

**ECEn 550 / ME 550, Fall 2008**

**Homework #4**

**Due October 31, 5:00 pm**

From the text Foundation of MEMS, do the following problems:

4.5, 4.6, 4.9, 4.16, 4.20, 4.30

(Note: Both problems 4.5 and 4.6 refer to a “problem 4.6”. They are actually referring to problem 4.4)

**RF MEMS Problems**

- A. A fixed-fixed beam is being used as a capacitive RF MEMS switch. The beam is  $300\ \mu\text{m}$  long,  $50\ \mu\text{m}$  wide, and  $3\ \mu\text{m}$  thick. The gap between the beam and the electrode under it is  $1.5\ \mu\text{m}$ . The actuating electrode under the beam is  $50\ \mu\text{m}$  long, centered under the beam. The electrode is covered with nitride ( $50\ \text{nm}$  thick) to allow it to act as the capacitive electrode for switching. Find the up-state and down-state impedances assuming a signal frequency of  $5\ \text{GHz}$ . The switch is operating as a series switch. Find its down-state insertion loss and up-state isolation. Assume a  $50\ \Omega$  transmission line.
  
- B. A DC contact switch is made from a cantilever beam  $100\ \mu\text{m}$  long,  $20\ \mu\text{m}$  wide, and  $1\ \mu\text{m}$  thick. It is actuated electrostatically using an electrode under the final  $20\ \mu\text{m}$  of its length, with a gap of  $3\ \mu\text{m}$ . Find its up-state capacitance. In the down-state, it has a contact resistance of  $10\ \Omega$ . The switch operates as a shunt switch. Find its down-state isolation and up-state insertion loss, assuming a signal frequency of  $5\ \text{GHz}$ . Assume a  $50\ \Omega$  transmission line.