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Exam – 14.12.2012

You may not use any notes, but **use of your own calculator is allowed**.
Each question is worth six (6) points.

1. Explain BRIEFLY the following terms or perform the tasks:
   - Inverting and non-inverting amplifier.
   - Ideal voltage amplifier model.
   - Current gain $\beta$ of BJT.
   - In which region of operation the NMOS transistor can be used as a controllable resistor?
   - Power added efficiency (PAE) in power amplifiers.
   - Common-mode rejection ratio (CMRR) in differential amplifiers.

2. Compare the Common Emitter, Common Collector and Common Base amplifiers concerning their voltage gain, current gain, input impedance, output impedance and frequency bandwidth.

3. a) In Figure 1 is shown a basic Common Gate LNA. How it should be modified to obtain LNA with gain step? Draw the schematic and explain briefly how the gain step is achieved.
b) Which LNA configuration, Common Base or Common Emitter, couples more signal (backward) to the antenna?
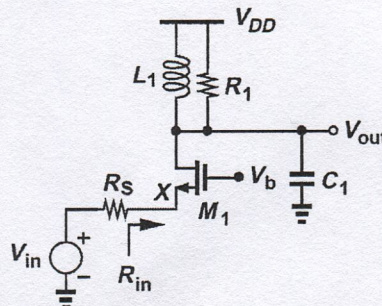


**Figure 1.** Basic CG LNA.

4. Draw a **block** diagram of a simple phase locked loop (with low pass filter) and explain its operation. Support your explanation with waveforms.

5. a) Which type of power amplifier (PA) is shown in Figure 2? Explain the operation principle. How much is the ideal maximum drain efficiency this PA could achieve (assume lossless matching network)?
b) Compare the PA in Figure 2 with at least two other PAs in terms of efficiency. Why the efficiency is higher or lower in other PAs?
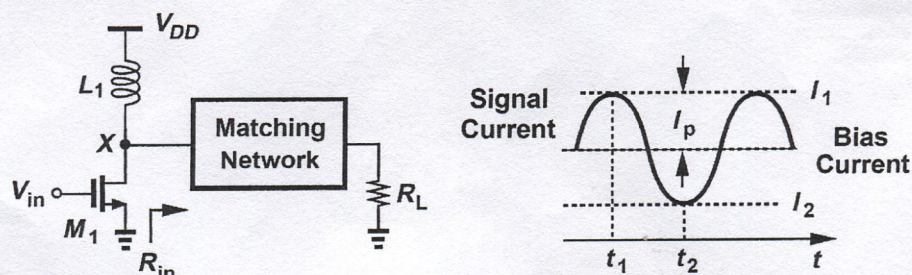


**Figure 2.** Some power amplifier.