acoustic waves – sound waves traveling in air, fluid, or solid

acoustics – the study of sound

amplitude – the measure of the wave strength from the equilibrium (center line) to the highest point of a wave. Sometimes engineers like to measure from the very bottom to the very top and thus obtain twice this value. To avoid confusion we refer to the later as “anti-peak-to-peak” amplitude or simply as “peak-to-peak” amplitude. Do not confuse this with measuring horizontally from one peak to the next, in which case you obtain the wavelength.

amplitude modulation (AM) – the change of the amplitude of a wave

antinode – a place on a wave that undergoes maximum change, e.g., displacement antinode means maximum changes in displacement (movement) at that point

aperiodic – not periodic

Armstrong, Louis - famous jazz trumpet player

Bach, Johann Sebastian - composer of the Baroque Period

baffle – a barrier with a hole in it so that a speaker can be inserted, thus preventing the out-of-phase waves leaving the rear from destructively interfering with the waves leaving the front of the speaker

Baroque Period - period in European music from 1600-1750 characterized by grand long melodic lines

bass – low frequencies; also, the stringed instrument that produces the lowest pitches in the string family

beats – the pulsations that occur when two waves have nearly the same frequency

beat frequency – the pulsation frequency that occurs when two waves have nearly the same frequency. The beat frequency is given by the difference of the frequencies. The frequency of the actual tone undergoing the pulsations is given by the average of the frequencies of the two original waves.

Beethoven, Ludwig van - a transition composer that bridges the classic and romantic periods in music. He helps usher in the romantic period with music heroic in proportion.

bell jar – jar used to place a bell inside and pump out the air so that no sound can be heard. It is used to demonstrate that sound needs a medium to travel through while light does not (since you can see the bell when there is no air inside the jar).
blues – song following the pattern of 12 sections (measures or bars) with harmonic content 1-4-1-1, 4-4-1-1, 5-4-1-1 where substitutions for harmony are allowed.

blues scale – a scale of six notes defined by adjacent intervals: whole step, whole step, half step, half step, minor third.

brass – the orchestral instruments made of metal based on open-pipe physics. The four brass instruments of the orchestra are the French horn, trumpet, trombone, and tuba.

bridge – on a guitar, the place where the strings are fastened opposite to the end that contains the tuning pins.

carrier wave – the wave upon which a modulation is applied.

chord – the dressing up of a degree of the scale so that you obtain a harmonic group of tones to accompany a melody. Chords can be labeled such as the 1-chord, meaning a chord built on the first degree of the scale. The simple major chord is built using Do-Mi-Sol simultaneously – a triad. When you add a low bass note (H1), then Do-Mi-Sol become H4, H5, and H6 relative to your H1. Think of chords are including harmonics that go with a given degree of the scale.

chorus effect – the effect whereby a group of sound sources are producing the same sound, e.g., singers in a choir singing the same song.

Classic Period in Music - the time from roughly 1750 - 1800. The music, in contrast to the grand baroque period that preceded it, is known for its Simplicity, Order, Balance, elegance, and Restraint (SOBER). Two of its major composers were Haydn and Mozart.

compression – a squeezing together of the medium in a longitudinal wave, analogous to the crest of a transverse wave.

consonance – pleasing combination of tones. The five most consonant intervals in order from most consonant to least are 1:1 (unison), 2:1 (octave), 3:2 (fifth), 4:3 (fourth), 5:4 (third).

constructive interference – interference where the crest of one wave lines up with the crest of the other and so do the troughs. We obtain a bigger wave and the waves are said to be in phase.

crescendo – musical term for a gradual increase in loudness.

crest – the part of a wave above the “sea level” reference line of the wave.

damped wave – a wave that reduces its amplitude to zero as time goes on.

damped harmonic motion – harmonic motion that decreases in amplitude such that eventually the motion stops.

decrescendo – musical term for a gradual decrease in loudness.

degree of the scale – the location of the note in the major scale where Do is 1, Re is 2, Mi is 3, Fa is 4, Sol is 5, La is 6, Ti is 7, and Do’ is 8.
destructive interference – interference where the crest of the first wave lines up with the trough of the second and the trough of the first lines up with the crest of the second, thus canceling each other out. The sum wave is zero. The waves are said to be out of phase or 180 degrees out of phase.

diatonic scale – the just diatonic scale, i.e., the major scale tuned to perfect ratios – Do (1:1), Re (9:8), Mi (5:4), Fa (4:3), Sol (3:2), La (5:3), Ti (15:8), Do’ (2:1)

diffraction – the bending of a wave due to passing through an opening, around a corner, or around an obstacle. The opening or obstacle size must be comparable to the wavelength of the wave.

