UCLA Engineering
HENRY SAMUELI SCHOOL OF ENGINEERING AND APPLIED SCIENCE
Mechanical and Aerospace Engineering Department

November 14, 2017

TO: HSSEAS Faculty Executive Committee

FROM: Jeff Eldredge, Professor
Mechanical & Aerospace Engineering

Richard Wirz, Associate Professor
Mechanical & Aerospace Engineering

Mitchell Spearrin, Assistant Professor
Mechanical & Aerospace Engineering

RE: Changes to the Requirements for B.S. in Aerospace Engineering

The Mechanical & Aerospace Engineering Department proposes to change the requirements to receive a B.S. in Aerospace Engineering. The changed curriculum was approved unanimously by the MAE faculty. We propose that the new curriculum plan and requirements will apply to students starting their third year in 2018-19.

The current requirements consist of 183 units—a relatively large number—and involve a cumbersome sequence of six classes that offer little leeway for a student who falls off track or seeks a more diverse curriculum.

Another negative aspect is that the curriculum is slanted more toward aeronautics (e.g. aircraft design) and only offers astronautics (e.g. spacecraft design) courses as electives. But many students are inclined more toward careers in the latter, and the astronautics courses are quite popular. Surveys taken of seniors and alumni reflect these aspects. It should be noted that the ABET standards only require that an aerospace engineering program provide knowledge of either aeronautics or astronautics, along with some topics from the other area.

Our proposed curriculum addresses all of these aspects. The principal changes in the proposed curriculum will be to

- Reduce the number of required units to 180
- Offer two possible ‘tracks’ at the upper division: one in aeronautics and one in astronautics. These tracks will consist of four courses, all of which already exist and

are offered yearly. A student will choose one of these two tracks, but will be required to apply one of their two technical electives toward a course from the alternate track.

- Require students to take MAE 105D Transport Phenomena (i.e. heat transfer). This class used to be required for AE majors (before the introduction of the technical breadth requirement), but has since only been offered to AE majors as a class in the Engineering Science TBA. It is a required class for ME majors.
- Require students to take MAE 1 Undergraduate Seminar, a one-unit P/NP class that is currently optional (but is nonetheless very well attended by MAE students).
- Eliminate the requirement for MAE 154B Design of Aerospace Structures.
- Change the name of the required class MAE 166A from "Analysis of Flight Structures" to "Analysis of Aerospace Structures" and make a small adjustment in content. This class is a prerequisite for MAE 154B, but, with the elimination of this requirement, MAE 166A will now serve as a stand-alone required class on the topic.

The two proposed tracks will consist of the following courses, all of which are 4 units:

- **Aeronautics track**:
    - MAE 150B Aerodynamics
    - MAE C150P Aircraft Propulsion
    - MAE 154S Flight Mechanics and Stability
    - MAE 154A Aircraft Design
- **Space track**:
    - MAE 161A Introduction to Astronautics
    - MAE C150R Rocket Propulsion
    - MAE 161B Space Technology
    - MAE 161C Spacecraft Design

In 2016-17, we transformed the class MAE 157A into a capstone design class focused on aerospace design. This class will serve as the capstone design of both tracks, with projects that cater to the interests and skills of students from either track.

The associated changes to courses for implementing this curriculum reform are relatively minor and are submitted through CIMS, in tandem with this proposal. These are

- Change to 166A as detailed above.
- Removal of MAE 150B (Aerodynamics) as a prerequisite for 157A. This will be instead changed to "Recommended requisites: MAE 150B and MAE C150R". (These are

designed to encourage students to take the corresponding courses in the alternate track.)

The attached pdf provides more details on the curriculum changes, including sample curricula for students on either track, a study of other AE programs, and some recent numbers of the class sizes in all affected courses.

Cc
Chris Lynch
Angie Castillo
Ajit Mal
Myrna Reneau
Michel Moraga
Marcela Moreno

Current

Aerospace Engineering B.S.

Preparation for the Major

Required: Chemistry and Biochemistry 20A, 20B, 20L; Mathematics 31A, 31B, 32A, 32B, 33A; Mechanical and Aerospace Engineering M20 (or Computer Science 31), 82; Physics 1A, 1B, 1C, 4AL, 4BL.

