EE303 Problem Set 3

Complete the following problems from the textbook *Principles of Electronic Communication Systems.*

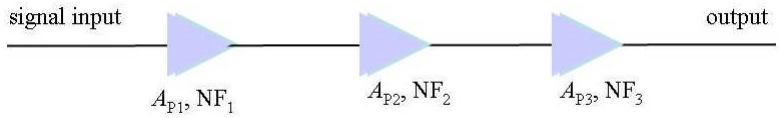
Chapter 9
Questions: 35, 39
Problems: 13, 14

1. An ideal, noiseless amplifier is one with no internal noise. Therefore, since it contributes no additional noise the signal that it is amplifying, the SNR at the output is the same as the SNR at its input. What is the noise ratio (NR) for such an ideal amplifier? What is its noise figure (NF)?

2. An amplifier provides a power gain of 3 dB. The test equipment measures an input SNR of 20 dB and an output SNR of 15 dB. What is this amplifier's noise figure (NF)? Can you perform this calculation without any ratio-to-dB or dB-to-ratio conversions (hint: take the logarithm of both sides of the noise ratio formula, multiply both sides by 10, and apply a simple logarithm identity).

For the following questions, consider the cascade of three amplifiers with the specifications given below. The SNR at the input to stage 1 is 30 dB.

A_{P1} = 9.0 dB, NF_1 = 1.8 dB
A_{P2} = 24.0 dB, NF_2 = 4.0 dB
A_{P3} = 12.0 dB, NF_3 = 8.0 dB



3. Find the total power gain in dB and the overall noise ratio of this system (note: all quantities in Friis' formula must be expressed as ratios, not in dB!).

4. Given the system's noise ratio that you calculated, determine system's noise figure (NF).

5. Calculate the output SNR (in dB).

6. Suppose the amplifiers are cascaded in reverse order, namely, 3, 2, then 1.
(a) Does the overall system power gain change?
(b) Is this a good idea from a system NR perspective? Why, or why not? Quantify your answer.