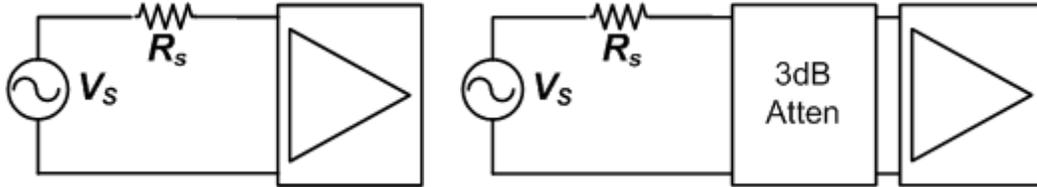
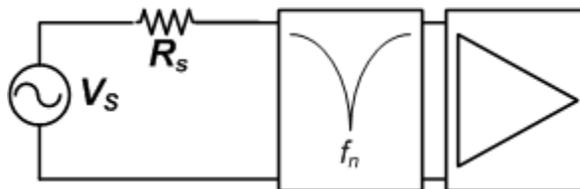


**MS Exam: ECE166/265A (Spring 2014)**

- 1) Consider the amplifier shown below to the left. The amplifier has a noise figure of 4 dB and an IIP3 of 0 dBm and operates at room temperature. Assume that IIP2 is infinity.



- If source temperature is 270K, how much noise power is available at the input of the amplifier if the amplifier bandwidth is 100 MHz? (5)
- What is the SFDR of the amplifier shown on the left? (5)
- A 3-dB attenuator is placed between the source and the amplifier as shown in the right. What is the noise figure of the cascade of the attenuator and amplifier? (6)
- What is the IIP3 of the combination of the attenuator and amplifier? (8)
- What is the SFDR of the new combination? Has it improved over the first case? (5)
- If the input frequency is 990 MHz and a jammer is located at 1 GHz, at what frequency are the third-order intermodulation (IM3) products located? (4)
- Now return to the circuit on the left without the attenuator. Each of the input tones is -20 dBm. What is the input-referred power of each of the IM3 products? (6)
- Instead of an attenuator, you are presented with the notch filter shown below. The notch is located at 1 GHz with rejection of 10 dB. The filter provides no attenuation at 990 MHz. What are the power levels of each of the IM3 tones? (6)



- What is the SFDR of the receiver with the notch? (5)

## Problem 2

- a) Consider a circuit with  $\Gamma_G=0.6 \angle -50^\circ$  and  $\Gamma_L=0.4 \angle +130^\circ$ . For  $V_G=1$  Vrms, calculate  $V_{o+}$ ,  $V_{o-}$ ,  $V_L$ , and the power delivered to the load. The (very short) transmission-line impedance connecting the generator to the load is  $Z_o=50 \Omega$ .
- b) Design a matching network using LC components to match the generator to the load. The matching network should contain only one L and one C component. Determine the L and C values at 2 GHz. Show your work on a Smith chart.
- c) Why load impedance one should use for maximum power transfer? Calculate this maximum power.