上 海 交 通 大 学 试 卷（___卷）

（ 2018 至 2019 学年 第二学期 ）

班级号_____ 学号_____ 姓名 _____

课程名称 _____通信基本电路与实验_____ 成绩 _____

1. Nonlinearity is one of the biggest issues confronted by the RF circuit designer.
   a) Please name three different nonlinearity phenomena that we have covered in the class. (1pt)

   b) Please specify which orders of nonlinearity they are, respectively. (1pt)

2. Another important design parameter for RF circuit design is the noise figure (NF).
   a) What is the definition of NF? (1pt)

   b) What is the NF of a lossy network (system)? Assume the loss of the system is L. (1pt)

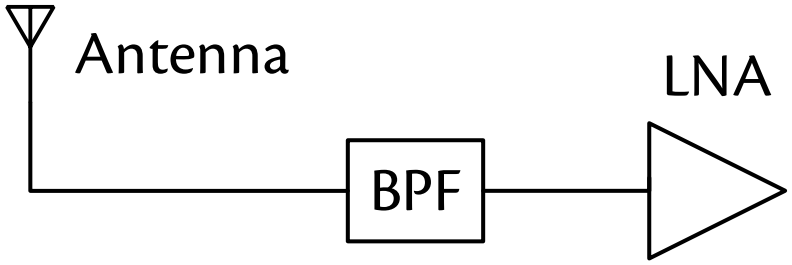
   c) For a cascaded network (system), which stage determines the overall NF? How should we design this chosen stage to minimize the overall NF? (2pt)

3. Analog modulation formats could be divided into two categories, amplitude modulation and phase/frequency modulation.
   a) Assume we have an incoming AM signal: $x_{AM}(t)=A_c[1+mx_{BB}(t)]\cos\omega_c t$, how can we demodulate the signal? In addition, please draw a system BLOCK diagram to illustrate. Note: use the technique that is described in Problem Set #2. (2pt)

   b) What is the fundamental difference between AM signal and PM/FM signal in the spectral domain? You could use drawings to illustrate this if necessary. (1pt)

4. The most classic architecture for RF receiver is a single-stage superheterodyne receiver.
   a) Please draw its diagram and describe the functionality of each building block. Suppose that the signal is obtained from the antenna, and it is terminated by the intermediate frequency (IF) processer. (2pt)

b) Why do we perform superheterodyne detection instead of the direct filtering (as show in the figure below)? (2pt)



c) A single-stage superheterodyne receiver suffers from a phenomenon called “problem of image”. Please draw a diagram to explain and illustrate this phenomenon. Note: You don’t need to draw the full picture, just show the essence. Be sure to show the relationship between different frequency components. Assume that the local oscillation is a cosine wave, and you could use EITHER high-side injection OR low side-injection. (2pt)

d) Based on the diagram plotted above, design a quadrature downconversion architecture as a second stage to eliminate the “image”. (2pt)

5. MOSFET is a basic building block in integrated circuits.
   a) Please draw its small-signal equivalent model at low frequency. You could use either hybrid-Π model or hybrid-T model. (1pt)

   b) Please draw the small-signal equivalent model of the chosen model in a) at RADIO FREQUENCY. Try to explain the differences and their consequences. (2pt)

c) (Bonus) Calculate the unity frequency gain of a MOSFET. (1pt)

我承诺，我将严格遵守考试纪律。

承诺人： _____

题号										
得分										
批阅人(流水阅卷教师签名处)										