The Major

Required: Mechanical and Aerospace Engineering 101, 102, 103, 105A, 107, 150A, 150B, C150P, C150R or 161A, 154S, 157A, 157S, 166A, 171A; two departmental breadth courses (Electrical and Computer Engineering 100 and Materials Science and Engineering 104
—if one or both of these courses are taken as part of the technical breadth requirement, students must select a replacement upper-division course or courses from the department—except for Mechanical and Aerospace Engineering 156A—or, by petition, from outside the department); three technical breadth courses (12 units) selected from an approved list available in the Office of Academic and Student Affairs; two capstone design courses (Mechanical and Aerospace Engineering 154A, 154B); and two major field elective courses (8 units) from Mechanical and Aerospace Engineering 94, 105D, 131A, C132A, 133A, 135, 136, C137, CM140, CM141, 150C, C150G, C150R (unless taken as a required course), 153A, 155, C156B, 161A (unless taken as a required course), 161B, 161C, 161D, 162A, 166C, M168, 169A, 171B, 172, 174, C175A, 181A, 182B, 182C, 183A, M183B, C183C, 184, 185, C186, C187L.

For information on University and general education requirements, see Requirements for B.S. Degrees on page 21
or http://www.registrar.ucla.edu/Academics/GE-Requirement.

Proposed

Aerospace Engineering B.S.

Preparation for the Major

Required: Chemistry and Biochemistry 20A, 20B, 20L; Mathematics 31A, 31B, 32A, 32B, 33A; Mechanical and Aerospace Engineering M20 (or Computer Science 31), 82; Physics 1A, 1B, 1C, 4AL, 4BL.

The Major

Required: Mechanical and Aerospace Engineering 1 (1 unit); Mechanical and Aerospace Engineering 101, 102, 103, 105A, 105D, 107, 150A, ~~150B, C150P, C150R or 161A~~, ~~154S~~, ~~157A~~, ~~157S~~, 157, 166A, 171A; two departmental breadth courses (Electrical and Computer Engineering 100 and Materials Science and Engineering 104—if one or both of these courses are taken as part of the technical breadth requirement, students must select a replacement upper-division course or courses from the department—except for Mechanical and Aerospace Engineering 156A—or, by petition, from outside the department); one of the following two tracks (16 units): the Aeronautics track (150B, C150P, 154S, 154A) or the Space track (161A, C150R, 161B, 161C); three technical breadth courses (12 units) selected from an approved list available in the Office of Academic and Student Affairs~~; two capstone design courses (Mechanical and Aerospace Engineering 154A, 154B)~~ one capstone design course (Mechanical and Aerospace Engineering 157A); one major field elective course (4 units) from the track not chosen (150B or C150P; 161A or C150R) and ~~two~~ one major field elective courses (~~8~~ 4 units) from Mechanical and Aerospace Engineering 150B, C150R, 154S, 161A, 161B, 161C (unless any of the preceding are taken as a required course), 94, ~~105D~~, 131A, C132A, 133A, 135, 136, C137, CM140, CM141, 150C, C150G, ~~C150R (unless taken as a required course)~~, 153A, 155, C156B, ~~161A (unless taken as a required course)~~, ~~161B, 161C~~, 161D, 162A, 166C, M168, 169A, 171B, 172, 174, C175A, 181A, 182B, 182C, 183A, M183B, C183C, 184, 185, C186, C187L.

For information on University and general education requirements, see Requirements for B.S. Degrees on page 21
or http://www.registrar.ucla.edu/Academics/GE-Requirement.

