Texas A&M University
Departmental Request for a New Course
Undergraduate • Graduate • Professional
• Submit original form and attach a course syllabus.

1. This request is submitted by the Department of AEROSPACE ENGINEERING

2. Course prefix, number and complete title of course: AERO 617 Micromechanics

3. Course description (not more than 50 words): Eigenstrains; inclusions, and inhomogeneities; Eshelby's solution for an ellipsoidal inclusion; Eshelby's equivalent inclusion method. Effective elastic properties of composites; composite spheres and cylinders models; bounds on effective moduli; Hashin-Shtrikman bounds; applications to fiber, whisker and particulate reinforced composites; introduction to micromechanics of inelastic composites and solids with damage.

4. Prerequisite(s) MEMA 601,602 or AERO 603,605 Cross-listed with MEMA 625 Cross-listed courses require the signature of both department heads.

5. Is this a variable credit course? ☐ Yes ☑ No If yes, from _______ to _______.

6. Is this a repeatable course? ☐ Yes ☑ No If yes, this course may be taken _______ times. Will the course be repeated within the same semester/term? ☐ No ☑ Yes

7. Has this course been taught as a 289/489/689? ☑ Yes ☐ No If yes, how many times? 2 Indicate the number of students enrolled for each academic period it was taught. 11-93A, 8-95A(taught beg. 96C as MEMA 625)

8. This course will be:
   a. required for students enrolled in the following degree program(s) (e.g., B.A. in history)
   b. an elective for students enrolled in the following degree program(s) (e.g., M.S., Ph.D. in geography)

9. If other departments are teaching or are responsible for related subject matter, the course must be coordinated with these departments. Attach approval letters.

10. Prefix | Course # | Title (excluding punctuation)

| AERO | 617 | MICROMECHANICS |

<table>
<thead>
<tr>
<th>Lect.</th>
<th>Lab</th>
<th>SCH</th>
<th>Subject Matter Content Code</th>
<th>Admin. Unit</th>
<th>Acad. Year</th>
<th>FICE Code</th>
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Approval recommended by:
Head of Department: Name
Date: 1-14-08

Head of Department (if cross-listed course): Name
Date: 1-14-08

Chair, College Review Committee: Name
Date: 11/08

Dean of College: Name
Date: 11/08

Submitted to Coordinating Board by:

Date: 11/08

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

1 of 3 B1
Department of Aerospace Engineering
AERO 617 - MICROMECHANICS
Cross listed as MEMA 625  3.0 credits (3-0)

Course Description
Eigenstrains; inclusions, and inhomogeneities; Eshelby’s solution for an ellipsoidal inclusion; Eshelby’s equivalent inclusion method. Effective elastic properties of composites; composite spheres and cylinders models; bounds on effective moduli; Hashin-Shtrikman bounds; applications to fiber, whisker and particulate reinforced composites; introduction to micromechanics of inelastic composites and solids with damage.

Objectives
The course will present an in-depth analysis of the macroscopic mechanical response of heterogeneous media. The main objective will be to develop a methodology for calculating the effective elastic response at the macroscale of composites in terms of microscale parameters, e.g., shape and volume fraction of heterogeneities, as well their own constitutive properties. Applications will be presented for continuous fiber and particulate composites, nanocomposites and multifunctional heterogeneous media for both random and periodic microstructures.

Syllabus (42 lecture hours)

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<tr>
<td>1</td>
<td>Review of solid mechanics: kinematics, conservation laws, constitutive equations, BVPs</td>
<td>3.5</td>
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<td>2</td>
<td>Elastic fields due to eigenstrains. Eshelby’s inclusion problem and equivalence principle. Eshelby’s tensor.</td>
<td>3.5</td>
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<td>3</td>
<td>Effective elastic properties (moduli) of heterogeneous media.</td>
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<td>4</td>
<td>Bounds on effective moduli: Voigt, Reuss and Hashin-Shtrikman bounds.</td>
<td>3</td>
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<td>5</td>
<td>Self-consistent averaging method for effective elastic properties of. Generalized self-consistent method.</td>
<td>3</td>
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<tr>
<td>6</td>
<td>Mori-Tanaka averaging method. Comparison of different averaging methods.</td>
<td>4</td>
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<tr>
<td>7</td>
<td>Composite cylinders and composite spheres models for effective moduli.</td>
<td>3</td>
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<td>8</td>
<td>Computational methods in micromechanics. Effective properties of heterogeneous solids with periodic microstructure.</td>
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<td>9</td>
<td>Applications of micromechanics to nanocomposites.</td>
<td>4</td>
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<tr>
<td>10</td>
<td>Effective thermal properties of heterogeneous materials.</td>
<td>3</td>
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<td>11</td>
<td>Effective electric properties of multifunctional composites.</td>
<td>4</td>
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<td>12</td>
<td>Elements of homogenization theory using multiscale expansions.</td>
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<td><strong>Total Hours:</strong></td>
<td><strong>42</strong></td>
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Recommended Textbooks

Prerequisites / Co-requisites
Theory of Elasticity (MEMA 601 or AERO 605) or Continuum Mechanics (MEMA 602 or AERO 603)

Grading
Homework 25%; Midterm 25%; Project 25%; Final Exam 25%

Instructor
Dr. Dimitris C. Lagoudas, Department of Aerospace Engineering
HRBB 736A; phone: 845-1604; e-mail: lagoudas@aero.tamu.edu
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.

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Scholastic Integrity
As commonly defined, plagiarism consists of passing off as one's own the ideas, work, writings, etc., that belong to another. In accordance with this definition, you are committing plagiarism if you copy the work of another person and turn it in as your own, even if you have the permission of that person. Plagiarism is one of the worst academic sins, for the plagiarist destroys the trust among colleagues without which research cannot be safely communicated. If you have questions regarding plagiarism, please consult the latest issue of the Texas A&M University Student Rules [http://student-rules.tamu.edu/], under the section "Scholastic Dishonesty."