

# AERONAUTICS AND ASTRONAUTICS

The principal purpose of the undergraduate interdisciplinary major in Aeronautics and Astronautics is to prepare students who are strongly interested in aerospace for subsequent graduate study in the field. In particular, it is expected that students completing this undergraduate curriculum can then satisfy the requirements for the degree of Master of Science in Aeronautics and Astronautics at Stanford University in one additional academic year or, alternatively, complete the B.S. in General Engineering and the M.S. in Aeronautics and Astronautics as a co-terminal program in five years.

Another objective of the program is, of course, to provide an opportunity for interested undergraduates to become acquainted with the challenges of the aerospace field, with aeronautical and astronautical principles, and with the faculty who teach and do research in aeronautics and astronautics.

Students interested in aerospace are also encouraged to consider the undergraduate minor in Aeronautics and Astronautics, which is described in the "Minors and Honors" section of this Handbook.

The departmental requirements of this major include a core set of courses required of every Aeronautics and Astronautics major; a set of depth areas from which two areas (four courses) must be chosen; and an engineering elective. Students are expected to consult closely with an advisor about how best to satisfy these and all other requirements of the major, to submit a program planning sheet when declaring the major, and to have a final plan (program sheet) approved by the advisor and department at least one quarter prior to graduation.

## REQUIREMENTS

### **Mathematics: 24 units (Fr, So, Jr)**

Mathematics through ordinary differential equations is a prerequisite to depth courses. Some statistics is desirable. For a list of acceptable courses, see the Mathematics Requirement section of this handbook. Required: Ordinary Differential Equations, satisfied by MATH 53 or CME 102 (same as ENGR 155A).

### Science: 18 units (Fr, So)

For a list of courses approved by the School, see the Science Requirement section of this handbook. Aero/Astro depth courses rely on a strong foundation in classical physics, particularly mechanics. Chemistry is needed for students without high school chemistry and is recommended for others. Required: Physics 41 and 43, plus one more advanced physics course.

### Technology in Society: One course

See Figure 3-3 for a list of courses that fulfill the Technology in Society requirement.

### ENGINEERING FUNDAMENTALS:

Three courses minimum, at least one of which is left up to the student to choose.

Course	Title	Units
ENGR 30	Engineering Thermodynamics (req'd)	3
CS106A	Programming Methodology (recommended)	3-5
	Fundamentals Elective	

### DEPARTMENTAL REQUIREMENTS: 39 UNITS

Course	Title	Units
AA 100	Introduction to Aeronautics & Astronautics	3
ME 70	Introductory Fluids Engineering	4
ME 131A	Heat Transfer	3-4
ENGR 15	Dynamics	3
ME 161 <i>or</i> PHYS 110	Dynamic Systems Intermediate Mechanics	3-4 4
CEE 101A <i>or</i> ME 80	Mechanics of Materials Strength of Materials	4 3
AA 190	* Directed Research & Writing in Aero/Astro	3
Depth Area I	two courses from a department Depth Area (see Depth Area lists below)	6
Depth Area II	two courses from a second Depth Area	6
	One engineering elective	3

\* Students should discuss their AA190 (WIM) topic with their advisor & the Student Services Manager during their junior year.

### Depth Areas

Students should select four courses from the list on the next page, two from each of two areas. One additional engineering elective (at least 3 units) should also be selected: this may be an additional course from any of the depth areas below, another course in Aeronautics and Astronautics, or an appropriate elective from another Engineering department. In any case, the choice of depth areas and engineering elective should be determined in consultation with the Aeronautics and Astronautics major advisor.