Proposed:
B.S. in Aerospace Engineering Curriculum
Aeronautics track

FRESHMAN YEAR	UNITS
1st Quarter	
Mechanical and Aerospace Engineering 1—Undergraduate Seminar	1
Chemistry and Biochemistry 20A—Chemical Structure[1]	4
English Composition 3—English Composition, Rhetoric, and Language	5
Mathematics 31A—Differential and Integral Calculus[1]	4
2nd Quarter	
Chemistry and Biochemistry 20B/20L—Chemical Energetics and Change/General Chemistry Laboratory[1]	7
Mathematics 31B—Integration and Infinite Series[1]	4
Physics 1A—Mechanics[1]	5
3rd Quarter	
Mathematics 32A—Calculus of Several Variables[1]	4
Physics 1B/4AL—Oscillations, Waves, Electric and Magnetic Fields/Mechanics Laboratory[1]	7
HSSEAS GE Elective[3]	5
SOPHOMORE YEAR	
1st Quarter	
Mathematics 32B—Calculus of Several Variables[1]	4
Physics 1C/4BL—Electrodynamics, Optics, and Special Relativity/Electricity and Magnetism Laboratory[1]	7
HSSEAS GE Elective[3]	5
2nd Quarter	
Materials Science and Engineering 104—Science of Engineering Materials[2]	4
Mathematics 33A—Linear Algebra and Applications[1]	4
Mechanical and Aerospace Engineering 101—Statics and Strength of Materials[2]	4
Mechanical and Aerospace Engineering 105A—Introduction to Engineering Thermodynamics[2]	4
3rd Quarter	
Mechanical and Aerospace Engineering M20 (Introduction to Computer Programming with MATLAB) or Computer Science 31 (Introduction to Computer Science I)[2]	4
Mechanical and Aerospace Engineering 82—Mathematics of Engineering[2]	4
Mechanical and Aerospace Engineering 102—Dynamics of Particles and Rigid Bodies[2]	4
HSSEAS GE Elective[3]	4
JUNIOR YEAR	
1st Quarter	
Electrical and Computer Engineering 100—Electrical and Electronic Circuits[2]	4
Mechanical and Aerospace Engineering 103—Elementary Fluid Mechanics[2]	4
HSSEAS Ethics Course	4
HSSEAS GE Elective[3]	5
2nd Quarter	

Mechanical and Aerospace Engineering 107—Introduction to Modeling and Analysis of Dynamic Systems[2]	4
Mechanical and Aerospace Engineering 150A—Intermediate Fluid Mechanics[2]	4
Mechanical and Aerospace Engineering 105D—Transport Phenomena	4
~~HSSEAS GE Elective[3]~~	~~5~~
3rd Quarter	
Mechanical and Aerospace Engineering 150B—Aerodynamics[2]	4
~~Mechanical and Aerospace Engineering C150R (Rocket Propulsion Systems) or 161A (Introduction to Astronautics)[2]~~	~~4~~
Mechanical and Aerospace Engineering 171A—Introduction to Feedback and Control Systems[2]	4
Aerospace Engineering Elective[2]	4
~~Technical Breadth Course[3]~~	~~4~~
[2]HSSEAS GE Elective[3]	5
SENIOR YEAR	
1st Quarter	
Mechanical and Aerospace Engineering C150P—Aircraft Propulsion Systems[2]	4
Mechanical and Aerospace Engineering 154S—Flight Mechanics, Stability, and Control of Aircraft[2]	4
Mechanical and Aerospace Engineering 166A—Analysis of Flight Structures[2]	4
Technical Breadth Course[3]	4
2nd Quarter	
Mechanical and Aerospace Engineering 154A—Preliminary Design of Aircraft[2]	4
Mechanical and Aerospace Engineering 157—Basic Mechanical and Aerospace Engineering Laboratory[2]	4
~~Aerospace Engineering Elective[2,4]~~	~~4~~
Technical Breadth Course[3]	4
3rd Quarter	
~~Mechanical and Aerospace Engineering 154B—Design of Aerospace Structures[2]~~	~~4~~
Mechanical and Aerospace Engineering 157A—Fluid Mechanics and Aerodynamics Laboratory[2]	4
Aerospace Engineering Elective[2,4]	4
Technical Breadth Course[3]	4
TOTAL	**~~184~~ 180**

