ME 250 Term Project

Your term project is one of the most important learning opportunities you will have in the class. The purpose of the term project is to give you an opportunity to apply the concepts presented in the class in a practical way. This semester you can select from two project areas:

- Capillary Electrophoresis (CE) micro channel chip alignment device
- Small-motion positioning device for a semiconductor wafer metrology station

The requirements for the projects are:

**Capillary Electrophoresis (CE) Alignment Device**

The objective of this project is to design a device that will properly position a standard microfluidic chip in a capillary electrophoresis (CE) instrument at SJSU. The CE instrument that we have was not designed to accommodate microfluidic chips. It uses a cartridge containing a conical ring that has two holes through the walls of the ring. A standard capillary tube is threaded through the two holes, which are aligned along a centerline of the ring. The cartridge is seated via the conical ring over a tapered cylindrical nose, and thus positions the capillary directly in line with the detector (which is mounted on the centerline of the cylindrical nose). To use a microfluidic chip under the present arrangement, one of the conical rings is painstakingly aligned so that its centerline is centered on the microchannel on the chip using a microscope, and is then glued into place. The current process takes about 20 minutes to accomplish.

The Functional Requirements (FR’s), and Important Constraints (IC’s) are:

- FR-1: vertical position of micro channel centerline to within ±5 microns of detector centerline
- FR-2: perpendicularity of micro channel centerline to detector centerline to within ±1º
- FR-3: cycle time for positioning to be not longer than 2 minutes
- IC-1: must fit within a volume of 160 x 180 x 70 mm
- IC-2: connections to the existing baseplate should use existing threaded holes or require modifications that can be made without having to disassemble the instrument

**Positioning Device for Wafer Metrology Station**

The objective of this project is to design a device that will allow a 6 in. diameter silicon wafer to be adjusted in tip, tilt, θ, and z for an optical metrology station.

The Functional Requirements (FR’s), and Important Constraints (IC’s) are:

- FR-1: tip angle range: 3º
- FR-2: tip angle resolution: 1 arc-sec
- FR-3: tilt angle range: 3º
- FR-4: tilt angle resolution: 1 arc-sec
- FR-5: θ angle range: 3º
- FR-6: θ angle resolution: 1 arc-sec
- FR-7: z height range: 3 mm
- FR-8: z height resolution: 0.1 micron
- IC-1: must fit within a volume of 200 x 200 x 50 mm
You will develop detail drawings for parts making up your design, analyze the design for performance to verify that your design will function properly, determine how much it will cost to fabricate, and document your work in a report.

Your grade for the term project will be based on performance in these areas:

1. Design and analysis 40%
   - **Design**: How well were principles of precision machine design used in the solution? How sound is the design from a performance and manufacturing standpoint?
   - **Analysis**: How thorough and accurate was your performance and cost analysis?

2. Completeness and quality of your final report and deliverables 40%

3. Individual contribution and effectiveness as a team member 20%

On the way, you must produce the following deliverables:

- **Project Team and Design Concepts**
  - You must generate at least 5 fundamentally different approaches to achieving the design goal. Each team member is responsible for at least one of the 5 concepts. Rough sketches with notes that clearly explain how the design is to work and how the parts are to be arranged must be part of the documentation of your concepts. Indicate which concept is your ‘prime’ design and why. It is recommended that you use a structured approach, such as the Pugh Selection Chart to choose your prime design.

- **Presentation of results (Poster Fair in class)**
  - You will present the results of your project in a poster board format.

- **Final report**
  - The final report should have at least the following sections:
    - Title page
    - Introduction (which gives some background on the problem you solved)
    - Proposed Design (thorough description of your design, and make sure you identify the precision engineering concepts you applied in the design)
    - Performance and Cost Analyses
    - Conclusions and Recommendations for Future Work
    - Reflections on What You Learned in Doing the Project
    - References
    - Appendices (which include the detail drawings of the parts, spec/catalog sheets for any purchased components, etc.)
  - Please submit both a softcopy of your report on a CD and a hardcopy of your report

**References**
