I. COURSE DESCRIPTION

This is a lecture course about sound and acoustics, relating music and physics. Prerequisites: None. Offered yearly. This course has been approved in the category: University Studies – Natural Science.

II. MAJOR FOCUS

Physics and music have always been closely connected, from the time of Ancient Greek civilization to the present. As the understanding of science advanced, so did the theory of music. This course will trace the development of music, while highlighting the underlying concurrent developments in science. Numerous in-class demonstrations of both physics and music will be used to show the physical principles of sound. Various families of musical instruments will be analyzed, including electronic instruments. Concert Hall Acoustics, sound recording, and digital sound will also be examined.

III. TEACHING AND LEARNING STYLE

The instructor will post the suggested reading and problem assignments for the following week on the course web site. The student should look over the assigned materials and practice concepts covered in class by doing the assigned problems. The answers to all assigned problems will be given on the due date for the assignment. The instructor will use class time to (1) demonstrate concepts covered in the reading material, (2) show the historical connections and development of the concepts discussed (3) provide demonstrations illustrating the principles being studied, and (4) answering questions from class.

IV. EVALUATION

The student’s grade is determined by scores on two midterm exams, homework, class participation and a final exam. The last of these exams will be a comprehensive final exam containing material covered during the entire semester. The weighting of the various scores is as follows:
V. POLICIES

Students are expected to attend and participate in class. Class exams are announced well in advance and students are obliged to take tests at the scheduled times. The obvious reasons for the exam policy are for fairness to the entire class. A penalty of a 10% per day deduction from the score will be given to those who have an unexcused absence.

Examples of unexcused absences include, but are not limited to: attendance at weddings, convenient rides home, oversleeping, unpreparedness. Examples of excusable absences include verifiable illness, and family emergency. Prior notice may be given by calling the Physics Department office at 457-5260, or the instructor at 457-5854, or by sending e-mail to the instructor at the e-mail address listed above. If you are in doubt of the status of a pending absence, discuss the matter with the instructor prior to the test date.
Course Outline:

**Periodic Motion**
- Vibrations
- \( F = m a \) – Newton’s Second Law
- Force, mass, position, velocity, acceleration
- Mass-Spring System
- Simple Harmonic Motion
- Damped Harmonic Motion
- Driven Harmonic Motion; Resonance

**What are Sound Waves?**
- Periodic pressure waves: Longitudinal Waves
- Speed of Sound
- Frequency: Pitch
- Amplitude: Loudness
- Timbre: Quality: Mixture of harmonics
- Frequency \( \times \) Wavelength = Wave Velocity
- Why does helium change one’s voice?
- The Doppler Effect
- Sonic Booms: Shock Waves

**How Do We Hear?**
- Human Hearing Frequency Range
- Decibels
- Beats
- Pitch Perception
- Spatial Location and Phase

**What Elements Make Up Music?**
- Musical Scales: Why these notes?
- Rhythm
- Tempo
Dynamics
Tone Quality

How Do Musical Instruments Work?
Strings
Woodwinds
Brass
Voice
Percussion
Miscellaneous Instruments

Reflection and Absorption of Sound Waves
Tuned Pipes
Echoes

Concert Hall Design
Soundproofing
Acoustical Paths: Reflections
Reverberation

Diffraction of Sound Waves
Diffraction of sound from a source
Dispersion angle of sound

Electronic Instruments
Electric Organs
Electric Pianos
Synthesizers
Garage Band, etc.

Electronic Systems
Recording and Reproduction of Sound
Digital Music: Producing Sound
Filtering and Equalization

New Media
Music on the Web
CD music
MP3 Players