displacement – change in position, e.g., when the medium is moved away from its natural position (equilibrium) forming a crest (above equilibrium, i.e., positive displacement) or trough (below equilibrium, i.e., negative displacement)

displacement antinode – a place where maximum movement of the medium occurs

displacement node – a place where no movement of the medium occurs

dissonance – the opposite of consonance

Doppler effect – the change in pitch due to the relative motion between the sound source and the observer. The pitch is higher when the source and observer approach each other and the pitch is lower when the source and observer move away from each other.

driven oscillation – an oscillation resulting from an agent (driver) forcing a system to oscillate. The system being driven (the “drivee”) oscillates at the same frequency as the driver but the amplitude of response depends on the frequency.

echo – the reflection of sound from an object or surface

echolocation – locating objects by reflecting sound waves off the objects. A bat sends out high-frequency sound waves that reflect off objects and then return to the bat.

equilibrium – the state of the medium when no waves are present

fourth – the musical interval from Do to Fa, e.g., the beginning of “Here Comes the Bride,” which is also an interval of 5 half steps

fifth – the musical interval from Do to Sol, which outlines the beginning of “Twinkle, Twinkle Little Star,” which is also an interval of 7 half steps

frequency – the number of times something repeats during a time interval. The common example used often is the number of cycles per second, written as 1/s and defined as hertz, i.e., Hz.

frequency modulation (FM) – the change of the frequency of a wave
fundamental – the first harmonic in the harmonic series

graph – a plot of data where the vertical axis represents one characteristic or parameter and the horizontal axis another such as distance and time respectively. One can then say that we are plotting distance against time.

half wave – one half of the wavelength, e.g., a crest or trough of a sine wave

Handy, William Christopher (WC) - jazz composer known as the "father of the blues"

harmonic – a sine wave with frequency in the series \( f, 2f, 3f, \) etc. where \( f \) is the first frequency

harmonic motion – natural motion with smooth crests and troughs described by a sine wave such as that made by a mass attached to a spring. The same as simple harmonic motion.

harmonic series – the harmonics \( f, 2f, 3f, \) and so on, sometimes designated as \( H1, H2, H3, \) ...

Haydn, Franz Joseph - composer of the classic period in music and known as the "father of the sonata"

Helmholtz resonator – a device shaped like a big empty apple cider jug. When you blow across the top, the entire air mass swishes around producing a very low pitch. This is unlike the longitudinal standing waves produced in narrow pipes.

in phase – two waves with the same wavelength are such that the crest of one wave lines up with the crest of the other wave. The phase shift of one with respect to the other is 0 degrees.

interference – the effect due to superimposing two waves, i.e., adding two waves together

interval – the musical jump or span from one note to another, e.g., a fifth is the interval you span going from Do to Sol

just diatonic scale – the major scale tuned to perfect ratios – Do (1:1), Re (9:8), Mi (5:4), Fa (4:3), Sol (3:2), La (5:3), Ti (15:8), Do’ (2:1)

Lissajous figure – a stationary pattern formed when a horizontal wave motion is combined with a vertical wave motion because the frequency ratio can be expressed with whole numbers such as 1:1, 3:2, or 4:3

longitudinal standing wave – a harmonic vibration in a pipe so named because the “dancing pattern” has a “kind of stationary characteristic” with its fixed displacement nodes and moving antinodes in between

kilo – the metric prefix for 1000, e.g., 1 kilosecond = 1000 seconds

longitudinal wave – a wave where the medium moves parallel (or antiparallel) to the direction of propagation of the wave

loudness – the perceived strength of an acoustic wave as experienced by the ear/brain system where stronger perceived waves are said to be louder
Mach speed – the speed in units where the value “1” stands for the speed of sound in the medium under consideration. At standard temperature and pressure, Mach 1 = 340 m/s = 1125 ft/s = 750 mi/h.

major key (song in) – a song that sounds happy because the third degree of the scale is used in the song as well as in the root harmony (1-chord)

major scale – Do, Re, Mi, Fa, Sol, La, Ti, Do’, which in the equal-tempered scale has these adjacent intervals: Do-Re (whole step), Re-Mi (whole step), Mi-Fa (half step), Fa-Sol (whole step), Sol-La (whole step), La-Ti (whole step), Ti-Do’ (half step)

Mancini, Henry - composer of film music. He employs two consecutive 5th intervals effectively in his theme for the movie Condorman.

mass – “stuff” that makes up any object

medium – the environment such as air or a spring through which a wave can travel

Mersenne’s laws – three string laws: 1) longer strings have lower pitches, 2) greater string tension means higher pitch, and 3) heavier strings have lower pitches

milli – the metric prefix for 1/1000, e.g., 1 millisecond = 1/1000 of a second

minor key (song in) – a song that sounds mysterious or sad because the root harmony (1-chord) is built using the minor third (tone a half-step lower than the third) and the song may use the minor third in the melody line

modulation – changing a property of a wave such as its amplitude or frequency

modulator – the wave that modulates a carrier wave in some way

Mozart, Wolfgang Amadeus - composer of the classic period in music. A child prodigy and super genius composer often used as a "yardstick" to measure other composers.

musical scale – a discrete set of tones from which one can compose a tune. Examples include the major scale, the common minor scale, blues scale, whole-tone scale, pentatonic scale (black keys only on the piano).

