Term project

- Goal: Design and Fabrication of the MEMS Resonator

You are to design a *x/y* dual-axis comb-drive resonator to resonate at about 5 kHz. The base frequency must be within ± 20% of 5 kHz. The resonator must have a difference of 500 Hz between *x*- and *y*-axis frequencies. The use of a serpentine spring** , as a gimbal mechanism as shown in Fig 1, is strongly recommended.

The total marks allotted for this project is 100 points. You will be given 40 points if the base frequency (average of the 2 modes) is within 5 kHz ± 20%, and if the difference of the two frequencies is 500 Hz ± 10%.

Twenty points will be based on the voltage of actuation. That is the lowest voltage will receive full 20 points. Your grade will be reduced ratiometrically from the lowest voltage depending on your actuation voltage.

The remaining 40 points of the grade will be based on how much theory you have applied to your design as well as how well organized your report is. Your report should be in the same format as a master's thesis, including proper references.

Design rule will be given separately. Example of design is shown in Fig 2.***

- Design Constraints

1. Chip size: 4 mm x 4 mm
2. Lithography, etch constraints: minimum dimension (4 um line and space)
3. Primary mode natural frequency: 5 kHz
4. Secondary mode natural frequency: 5 kHz + 500 Hz (± 10 %)
5. Actuation voltage: The lower, the better.

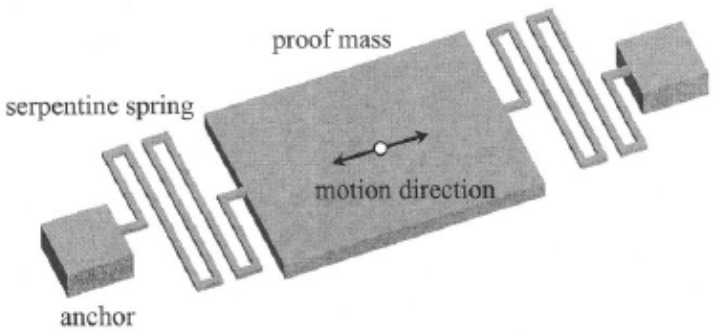

Fig 1. Serpentine Spring

** Ref) Nicole Lobntiu and Ephrahim Garcia, *Mechanics of Microelectromechanical Systems*, Kluwer Academic Publishers, 2005, pp. 154 – 159

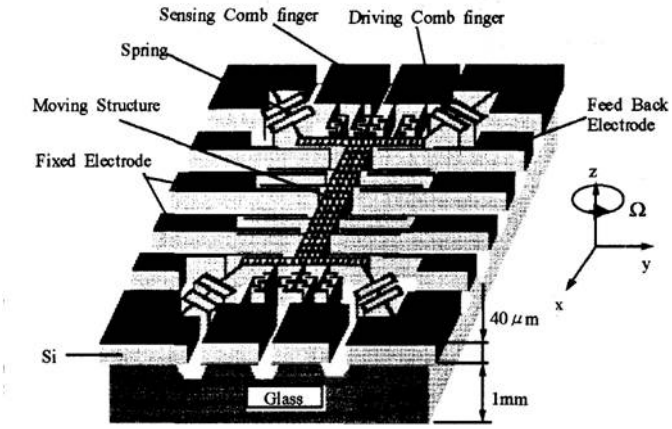

Fig 2. Example of Design

***Ref) S.S Beak, et al., *Asymmetrical Z-axis gyroscope with a high aspect ratio using simple and new process*, MEMS 99, pp. 612-617

1. Midterm presentation
   - Due date: 2008/4/19
   - Midterm report should include,
     - Design concept of the resonator
     - Mechanical and electrical analysis of the resonator
     - Layout of the resonator
     (Must follow the SNU M.S. Thesis format, including references.)

2. GDS layout submission
   - Due date: 2008/4/23
   - After submitting the layout, TA will check for errors.

3. Submitted GDS review (by TA) & modified (final) GDS layout submission
   - Due date: 2008/4/26
   - On 4/28 layout will be sent to Microimage for the chrome pattern.

4. Fabrication & Die distribution
   - Fabrication process (5/2 ~ 5/14)
   - Die distribution date: 5/15

5. Die measurement
   - Duration: 2008/5/15 ~ 2008/5/30 (about 2 weeks)

6. Final presentation
   - Due date: 2008/5/31
   - Presentation: fabrication result of the resonator
   - Final report should include,
     - Design concept of the resonator
     - Mechanical and electrical analysis of the resonator
     - Layout of the resonator
     - Fabrication results of the resonator, including SEM images
     - Measurement results and discussion, including error analysis
     (Must follow the SNU M.S. Thesis format, including references.)