Proposed:
B.S. in Aerospace Engineering Curriculum
Space track

FRESHMAN YEAR	UNITS
1st Quarter	
Mechanical and Aerospace Engineering 1—Undergraduate Seminar	1
Chemistry and Biochemistry 20A—Chemical Structure[1]	4
English Composition 3—English Composition, Rhetoric, and Language	5
Mathematics 31A—Differential and Integral Calculus[1]	4
2nd Quarter	
Chemistry and Biochemistry 20B/20L—Chemical Energetics and Change/General Chemistry Laboratory[1]	7
Mathematics 31B—Integration and Infinite Series[1]	4
Physics 1A—Mechanics[1]	5
3rd Quarter	
Mathematics 32A—Calculus of Several Variables[1]	4
Physics 1B/4AL—Oscillations, Waves, Electric and Magnetic Fields/Mechanics Laboratory[1]	7
HSSEAS GE Elective[3]	5
SOPHOMORE YEAR	
1st Quarter	
Mathematics 32B—Calculus of Several Variables[1]	4
Physics 1C/4BL—Electrodynamics, Optics, and Special Relativity/Electricity and Magnetism Laboratory[1]	7
HSSEAS GE Elective[3]	5
2nd Quarter	
Materials Science and Engineering 104—Science of Engineering Materials[2]	4
Mathematics 33A—Linear Algebra and Applications[1]	4
Mechanical and Aerospace Engineering 101—Statics and Strength of Materials[2]	4
Mechanical and Aerospace Engineering 105A—Introduction to Engineering Thermodynamics[2]	4
3rd Quarter	
Mechanical and Aerospace Engineering M20 (Introduction to Computer Programming with MATLAB) or Computer Science 31 (Introduction to Computer Science I)[2]	4
Mechanical and Aerospace Engineering 82—Mathematics of Engineering[2]	4
Mechanical and Aerospace Engineering 102—Dynamics of Particles and Rigid Bodies[2]	4
HSSEAS GE Elective[3]	4
JUNIOR YEAR	
1st Quarter	
Electrical and Computer Engineering 100—Electrical and Electronic Circuits[2]	4
Mechanical and Aerospace Engineering 103—Elementary Fluid Mechanics[2]	4
HSSEAS Ethics Course	4
HSSEAS GE Elective[3]	5
2nd Quarter	

Mechanical and Aerospace Engineering 107—Introduction to Modeling and Analysis of Dynamic Systems[2]	4
Mechanical and Aerospace Engineering 150A—Intermediate Fluid Mechanics[2]	4
Mechanical and Aerospace Engineering 105D—Transport Phenomena	4
~~HSSEAS GE Elective[5]~~	~~5~~
3rd Quarter	
~~Mechanical and Aerospace Engineering 150B—Aerodynamics[2]~~	~~4~~
Mechanical and Aerospace Engineering C150R (Rocket Propulsion Systems) ~~or 161A (Introduction to Astronautics)[2]~~	4
Mechanical and Aerospace Engineering 171A—Introduction to Feedback and Control Systems[2]	4
~~Technical Breadth Course[3]~~	~~4~~
[2]HSSEAS GE Elective[3]	5
SENIOR YEAR	
1st Quarter	
~~Mechanical and Aerospace Engineering C150P—Aircraft Propulsion Systems[2]~~	~~4~~
~~Mechanical and Aerospace Engineering 154S—Flight Mechanics, Stability, and Control of Aircraft[2]~~	~~4~~
Mechanical and Aerospace Engineering 161A—Introduction to Astronautics	4
Mechanical and Aerospace Engineering 166A—Analysis of Flight Structures[2]	4
Aerospace Engineering Elective[2,4]	4
Technical Breadth Course[3]	4
2nd Quarter	
~~Mechanical and Aerospace Engineering 154A—Preliminary Design of Aircraft[2]~~	~~4~~
Mechanical and Aerospace Engineering 161B—Introduction to Space Technology	4
Mechanical and Aerospace Engineering 157S—Basic Aerospace Engineering Laboratory[2]	4
Aerospace Engineering Elective[2,4]	4
Technical Breadth Course[3]	4
3rd Quarter	
~~Mechanical and Aerospace Engineering 154B—Design of Aerospace Structures[2]~~	~~4~~
Mechanical and Aerospace Engineering 161C—Spacecraft Design	4
Mechanical and Aerospace Engineering 157A—Aerospace Design Laboratory	4
~~Aerospace Engineering Elective[2,4]~~	~~4~~
Technical Breadth Course[3]	4
TOTAL	~~184~~ **180**

