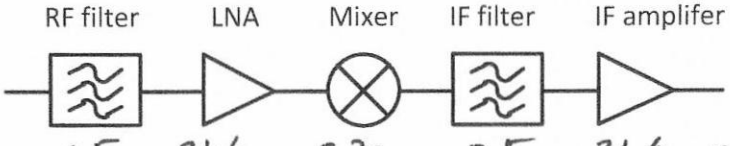
ECE5220 RFIC Midterm, 03/19/2012 **Name:** Solution **Grade:**

2. Consider the cascaded system shown below. All interfaces are matched to 50 Ω and signal bandwidth is 1MHz. **The required output SNR is 20 dB**.



		0.5	31.6	0.2	0.5	31.6
Gain		-3 dB	15 dB	-7 dB	-3 dB	15 dB
NF	1.78	3 dB	2.5 dB	7 dB	3 dB	4 dB
IIP3		43 dBm	-10 dBm	12 dBm	43 dBm	-9 dBm

2.5

← linear scale

1) Determine input noise floor and input minimum detectable signal (MDS) of the system in dBm scale (10pt). Note, 10*log(KT)=-174 dBm @T=300K.

$$\text{overall } F = 2 + \frac{1.78-1}{0.5} + \frac{5-1}{0.5\times 31.6} + \frac{2-1}{0.5\times 31.6\times 0.2} + \frac{2.5-1}{0.5\times 31.6\times 0.2\times 0.5}$$

$$= 5.078 \rightarrow 7.05\,\text{dB}$$

$$\therefore \text{Input Noise Floor} = KT\Delta f \cdot F = -114\,\text{dBm} + 10\log(1\text{MHz}) + 7.05\,\text{dB}$$

$$= -107\,\text{dBm}$$

$$\Rightarrow \text{MDS} = \text{Input noise floor} \times \text{SNR}_{min}$$

$$= -107\,\text{dBm} + 20\,\text{dB} = -87\,\text{dBm}$$

2) Determine spurious free dynamic range (SFDR) of the system (10pt).

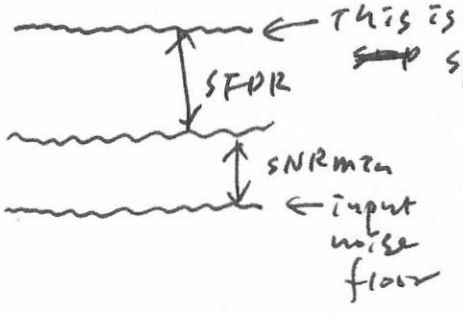
$$\frac{1}{\text{overall IIP3}} = \frac{1}{10^{4.3}} + \frac{0.5}{10^{1}} + \frac{0.5\times 31.6}{10^{1.2}} + \frac{0.5\times 31.6\times 0.2}{10^{4.3}} + \frac{0.5\times 31.6\times 0.2\times 0.5}{10^{-0.9}}$$

$$\rightarrow \text{overall IIP3} = 54\times 10^{-3}\,\text{mW} \rightarrow -12.7\,\text{dBm}$$

$$\therefore \text{SFDR} = \frac{2}{3}(\text{IIP}_3 - \text{Noise floor}) - \text{SNR}_{min}$$

$$= 62.87\,\text{dBm} - 20\,\text{dB} = 42.87\,\text{dB}$$

3) What is the maximum input power that allows no spurious tone? (10pt).



$$P_{max} = \text{Noise floor} + \text{SNR}_{min} + \text{SFDR}$$

$$= -107\,\text{dBm} + 20\,\text{dB} + 42.87\,\text{dBm}$$

$$= -44.13\,\text{dBm}$$