Name:

Student Number:

Quiz 4 ELEC 4705

Tuesday Nov. 28 2013

1. (15 marks) IC Fabrication

   (a) What is photolithography? (5 Marks)

   - What is the primary goal?
     The primary goal is the transfer of patterns or images to the surface of the wafer.
   - Describe the three basic steps in photolithography.
     i. **Deposition (spinning/coating) of photoresist on the surface of the wafer.**
     ii. **Exposure of the photoresist to an optical image.**
     iii. **Developing of the image in the photoresist.**

   (b) Describe the basic procedure to create an opening of SiO_2 on a wafer and create a metal contact. (10 Marks)

   i. How do we create the oxide layer?
   One of:
   A. thermal oxidation
   B. physical deposition (sputtering)
   C. chemical deposition (CVD)

   ii. How do we create the contact cut in the oxide?
   We use photolithography to define the cut and then use etching.

   iii. Why might we dope the Si under the cut heavily?
   To obtain a ohmic contact.

   iv. What is a method by which we could deposit the metal?
   Sputtering or CVD

   v. How would we pattern the metal layer?
   We use photolithography to define the lines/contacts and then use etching to remove the metal we don't want.

2. (8 Marks) Nano-technology and MEMS

   (a) Why are electron microscopes used as basic tools in nano-technology and not optical microscopes?

   The minimum resolution obtainable in imaging tools is determined by the wavelength of the field (optical or electron). Nano-structures are much smaller than the wavelength of light so it can not be used to image them

   (b) What do we mean by "self-assembly"?

   Self-assembly is the spontaneous organization of objects (molecules, atoms, polymers) into a structured assembly – showing some pattern, periodicity or preferential orientation.

   (c) Why do objects such as molecules self-assemble into organized structures?

   To minimize their total energy.

   (d) What is the technique that we use to form "free" structures such as rotating gears in MEMS devices?

   We use a "sacrificial layer". A layer of material is deposited to allow for the creation of a final structure (including parts that may be "free"). This layer is later removed by etching to release the structure.