# Exam – 18.1.2010

*You may not use any notes, but **use of your own calculator is allowed.***
*Each question is worth ten points, making the total maximum 50 points. Good luck!*

1. Explain the following terms or perform the tasks briefly (1pt per correct answer):
   - Voltage gain
   - Current gain
   - Inverting and non-inverting amplifier
   - Frequency response of an amplifier
   - Differential amplifier
   - Common-emitter amplifier
   - Draw the circuit symbol of an NMOS transistor and name its terminals
   - Draw the circuit symbol of an *npn* BJT and name its terminals
   - Current gain $\beta$ of a BJT
   - Low-pass, high-pass and band-pass filter

2. Draw the circuit of a non-inverting amplifier realized with an operational amplifier. Derive the formulas for its voltage gain and input resistance.

3. A given *npn* BJT has $\beta = 100$. Determine the region of operation (and explain your reasoning) when

   (a) $I_B = 50\mu A$ and $I_C = 3mA$

   (b) $I_B = 50\mu A$ and $V_{CE} = 5V$

   (c) $V_{BE} = -2V$ and $V_{CE} = -1V$

4. Design a four-resistor bias circuit for an *npn* BJT so that $I_C = 10$ mA and $V_{CE} = 5$ V. The power supply is 15 V, and the BJT has $\beta = 100$ and $V_{BE} = 0.7$ V. Assume room temperature.

5. Prepare a Bode plot of the magnitude of the voltage transfer function $A_v(f) = \mathbf{V}_o/\mathbf{V}_{in}$ for the circuit illustrated in the figure below. Explain your reasoning.