**DEPTH AREA: FOUR COURSES, TWO FROM EACH OF TWO AREAS**

Course	Title	Units
<b>Dynamics and Controls</b>		
ENGR 105	Feedback Control Design	3
ENGR 205	Intro to Control Design Techniques	3
AA 242A	Classical Dynamics	3
AA 271A	Dynamics and Control of Spacecraft and Aircraft	3
AA 279	Spacecraft Mechanics	3
<b>Systems Design</b>		
AA 236A,B	Spacecraft Design, Spacecraft Design Laboratory	3-5, 3
AA 241A,B	Introduction to Aircraft Design, Synthesis, and Analysis	3, 3
<b>Fluids and CFD</b>		
AA 200A	Applied Aerodynamics	3
AA 210A	Fundamentals of Compressible Flow	3
AA 214A	Numerical Methods in Fluid Mechanics	3
AA 283	Aircraft & Rocket Propulsion	3
ME 131B	Fluid Mechanics: Compressible Flow and Turbomachinery	4
<b>Structures</b>		
AA 240A	Analysis of Structures I	3
AA 240B	Analysis of Structures II	3
AA 256	Mechanics of Composites	3

\*It is recommended that students review prerequisites for all courses.

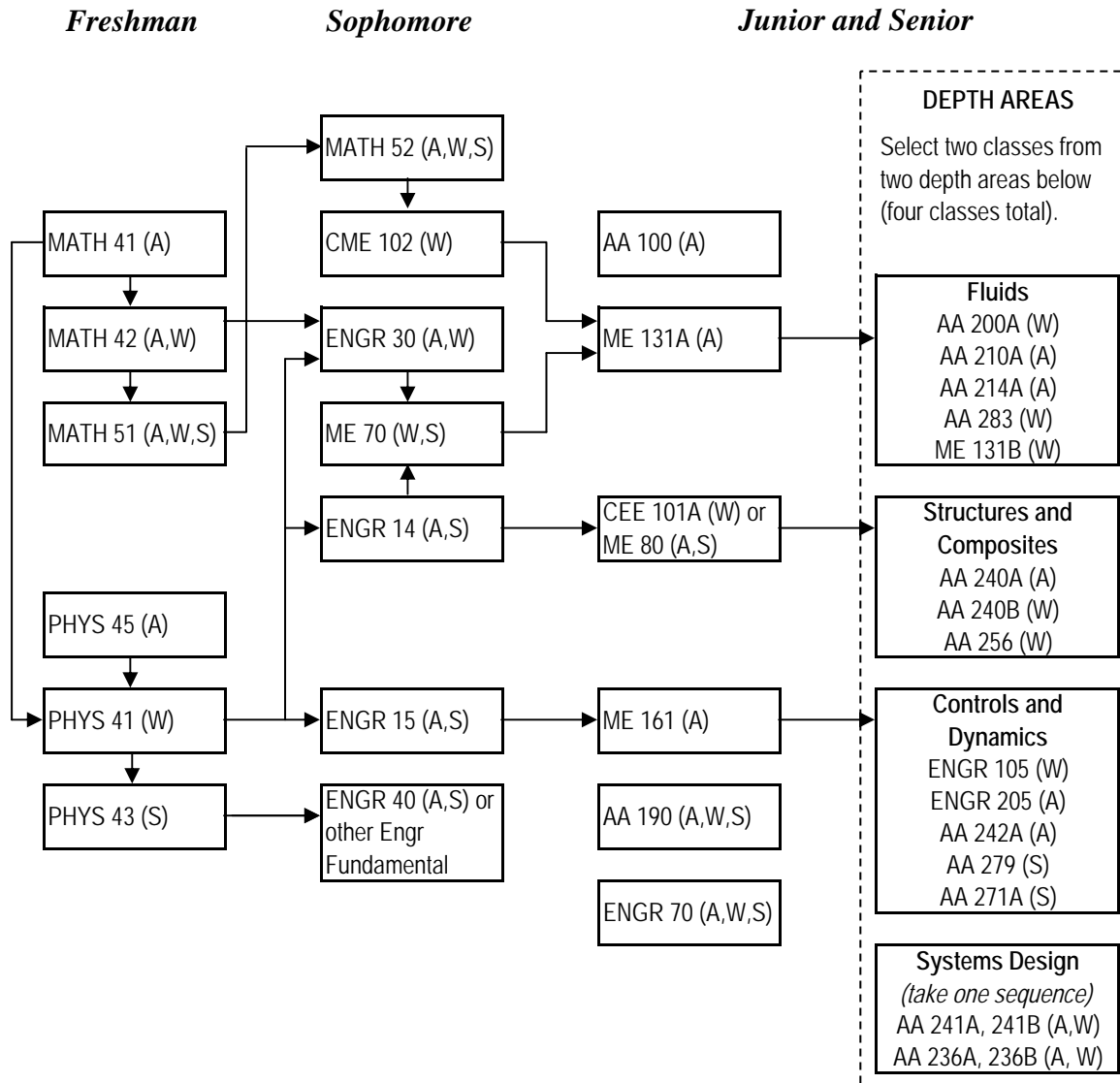
**Free Electives**

To bring total units to the 180 required for graduation.

**Note: The online version of the UGHB is considered the definitive and final version of SoE requirements for each major.** Since corrections or updates may have been made after this Handbook went to press in August 2008, download the online AA program sheet from [ughb.stanford.edu](http://ughb.stanford.edu) to ensure you are using an accurate major plan.

# Aeronautics and Astronautics

Typical Sequence of Courses



\* Plus one engineering elective and additional free electives to bring the total to 180 units.

## Aeronautical and Astronautical Engineering

*Sample Program with Math 40 Series\**

	<i>Fall</i>			<i>Winter</i>				<i>Spring</i>				
