THE UNIVERSITY OF TEXAS AT AUSTIN
Department of Aerospace Engineering and Engineering Mechanics

ASE 324L Aerospace Materials Laboratory
Fall 2009

SYLLABUS

Unique Numbers:	13540, 13545, 13550, 13555, 13560
Instructor:	Rui Huang WRW 117D, 471-7558, ruihuang@mail.utexas.edu
Time:	MW 9:00am - 10:00am (lectures) T 2:00pm - 5:00pm (labs, 13540) Th 2:00pm - 5:00pm (labs, 13545) T 5:00pm - 8:00pm (labs, 13550) W 5:00pm - 8:00pm (labs, 13555) Th 5:00pm - 8:00pm (labs, 13560)
Location:	WRW 102 (lectures) WRW 5W (labs)
Teaching Assistants:	Shravan Gowrishankar, WRW 214, shravan.g.shankar@gmail.com Aaron Albrecht, WRW 214, albrecht.aaron@gmail.com Fasset Hickey, WRW 311, whickey@mail.utexas.edu Matthew Manley, WRW 214, mhmanley@mail.utexas.edu John Huang, WRW 214, johnzilla76@gmail.com
Web Page:	**Blackboard** (lab manual and grades) http://www.ae.utexas.edu/courses/ase324_huang/ (lab data and reading materials)
Catalog Description:	Study of the deformation and fracture behavior of materials used in aerospace vehicles. Structure-property relations, methods of characterizing material behavior, use of properties in the design process. Case histories. Written reports. Two lecture hours and three laboratory hours a week for one semester.
Course Objectives:	To learn how to characterize mechanical properties of common aerospace materials. To understand the material and environmental effects on the mechanical behavior of aerospace structures.
Prerequisites:	Engineering Mechanics 319 with a grade of at least *C.*

Knowledge, Skills, and Abilities Students Should Have Before Entering This Course:
Calculate stress and strain, reduce data obtained from computer data acquisition systems, communicate via technical writing, use spreadsheets, word processors, and statistical analysis software.

Knowledge, Skills, and Abilities Students Gain from this Course (Learning Outcomes):
Understand the deformation and fracture characteristics of common aerospace materials. Conduct ramp and creep tension tests and fracture tests. Link the behavior of materials to their microstructures.

Impact On Subsequent Courses In Curriculum:
This course helps students with material selection in subsequent design classes.

Relationship of Course to Program Outcomes:
This course contributes to the following ABET Criterion 3 outcomes and those specific to the EAC accredited program.

Outcome	√	Outcome	√
a. An ability to apply knowledge of mathematics, science, and engineering	√	g. An ability to communicate effectively	√
b. An ability to design and conduct experiments, as well as to analyze and interpret data	√	h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	√
c. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.		i. A recognition of the need for and an ability to engage in life-long learning	
d. An ability to function on multi-disciplinary teams		j. A knowledge of contemporary issues	√
e. An ability to identify, formulate, and solve engineering problems	√	k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice	√
f. An understanding of professional and ethical responsibility			

ABET Program Criteria Achieved:
Program criteria are unique to each degree program and are to be compiled from the program criteria given for each degree program and listed in table format below. The faculty should check which of the program criteria are achieved in the course.

Criterion	√	Criterion	√	Criterion	√
A. Aerodynamics		G. Orbital Mechanics		M. Preliminary/Conceptual Design	√
B. Aerospace Materials	√	H. Space Environment		N. Other Design Content	√
C. Structures	√	I. Attitude Determination and Control		O. Professionalism	
D. Propulsion		J. Telecommunications		P. Computer Usage	√
E. Flight Mechanics		K. Space Structures			
F. Stability and Control		L. Rocket Propulsion			

Topics:

1. Deformation behavior of hot and cold rolled steels (3)
2. Crystalline structures and dislocations (3)
3. Aluminum alloys and strengthening mechanisms (3)
4. Solid solutions and heat treatments (3)
5. High-temperature creep (3)
6. Ceramics and glasses (3)
7. Deformation behavior of polymers (3)
8. Deformation behavior of fiber reinforced composites (3)
9. Fractography and fracture toughness (3)
10. Embrittlement and environmental effects (3)
11. Fatigue and fatigue crack growth (3)
12. Material selection and case studies (9)

Professionalism Topics: Safety, broad education, teamwork

Design Assignments:
Material indices for stiffness, strength, and fracture-limited design.

