Course Description
This course develops quantitative biomechanical methods to analyze cell/tissue behavior and properties and to solve biomechanical engineering problems. Topics include: molecular and cellular basis for mechanotransduction, mechanobiology in skeletal and cardiovascular tissues, tissue regeneration, and molecular/cellular experiments. Students will solve problems appropriate for the class materials, and conduct experiments in the area of molecular/cellular engineering.

Prerequisites
BME241

Co-requisites
BME352

Instructor
Hiroki Yokota, PhD (hyokota@iupui.edu)

Instructional Goals
Through problem sets and bioengineering experiments, introduce students to quantitative methods to analyze cell/tissue behavior and properties.

General Topics
- Molecular and cellular force
- Mechanotransduction
- Signal transduction
- Gene expression
- Biofluid dynamics
- Cell/tissue growth and differentiation

References
Outcomes
After completion of this course students should be able to:

1. Formulate elasticity and viscosity in biological system. [e]
2. Determine stress and strain. [a4]
3. Evaluate failure load. [a4]
4. Determine flow speed, and flow induced shear using mathematical computing [a4; k4]
5. Evaluate forces acting on a cell. [a]
6. Formulate dynamics in cell adhesion and migration. [e]
7. Model cellular responses to mechanical stimuli. [e]
8. Design experiments to evaluate force acting on molecules, and cells. [c1, c2]

Grading
- Class participation 10%
- Homework 40% (8 pts each x 5)
- Lab Report 20% (10 pts each x 2; group work)
- Quiz 30% (10 pts each x 3)

Class Schedule

<table>
<thead>
<tr>
<th>#</th>
<th>Date</th>
<th>Subject</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>Introduction</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>Molecular and Cellular Mechanics</td>
<td>Molecular Basics</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>Molecular Dynamics</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>Filaments</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>Motor Proteins</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Mechanobiology in Skeletal Tissue</td>
<td>Gene Expression</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>Mechanical Strength</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>Loading Modalities</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>Soft Connective Tissue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Spring Break</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Experiments</td>
<td>Polymerase Chain Reaction</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>Gel Electrophoresis</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Biofluid and Tissue Engineering</td>
<td>Couette Flow</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>Poiseuille Flow</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>