

University of Rochester  
AME 191  
Final Exam  
Fall 2014

1. Define the following terms:

a. Sampling Rate

Sampling Rate is defined as the frequency that information from an analog signal is being stored at as digital values. For example, an audio file with a sampling rate of 96kHz has 96,000 pieces of information per second of audio. The higher the sampling rate, the more resolution an audio file will have.

b. Nyquist Theorem

The Nyquist Theorem is a theorem used to calculate the frequency content of a discrete set of values. This theorem can only be applied to functions that have a finite bandwidth (a bandlimited function) and can be only accurately applied to calculating frequencies below half the sampling rate of the function. This frequency is called the Nyquist Frequency.

c. Aliasing

Aliasing is a phenomenon that occurs during calculations involving the Nyquist Theorem. This occurs when calculating frequencies higher than the Nyquist frequency. For frequencies high the Nyquist frequency, the Nyquist theorem calculates frequencies as lower than they actually are. They become "mirrored" across the Nyquist frequency; frequencies that are originally 10 Hz above with be calculated to have been 10 Hz bellow the Nyquist frequency. This happens because those lower frequencies that are calculated can fit the curve of the discrete information just as well as the actual high frequencies that were originally recorded. The result is excess frequency content near the Nyquist frequency when using the Nyquist Theorem.

2. Define the following terms:

a. Quantization

Quantization refers to the act of rounding a signal value to a bit value when recording an analog signal to a digital format. One of the main differences between analog and digital information is that digital values are not continuous. Instead, digital values store whole numbers and cannot record halves or quarters of values from a signal. Due to

the digital restriction, quantization needs to be done, which means losing the small fraction of signal that steps in between the bit-wise values and rounding up or down to the next bit-wise value.

b. Mid-Riser/Mid-Tread

Mid-riser and mid-tread are two quantization formats that deal with what happens to signal values quantized close to zero. The term “riser” and “tread” refer to the rises and treads of a staircase, which discrete values are many times depicted as. In this analogy, a signal value that falls in the domain of a riser is then rounded to the value of a tread when quantized. Mid-Riser refers to the format of letting signal values close to or at zero become quantized to values that represent slightly higher or lower than zero because the bit-wise values increment through, but not at, zero. Mid-Tread refers to the format of letting signal values close to or at zero become quantized to a value that represents zero because the bit-wise values increment at zero. The significant difference between the two is that Mid-Riser quantization cannot quantize to a zero value while Mid-Tread quantization can.

c. Dither

Dithering is the act of trying to smooth out the stepwise quantization of a digital audio file. This is done by adding little bits of random noise to offset the effects of quantizing to a rigid, stepwise form. Quantizing can add distortion and dither helps prevent that, so adding some noise to prevent a huge issue is the trade off for adding some hiss.

3. Give the corresponding dynamic range (in dB) for each bit value

The corresponding dynamic range for a bit value can be formulated as such:

$$\text{Dynamic Range} = \text{Number of Bits} * 6$$

- a. 1 bB = 6 dB
  - b. 8 bit = 48 dB
  - c. 12 bit = 72 dB
  - d. 16 bit = 96 dB
  - e. 24 bit = 144 dB
4. Give the bit depths for the following media at their best
- a. Reel to Reel Tape; Peak dynamic range 84 db = 14 bit
  - b. Cassette Tape; 72 db range at best = 12 bit
  - c. Vinyl; 70 db at best  $\approx$  12 bit
  - d. CD; 16 bit

- e. DVD-Audio; 24 bit
- 5. Discuss the difference between Mechanical and Performance Royalties. Name three major publishing/collection firms for each type of royalty.

Performance Royalties are payments that come from the public use of an artists work. This includes cases such as radio play or television ads or shows. Streaming from sites such as Pandora or Spotify also count towards performance royalties, though not very much at all.

Mechanical Royalties are payments from making sales or licensing songs. For example, if a radio station buys an artist's album, the artist will get a certain percentage of that sale. Also, if a person is given permission to use a song or part of a song of an artist, the initial payment for that right will give some mechanical royalty to the artist.

The main distinction between the two is that there is an initial payment for mechanical royalties, which is often used to account for people using the media privately, and there are redundant payments of performance royalties, which is generally acquired by commercial use.

#### Mechanical Royalty Firms

1. Harry Fox Agency (huge)
2. RightsFlow (online)
3. Limelight (online)

#### Performance Royalty Firms

1. BMI, Broadcast Music, Inc.
  2. ASCAP, American Society of Composers, Authors, and Publishers
  3. SESAC, Inc.
6. What were the last three albums you **bought**? Meaning you paid money for the CD, MP3, Vinyl, Cassette?
1. Vs. – Pearl Jam
  2. Battleborn – The Killers
  3. St. Elsewhere – Gnarl Barkley

7. What were the last three albums/songs you downloaded illegally?

The last set of music I downloaded illegally was Eminem's discography.

1. The Marshall Mathers LP 2
2. Recovery
3. Curtain Call

I didn't get Relapse and Refill because they're eh.

8. At what dB does a sonic boom occur?

213 dB