MEC 520 Smart Materials and Structures

COURSE INFORMATION
Course Title: Smart Materials and Structures
Course Catalog # & Section: MEC 520
Credit Hours: 3
Pre-/Co-requisites: Knowledge in basic material structures, mechanics of solids, basic electronics, numerical methods in engineering design and analysis.
Lectures: Tu 4:45PM – 7:35PM
Instructor Name: Shanshan Yao, Ph. D.
Instructor Contact Information: shanshan.yao@stonybrook.edu
Office Hours: Wednesday 2 – 5 pm at Light Engineering 134 or By appointment
Teaching Assistant: Zihan Yu, Email: zihan.yu@stonybrook.edu

Course Description:
An introduction to the properties, characterization, and applications of various smart materials and structures. This course will cover sensors, actuators, and energy devices based on smart materials, including piezoelectric materials, electroactive polymers, magnetostrictive materials, magnetorheological fluids, and shape memory polymers. The goal is to expose students to fundamentals of smart materials and structures needed for the design and applications in engineering applications.

Learning Objectives:
1. Understand the fundamentals and applications of various smart materials and structures.
2. Be able to identify major smart materials and their properties.
3. Be able to identify major smart structures, mechanisms, and performance.
4. Be able to select and use smart materials and structures for specific engineering applications.
5. Get familiar with the characterization and manufacturing techniques for smart materials, structures, and systems.

Required Course Textbook and Materials:
Lecture notes, assignments, and other course materials will be uploaded on Blackboard.

Recommended Readings/Bibliography:

Assignments and Expectations:
**Homework Assignments:** There will be regularly assigned homework problems (due in one week), which will be posted on blackboard and/or sent by email. Students will submit homework via Blackboard. Homework must be neat, professional, and well organized.

**Exams:** There will be in-class exams on the date to be determined by the instructor. Academic integrity during exams will be administered. Students must use a blue or black pen rather than pencil for writing in your answers. More detailed instructions will be given prior to each exam. No makeup exam unless arranged prior to the exam. An unexcused exam absence will be scored as a zero.

**Final Project:** The students will conduct a final project in groups of 3-4 students on topics related to smart materials and structures of their interest. At the end of this class, students will orally present the design in class and submit a comprehensive written report (in .pdf or .docx format) by the end of the semester.

**COURSE SCHEDULE (SUBJECT TO CHANGES):**

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
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<tbody>
<tr>
<td>Week 1</td>
<td>Introduction, Piezoelectric Materials and Structures</td>
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<tr>
<td>Week 2</td>
<td>Piezoelectric Materials and Structures</td>
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<tr>
<td>Week 3</td>
<td>Piezoelectric Materials and Structures, Electrostrictive Materials and Structures</td>
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<td>Week 4</td>
<td>Electroactive Polymer and Devices</td>
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<td>Week 5</td>
<td>Electroactive Polymer and Devices</td>
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<tr>
<td>Week 6</td>
<td>Advanced Topics Student Presentation (Midterm)</td>
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<tr>
<td>Week 7</td>
<td>Shape Memory Polymer and Devices</td>
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<td>Week 8</td>
<td>Spring Recess (No Class)</td>
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<tr>
<td>Week 9</td>
<td>Shape Memory Polymer and Devices</td>
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<td>Week 10</td>
<td>Magnetic Materials and Devices</td>
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<td>Week 11</td>
<td>Magnetorheological and Electrorheological Fluids</td>
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<td>Week 12</td>
<td>Exam (Comprehensive)</td>
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<td>Week 13</td>
<td>Case studies/Labs</td>
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<tr>
<td>Week 14</td>
<td>Case studies/Labs</td>
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<tr>
<td>Week 15</td>
<td>Design Project Presentations</td>
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<tr>
<td>Week 16</td>
<td>Finals Week</td>
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**Assessment & Grading:**
In this course, you will be assessed on the following:

<table>
<thead>
<tr>
<th>Activity/Assignment</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Homework Assignments</td>
<td>20</td>
</tr>
<tr>
<td>Midterm I</td>
<td>20</td>
</tr>
<tr>
<td>Midterm II</td>
<td>20</td>
</tr>
<tr>
<td>Project Presentation</td>
<td>10</td>
</tr>
<tr>
<td>Project Written Report</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total Possible</strong></td>
<td><strong>100</strong></td>
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Note: There will be no exam retakes. Above distributions are subject to minor adjustments. Question(s) on graded homework/exam must be settled within one week after the graded material is returned.

**Letter Grades:**

\[
\begin{align*}
100, 95 & = A \\
95, 90 & = A-
\end{align*}
\]

\[
\begin{align*}
90, 85 & = B+ \\
85, 80 & = B \\
80, 75 & = B- \\
75, 70 & = C+ \\
70, 65 & = C \\
65, 60 & = C- \\
<60 & = F
\end{align*}
\]

Final grades for this course maybe be curved and will be decided based your relative placement in the class.

**Attendance, Late Work and Make Up Exam Policy:**

**Attendance:** Attendance is required. Failure to participate in required course activities will impact your final grade.

**Late Work Policy:** No late submission is allowed.

**Make up exams:** If you miss an exam due to unforeseen events, you will have to contact Office of Dean of Students to send me an official notification before I will give you a makeup exam. There will be no make-up exams for reasons that are within your control. Make-up exam policy is consistent with university policy on:

1. Student Participation in University Sponsored Events
   http://sb.cc.stonybrook.edu/bulletin/current/policiesandregulations/policies_expectations/participation_univsponsered_activities.php
2. University policy on Final Exams:
   http://sb.cc.stonybrook.edu/bulletin/current/policiesandregulations/records_registration/final_examinations.php
3. New York State Education Law regarding Equivalent Opportunity and Religious Absences
   http://sb.cc.stonybrook.edu/bulletin/current/policiesandregulations/policies_expectations/equivopportuni ty_religiousabsences.php

**STUDENT ACCESSIBILITY SUPPORT CENTER STATEMENT**

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center. For procedures and information go to the

**ACADEMIC INTEGRITY STATEMENT:**
Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

**CRITICAL INCIDENT MANAGEMENT:**
Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Until/unless the latest COVID guidance is explicitly amended by SBU, during Spring 2022 "disruptive behavior" will include refusal to wear a mask during classes.

**Course Materials and Copyright Statement:**
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