

# Review Topics

## Physics of Music

### Chapters 4-6

#### **Chapter 4: Analysis and Synthesis of Complex Waves**

Synthesis of electronic complex waves

Sine, Triangle, Square, Sawtooth, Pulse train

Analysis of complex waves

Sine, Triangle, Square, Sawtooth, Pulse train

Recorder, Violin, Krummhorn, Clarinet

Comparison of electronic waves and musical sounds

Effect of spectrum on timbre

Effect of harmonic phase

Missing fundamental

Spectral similarities and differences

Factors affecting tone quality

Amplitudes of harmonics

Transients

Inharmonicities

Formants

Vibrato

Chorus effect

Resonance Curves

Helmholtz Resonator

Noise

White noise

Pink noise

Colored noise (generic)

Production of musical sound

Noise or other source

Resonances of instrument

Feedback mechanism

#### **Chapter 5: Electronic Music and Synthesizers**

Combination of Waves and Modulation

Simple Addition

Gating

Amplitude Modulation

Balanced Modulation (Ring Modulation)

Frequency Modulation

Pulse Width Modulation

Analog Synthesizers

Signals

Control and Audio

Keyboard

- Sample and Hold
- Voltage-controlled Oscillator (VCO)
- Voltage-controlled Amplifier (VCA)
- Envelope Generator
- Low-frequency Control Oscillator
  - Vibrato (FM)
  - Tremolo (AM)
  - Filter (PWM)
- Filters
  - Low-pass
  - High-pass
  - Bandpass
  - Notch
- Noise Generator
- Ring Modulator
- Digital Synthesizers
  - Source of sound
    - FM synthesis
    - Digitized wave forms
  - Primary features
  - Studio vs. Performance
- Musical Instrument Digital Interface (MIDI)
  - MIDI Lab
  - Electronic Music Lab

## **Chapter 6: The Human Ear and Voice**

- The Peripheral Auditory System
  - Outer, Middle, and Inner Ear
- The Place Theory of Hearing
  - Basic Features
  - Critical band
  - Sharpening
  - Limit of frequency discrimination
  - Frequency Just Noticeable Difference
- Amplitude response of the ear
- Logarithms and the decibel scale
  - Logarithms of simple ratios
  - Mathematical relationship:  $SIL = SIL_0 + 10 \log \frac{I}{I_0}$
  - Intensity Just Noticeable Difference
  - Loudness Level and the Phon
- Periodicity Pitch
- Fundamental Tracking
- Aural Harmonics
- Combination Tones
- Ohm's Law of Hearing
  - Second Order (Quality) Beats

## Masking

- Masking tone and Masked tone

## Binaural Effects

- Binaural Beats

- Diplacusis

- Lateral sound location

## Hearing Loss

- Temporary threshold shift

- Permanent threshold shift

- Presbycusis

- Tinnitus

- Audiogram

- Hearing aid

## Cochlear implant technology

## Anatomy of the Vocal Tract

- Vocal folds as source of sound

- Filtering by vocal tract

- Effect of nasal cavity

## Vocal Formants

- Source: vocal tract closed tube

- Sound Spectrogram

- Differences between vowel sounds

## Analysis of Vocal Sounds

- Formants

- Sibilants: voiced and unvoiced

## Other vocal phenomena

- Helium voice

- Sulfur Hexafluoride voice

- Tantric Rituals

- Harmonic Choir

- Tuvan Throat Singers