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 __AEROSPACE ENGINEERING__
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. Underscore 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:

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Course #</th>
<th>Title (excluding punctuation)</th>
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<tbody>
<tr>
<td>MSEN</td>
<td>606</td>
<td>MULTIFUNCTIONAL MATERIALS</td>
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<tr>
<td>Lect.</td>
<td>Lab</td>
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b) Change to:

<table>
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Approval recommended by:

Walter L. Haisler - AERO
Head of Department for Helen L. Reed Date

Tahir Cagin for MSEN
Head of Department (if cross-listed course) Date

Submitted to Coordinating Board by:

N. K. Kanand Date
Chair, College Review Committee

Dean of College
Date

Questions regarding this form should be directed to Sandra Williams at 845-8836.
OAR/AS – 04/07
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

<table>
<thead>
<tr>
<th>Course Outline</th>
<th>Hours</th>
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<tbody>
<tr>
<td>1. Multifunctional materials and their applications.</td>
<td>6</td>
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<tr>
<td>2. Coupled fields; constitutive relations.</td>
<td>6</td>
</tr>
<tr>
<td>3. Classes of multifunctional materials.</td>
<td>6</td>
</tr>
<tr>
<td>4. Characterization of multifunctional materials.</td>
<td>6</td>
</tr>
<tr>
<td>5. Multifunctionality at different length scales.</td>
<td>6</td>
</tr>
<tr>
<td>6. Applications in design of multifunctional structures.</td>
<td>3</td>
</tr>
<tr>
<td>7. Project/lab</td>
<td>10</td>
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<tr>
<td>8. Midterm</td>
<td>2</td>
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</tbody>
</table>

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/)
April 17, 2008

MEMORANDUM

TO:     GC/GOC

THRU:   Dr. N.K. Anand  
         Associate Dean, Graduate Programs  
         ESSAP – 204 Zachry

FROM:   Dr. Walter E. Haisler  
         Professor and Director of Graduate Programs  
         AERO – 719C Bright

RE:     AERO/MEMA/MSEN 606 - MULTIFUNCTIONAL MATERIALS  
         Change Lecture/Lab listing in course inventory, item 6. b)

Permission is requested to correct the course inventory listing for AERO/MEMA/MSEN 606.  
Please change Item 6. a)
   FROM:  Lecture 2, Lab 2, Scholastic Credit Hour 3  
   TO:    Lecture 3, Lab 0, Scholastic Credit Hour 3

This action is to correct an error in the new course request documentation approved during the  
07-08 Academic Year.  A course syllabus is attached.

Thank you for your consideration of this request.

cc:      file  
         Dr. Ounaies
W-R0028 -NO TERM, MAINTAINING MOST RECENT
125 COURSE INVENTORY MAINTENANCE MULTIFUNCTNAL MATERIALS

SCREEN: ___ SID: _______ CRS: AERO606 TERM: ___

FUNCTION: A=ADD; D=DELETE

COLLEGE: EN
CIP CODE: 1402010006

FUNCTION: A=ADD; D=DELETE

COURSE TITLE: MULTIFUNCTNAL MATERIALS
FIRST TERM: 08C
MINIMUM CREDIT: 3.0
CREDIT CONNECTOR: F
TERMS OFFERED:
DEPT OF RECORD: AERO
XLIST COURSE 1: MEMA606
XLIST COURSE 3:
COURSE LEVEL: 6

*----HOURS-----*
ACTIVITY CODE  LEC CONTACT  CREDIT  ENR
FIRST: LEC  2.0  2.0  10
SECOND: LAB  3.0  1.0
THIRD:  0.0  0.0

REPLACED BY:
EFFECTIVE TERM:

COURSE REPEAT FLAG: N

NEXT ID: 4-©
DATE LAST MAINT: 08-02-07

Sess-1 128.194.103.18 TMT2590

Name: karen - Date: 4/17/2008  Time: 1:08:33 PM