	Math/ Sci	Engr	Other	Class	Math/ Sci	Engr	Other	Class	Math/ Sci	Engr	Other	
<i>Freshman</i>	IHUM		5	IHUM			5	IHUM			5	
	Writing	-	-	3	Writing	-	-	3	MATH 51	5	-	-
	MATH 41	5	-	-	MATH 42	5	-	-	PHYSICS 43	4	-	-
	PHYSICS 45	4	-	-	PHYSICS 41	4	-	-		-	-	-
	<i>Subtotals</i>	<i>9</i>	<i>0</i>	<i>8</i>	<i>Subtotals</i>	<i>9</i>	<i>0</i>	<i>8</i>	<i>Subtotals</i>	<i>9</i>	<i>0</i>	<i>5</i>
<b>Total</b>			<b>17</b>	<b>Total</b>			<b>17</b>	<b>Total</b>			<b>14</b>	
<i>Sophomore</i>	AA100	-	3	-	ME70	-	4	-	ENGR 15	-	3	-
	ME80	-	3	-	CME 102	5	-	-	Sci. Elective	3	-	-
	ENGR 40	-	5	-	ENGR 30	-	3	-	Elective	-	-	5
	MATH 52	5	-	-	Elective	-	-	3	GER	-	-	4
	<i>Subtotals</i>	<i>5</i>	<i>11</i>	<i>0</i>	<i>Subtotals</i>	<i>5</i>	<i>7</i>	<i>3</i>	<i>Subtotals</i>	<i>3</i>	<i>3</i>	<i>9</i>
<b>Total</b>			<b>16</b>	<b>Total</b>			<b>15</b>	<b>Total</b>			<b>15</b>	
<i>Junior</i>	ME 131A	-	4	-	ENGR 70A	-	5	-	Elective	-	-	3
	ME 161	-	4	-	Language	-	-	5	Language	-	-	5
	Language	-	-	5	GER	-	-	4	GER	-	-	4
	Sci. Elective	3	-	-	Depth course	-	3	-	Depth Course	-	3	-
	<i>Subtotals</i>	<i>3</i>	<i>8</i>	<i>5</i>	<i>Subtotals</i>	<i>0</i>	<i>8</i>	<i>9</i>	<i>Subtotals</i>	<i>0</i>	<i>3</i>	<i>12</i>
<b>Total</b>			<b>16</b>	<b>Total</b>			<b>17</b>	<b>Total</b>			<b>15</b>	
<i>Senior</i>	Elective	-	3	-	AA 190	-	3	-	Elective	-	-	3
	Depth Course	-	3	-	Depth Course	-	3	-	Elective	-	-	3
	TIS course	-	-	5	GER	-	-	5	Elective	-	-	3
	GER	-	-	5	GER	-	-	4	GER	-	-	5
	<i>Subtotals</i>	<i>0</i>	<i>6</i>	<i>10</i>	<i>Subtotals</i>	<i>0</i>	<i>6</i>	<i>9</i>	<i>Subtotals</i>	<i>0</i>	<i>0</i>	<i>14</i>
<b>Total</b>			<b>16</b>	<b>Total</b>			<b>15</b>	<b>Total</b>			<b>14</b>	

