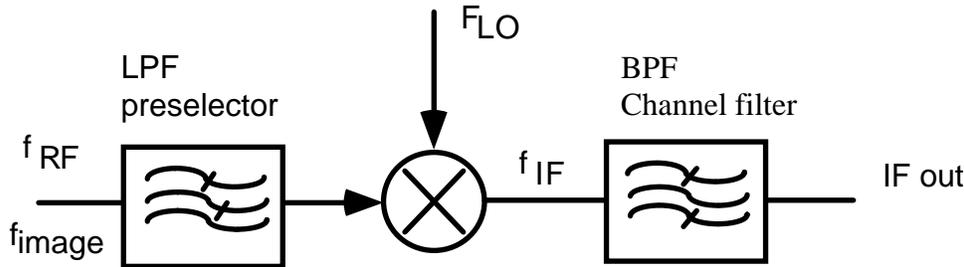Work the problems before you look up the solution on the RBS website. These problems will not be graded, but this material could be tested on the final exam.
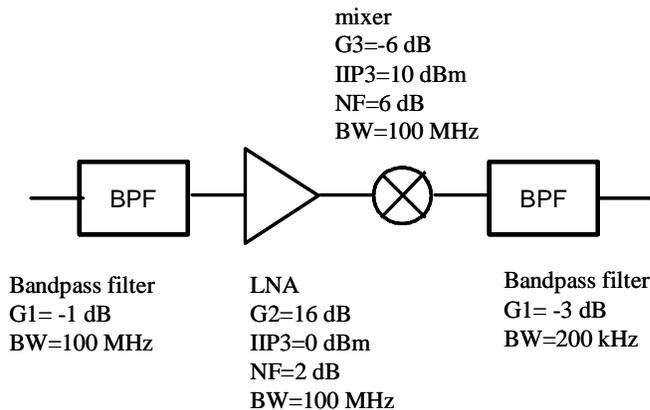
1. Image frequency problem.

Consider the receiver front end below. The minimum RF frequency is 10 MHz and maximum is 20 MHz. $f_{IF} = 45$ MHz.
a. Choose a f_{LO} to maximize the image rejection. Identify the image frequency, f_{image}.
b. The preselector low pass filter has a cutoff frequency of 20 MHz. How many dB/decade slope after cutoff is necessary to achieve 30 dB of image rejection?

2. Receiver system analysis.

mixer
G3=-6 dB
IIP3=10 dBm
NF=6 dB
BW=100 MHz

Bandpass filter
G1= -1 dB
BW=100 MHz

LNA
G2=16 dB
IIP3=0 dBm
NF=2 dB
BW=100 MHz

Bandpass filter
G1= -3 dB
BW=200 kHz

a Calculate the noise figure of this system.
b. Calculate the input intercept point of this system.
c. Calculate the minimum detectable signal input power and the spurious free dynamic range.
d. Calculate the S/N at the output if a signal power of -100 dBm is applied to the input.

3. Bias circuit design.

Design an active bias circuit using an opamp that will bias a bipolar transistor low noise amplifier at $V_{CE} = 3$V and $I_C = 5$ mA. The power supply DC voltage is 5V. Show how the active bias circuit can be connected to the BJT so that no RF power is lost.