

Multidisciplinary Senior Design Project Readiness Package

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| Project Title: | Mechanical Bioreactor |
| Project Number: (assigned by MSD) | 18081 |
| Primary Customer: (provide name, phone number, and email) | Dr. Bailey and BME department jlbme@rit.edu |
| Sponsor(s): (provide name, phone number, email, and amount of support) | Dr. Bailey jlbme@rit.edu \$700 from BME department |
| Preferred Start Term: | Fall 2017 |
| Faculty Champion: (provide name and email) | Dr. Bailey jlbme@rit.edu |
| Other Support: | As applicable |
| Project Guide: (assigned by MSD) | |

Prepared By

Date

Received By

Date

Items marked with a * are required, and items marked with a † are preferred if available, but we can work with the proposer on these.

Project Information

* Overview:

Please provide a brief (2-3 paragraphs) overview of the background on the problem to be solved, the motivation for solving it, the short-term goals for the proposed project, and the long-term goals for any program the project may support.

Cell culture is typically performed on two-dimensional plastic surfaces under static conditions. Cells *in vivo* do not live in these conditions and thus studying cells in these conditions is not representative. Culturing cells with varied stimuli that is not simply chemically induced is a challenging task.

An advanced cell culture class (BIME 470) will benefit from the ability to study premyocytes under various levels of mechanical stimulation. An ideal culture chamber would maintain sterile, standard culture conditions (5% CO₂, 37°C) while applying tensile strain on cultured cells. The ability to view the culture with a microscope is crucial for the purpose of the culture system.

* Preliminary Customer Requirements (CR):

What attributes does the customer seek in the final project? Each CR should map to one or more ER (see below).

| CR | | Importance (1 must have, 3 good to have) |
|----|--|---|
| 1 | Maintain proper culture conditions including sterility, temperature, humidity, and CO ₂ | 1 |
| 2 | Maintain pH levels of media | 1 |
| 3 | Maintain cell growth for up to 3 weeks | 3 |
| 4 | Allow for viewing of cells during the experiment | 2 |
| 5 | Easy to clean and sterilize | 2 |
| 6 | Apply a cyclic tensile strain across the culture for up to 3 weeks | 1 |
| 7 | Controllable and adjustable stimulation during the experiment | 3 |
| 8 | Safe for student population in a course | 1 |
| 9 | Disassembly allows for collection of culture or culture products | 3 |

* Preliminary Engineering Requirements (ER):

Include both metrics and specifications. Each ER should map to one or more CRs (see above).

Metrics: what quantities will be measured in order to verify success?

Specifications: what is the target value of the metric that the team should design to?

| Specification | | Ideal Value | CR map |
|-----------------|---|--|--------|
| Sterility | Resistant to Ethanol | 100% | 5,1 |
| | Gas exchange is Filtered | 100% | 1 |
| | Media is Contained | 100% | 1 |
| Experimentation | Maintains Media pH | 7.4 | 2 |
| | Fits in Incubator | | 1 |
| | Fits on Microscope during Experiment | | 4 |
| | Culture Surface Area | $\geq 25\text{cm}^2$ | 9 |
| | Applies a Cyclic Tensile Strain | | 6 |
| | Quickly Adjustable Applied Strain Profile | <1min | 7 |
| Usability | Assembly Time | $\leq 60\text{min}$ | 5 |
| | Disassembly Time | $\leq 30\text{min}$ | 8 |
| | Software Use Straightforward | No questions from a 3 rd year BME student | 8 |
| Safety | Pinch Hazard during normal operation including moving for media exchange or viewing on microscope | none | 8 |

*** Constraints:**

List any external factors that limit the selection of alternatives, e.g., allowable footprint, budget, required use of legacy hardware/software.

Must fit generic, EVOS, and Leica microscopes used for class

*** Project Deliverables:**

Minimum requirements:

- All design documents (e.g., concepts, analysis, detailed drawings/schematics, BOM, test results)
- working prototype
- technical paper
- poster
- All teams finishing during the spring term are expected to participate in ImagineRIT

Additional required deliverables:

- List here, if applicable

† **Budget Information:**

Include total budget, any major cost items anticipated, and any special purchasing requirements from the sponsor(s).

| Items | Projected Cost |
|--------------------------|-----------------------|
| Materials | \$600 |
| Cell culture disposables | \$100 |

* **Intellectual Property:**

Describe any IP concerns or limitations. According to RIT policy, students have the right to retain any IP they generate during a course, but some students voluntarily agree to be placed on projects where they will be asked to assign their IP. If a sponsor wishes to have a team assign their IP, we need to know ahead of time so that we can place appropriate students on the team.

In order to ensure that students can discuss their projects openly during presentations and job interviews, we ask that no more than ~20% of the project be considered confidential.

Project Resources

† Required Resources (besides student staffing):

Describe the resources necessary for successful project completion. When the resource is secured, the responsible person should initial and date to acknowledge that they have agreed to provide this support. We assume that all teams with ME/ISE students will have access to the ME Machine Shop and all teams with EE students will have access to the EE Senior Design Lab, so it is not necessary to list these. Limit this list to specialized expertise, space, equipment, and materials.

| | |
|--|--------------------------|
| Faculty list individuals and their area of expertise (people who can provide specialized knowledge unique to your project, e.g., faculty you will need to consult for more than a basic technical question during office hours) | Initial/ date |
| | |
| Environment (e.g., a specific lab with specialized equipment/facilities, space for very large or oily/greasy projects, space for projects that generate airborne debris or hazardous gases, specific electrical requirements such as 3-phase power) | Initial/ date |
| | |
| Equipment (specific computing, test, measurement, or construction equipment that the team will need to borrow, e.g., CMM, SEM,) | Initial/ date |
| | |
| Materials (materials that will be consumed during the course of the project, e.g., test samples from customer, specialized raw material for construction, chemicals that must be purchased and stored) | Initial/ date |
| | |
| Other | Initial/ date |
| | |

† Anticipated Staffing By Discipline:

Indicate the requested staffing for each discipline, along with a brief explanation of the associated activities. “Other” includes students from any department on campus besides those explicitly listed. For example, we have done projects with students from Industrial Design, Business, Software Engineering, Civil Engineering Technology, and Information Technology. **If you have recruited students to work on this project (including student-initiated projects), include their names here.**

| Dept. | # Req. | Expected Activities |
|-------|--------|---|
| BME | 2 | Knowledge of requirements for cell culture Testing chamber |
| CE | | |

| | | |
|-------|---|--------------------------------|
| EE | | |
| ISE | | |
| ME | 2 | Design and assembly of chamber |
| Other | | |