Total Math & Science Units: 43

Total Engineering Units: 52

Total Other Units: 92

**Total Units: 187**

*Notes:*

\*AP Math may be used for Math 41 & 42; see *Stanford Bulletin* for placement

AA190 fulfills the Writing in the Major requirement.

Students who test out of the language requirement should replace language units with technical electives.

CME 100, 102, 104 are also listed as ENGR 154, 155A, and 155B.

## INSTRUCTIONS FOR DECLARING MAJOR IN ENGINEERING: AERONAUTICS & ASTRONAUTICS

1. Print your Stanford unofficial transcript from Axess.
2. Download the AA Program Sheet from the School of Engineering web site. Complete the Program Sheet indicating how you plan to fulfill the major requirements – or do this when you meet with your advisor. Your program proposal may change as you progress in the program: submit revisions in consultation with your advisor. Submit a final Program Sheet at least two quarters before you graduate.
3. Complete the form below and take it, along with your transcript and Program Sheet, to the Aero/Astro Student Services Manager (Durand Building, room 117) for an academic advisor assignment.
4. Make an appointment with your advisor to discuss your program. Have your advisor sign the Program Sheet and the declaration form.
5. Return the signed forms to the Aero/Astro Student Services Manager.
6. Declare the Aero/Astro major on Axess!

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### MAJOR DECLARATION BS ENGINEERING: AERONAUTICS AND ASTRONAUTICS

Student Information (please print)

Date \_\_\_\_\_

Name (last) \_\_\_\_\_ (first) \_\_\_\_\_

Student ID \_\_\_\_\_

Email \_\_\_\_\_@stanford.edu

For Office Use

Advisor Professor \_\_\_\_\_

Office \_\_\_\_\_

Advisor's Signature \_\_\_\_\_ Date \_\_\_\_\_

Student Services \_\_\_\_\_ Date \_\_\_\_\_

**Stanford University ♦ School of Engineering  
Aeronautics and Astronautics  
2008–2009 Program Sheet**

**Final version of completed and signed program due to the department no later than one month prior to the last quarter of senior year.**

**\*Follow all requirements as stated for the year of the program sheet used.\***

Name: \_\_\_\_\_ SU ID: \_\_\_\_\_  
 Email: \_\_\_\_\_ Local Phone: \_\_\_\_\_  
 Date: \_\_\_\_\_ Date B.S. expected: \_\_\_\_\_

**Mathematics and Science Requirements**

Dept	Course	Title	Transfer/AP Approval			Unit	Grade
			✓ if Transfer	Initials	Date		
<i>Mathematics (24 units minimum; must include differential equations, eg CME 102 or Math 53)</i>							
CME or	102	Ordinary Differential Eq for Engineers or				5	
Math	53	Ordinary Differential Eq w/ Linear Algebra (req'd)					
						(24 units minimum)	

*Science (18 units minimum)*

PHYS	41	Mechanics (req'd)				4	
PHYS	43	Electricity and Magnetism (req'd)				4	
						(18 units minimum)	
						(42 units minimum)	