Aerospace Engineering Undergraduate Curriculum Reform

Committee: Jeff Eldredge (chair), Richie Wirz, Mitchell Spearrin

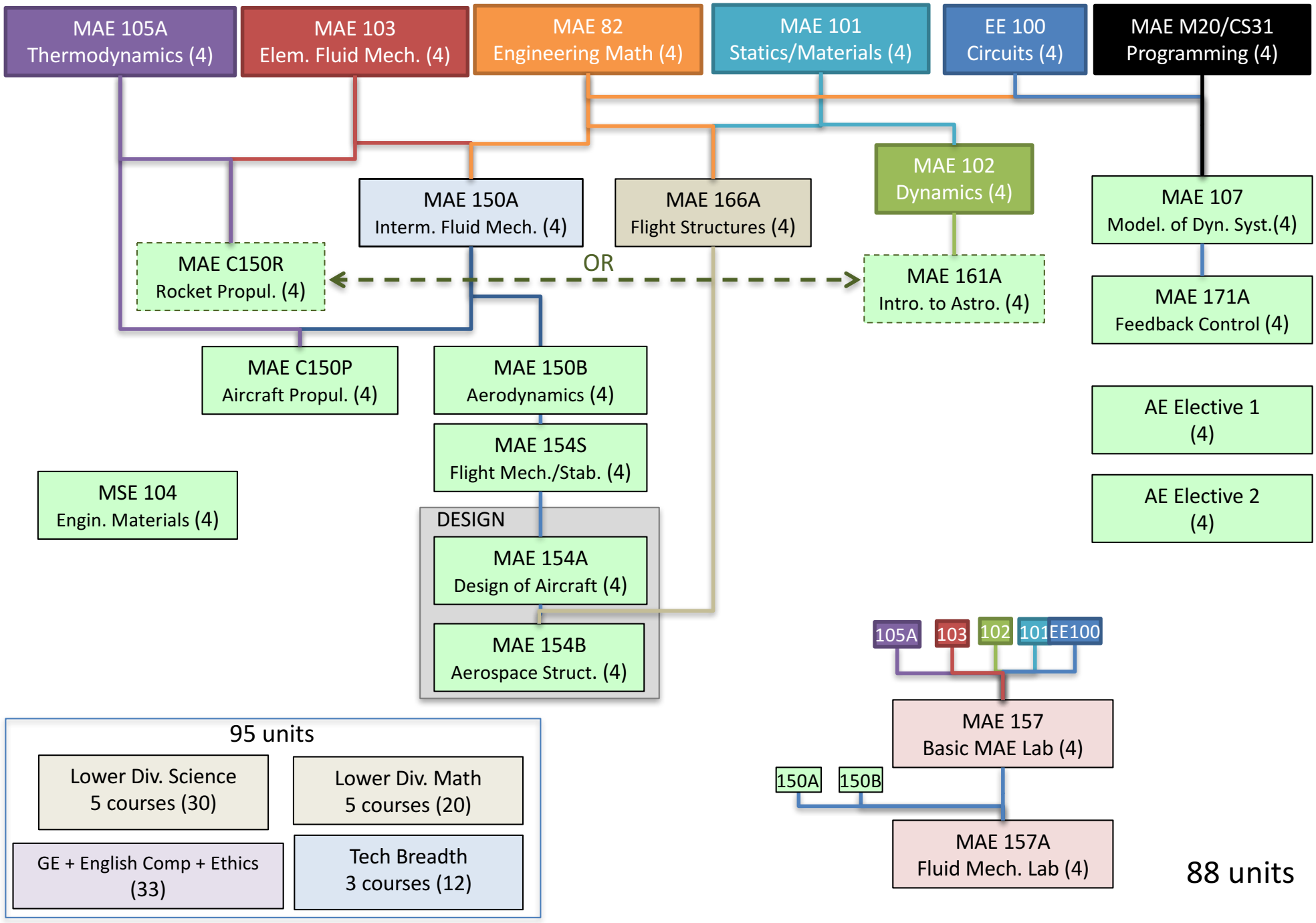
November 2017

Motivation

- Take a fresh look at the current curriculum to determine whether it suits the needs of department and the preparation of students.

- Couple this curriculum review with current AE hiring thrusts (e.g. space technology)

Current Aerospace Engineering Curriculum (183 units)



Observations

- It is highly constrained, particularly for students interested in space technology sequence.
- It lacks a clear capstone design class, where students actually build something
- There is no requirement for heat transfer (105D)
- It requires 183 units, which is high.
- Many of these observations are reflected in exit surveys from AE seniors and alumni board feedback.

