ELEG 667–016; MSEG-667-016 - Solid State Nanoelectronics – Fall 2005
Homework #4 - due Tuesday, 4 October 2005, in class

1. **Structure:** Using the nomenclature for the branching group from Fig. 1, p. 131 in Waser, and Fig. 7 for the location of the double bond, draw the structures for the *cis* and *trans* isomers of:
(a) 1,2 dichloroethene
(b) 3-methyl-3 hexene

(*Hint:* (b) can be tricky - it simplifies if you consider the C_2H_5 at the ends of the chain as a group for the 2 *cis/trans* isomers.).

2. **Electronic Conduction:** Organic molecules have great promise as electronic conductors. Consider a chain of conjugated C bonds, as shown in the upper part of Fig. 9, p. 132 in Waser. Roughly, consider the average bond length to be the achievable atomic spacing, and that 1 electron per atom contributes to conduction. What is the numerical value of electronic mobility that would be required in a bulk sample of such molecules in order to equal the electrical conductivity of copper metal ($5.96\ 10^5$ S/cm)?

3. **Hückel Theory:** Within the Hückel approximation, write down the secular determinant for benzene p_z orbitals to yield the molecular π-orbitals of 1,3 cyclobutadiene (C_4H_4). Is 1,3 cyclobutadiene aromatic?

4. **Landauer Theory.** One reason that we may not see the effects of quantum resistors is because there are many possible modes. In Landauer formalism the conductivity for a quantum wire with one conduction mode and one scattering center is given by $G = (2e^2/h)(T/R)$. What would the conductivity be for M modes, in parallel?