EE C247B / ME C218 INTRODUCTION TO MEMS DESIGN SPRING 2020

INFORMATION ABOUT THE MIDTERM EXAM

Office Hours During Exam Week:

Prof. Nguyen	11:30-12:30 p.m. on Wednesday, March 18, by Zoom
Kieran Peleaux	Review Session, 9:30-11 a.m. on Tuesday, March 17, by Zoom 10-11 a.m. and 3-4 p.m. on Wednesday, March 18, by Zoom

Date of Exam:

Thursday, March 19, 9:30-12:00 noon. (sharp)

Exam Logistics:

This will be a remote exam. We will release the exam on Piazza at 9:30 a.m. sharp. You will then need to print the exam and write out your answers using pen or pencil. Make sure your writing is dark enough to scan well. It is best to use a dark pen. Also, leave enough time at the end to scan the entire exam (front and back), including this cover sheet, and email the pdf file to Prof. Nguyen at ctnguyen@berkeley.edu.

General Information:

You must work on this exam alone. The exam will be open book, and you can use a calculator. You will be provided with exam sheets with enough space to put all your work on these sheets. You should show and include all your work on the exam sheets. The exam will consist of a few problems, each with a number of parts.

Material to be Covered:

Reading in Senturia, class lecture notes, handouts, and homeworks. The exam is meant to include all material covered so far in the class. You might pay more attention to the following areas:

1. Basic MEMS fabrication process modules, including oxidation, film deposition, lithography, etching, ion implantation, and diffusion. You should especially have a good understanding of MEMS-centric etching and what influences selectivity and the degree of anisotropy.
2. Physics of stiction and bending/warping due to residual or thermal stresses and other phenomena. Be able to quantitatively determine whether a particular structure is warped or stuck down.
3. MEMS process flow design and layout. Be prepared to design your own process flow and layout for some arbitrary cross-section or 3D structure.
4. Surface and bulk micromachining, including its basic process flow, release issues (e.g., stiction), material choices, residual stress, stringers and methods for eliminating them.
5. Mechanics of materials for MEMS, including stress, strain, material properties, and on-chip measurement & characterization of mechanical properties.

6. Microstructural elements, including bending moment and strain, flexural rigidity, residual stress analysis, boundary conditions, and spring combinations. You should be familiar with beam bending equations and their application. You should also be able to derive properties for arbitrary connections of beams (i.e., springs).
7. Energy methods to determine various things, e.g., an approximate force-to-displacement transfer function for a mechanical structure.
8. Pros and cons of scaling, including understanding of thermal circuits and impact of scaling on surface-to-volume ratios.