“Musician’s Scale” – term used by your instructor to refer to the major scale (Do-Re-Mi-Fa-Sol-La-Ti-Do’)

node – a place on a wave that does not change, e.g., displacement node means no displacement

noise – term to describe the presence of all frequencies

octave – the musical interval from Do to Do’ which starts the song “Somewhere, Over the Rainbow,” which is also an interval of 12 half steps
oscillation – the generic term for vibration or production of one cycle of a periodic wave

oscilloscope – an electrical measuring instrument that sweeps out a picture of an electrical wave

overtone – any harmonic above the fundamental (1\textsuperscript{st} harmonic). Thus the first overtone is the 2\textsuperscript{nd} harmonic, the second overtone is the 3\textsuperscript{rd} harmonic and so on.

overtone series – the overtones: H\textsubscript{2}, H\textsubscript{3}, H\textsubscript{4}, H\textsubscript{5}, and so on. When you include the fundamental with the overtone series you get the harmonic series.

out of phase – two waves with the same wavelength where the crest of one wave lines up with the trough of the other wave. The phase shift of one with respect to the other is 180 degrees.

partial – any harmonic in the harmonic series H\textsubscript{1}, H\textsubscript{2}, H\textsubscript{3}, .. (f, 2f, 3f, ..)

peak-to-peak amplitude – a measure equal to twice the amplitude

perfect ratio – a ratio of two whole numbers such as 2:1, 1:2, 3:2, 2:3, etc.

period – the time it takes to complete one cycle of anything that repeats such as a periodic wave

periodic wave – a wave pattern that repeats

phase – the horizontal shift of a wave, where 360 degrees represent a shift of one wavelength. A phase of 180 degrees means you have shifted a wave by one-half wavelength so that a crest has moved over to where a trough was initially located. A phase shift of 90 degrees means you have shifted the wave by one-quarter wavelength.

“Physicist’s Scale” – term used by your instructor to refer to the scale you would get using just the harmonics: f, 2f, 3f, ...

pitch – the perception of the frequency of a sound wave where higher frequencies are said to have higher pitch

physics – the study of the fundamental properties and laws of matter and energy

plot – graph

propagation – the traveling of a wave. To propagate is the same as to travel in this context.

pulse – a wave disturbance that does not repeat

pulse-train wave – a wave with a narrow pulse in each wavelength

pulse wave – a wave consisting of a “rectangular building” and “courtyard.” If the building takes up half the wavelength, you have a square wave. If the building is very narrow, you have a pulse train wave.
pulse-width modulation (PWM) – a form of timbral modulation where the pulse-width of a rectangular-shaped wave changes its width

pulse-width – the width of a rectangular-shaped wave crest

Rainey, Ma - early jazz singer known as the "mother of the blues"

ramp wave – a wave with a ramp waveform

reflection – the bouncing of a wave off a surface

rarefaction – a stretching of the medium in a longitudinal wave, analogous to a trough of a transverse wave

refraction – a change in direction of a wave due to a change in the wave properties of the medium

resonance – the phenomenon occurring when a driven oscillatory system gives the greatest amplitude of response. The frequency at which this occurs is called the resonance frequency.

resonance curve – the plot or graph of the amplitude response (vertical axis) versus the frequency (horizontal axis)

resonance frequency – the frequency that results in the greatest response of a driven oscillating system

Romantic Period in Music - roughly the time spanning 1800 - 1900. This period reacts against the simplicity and order of the classic period that preceded it. Romantic music can be excessive in nature, exaggerated, and over the top.

saw tooth wave – a ramp wave

Schumann, Clara Wieck - super talented daughter of piano teacher Friedrich Wieck who was groomed by her father to be one of the best pianists in Europe. Also, romantic composer and wife of Robert Schumann, who also studied piano with her dad.

