# NS A115: SCIENCE AND TECHNOLOGY IN MUSIC

| Item | Value |
|---|---|
| Curriculum Committee Approval Date | 11/15/2023 |
| Top Code | 190200 - Physics, General |
| Units | 3 Total Units |
| Hours | 54 Total Hours (Lecture Hours 54) |
| Total Outside of Class Hours | 0 |
| Course Credit Status | Credit: Degree Applicable (D) |
| Material Fee | No |
| Basic Skills | Not Basic Skills (N) |
| Repeatable | No |
| Grading Policy | Standard Letter (S),<br>• Pass/No Pass (B) |
| Associate Arts Local General Education (GE) | • OC Physical/Biological Sci - AA (OB) |
| Associate Science Local General Education (GE) | • OCC Physical/Biological Sci-AS (OSB) |

## Course Description

An introduction to the physics that shapes our natural world through an investigation of the creation, transmission, and perception of sound and music. Fundamentals of oscillations, waves, forces, energy, and electromagnetism are explored through scientific inquiry of musical tones, harmony, timbre, acoustics, and acoustic and electronic instruments. ADVISORY: Successful completion of a course at the level of elementary algebra or Appropriate OCC math placement. Transfer Credit: CSU; UC.

## Course Level Student Learning Outcome(s)

1. Describe the basic physical principles involved in the creation, transmission, and perception of sound and music, and apply these principles to solve real-world problems beyond sound and music.
2. Utilize physical principles and appropriate technology to analyze and design real-world examples of sound and music.

## Course Objectives

- 1. Understand the roles of scientific inquiry, the scientific method, and technology in gaining insight into the physical principles that shape the natural world.
- 2. Explain the generation, transmission, and perception of sound and music in terms of the core physical concepts of oscillations, waves, forces, energy, and electromagnetism.
- 3. Apply the core physical concepts of oscillations, waves, forces, energy, and electromagnetism to solve real world problems beyond sound and music.
- 4. Analyze and design musical scales, harmonies, and timbres utilizing physical principles and appropriate technology.

## Lecture Content

Course content parallels similar courses in the UC/CSU system that fulfill GE science requirements for graduation (e.g. Physics 15 at UCI, Physics 1050 at CPP, Physics 335 at CSUCI, Physics 305 at CSUN, Physics 356 at CSUSM). This course takes a phenomenological approach to the study of physics. Students gain an understanding of fundamental physical concepts and principles that shape the natural world at-large through the investigation of sound and music. The core scientific content of the course includes: Scientific Method – inquiry process, inductive versus deductive reasoning, evidence-based argumentation, mathematical tools, fundamentals of measurement, utilization of technology Oscillations and Waves – oscillation and wave properties, simple harmonic motion, traveling sine waves, sound waves in media, velocity of sound, Doppler effect, superposition of waves, wave interference, wave reflections, standing waves, frequency spectra, Fourier analysis Forces and Energy – simple machines, mechanical advantage, forms of energy, energy conservation, energy of oscillations and waves, sound intensity, resonance Electromagnetism – electric force, voltage, current, magnetic force, electromagnetic induction Psychoacoustics – human auditory system, neuroanatomy, perception of sound The psychoacoustics category provides opportunities for developing interdisciplinary connections between physics and the fields of human anatomy, physiology, and psychology. Utilizing examples of music from around the world to explore core scientific principles encourages students to integrate rational and aesthetic thought, fostering perspective on how science translates across a diverse global society.

## Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- DE Online Lecture (02X)

## Instructional Techniques

Lectures with demonstrations as well as in-class activities and discussion engage students in scientific inquiry, operation of technology, and problem-solving techniques. Assigned readings and homework reinforce conceptual understandings and improve problem-solving skills. Individual and/or group projects challenge students to expand and apply their scientific knowledge and technical skills towards solving real-world problems and developing novel applications. Written summaries, oral presentations, and/or peer evaluation of student projects provide further opportunities to improve analytical and communication skills. Students are encouraged to interact with the instructor and each other through in-class discussions and activities, as well as group projects and instructor office hours.

## Reading Assignments

One hour per week as assigned by the instructor from texts, technical manuals, and/or instructor handouts

## Writing Assignments

One hour per week on written summaries and/or peer review of projects that include appropriate use of scientific and technical vocabulary, as well as significant qualitative and quantitative analysis

## Out-of-class Assignments

Four hours per week on assignments (homework and projects) and test preparation emphasizing problem-solving and concept application

## Demonstration of Critical Thinking

Exams and quizzes, homework assignments, in-class discussions and activities, and at least one design project requiring the critical application of scientific knowledge and technical skills towards the analysis and/or design of real-world examples of music

## Required Writing, Problem Solving, Skills Demonstration

Exams and quizzes, homework assignments, in-class discussions and activities, and at least one design project requiring a written summary that includes appropriate use of scientific and technical vocabulary, as well as significant qualitative and quantitative analysis

## Eligible Disciplines

Physical sciences: See interdisciplinary studies Masters degree required. Physics/Astronomy: Masters degree in physics, astronomy, or astrophysics OR bachelors degree in physics or astronomy AND masters degree in engineering, mathematics, meteorology, or geophysics OR the equivalent. Masters degree required.

## Textbooks Resources

1. Required Gunther, L.. The Physics of Music and Color: Sound and Light, 2 ed. Springer International, 2019