Laboratory Assignments:
- Tension tests, hardness tests, creep tests, relaxation tests, fracture toughness tests, Charpy impact tests, fatigue tests, microscopy.
- Electromechanical and servohydraulic test machines, Rockwell hardness testers, level arm creep testers, Charpy impact tester, fatigue testers, microscopes, computer data acquisition.

Computer:
All of the lab assignments listed above involve computer usage.

Text:
- *Materials: engineering, science, processing and design*, by Michael Ashby, Hugh Shercliff, David Cebon (Elsevier, 2007)
- Laboratory Manual by Dr. K. M. Liechti (free download from Blackboard)

Class Format:
Each week there will be two 50-minute lectures. Each student will attend one lab session weekly.

Class Schedule:

Date	**Lectures (MW)**	**Labs (TWTh)**
August 26	Introduction	
August 31/September 2	Tension test and steels	Lab 1 (intro)
September 7	no class (Labor Day)	
September 9	Plasticity and dislocations	Lab 2* (steels)
September 14/16	Stiffness-limited design	CES 1
September 21/23	Aluminum alloys	Lab 3* (Al alloys)
September 28/30	Heat treatments	Lab 4 (microstructures/hardness)
October 5/7	Strength-limited design	CES 2
October 12/14	High-temperature creep	Lab 5 (creep)
October 19/21	Ceramics and glasses	Lab 6 (ceramics)
October 23 (Friday)	**Midterm exam**	
October 26/28	Polymers	Lab 7 (polymers)
November 2/4	Composite materials	Lab 8* (composites)
November 9/11	Fractography/Fracture toughness	Lab 9* (Fracture)
November 16/18	Charpy impact test	Lab 10 (Charpy and Fatigue)
November 23/25	Fatigue	no labs (Thanksgiving)
November 30/Dec 2	Fracture-limited design	CES 3
December 12 (Saturday)	**Final exam (2-5 pm)**	

* Formal lab reports.

Class Outline: see Topics and Class Schedule.

Grading:
- Formal lab reports (4) 20%
- Other Assignments (10) 30%
- Pop-up quizzes 5%
- Mid-term exam 20%
- Final exam 25%
- Attendance of classes and labs is required but not used for grading.
- Plus/minus grades will NOT be assigned for the final grade.

Homework Policy:

- There will be 4 formal lab reports and 10 other weekly assignments.
- Questions that accompany the formal lab exercises must be carefully considered and answered in the report.
- Reports/assignments must be neat, concise, and timely.
- Reports/assignments not turned in at the next subsequent lab meeting are considered late. Reports/assignments that are turned in no more than a week late are penalized 50%. Reports/assignments more than one week late will be penalized 100%.

Examinations:
There will be one mid-term exam and one final exam.

Attendance:
Attendance in classes and labs is required. Strong evidence must be provided in advance for an excused absence.

Office Hours:
TTh 1-2 pm (other time available by appointments)

Important Dates:

August 26:	first class
September 11:	last day to add or drop a course for possible refund
September 23:	last day to drop a course without academic penalty
October 21:	last day to withdraw or drop a course with approval
	last day to apply for an undergraduate degree
October 23:	midterm exam
December 2:	last class
December 12:	final exam

Special Notes:
The University of Texas at Austin provides upon request appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TDD or the Cockrell School of Engineering Director of Students with Disabilities at 471-4321.

Evaluation:
The Measurement and Evaluation Center forms for the Cockrell School of Engineering will be used during the last week of class to evaluate the course and the instructor.

Prepared by: Rui Huang **Date:** August 21, 2009