

I. Course Overview:

Upon successful completion of this course, the students should be able to solve algebraic and logarithmic problems related to the study of acoustics and explain, using appropriate scientific terminology, the basic principles of vibrating bodies, wave motion, musical instrument function, human hearing and auditorium acoustics.

II. Units:

Unit 1. The Basic Principles of Physics and Wave Motion

General Outcome:

- 1.0 The students should be able to define terms associated with SHM and apply physics formulas to wave phenomena.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 1.1 Correctly define potential and kinetic energy, elasticity, acceleration, displacement, weight and mass, speed and velocity, force, work, and power.
- 1.2 Distinguish between scalar and vector quantities.
- 1.3 Describe SHM and to distinguish among wave phenomena in the following:
 - 1.3.1 Reflection
 - 1.3.2 Refraction
 - 1.3.3 Diffraction
 - 1.3.4 Interference
- 1.4 Apply basic formulas to compute beats, speed of sound in different media and make temperature scale conversions.
- 1.5 Explain concepts related to sound absorption by being able to solve problems involving a coefficient of absorption.
- 1.6 Sketch and interpret sinusoidal waves on graph paper.

Unit 2. Auditory Response in Humans

General Outcome:

2.0 The students should be able to demonstrate an understanding of the hearing process including the ability to distinguish between physical phenomena and psychological perceptions.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 2.1 Describe the anatomy of the human ear, including the contents and function of the outer, middle, and inner ear.
- 2.2 Detail the functions of the auditory nerve and related physiology.
- 2.3 Associate physical concepts with phenomena of auditory sensitivity including the thresholds of hearing and pain, as well as masking.
- 2.4 Distinguish between intensity and loudness, frequency and pitch, broad and sharp resonance.
- 2.5 Compute loudness in decibels according to the Weber-Fechner law.
- 2.6 Solve problems involving Doppler effect.
- 2.7 Define and distinguish between subjective (summation and difference) tones.
- 2.8 State and apply the stroboscopic principle.
- 2.9 Define and describe partials.
- 2.10 Use sound spectra for sound synthesis.
- 2.11 Distinguish between vibrato (pitch and dynamic) types and state applications.

Unit 3. Temperament and Principles of Vibrating Bodies

General Outcome:

- 3.0 The students should be able to demonstrate an understanding of the reasons for and the methods of different means of temperament and express differences and similarities of vibrating strings, air columns, reeds, etc.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 3.1 Distinguish among Just, Pythagorean, and equal temperament tuning and show computations of intervallic frequencies for each method.
- 3.2 Express the scientific cause for consonance and dissonance.
- 3.3 Calculate fundamental and overtone frequencies for vibrating strings.
- 3.4 Calculate fundamental and overtone frequencies for open and closed air columns.
- 3.5 Discuss vibrating reeds, vibrating rods and plates.
- 3.6 Discuss the anatomy and function of the human voice.

Unit 4. Auditorium and Other Room Acoustics

General Outcome:

- 4.0 The students should be able to demonstrate an understanding of room acoustics involving the room's purpose, displacement, and surfaces.

Specific Learning Outcomes:

Upon successful completion of this unit, the students should be able to:

- 4.1 Define related terminology such as reverberation, growth period, steady state, cessation of sound emission, decay, and reverberation time.
- 4.2 Describe procedures for creating different acoustics for different room usages.
- 4.3 Read a graph showing desired reverberation times for different room displacements.
- 4.4 State the characteristics of room acoustics and describe ways to alter room acoustics with different materials, splays, and artificial ceilings and walls.
- 4.5 List desirable features of public address systems and describe procedures to attain them.