

MEC 520 Smart Materials for Sensing and Actuation

COURSE INFORMATION

Course Title: Smart Materials and Structures

Course Catalog # & Section: MEC 520

Credit Hours: 3

Pre-/Co-requisites: Knowledge of basic material structures, mechanics of solids, basic electronics, numerical methods in engineering design and analysis.

Lectures: Tu 4:00 PM – 6:50 PM

Instructor Name: Shanshan Yao, Ph. D.

Instructor Contact Information: shanshan.yao@stonybrook.edu

Office Hours:

Monday 10:00 – 11:30 am at Light Engineering 134

Thursday 9:00 – 10:30 am on Zoom (<https://shorturl.at/itTV4>)

or By appointment

Teaching Assistant: Penghao Dong, Email: penghao.dong@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 the 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 Brightspace.

Recommended Readings/Bibliography:

1. Leo, Donald J. "*Engineering Analysis of Smart Material Systems*", John Wiley & Sons, 2007.
2. Culshaw, Brian. "*Smart Structures and Materials*", Artech House, 1996.
3. Gandhi, M. V., and B. S. Thompson. "*Smart Materials and Structures*", Chapman & Hall, 1992.
4. Janocha, Hartmut. "*Adaptronics and Smart Structures: Basics, Materials, Design, and Applications*", Springer-Verlag Berlin Heidelberg, 2007.
5. Sinapius, Johannes Michael. "*Adaptronics-Smart Structures and Materials*", Springer, 2021.
6. Gaudenzi, Paolo. "*Smart Structures: Physical Behaviour, Mathematical Modelling and Applications*", John Wiley & Sons, 2009.
7. Schwartz, Mel. "*Smart Materials*", Taylor & Francis Group, 2008.

Assignments and Expectations:

Homework Assignments: There will be regularly assigned homework problems (due in one week), which will be posted on Brightspace and/or sent by email. Students will submit homework via Brightspace. 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 a pencil for writing their 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. If any of your group members are not contributing to the lab work, please discuss this with me ASAP to avoid negative impacts on your group.

HOW WE WILL COMMUNICATE:

Course-related questions should be asked during lectures. Other methods of contact are via office hours and emails. Please include MEC520 in the subject line and your full name and SBID# in your emails. The instructor and TA strive to respond to your emails as soon as possible, but please allow between 24-48 hours for a reply. You are encouraged to send a reminder email if your email is not responded to within a reasonable time period. The window for email questions will be closed 24 hours before the exam and report due dates. Students must have an active Stony Brook University email account and access to the Internet. *All instructor correspondence will be sent to your SBU email account or posted on Brightspace.* Please plan on checking your SBU email account regularly for course-related messages. To log in to Stony Brook Google Mail, go to <http://www.stonybrook.edu/mycloud> and sign in with your NetID and password. Please make sure that your email ID is a current one in the Brightspace system.

STUDENT SUCCESS RESOURCES: HOW TO BE A SUCCESSFUL STUDENT IN THIS COURSE

There are multiple resources, university offices, and help desks that are available to assist you with everything from advising, tutoring, accessibility and much more. Review some [Academic Success Strategies](#) and visit the [Student Resources](#) page for links to resources on campus. How to be successful in this course:

- Check your email and Brightspace frequently for announcements.
- Complete all assignments timely.
- Ask questions when you are confused about a topic or course expectation.

COURSE SCHEDULE (SUBJECT TO CHANGES):

	Topics
Week 1	Introduction, Piezoelectric Materials and Structures
Week 2	Piezoelectric Materials and Structures
Week 3	Piezoelectric Materials and Structures, Electrostrictive Materials and Structures
Week 4	Electroactive Polymer and Devices
Week 5	Electroactive Polymer and Devices
Week 6	Advanced Topics_ Student Presentation (Midterm)

Week 7	Shape Memory Materials and Devices
Week 8	Spring Recess (No Class)
Week 9	Shape Memory Materials and Devices
Week 10	Magnetic Materials and Devices
Week 11	Magnetorheological and Electrorheological Fluids
Week 12	Exam (Comprehensive)
Week 13	Case studies/Labs
Week 14	Case studies/Labs
Week 15	Design Project Presentations
Week 16	Finals Week

Assessment & Grading:

In this course, you will be assessed on the following:

Activity/Assignment	Percentage
Homework Assignments	20
Midterm I	20
Midterm II	20
Project Presentation	10
Project Written Report	30
Total Possible	100

Note: There will be no exam retakes. Above distributions are subject to minor adjustments. Question(s) on graded homework/exams must be settled within one week after the graded material is returned.

Letter Grades:

[100, 95] = A

(95, 90] = A-

(90, 85] = B+

(85, 80] = B

(80, 75] = B-

(75, 70] = C+

(70, 65] = C

(65, 60] = C-

<60 = F

Note: Final grades for this course may be curved and will be decided based on your relative placement in the class.

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

Attendance: Attendance is required. Failure to participate in 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 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_univponsored_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/equivopportunity_religiousabsences.php

Students will be expected to notify their professor in advance for religious observance. Notification of intention to be out for a religious holiday **MUST** be made through the CEAS Undergraduate Student office, who will verify and evaluate the notification, and provide the instructor with appropriate instructions; you must include your name, SBID#, and the course number when contacting CEAS in regards to your absence. Students are excused from lecture attendance due to illness without penalty. Please notify the instructor and make arrangements with a classmate to get any notes that you miss. Making a false request for an excused absence is an act of academic dishonesty and will be prosecuted accordingly.

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 following website: <https://ehs.stonybrook.edu/programs/fire-safety/emergency-evacuation/evacuation-guide-disabilities> and search Fire Safety and Evacuation and Disabilities.

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 are 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:

Course material accessed from Brightspace, SB Connect, SB Capture, the instructor, or a Stony Brook Course website is for the exclusive use of students who are currently enrolled in the course. Content from these systems cannot be reused or distributed without the written permission of the instructor and/or the copyright holder. Duplication of materials protected by copyright, without permission of the copyright holder is a violation of the Federal copyright law, as well as a violation of Stony Brook's Academic Integrity. Students are expressly forbidden to upload course materials (e.g. lecture notes, homework answer keys, exams) developed by the instructor to websites that store such materials. This is considered a violation of the copyright protection afforded by the professor. Examples of websites include www.coursehero.com, www.chegg.com, and www.study.com.