TLEN 5830 - HW-02 – DUE 31-Jan-2017

1. *The various methods of **amplitude modulation** are essential to both the earliest and the most modern communications techniques. This problem is to help you to understand the consequences of some of these methods and to give you some more practice with energy "flux budget" calculations.*

Radio station "KTSO" has limited funds to broadcast and needs to calculate its technical operating expenses, specifically its electric bill. KTSO has obtained a license to broadcast using either conventional AM (DSB + full carrier) or SSB with no carrier. The treasurer of the TSO wants to use SSB to save operating costs, but the chief engineer (also the president) likes the much simpler and easier to maintain full AM approach.

Help station KTSO out with the calculations. Here's the details:

- Both the possible AM or SSB transmitters are 80% efficient in terms of converting mains power into radio frequencies. That is, the loss from the power mains to RF energy into the feed (transmission) line that goes to the antenna is 1 dB.
- The feed line is 200 feet long and has a loss at the licensed frequency of 7.415 MHz of 1 dB per 100 feet.
- The antenna consists of four large towers that concentrate the signal towards one direction, the corner of Broadway and 27th Way where many KTSO members live. The effective gain of this antenna is 6 dB in the desired direction.
- To reach the targeted coverage area, from the transmitter site, the president/chief engineer at KTSO has calculated that the station must have this effective radiated power of 300,000 watts.
- The cost of electricity in Boulder is 10 cents per kilowatt hour. That means that each kilowatt of mains power consumed will cost 10 cents per hour the station is on the air.
- The station transmits 10 hours a day for every day of the year except 9 August.
- The station's program material has an average modulation index of 50%.

a. What is the cost per year for the electricity for KTSO's possible "full AM" transmitter?

Hints: to do this assignment, you will need to "add up" the dB gains and losses and work backwards to what the transmitter needs to draw from the mains. Then you should calculate the total kilowatt-hours per year and multiple that value by the cost per kw-hr. For your calculation, assume the same power as a single frequency sine wave modulating signal.

b. What would be the yearly power cost if KTSO had used SSB with suppressed carrier? (Assume that the power in the one sideband transmitted with SSB is the same as for BOTH sidebands in the full AM scheme.)

2. *The president/chief engineer (whose salary just got reduced by more than $50,000 for some reason) decides resign and move to Ascension Island where electricity is very cheap due to an experimental wave powered generator and people light their homes with mirrors diverting the glow from the active volcano.) So, cost is no longer a problem. Good thing since the ex-president couldn't take any tee-shirts with him to sell. He wants to operate a broadcast station that programs only Heavy Metal with 20 kHz bandwidth high fidelity audio bandwidth. He needs to know what to put on his license application*

For 20 kHz audio, makes these calculations:

a. What bandwidth allocation is needed to send full AM?
b. What bandwidth allocation is needed to send SSB?