Texas A&M University
Departmental Request for a Change in Course
Undergraduate • Graduate • Professional
• Submit original form and attachments •

1. This request is submitted by the Department of ____________________________

2. Course prefix, number and complete title of course: AERO 606/MEMA 606/MSEN 606 Multifunctional Materials

 Attach a brief supporting statement for changes made to items 3a thru 3d, and 5 below.

3. Change requested
   a) Prerequisite(s): From ______________________ To ______________________

   b) Withdrawal (reason) ______________________

   c) Cross-list with ______________________ (Cross-listed courses require the signature of both department heads.)

   d) Change in course title and description. Enter complete current course title and current course description; complete proposed course title and proposed course description in items 4 and 5.

   e) Change in credit/contact hours. Complete item 6b. Underline change(s). Attach a course syllabus.

4. Complete current course title and current course description: ______________________

5. Complete proposed course title and proposed course description (not to exceed 50 words): ______________________

6. a) As currently in course inventory:

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<th>Prefix</th>
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<tr>
<td>AERO</td>
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<td>MULTIFUNCTIONAL MATERIALS</td>
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   b) Change to:

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Approval recommended by:

[Signature]
Head of Department

[Signature]
Head of Department (if cross-listed course)

Submitted to Coordinating Board by:

[Signature]
Director of Academic Support Services

Questions regarding this form should be directed to Sandra Williams at 845-8836.

OAR/AS – 04/07

1 of 3 C19
AERO 606: Multifunctional Materials  
Crosslisted as MEMA 606 / MSEN 606

Instructors
Dr. Zoubeida Ounaies, Department of Aerospace Engineering
HRBB 736B; phone: 458-1330; e-mail: zounaies@aero.tamu.edu

Course Description
- Semester course, 3 lecture hours, 0 lab hour, 3 credits

The course will present an in-depth analysis of multifunctional materials and composites, and their novel applications. Multifunctionality is a term generally used to describe the ability of certain materials to integrate structural utility with other non-structural functionality, such as sensing/actuation or self-healing. Biological materials are inherently multifunctional in that they have a hierarchical structural organization and a coupling between structure and function that combines a range of capabilities, to save weight and volume (e.g., wood and bone). They are the inspiration for emerging synthetic multifunctional materials and systems.

Topics covered will include processing, characterization and constitutive modeling of multifunctional materials. Materials such as electroactive polymers; piezoelectric, magnetostrictive, and shape memory materials and nanostructured polymer composites will be considered. The constitutive behavior of multifunctional materials will be covered both from a theoretical and an experimental perspective. Applications to actuators, nanostructured composites and smart structures will be discussed. Other materials and applications will be introduced through course projects.

Course Objectives
The overall course objective is to provide students with a comprehensive look into the state of the art in multifunctional materials and structures.

- Introduce multifunctionality as exhibited by synthetic materials and biological material systems.
- Demonstrate how resulting properties in multifunctional materials are related to molecular and atomic level mechanisms that translate into useful macroscopic properties.
- Establish principles for deriving multifunctional constitutive response, emphasizing scale transitions.
- Use characterization tools for multifunctionality.

Course Content
1. Introduction to multifunctional materials and their applications:
   a. Biological materials exhibiting multifunctionality (e.g. bone, marine organisms, etc.)
   b. Bioinspired synthetic materials
   c. Aerospace, medical and MEMS applications
2. Coupled fields in multifunctional materials; constitutive relations.
   a. Microscale mechanisms
   b. Constitutive models for macroscale representation of response
3. Classes of multifunctional materials
   a. Electroactive polymers and composites.
   b. Nanostructured and nanoreinforced polymers
   c. Carbon nanotube and carbon nanotube-based composites
d. Magnetoactive materials.
e. Shape and magnetic shape memory alloys.

   a. Lab familiarity with applicable characterization such as microscopy, mechanical, magnetic and electrical characterization.
   b. Mechanical, thermal, electrical and magnetic response
   c. Sensing and actuation performance

5. Multifunctionality at different length scales – from nano to macro.
   a. Difference between bulk and nanoscale properties will be presented
   b. Coupling between nanoscale properties and macroscale performance

6. Applications in design of multifunctional structures.

Course Outline with Approximate Times Assigned to Each Hours

1. Multifunctional materials and their applications. 6
2. Coupled fields; constitutive relations. 6
3. Classes of multifunctional materials. 6
4. Characterization of multifunctional materials. 6
5. Multifunctionality at different length scales. 6
6. Applications in design of multifunctional structures. 3
7. Project/lab 10
8. Midterm. 2

Total 45

Course Materials
Course materials consist of lecture notes and articles from the current literature.

Prerequisites / Co-requisites
Theory of Elasticity (MEMA 601) or Continuum Mechanics (MEMA 602 / AERO 603)
MSEN 601 or MEMA 609

Grading
Homework, labs, quizzes 35%; Midterm 30%; Project 35%.

Americans with Disabilities Act
The Americans with Disabilities Act (ADA) is a federal antidiscrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Department of Student Life, Services for Students with Disabilities in Room B118 Cain Hall, or call 845-1637.

Academic Integrity
"Aggies do not lie, cheat, or steal, nor do they tolerate those who do."

"It is the responsibility of students and instructors to help maintain scholastic integrity at the university by refusing to participate in or tolerate scholastic dishonesty.” (20. Scholastic Dishonesty (Revised: 2002), http://student-rules.tamu.edu/"