EECS 562
Homework #5

1. Problem 11.12

2. Problem 11.13 Assume $T_i=T_o$ and $G_P=1$

3. A receiver has a bandwidth of 5 MHz, sensitivity of -92 dB_m and a noise figure of 14 dB. What is the minimum predetection S/N in dB. The receiver sensitivity is defined as the minimum received signal power (pre-detection) that will provide a demodulated signal with acceptable performance. Assume $T_i=T_o$ and $G_P=1$

4. Problem 11.22

5. We are given the following parameters for a relay-satellite-user link:

Relay satellite power P_T	12 dB_W
Transmit Satellite antenna gain G_T	30 dB
Transmit carrier frequency	400MHz
Receiver noise temperature of user (antenna included)	1000K
User Receiver Satellite antenna gain G_R	3 dB
Total system losses	3 dB
System bandwidth	1000 Hz
Relay-user separation	41,000 km

a) What is the EIRP in dB_W?

b) Find the signal-to-noise power ratio in a 1000 Hz bandwidth at the user satellite receiver output.

c) The cost of a satellite is proportional to its weight and power consumption. Assume that the cost is $1,000,000 per W of transmit power – P_T. What is the cost of this system?

d) Given that the signal-to-noise power ratio in a 1000 Hz bandwidth at the user satellite receiver output has to be fixed to the value found in part a) what system parameter would you change and by how much to reduce the cost by $5,000,000.

6. Calculate the overall equivalent system noise temperature for the following cases

a) For the system shown in Fig. (a), the receiver noise figure is 12 dB, the cable loss is 5 dB, the Low Noise Amplifier (LNA) gain is 50 dB and its noise temperature is 150K. The antenna noise temperature is 35 K.

b) Repeat the calculation of when the system of Fig. (a) is arranged as shown in Fig. (b).

c) Which configuration (a) or (b) exhibits better performance? If the antenna is at the top of a 50 ft tower would you place the LNA at the antenna and run a cable to the receiver at the bottom of the tower, or run a cable from the antenna to a combined LNA/receiver at the bottom of the tower?

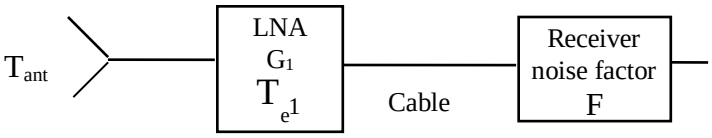

Fig (a)

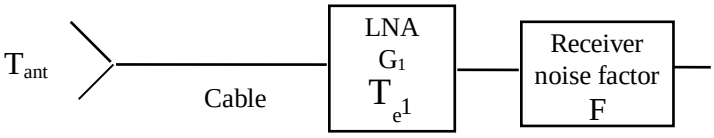

Fig (b)

7. Go to http://www.rflambda.com/product_list.jsp?catalog=62 What is the Gain and Noise Figure for the amplifier with the widest bandwidth?

8. A received signal is r(t) is composed of the transmitted signal x(t) plus noise n(t), i.e., r(t)=x(t)+n(t). The received signal is r(t) is input to a filter H(f) to produce the output signal y(t).

a) Find the output S/N in dB given H(f) is an IBPF centered at 10 MHz with a bandwidth B_r of 50 kHz and the following

$S_n(f) = \frac{\eta}{2}$ with $\eta = 2x10^{-12}$

$x(t) = A\cos(2\pi f_c t)$ with $f_c = 10\text{MHz}$ and $A = 10^{-3}$

b) As B_r increased the output S/N increases, circle TRUE or FALSE.