Schumann, Robert - romantic composer known for his bipolar nature producing many works during his manic phases and attempting suicide twice during depression stages. He died in an insane asylum, believed to be the result of contracting syphilis in his youth. He married his former piano teacher's daughter Clara.

second – the musical interval from Do to Re, e.g., the beginning of the song “Doe a Deer, a Female Deer, ...,” which is also an interval of 2 half steps (1 whole step)

seventh – the musical interval from Do to Ti, which was prominently used by John Williams in the theme to the movie Superman in 1978

simple harmonic motion – natural motion with smooth crests and troughs described by a sine wave such as that made by a mass attached to a spring. The same as harmonic motion.
sine wave – the motion made by a mass attached to a spring, the simplest and most natural waveform. The Fourier amplitudes are 1, 0, 0, 0, 0, 0, 0, 0, 0, etc. for the Fourier components H1, H2, H3, H4, H5, H6, H7, H8, H9, and so on. In other words, you just have one Fourier component – the fundamental H1.

sixth – the musical interval from Do to La, e.g., the beginning of the song “My Bonnie Lies Over the Ocean,” which is also an interval of 9 half steps

shock wave – a wave with a large “V” (in two dimensions) or “cone structure” (in three dimensions) that is created when an object travels faster than the wave speed in the medium. An example is a speeding motor boat making a V-formation in the water.

scope – abbreviated form for oscilloscope, often used by personnel in physics and electronics labs

Smith, Bessie - early jazz singer known as the "Empress of the Blues"

SONAR – SOund Navigation And Ranging. One can determine the depth of water by noting the time it takes a sound wave to leave the boat to reach the bottom and reflect back to the boat. You need to use the speed of sound in water, which is 1500 m/s.

sonata - "classic" form in music consisting of exposition, development, and recapitulation. In the exposition there is the primary theme followed by a contrasting secondary theme.

sonic boom – an acoustic shock wave

source – term used for source of sound or source of electrical signal

speaker – device that converts electrical oscillations into the mechanical vibrations of a diaphragm via Ampère’s law

Spivey, Victoria - early jazz singer and known for singing "Black Snake Blues"

square wave – a wave with a square crest and upside-down square trough waveform

standing wave – any single harmonic vibration on a string or in a pipe so called because the “dancing pattern” has “kind of a stationary characteristic” with its stationary displacement nodes and moving displacement antinodes in between each pair of displacement nodes

string – used as an ideal model for string physics. A string of length L is fixed on each end. The natural modes of the transverse vibrations are called harmonics and they have frequencies f1, 2f1, 3f1, etc., where f1 is the frequency of the first harmonic (fundamental). The corresponding wavelengths are λ1 = 2L, 2L/2, 2L/3, and so on. For each frequency f and its associated wavelength λ the wave relation is always true: v = λ f, where v is the speed of waves on the string.

strings – instruments in the string family where vibrating strings are used to make sounds: violin, viola, cello, and bass. In the typical orchestra you might find a group of 10 violins categorized as the first violins, another 10 violins categorized as the second violins, about 8 violas, 10 cellos, and 6 basses.
sum displacement – addition of the displacements for two waves or more, remembering that positive heights are above the “sea level” reference line and negative heights are below. You need to combine the displacements including the relevant plus or minus signs during your addition.

supersonic – faster than the speed of sound, i.e., greater than Mach 1

third – the musical interval from Do to Mi, e.g., the beginning of the “Marine’s Hymn,” which is also an interval of 4 half steps (2 whole steps)

timbre (or timber) – the perception of the waveform of a wave, which allows us to distinguish one instrument from another such as a flute from an oboe

timbral modulation (TM) – the change of the timbre of a wave

transverse wave – a wave where the wave disturbance moves sideways (perpendicular) to the direction of propagation of the wave

tremolo – the musical term for an amplitude modulation, i.e., periodic changes in loudness levels alternating between louder and softer levels

triangle wave – a wave with a triangle crest and upside-down triangle trough waveform

trough – the part of a wave below the “sea level” reference line of the wave. The “sea level” line is the horizontal equilibrium line drawn through the middle of the wave.

ultrasound – sound with a frequency above the range of human hearing, i.e., above 20,000 Hz. Also, the image of a fetus made by ultrasound.

unit – in physics, this designates the word that goes with the number when you make a measurement, e.g., for a weight of 120 pounds (120 lb), the value is 120 and the unit is lb

velocity – technically the speed you are going AND the direction you are going; however, often just used to represent your speed without a concern for the direction

vibrato – the musical term for a gentle frequency modulation where the frequency changes do not vary too far from the original pitch. The result is a quivering pitch characteristic of singers.

wave – a traveling disturbance

waveform – the shape of one pattern of a periodic wave

wavelength – the distance corresponding to one pattern of a periodic wave

whispering chamber – an elliptically-shaped room where sound from one of two special points (each called a focus) gets reflected by the chamber walls so that the reflected wave heads towards the other special point (the second focus)
Williams, John - composer of music for film. In *Superman* he employs the dissonant 7th interval in an effective way.

woodwinds – originally made of wood, instruments where the performer blows air against an edge or reed to excite the pipe into resonance. The basic woodwind types in the orchestra are the flute, oboe, clarinet, and bassoon. There are two of each in the standard orchestra.