

## Exercise 7.1-1

### Class Exercises and Quick Questions to

#### 7.1 MEMS - Products and Developments

▶ We had the following class exercises:

- How large is the [resistance of a 1 pF capacitor](#) at **10 GHz**?
- Consider that the layer of whatever it is that forms the cantilever in the picture above would be under [tensile stress](#) in its top part (maybe the cantilever consists of two different materials stacked on top of each other). What would happen?
- [Calculate](#)  $\Delta R/R$  for a rectangular piece of material with length  $l$ , width  $w$ , thickness  $t$  and specific resistivity  $\rho$  that is strained by  $\epsilon$  in  $l$ -direction.
- Give examples of **MEMS** products, their working principles and range of applications.
- Describe the working principle of a **DLP** beamer. Consider strengths and problems.
- Describe the working principle of a **MEMS** gyro. Provide a rough sketch of a possible implementation.
- Describe possibilities for inducing and detecting mechanical movement in a **MEMS** device.
- Compare a gyro or acceleration sensor operated around resonance or at lower than resonance frequencies. Give curves of amplitude and damping as a function of frequency and discuss the role of damping.
- Give some principles for making actuators and compare the relative merits of the approach.