COLLEGE OF ENGINEERING & TECHNOLOGY

Department: Electronics and Communications Engineering

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Course Title: Modern Electronics Circuits

Course No.: EC560 Assignment 4

Date: March 16, 2016

Noise, LNA, Mixers

Note: For **all transistors:**

- Use the 1st Edition of the textbook
- Use -N-MOSFETs with the BSIM model in page 80-82
- Use W = 100um, Lgate = 0.5um, Source and drain dimensions are W x 2um
- Assume that in short channel, Ids = Idso(1 + Vds/VA), VA=10V, where Idso is current at velocity saturation, assuming no short channel effects on Vto or Leff.
- Use velocity saturation and channel length modulation for short channel at high Vds
- Assume Vgs=3.3V, Vds = 5V for all problems. You should start by finding, gm, gd, Cgs, Cgd. Ignore Csb, but keep Csd. Ignore RE

Question 1 :

Solve examples 1 and 2 p. 261-262, 1st Edition .

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Question 2 :

Design a source degenerate inductance-based resistance which has a value of 50Ohm at 1GHz.

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Question 3 :

Draw the small signal ac model of the MOSFET, with noise source included. For the transistor in the header, use eqn. (5) p. 246, to find the values of the noise sources

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Question 4 :

Design a power-optimized single-ended LNA to meet the following specifications (you are required to put current mirror biasing in your design):

- $\omega_{resonance}$ = 2 Grad/sec, R_{source} = 50 Ohm.

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Question 5 :

Design a square-law downconversion mixer with f_{RF}=1GHz, f_{out} = 100MHz. Use a different channel length (L) for the MOSFET. Make sure your design is not sensitive to parastics or output loads. (Hint. Consider cascode and source follower designs)

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Question 6 :

Design a single-balanced mixer, like the one in Fig. 12.9, to meet the same requirements in Q5. Use Rs = 50Ohm. Match Ls to this Rs (although this is might not be the best option)

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Question 7 :

Design a double-balnced active mixer, using Fig. 12.10, 12.11 (322-323) to meet requirments of Q5. Rs is 50Oh for each pair of the differential RF.