MUS/COM/ELE 369G Technologies and Music Exam #2 Spring 2019 Name: Solution
Open book/notes (14 questions, 7 points each, plus 2 points for entering your name above)

1. (**C**) In the history of audio recording, when did mechanical recording begin? (A) 1750s, (B) 1800s, (C) 1850s, (D) 1900s, (E) none of the above.

   See Prof. Reyes' slides "Recording Studio Tools and Signal Flow."

2. (**D**) Which of the following components is not part of the signal flow for a typical 21st century pubic address (PA) system? (A) microphone, (B) pre-amp, (C) analog-to-digital converter, (D) CD-ROM recorder, (E) digital audio workstation.

   See Prof. Reyes' slides "Recording Studio Tools and Signal Flow."

3. (**A**) Who is the influential producer promoting artists such as Paul McCartney, Britney Spears, and Taylor Swift? (A) Max Martin, (B) Eddie Holland, (C) Ryan Tedder, (D) Berry Gordy, (E) none of the above.

   See Prof. Reyes' slides "Technology, Aesthetics, and the Music Industry."

4. (**B**) Which of the following instruments is common for both the Eastcoast-style synthesis (Moog) and the Westcoast-style synthesis (Buchla)? (A) accordion, (B) theremin, (C) Hammond organ, (D) music easel, (E) none of the above.

   See Prof. Reyes' slides "East Coast vs. West Coast Synthesis."

5. (**A**) The strings and woodwind section creates a sound level of 80 dB. The brass and percussions section also creates a sound level of 80 dB. What is the sound level of the two sections combined? (A) 83 dB, (B) 96 dB, (C) 120 dB, (D) 160 dB, (E) none of the above.

   Let the sound level of the strings and woodwind section be x. Thus, $10\log_{10} x = 80$ dB. The sound level of the brass and percussions section is also x. The sound level of the two sections combined is $2x$. Change it to dB, we have $10\log_{10} 2x = 10\log_{10} 2 + 10\log_{10} x = 3 + 80 = 83$ dB. Hint: Enter "=10*LOG(2)" in the spreadsheet, and the result is 3 (dB).

6. (**B**) We try to tune the A string of a violin to A440. The A string is 8 cents flat and creates a beating frequency against the 440 Hz tuning reference. What is this beating frequency? (A) 1 Hz, (B) 2 Hz, (C) 3 Hz, (D) 4 Hz, (E) none of the above.

   This question is about converting cents to frequencies. We use the equation: $\frac{f_2}{f_1} = 2^{(c_2 - c_1)/1200}$.

   $\frac{440}{f_1} = 2^{8/1200} \Rightarrow$ $f_1 = 440 / 2^{8/1200} = 440 / 1.004632 = 438$ Hz. Thus, the beating frequency is 440 Hz – 438 Hz = 2 Hz. Hint: Enter "=440/(2^(8/1200))" in the spreadsheet, and the result is 438 (Hz).

7. (**C**) What is the dynamic range of a 12-bit analog-to-digital converter? (A) 60 dB, (B) 66 dB, (C) 72 dB, (D) 84 dB, (E) none of the above.

   The dynamic range of a 12-bit A/D converter is $2^{12} = 4096$. Because it's amplitude not power, we take $20\log$ to change it to dB: $20\log 4096 = 72$ dB. Hint: Enter "=20*LOG(2^12)" in the spreadsheet, and the result is 72.25 (dB).

8. (**D**) The industry standard for compact disc (CD) specifies a sampling rate of 44.1 KHz, a 16-bit quantization level, and 2 stereo channels. This results in a bit rate of 1,411.2 Kbps (kilobits per second). If the quantization level is reduced to 12 bits, what is the bit rate of the audio signal? (A) 705.6 Kbps, (B) 882 Kbps, (C) 970.2 Kbps, (D) 1,058.4 Kbps, (E) none of the above.

   44,100 Hz x 12 bits x 2 channels = 1,058.4 Kbps

9. (**C**) For the above problem, if the 12-bit quantization is used, how long can uncompressed music be stored on a 700 MB (mega bytes) CD? (A) 1 hr 12 min, (B) 1 hr 21 min, (C) 1 hr 28 min, (D) 1 hr 34 min, (E) none of the above.

   700,000,000 bytes / (44,100 Hz x (12 / 8) bytes x 2 channels) = 5291 s
   1 hr = 3600 s, 5291 – 3600 = 1691 s, 1691 / 60 = 28 min ⇒ 1 hr 28 min

10. (**B**) The MP3 uses several data compression methods. One idea is to assign variable-length codes based on the frequencies of occurrence of the input characters. A frequently occurring character is assigned a short code, and an infrequently occurring character is assigned a long code. What is this method? (A) discrete cosine transform, (B) Huffman coding, (C) difference encoding, (D) run-length encoding, (E) none of the above.

    From handout "05b – Sampling theorem, MP3" and Prof. Sun's lecture.

11. (**D**) A chord consists of 3 notes: C, E, and G#. Which chord is it? (A) C major, (B) C minor, (C) C diminished, (D) C augmented, (E) none of the above.

    There are 4 half steps (major third) between C and E, and 4 half steps (major third) between E and G#. Thus, it's the C augmented chord.

12. (**D**) A major scale contains the following notes (not in order): G, D, A, Eb, Bb, F, C. What is the tonic (first note of this scale? (A) G major, (B) Eb major, (C) A major, (D) Bb major, (E) C major.

    The Bb major scale consists of the following notes: Bb, C, D, Eb, F, G, A. It's a major scale because there is a half step interval between D and Eb, as well as A to the Bb an octave higher. Other intervals are whole step. You can also see this on the "Circle of Fifths". The Bb key has two flats: Bb and Eb. See Prof. Aberdam's notes "10a – Music theory, MIDI."

13. (**D**) List the three minor triads that exist in the key of G Major: (A) Am, Cm, Dm, (B) Gm, Am, Bm, (C) F#m, Am, Bm, (D) Em, Am, Bm, (E) Bm, Cm, Dm.

    The triads in the G major key are: G, Am, Bm, C, D, Em, and F#^{o}. See Prof. Aberdam's notes "10a – Music theory, MIDI."

14. (**A**) In a 3/4 meter, the top number means _____ and the bottom number means _____: (A) three beats per measure, the quarter note is the beat, (B) four beats per measure, three is the beat value, (C) three beats per measure, half note is the beat, (D) three quarters of a beat per pulse, 4 is the beat, (E) none of the above.

    See Prof. Aberdam's notes "10a – Music theory, MIDI."