability to a number of disciplines and interests: students taking it will acquire the skills, experience and knowledge "appropriate to educated people within our society".

All Category B courses shall:

- Promote the understanding and appreciation of the methodologies of math or science as investigative tools and the limitations of mathematical or scientific endeavors.

→The course will present to non-science students a first hand look at the physical foundations of music by demonstration and computer study. These will be presented in a way to fuse art and science.

- Present mathematical or scientific knowledge in a historical perspective and the influences of math or science on the development of world civilizations, both past and present.

→ The art of music has a firm basis in the history of physical science and this connection will be presented as modern methods of analysis are studied. The relationship between physical science and the quantitative nature of musical harmonics will be studied.

- Apply inductive and deductive reasoning processes and explore fallacies and misconceptions in the mathematical or scientific areas.

→The methods of mathematics and experiment studied by example will demonstrate clearly the use of deductive and inductive reasoning. As these are utilized, misconceptions will necessarily be considered at the same time.

Category B-1 Physical Sciences—Chemistry, Physics, Geology, and Earth Sciences courses shall:

- Present the principles and concepts of the physical sciences and the physical universe.

→The course will provide non-science students with a physical basis for studying the generation of musical sounds.

All Category C courses shall:

- Develop students' ability to respond subjectively as well as objectively to experience

→ Although most students understand the beauty of music subjectively, the course will enable them to understand those feelings in an objective manner.

- Cultivate and refine students' affective, cognitive, and physical faculties through studying great works of the human imagination.

→ Fourier's elegant theorem, on which much of this course is based, was the result of imaginative mathematics, and this will be explained and utilized.

- Increase awareness and appreciation in the traditional humanistic disciplines such as art, dance, drama, literature, and music.

→ As the students study the variety of beautiful instruments designed by man, they will learn to appreciate the marvelous complexity of design that was necessary for their development.

- Examine the interrelationship between the creative arts, the humanities, and self.

→ This course provides a unique avenue for studying these connections in the analysis of the human voice.

- Include an exposure to world cultures.

→ Concepts of musical harmony from non-Western cultures will be addressed during the course.

Category C-1 Art courses shall:

- Impart knowledge of the visual and performing arts.

→ The physics of sound and music is a necessary part of performance in music. In fact, the beautiful display of the harmonic spectrum as a moving picture of sound has a unique artistic and pedagogical utility.

- Promote students' ability to effectively analyze and respond to works of human imagination

→ The term project which will be proposed by each student will give them a chance to show in a real quantitative manner how they respond to their own imagination.

In addition to meeting Category A-E criteria as appropriate all Upper Division Interdisciplinary GE courses shall:

- Emphasize interdisciplinarity by integrating content, ideas, and approaches from two or more disciplines.

→ This course is an example of connecting the discipline of physics with the art of music in a most explicit manner.

- Include substantive written work consisting of in-class writing as well as outside class writing of revised prose.

→ Each student is required to provide a written report on their term project. The writing consists of descriptive explanations of the methods and results of their individual project. The student also presents this material as an oral report to the class.