ECE 4670 Quiz Study/Reference Sheet

The lab quiz will take place at the start of class Wednesday May 4, 2022. I am going to have you write on real paper. This in the end I think will be best for all students. The quiz will be open book, open computer/calculator, but no operating of the test equipment. **Use of phones and/or any form of messaging is not permitted. The time limit will be 45 minutes.**

The below sample are representations of possible quiz questions. The actual quiz may contain some of the same problems, variations of these problems, or entirely different problems.

1. Signal Generator and Spectrum analyzer 50 ohm systems:
    a. Given a description of the signal generated by the signal generator
    b. Derive the total power delivered by the signal generator in watts
    c. What will the power dissipated by the spectrum analyzer in watts
    d. Write down the equation to convert watts to dBm
    e. Convert the power (watts) seen at the Spectrum analyzer to dBm
    f. Specify the frequency (or frequencies) that have a power content (from the given signal)

2. Given a schematic of an RC Low pass filter:
    a. Write down the transfer function in terms of R, C and s (Laplace complex variable)
    b. Write down the equation that determines the 3 dB frequency of the LPF
    c. Select either R or C and then determine the value of the other component given a desired 3 dB frequency
    d. Given that there is a 1 V signal that is swept through all frequencies (similar to the workings of a network analyzer)
        i. What will the amplitude be (in V) at the 3 dB frequency?
        ii. What will the phase of the signal be at the 3 dB frequency?
        iii. What is the group delay at the 3 dB frequency?

3. A pulse train, $p(t)$, having pulse width of 1μs and period 10μs is viewed on the spectrum analyzer.
    a. What is the name of the function used to describe the spectral shape?
    b. Is there a spectral line component at DC?
    c. If so, is the component visible on the spectrum analyzer?
    d. What is the frequency between the spectral lines?
    e. What is the spacing between spectral nulls?
    f. If we form $p(t)\cos(2\pi f_c t)$ where is the spectrum center located?
4. Given you have an $N = 4$ PN generator operating at 1 Hz:
    a. What is the period of the sequence?
    b. How many spectral lines will be between nulls?
    c. What is the frequency between the spectral lines?

5. Given a description of AM, FM and DSB modulation:
    a. Assume we are concerned with only the desired modulated signal coming from the modulator, i.e. don't worry about other frequencies generated by the mixer.

b. Check the appropriate boxes that are true for each modulated signal type.
c. Some of the descriptions that follow are geared toward looking at the spectrum and some are looking in the time-domain of the modulated signal. Please check those that apply to the respective modulated signal.
d. Examples of modulation description (in table below)

Description of modulation:	AM	DSB	FM
Spectrum has a carrier frequency component			
Single side-band around carrier frequency			
Double side-bands around carrier frequency			
Multiple side-bands around carrier			
Spectrum amplitude varies with message frequency			
Amplitude of the time-domain signal **varies**, with message			
Amplitude of the time-domain signal **does not vary**, with message			
BW is wider than $f_c \pm f_m$			

e. Describe and/or state, one way of demodulating the AM RF signal
f. Describe and/or state, one way of demodulating the FM RF signal

6. Given RF carrier frequency and message frequency, determine the local oscillator frequency required to obtain a specified IF frequency using a double-balanced mixer (DBM)
7. In Lab 4 you worked with two superheterodyne receivers. One receiver employed dual conversion. Give one advantage and one disadvantage of dual conversion.
8. In a superheterodyne receiver what is the beast way to keep image frequency from passing through the IF signal processing chain?
9. Modulation index (β), given amplitude, and frequencies
    a. Determine β
    b. Determine amplitude that will cause the second harmonic to reach its first null $J_2(\beta)$
10. Given specifications of a PLL system:
    a. Determine quiescent frequency lock range/bandwidth of the first-order loop.
11. What is software application SDR# used for?