**Technology in Society Requirement (1 course required; see note 1)**

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**NOTES**

- \* This form is available as an Excel file at <http://ughb.stanford.edu/>. The printed form must be signed by the advisor and, if required, by the departmental representative. Changes must be initialed in ink.
  - \* Read all emails from the Office of Student Affairs; this is the School's only effective method of communicating key information to ENGR majors.
  - \* All courses listed on this form must be taken for a letter grade if offered by the instructor.
  - \* Minimum Combined Grade Point Average for all courses in Engineering Topics (Engineering Fundamentals and Depth courses) is 2.0.
  - \* Transfer and AP credits in Math, Science, Fundamentals, & TIS must be approved by the SoE Dean's office. Transfer credits in Engineering Depth must be approved by the Advisor. Transfer credit information and petitions are available at <http://ughb.stanford.edu/transfer.html>.
  - \* All courses listed on this form must only be included under one category. Delete courses not taken.
- ( 1 ) For a list of approved TIS courses, see Figure 3-3 in the UGHB.

*program sheet continues on page 2*

## Aeronautics and Astronautics Program Sheet (continued)

### Engineering Fundamentals (3 courses required, at least one of which the student may choose)

Dept	Course	Title	Transfer/AP Approval			Units	Grade
			✓ if Transfer	Initials	Date		
ENGR	30	Engineering Thermodynamics (req'd)				3	
ENGR	70A	Programming Methodology				5	
		Fundamentals Elective; see UGHB, Fig 3-4 for options					

### Engineering Depth

AA	100	Intro to Aeronautics & Astronautics (req'd)				3	
AA	190	Dir Rsch & Writing in AeroAstro (req'd) (WIM)				3	
ME	70	Introductory Fluids Engineering (req'd)				4	
ME	131A	Heat Transfer (req'd)				4	
ENGR	15	Dynamics (req'd)				3	
ME 161 <i>or</i> PHYS 110		Dynamic Systems or Intermediate Mechanics (one req'd)				4	
CEE 101A <i>or</i> ME 80		Mechanics of Materials or Strength of Materials (one req'd)				3	
		Engineering Elective				3	
		Engineering Elective				3	

#### Depth Area I Fluid Struc Dyn/Ctrl Dsgn (check 1)

		depth course				3	
		depth course				3	

#### Depth Area II Fluid Struc Dyn/Ctrl Dsgn (check 1)

		depth course				3	
		depth course				3	

*Engineering Depth Unit Totals (39 units minimum)*

### Program Totals

*Mathematics and Science (42 units minimum)*

*Engineering Depth (39 units minimum)*

### Program Approvals

#### Advisor

Printed Name: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

#### Departmental

Printed Name: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

#### School of Engineering (Signature not necessary for graduation)

Printed Name: \_\_\_\_\_

Date: \_\_\_\_\_

Signature: \_\_\_\_\_

# ARCHITECTURAL DESIGN

The Architectural Design major seeks to integrate engineering and architecture in ways that blend innovative architectural design with cutting-edge engineering technologies. Combining hands-on architectural design studios with a wide variety of courses, students can choose from a broad mix of elective courses in energy conservation, sustainability, building systems, structures, as well as design foundation and fine arts courses.

In addition to preparing students for advanced studies in architecture and construction management, the program's strong math and science requirements prepare students well for graduate work in other fields, such as civil and environmental engineering, law, and business. The major provides a background for individuals wanting to explore a diversity of careers in architecture, engineering, construction, and structures.

This undergraduate major grants a degree of Bachelor of Science in Engineering with a specialization in Architectural Design. This engineering major is not an ABET-accredited engineering degree, nor is it designed to lead directly to professional licensure in architecture. In order to become a professional architect or engineer, additional graduate training is required.

The program's courses also benefit civil engineering majors who want to develop a "concentration" in architecture. In addition, for students majoring in related fields such as Urban Studies, Product Design, and Studio Arts, the course offerings in architecture and engineering can be used to fulfill the requirements for a minor in the Department of Civil and Environmental Engineering.

## REQUIREMENTS

A total of 100 units are required, distributed as follows.

**Mathematics and Science (36 units minimum), *Including***

Math 19, 20, 21 (or 41 & 42)

One course in Statistics required (see Chapter 3, Fig. 3-1 for list of approved courses)

Physics 21 or 41 (Mechanics) is required.