ABET Requirements

For Aeronautical Engineering program, knowledge of

- Aerodynamics
- Aerospace materials
- Structures
- Propulsion
- Flight mechanics, stability and control

For Astronautical Engineering program, knowledge of

- Orbital mechanics
- Space environment
- Attitude determination and control
- Telecommunications
- Space structures
- Rocket propulsion

For Aerospace Engineering program, knowledge of

- One of the two areas above, AND
- Some topics from the area not emphasized

In addition, programs must prepare graduates to have ***design competence*** that includes integration of aeronautical or astronautical topics

Proposal:

Create two parallel tracks. Student chooses one:

- **Aeronautics (AERO) track**, emphasizing:
  - Aerodynamics
  - Aircraft Propulsion
  - Aircraft Control & Design
- **Astronautics (SPACE) track**, emphasizing:
  - Astrodynamics
  - Spacecraft “Rocket” Propulsion
  - Spacecraft Control & Design

Proposed Aerospace Engineering Curriculum (180 units)

AE Electives (8 units)

- AE Elective 1 (AE cross-disciplinary)
- AE Elective 2

MAE Total (85 units)

All courses = 4 units unless otherwise noted

AERO (16 units)

- MAE 150B Aerodynamics
- MAE C150P Aircraft Propulsion
- MAE 154S Flight Mech./Stab.
- MAE 154A Aircraft Design

OR

SPACE (16 units)

- MAE 161A Intro. to Astronautics
- MAE C150R Rocket Propulsion
- MAE 161B Space Technology
- MAE 161C Spacecraft Design

MAE Labs (8 units)

- MAE 157A Aerospace Design Lab
- MAE 157 Basic MAE Lab

105A 103 102 101 EE100

Intro course (1 unit)

- MAE 1 (1 unit) Undergrad. Seminar

AE Fundamentals (28 units)

- MAE 166A Aerospace Structures
- MAE 150A Interm. Fluids
- MAE 171A Feedback Control
- MSE 104 Engr Materials
- MAE 105D Transport Phen.
- MAE 102 Dynamics
- MAE 107 Dyn. Syst.

MAE Core/Prerequisites (24 units)

- MAE 105A Thermo
- MAE 103 Elem. Fluids
- MAE 82 Engr Math
- MAE 101 Statics/Materials
- EE 100 Circuits
- MAE M20/CS31 Programming

Core Requirements (95 units)

- Lower Div. Science 5 courses (30)
- Lower Div. Math 5 courses (20)
- Tech Breadth 3 courses (12)
- GE + English Comp + Ethics (33)

Notes

- Number of units has been decreased by 4, to 180.
- To satisfy ABET requirements, **one** of the AE electives **must** be used to take a course in the other track.
  - A student on SPACE track could take 150B or 150P.
  - A student on AERO track might take 150R or 161A.
- Student can **choose** whether to use the second elective for the other track as well, or instead, to select an elective from a larger list of ME and AE classes
- 154B has been removed as a required class; 166A has been renamed “Analysis of Aerospace Structures”, will have to adjust its content.
- 105D has been (re-)introduced into the “AE Fundamentals” curriculum
- 157A is (already) transformed into a unified capstone design class for both tracks, e.g. focused on rocket design, already renamed to ‘Aerospace Design Lab’

Notes (cont'd)

- MAE 1 (Undergrad Seminar), a 1-unit course, has been made a required course.
- In the sample 4-year plans provided below, no changes of offerings need to be made. (But some are suggested.)
- The 2-year plan for transfer students follows naturally
- These are designed to easily allow students to take courses in the other track.
- New curriculum would be available to students starting their third year in 2018-19.
- Recommended 150R and 150B for 157A

Course plans

New example curriculum: Aero track

YEAR 3

1st quarter

- EE 100
- MAE 103
- HSSEAS Ethics
- HSSEAS GE elective

2nd quarter

- MAE 107
- MAE 150A
- MAE 105D

3rd quarter

- MAE 150B
- MAE 171A
- AE elective (cross-track)
- HSSEAS GE elective

YEAR 4

1st quarter

- MAE C150P
- MAE 154S
- MAE 166A
- Tech Breadth course

2nd quarter

- MAE 154A
- MAE 157
- Tech Breadth course

3rd quarter

- MAE 157A
- AE elective
- Tech Breadth course

New example curriculum: Aero track

YEAR 3

1st quarter

- EE 100
- MAE 103
- HSSEAS Ethics
- HSSEAS GE elective

2nd quarter

- MAE 107
- MAE 150A
- MAE 105D
- ~~HSSEAS GE elective~~

3rd quarter

- MAE 150B
- MAE 171A
- AE elective (cross-track)
- HSSEAS GE elective
- ~~C150R/161A~~
- ~~Tech Breadth course~~

