Department of Aeronautics and Astronautics
School of Engineering
Massachusetts Institute of Technology
Graduate Program (S.M., Ph.D., Sc.D.)
Field: Materials and Structures
Date: December 11, 2011

1. Introduction and Purpose

The graduate program in the Department of Aeronautics and Astronautics at M.I.T. provides educational opportunities in a wide variety of aerospace-related topics through academic subjects and research. The purpose of this document is to provide incoming masters- (S.M.) and doctoral- (Ph.D. and Sc.D.) level students guidance in planning the subjects they will take during their graduate program. The suggestions outlined here are to be understood as guidance and not as a mandatory, rigid framework. The final decision as to what subjects are taken and in what sequence is to be decided between each student and their academic advisor and/or doctoral committee. In addition to these recommendations, the official S.M. and doctoral degree completion requirements[1] must be taken into account during the design of a graduate program.

2. Materials and Structures in Course XVI at MIT

Materials and structures has long been one of the core disciplines in aerospace engineering, and many materials and structures advances have been borne out of the aerospace industry over the past decades, *e.g.,* carbon fibers and carbon fiber advanced composites. Study of Materials and Structures in Course XVI continues within the broad context of aerospace vehicle and systems design, and also extends beyond the traditional aerospace domain. Current faculty pursue research and teaching interests in computational modeling of materials and structures, fabrication and design of hybrid nano/micro materials, understanding and modeling of basic composite material and structural behavior/response, structural design, failure, and safety considerations, MEMS/NEMS materials and structures topics, among others. The graduate curriculum, and the broader research enterprise, benefits significantly from interactions with other Departments at the Institute including Mechanical Engineering (Course II), Materials Science and Engineering (Course III), Engineering Systems Division (ESD), among others. Furthermore, Materials and Structures students have a long history of using Harvard-MIT cross registration[2] to take advantage of numerous mechanics and materials courses offered there. Interactions with other Departments and institutions manifest in numerous ways, including rich research collaborations, co-advising of students, and cross-pollination of graduate courses.

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[1] Refer to the S.M., Ph.D. and Sc.D. degree requirements in Aeronautics and Astronautics section of the MIT Bulletin, or to http://web.mit.edu/aeroastro/academics/grad/index.html

[2] http://web.mit.edu/registrar/reg/xreg/harvard.html

3. Courses in Materials and Structures

Fundamentals	
2.071	Mechanics of Solid Materials
ES240[3]	Solid Mechanics
2.080J	Structural Mechanics
2.072	Mechanics of Continuous Media
2.074	Solid Mechanics: Elasticity
3.22	Mechanical Behavior of Materials
ES241	Advanced Elasticity
Materials and Structures (specialized)	
16.223	Mechanics of Heterogenous Materials
16.221J	Structural Dynamics and Vibrations
2.073	Solid Mechanics: Plasticity and Inelastic Deformation
ES246	Plasticity
ES247	Fracture Mechanics
16.230J	Plates and Shells
2.085	Structural Impact
3.91	Mechanical Behavior of Polymers
Computation	
16.225J	Computational Mechanics of Materials
16.910J	Introduction to Numerical Simulation
2.093	Finite Element Analysis of Solids and Fluids I
2.094	Finite Element Analysis of Solids and Fluids II
Micro/Nanotechnologies	
16.288J	Materials and Processes for Microelectromechanical Devices and Systems
3.44	Materials Processing for Micro- and Nano- Systems
2.57	Nano-to-Macro Transport processes
6.096	Graphene/CNT seminar
6.777	Design and Fabrication of Microelectromechanical Systems
Other Classes (of recent interest)	
3.971J	Molecular, Cellular, and Tissue Biomechanics
3.98	Polymer Synthetic Chemistry
3.371J	Materials Manufacturing
3.901	Experimental Mechanics of Soft Condensed Matter

[3] ES designates a course offered at Harvard: http://www.seas.harvard.edu/teaching-learning/graduate/model-programs - mechanics-program

4. Typical Program in Materials and Structures

A student in Materials and Structures would typically take 6 courses taken as an SM student. Such a student would typically build a program on a foundation of 2 fundamental subjects, supplement these with subjects in one or two specialized areas, and complement this with two subjects in mathematics as required by the department, from the approved subject list designed by the department.

A doctoral student would typically add 6 subjects to this study undertaken for an SM degree plus subjects in a Minor program. The 6 subjects outside of the Minor program would tend to combine broadening in the overall M&S field, further studying in the student's particular area(s) of specialization, and further work in mathematics. Example sets of subjects to minimally satisfy the program requirements might consist of:

S.M.:
2 fundamental courses, 2.071 or ES240, and 2.080J
2 specialization courses: 2.072 or ES241, and 3.44
2 math courses

Ph.D. or Sc.D.:
2 mechanics courses: 2.074 and 16.221J
2 specialization courses, *e.g.,* 16.223, 16.225J, or ES247
2 math courses