OUTCOMES BASED LEARNING MATRIX

Course: Science of Music (PHYS113) Department: Physical Science Fall 2007

At the end of the course, students will be able to: **Students will participate in:** **Faculty will evaluate with:**

COURSE OUTCOMES	OUTCOME ACTIVITIES	ASSESSMENT TOOLS
Musical Background: Define basic musical vocabulary and describe concepts such as: attributes of a single tone (pitch, loudness, duration, timbre), pitch designation, and relationships between tones (octave, half and whole steps, scales, simple intervals, consonance and dissonance).	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.
Basic physics overview: Use variables to represent physical quantities; be able to interpret and formulate direct and inverse proportions; define displacement, velocity and acceleration; state and explain Newton's Laws of Motion, Conservation of Energy and the concepts of work and power; be able to apply these to physical situations, including musical instruments; use appropriate units for these quantities	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.

Vibrations and Waves: Explain how Hooke's Law implies Simple Harmonic Motion; be able to use descriptive vocabulary for vibrations; predict changes in period/frequency due to changes in mass and spring constant; describe damping and resonance; describe production of transverse and longitudinal waves; qualitatively describe reflections, interference, diffraction, and the relationship between frequency, wavelength and wave speed.	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.
Sound waves: Describe production and propagation of sound waves; explain beats and other interference phenomena; distinguish between sound intensity and sound intensity level and know typical values; explain temperature dependence of the speed of sound	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.
Standing Waves on a String: Explain conditions necessary for production of standing waves; describe and apply relationships between frequency, length, tension, and density and the implications of these for string instruments; describe amplification in acoustic string instruments.	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.

Standing Waves in Air Columns: Explain conditions necessary for production of standing waves in air columns in open and closed tubes; describe and apply relationships between frequency, length, and the speed of sound, and the implications of these for wind instruments; explain tone production in reed instruments, flutes and pipe organs	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.
Modes of Vibration: Explain the difference between harmonic and non-harmonic modes of vibration; describe superposition of modes in surfaces such as drum heads and string instrument bodies; describe pitched and non-pitched instruments; qualitatively analyze frequency spectrums for sound timbre; characterize the process of Fourier Analysis.	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.
Frequency Ratios of Intervals and Harmony: Know frequency ratios for some intervals; use frequency ratios to calculate the frequency of the upper note of an interval knowing the frequency of the lower note; describe the harmonic series and state frequency ratios for its first four intervals; explain tone production in	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.

brass instruments; explain the criteria for consonance and dissonance in pure and complex tones.		
The Human Ear: Describe the anatomy and physiology of the ear from the point of view of basic physical concepts and the perception of musical sound; explain the influence of the ear's function on musical harmony thorough the critical bandwidth.	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.
Concert Hall Acoustics: Describe the important acoustic factors in concert halls, including reverberation time, initial time delay gap, and standing waves; explain how these characteristics can determine the acoustic quality of a concert hall and its suitable uses; describe the effect historically of concert halls on musical style.	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.
Temperament: Describe what a temperament is and why no choice is ideal; distinguish Pythagorean, Just and Equal Temperaments, and discuss the advantages and disadvantages of each; give the frequency ratio of the half step in equal temperament; state the contemporary pitch standard and	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.

explain why this and the choice of temperament determine the frequencies of all notes.		
Music Recording and Electronic Music: Describe analog and digital music recording systems and music synthesizers; explain how synthesizers control pitch, timbre, and loudness contour; describe sampling and sound modification by computer.	- Lectures (CT, QS), - Discussions (CT, OC), - Demonstrations (CT, TS), - Reading course materials. (CT, R, QS), - Answering homework questions (CT, R, W, QS)	- Objective test questions, - Essay test questions, - Participation during in-class discussions, - Homework questions.