YEAR 4

1st quarter

- MAE C150P
- MAE 154S
- MAE 166A
- Tech Breadth course

2nd quarter

- MAE 154A
- MAE 157
- Tech Breadth course
- ~~AE elective~~

3rd quarter

- MAE 157A
- AE elective
- Tech Breadth course
- ~~MAE 154B~~

Moved Added to curriculum Aeronautics Track courses

New example curriculum: Space track

YEAR 3

1st quarter

- EE 100
- MAE 103
- HSSEAS Ethics
- HSSEAS GE elective

2nd quarter

- MAE 107
- MAE 150A
- MAE 105D

3rd quarter

- MAE C150R
- MAE 171A
- HSSEAS GE elective

YEAR 4

1st quarter

- MAE 161A
- MAE 166A
- AE elective (cross-track)
- Tech Breadth course

2nd quarter

- MAE 161B
- MAE 157
- AE elective
- Tech Breadth course

3rd quarter

- MAE 161C
- MAE 157A
- Tech Breadth course

New example curriculum: Space track

YEAR 3

1st quarter

- EE 100
- MAE 103
- HSSEAS Ethics
- HSSEAS GE elective

2nd quarter

- MAE 107
- MAE 150A
- MAE 105D
- ~~HSSEAS GE elective~~

3rd quarter

- MAE C150R
- MAE 171A
- HSSEAS GE elective
- ~~MAE 150B~~
- ~~Tech Breadth course~~

YEAR 4

1st quarter

- MAE 161A
- MAE 166A
- AE elective (cross-track)
- Tech Breadth course
- ~~MAE C150P~~
- ~~MAE 154S~~

2nd quarter

- MAE 161B
- MAE 157
- AE elective
- Tech Breadth course
- ~~MAE 154A~~

3rd quarter

- MAE 161C
- MAE 157A
- Tech Breadth course
- ~~AE elective~~

Moved Added to curriculum Space Track courses

List of individual course changes

- 105D
  - No changes for now.
  - Should introduce a spring offering of the course, and AE students would be encouraged to take this. This would allow students to study convective heat transfer, after taking boundary layer theory in 150A
- C150P
  - Proposed to move to Winter term to accommodate teaching and spread out AERO track schedule
  - (Move C150P OR 154S)
- 154S
  - No changes for now.
  - Proposed to move to Winter term to spread out the AERO track schedule
  - Content of 154S and 154A should be re-aligned
  - (Move 154S OR C150P)
- 154A
  - No changes for now.
  - Content of 154S and 154A should be re-aligned
  - Proposed to move to Spring term to spread out the AERO track schedule
- 154B
  - Remove as a required class for AE students.
- 157A
  - Remove 150B as a prerequisite
  - Create “Recommended requisites: 150B and C150R” to encourage these as electives for students in each track.
- 161A:
  - No changes for now.
  - Proposed name change from “Introduction to Astronautics” to ???
  - Proposed concurrent listing at grad level (but need a different number, since 261A already taken)
- 161B:
  - No changes for now.
  - Proposed name change from “Introduction to Space Technology” to …
  - Proposed concurrent listing at grad level (but need a different number, since 261B already taken)
- 166A:
  - Name change from “Analysis of Flight Structures” to “Analysis of Aerospace Structures”
  - Should consider whether any material from 154B should be introduced in 166A

Enrollments

Enrollments in affected classes

Typical admissions in AE

- Freshman enrollees 34 – 41
- Transfers 12 - 13

- MAE 150B
  - S16 – 51
  - S17 - 45
- MAE 150P
  - F16 – 40
  - F17 – 40
- MAE 154S
  - F16 – 45
  - F17 - 41
- MAE 154A
  - W16 – 38
  - W17 - 45
- MAE 154B
  - S16 – 42
  - S17 - 44
- MAE C150R
  - S16 – 48
  - S17 - 46
- MAE 161A
  - F16 – 38
  - F17 - 46
- MAE 161B
  - W16 – 44
  - W17 - 41
- MAE 161C
  - S16 – 26
  - S17 - 28

