**Chapter 2 – Sound and Hearing (Modern Recording Techniques)**

The examination of sound is divided into four areas…

1. Basics of sound
2. Characteristics of the ear
3. How the ear is stimulated by sound
4. Psychoacoustics of hearing

**The Basics of Sound**

* SOUND-PRESSURE WAVES:
	+ Sound arrives at ear in the form of periodic variations in atmospheric pressure
* An analogy of how sound waves travel in air can be demonstrated by bursting a balloon in a silent room
* As vibrating mass moves outwards from normal resting state
	+ It squeezes air molecules in to a compress area away from sound source
* COMPRESSION:
	+ This causes area to have greater than normal atmospheric pressure
* As vibrating mass moves inwards from normal resting state
* RAREFRACTION:
	+ Area with lower than normal atmospheric pressure is created
* Molecules font move through air at velocity of sound
	+ Only sound wave moves through the atmosphere in form of high pressure compression waves that pushes across lower pressure
* WAVE PROPAGATION:
	+ Outward pressure motion

**Waveform Characteristics**

* WAVEFORM:
	+ Graphical representation of a sound-pressure level or a voltage level as it moves through a medium over time
	+ Has the following fundamental characteristics;
		- Amplitude
		- Frequency
		- Velocity
		- Wavelength
		- Phase
		- Harmonic content
		- Envelope
			* These allow one waveform to be distinguished from another
			* The most fundamental are AMPLITUDE & FREQUENCY
* It is very important to grasp the basic principles of acoustics

Amplitude

* Distance above and below centerline of a waveform reps amp level
* The greater the distance from centerline the more intense the…
	+ Pressure variation
	+ Electrical signal level
	+ Physical displacement
* Waveform amp can be measure in a few ways…
	+ PEAK AMPLITUDE VALUE or PEAK VALUE
		- Measure of either the max positive or negative signal level of a wave
	+ PEAK-TO-PEAK VALUE
		- Total measurement of positive and negative peak signal levels
	+ ROOT-MEAN-SQUARE (RMS) VALUE
		- Determine a meaningful average level of a waveform over time

Frequency

* Rate at which an acoustic generator, electrical signal or vibrating mass repeats within a cycle of positive and negative amplitudes
* CYCLE:
	+ One complete excursion of a wave
* Number of cycles that occur within a second is measured in hertz (Hz)

Wavelength

* Physical distant in a medium between the beginning and the end of a cycle
* PERIOD of waves:
	+ The time it takes to complete 1 cycle

Phase

* OUT-OF-PHASE
	+ Two waveforms that have equal AMP & FREQ but start cyclic periods at different times
* IN-PHASE
	+ Measures in degrees
	+ Two waveforms line up perfectly

Harmonic Content

* PARTIALS
	+ Factors that help differentiate between instrument voicing is the presence of frequencies
* UPPER PARTIALS or OVERTONES
	+ Partials higher than the fundamental frequency
* HARMONICS
	+ Overtone frequencies that are whole number multiples of the fundamental frequency
		- Frequency that corresponds to Concert A is 440Hz
			* First Harmonic – 440 Hz
				+ 1 time the fundamental frequency
			* Second Harmonic – 880 Hz
				+ 2 times the fundamental frequency
			* Third Harmonic – 1320 Hz
				+ 3 times the fundamental frequency

Envelope

* Characteristic variations in levels that occur in time over duration of a played note
* Composed by four sections
	+ ATTACK
		- The time it takes a sound to up to its full volume
	+ DECAY
		- How quickly the sound levels off to a sustain level after the initial attack peaks
	+ SUSTAIN
		- Duration of the ongoing sound that’s generated following the initial attack decay
	+ RELEASE
		- How quickly the sound will decay once the note is released