Enrollments in affected classes

- MAE 105D
  - W16 - 67
  - F16 - 66
  - W17 – 71
  - F17 – 85
- Expect ~40-45 additional students/year
- Maybe a spring offering

Other programs

Univ. of Colorado

Aerospace Engineering Sciences (semester system)

- Materials Science for AE
- Statics, Structures and Materials
- Intro to Thermodynamics and Aerodynamics
- Experimental and Computational Methods in AES
- Dynamics and Systems
- Aerospace Vehicle Design and Performance [covers both air and space]
- Aerodynamics
- Structures [covers both air and space]
- Thermodynamics and Heat Transfer
- Aircraft Dynamics
- Orbital Mechanics and Attitude Determination
- Electronics and Communications
- Foundations of Propulsion [covers both airbreathing and rockets]
- Senior Design Project (2 semester)
- Professional Area Electives

Univ. of Michigan
Aerospace Engineering (semester system)

- Technical core (12 units)
  - Intro to Materials Science
  - Intro to Dynamics and Vibrations
  - Circuit Analysis and Electronics
- Aerospace science (29 units)
  - Intro to Aerospace Engineering
  - Solid Mechanics and Aerospace Structures
  - Gas Dynamics
  - Aircraft and Spacecraft Structures
  - Aerodynamics
  - Aircraft and Spacecraft Propulsion
  - Space Flight Mechanics
  - Aircraft Dynamics and Control
- Aerospace engineering (16 units)
  - Intro to Aerospace Engineering Systems
  - Aerospace Engineering Seminar
  - Aerospace Engineering Lab (2 courses)
  - Aircraft Design or Space Systems Design
- Technical Electives (7 units)

Georgia Tech

Aerospace Engineering (semester system)

- Engineering Materials
- Intro to Aerospace Engineering
- Circuits and Electronics
- Instrumentation and Electronics Lab
- Statics
- Thermodynamics & Fluid Fundamentals
- Dynamics
- Mechanics of Deformable Bodies
- Intro to Experimental Methods in Aerospace
- Intro to Aerospace Vehicle Performance
- Aerodynamics
- Structural Analysis
- Design and Systems Engineering Methods
- System Dynamics and Vibration
- Control System Analysis and Design
- Experiments in Fluid and Solid Mechanics
- Choice between
  - Aircraft Flight Dynamics
  - Spacecraft Flight Dynamics
- Jet and Rocket Propulsion
- Choice between
  - Aircraft Design
  - Space System Design
  - Rotorcraft Design
- Dynamics and Control Laboratory

Princeton

Aerospace Engineering (MAE) (semester system)

- Introductory Courses
  - Engineering Dynamics
  - Thermodynamics
  - Mechanics of Fluids
  - Modern Solid Mechanics
  - Integrated Laboratory
- Engineering Science Courses
  - Automatic Control Systems
  - Fluid Dynamics
  - One of the these: Aircraft Flight Dynamics OR Space Flight
  - One of these: Rocket and Air-Breathing Propulsion OR Energy Conversion and the Environment
  - One of these: Statics of Structures OR Structural Analysis and Intro to FEM
  - One of these: Structure and Properties of Materials OR Materials Science and Engineering
- Engineering Design Courses
  - Engineering Design
  - One of these: Aircraft Design OR Space Systems Design

Stanford University

Aeronautics & Astronautics (quarter system)

- Intro to Aero Astro
- Into to Aero Fluid Mechanics
- Atmospheric Flight
- Space Flight
- AA Capstone Design
- AA Focus Electives (choose 5)
  - Autonomous Systems
  - Applied Aerodynamics
  - Air and Space Propulsion
  - Aerospace Computational Engineering
  - Embedded Programming
  - Intro to Space Policy
  - Lightweight Structures
  - Guidance and Navigation
  - Flight Mechanics and Controls
  - Independent Study

MIT

Aeronautics & Astronautics (quarter system)

- Departmental Core Classes (from Unified Engineering Curriculum)
- Concentration Subjects
  - Aerospace Software Engineering
  - Autonomous systems
  - Communications, embedded systems and networks
  - Computational engineering
  - Computational sustainability
  - Energy
  - Engineering management
  - Environment
  - Space exploration
  - Transportation.
- Lab and Capstone Subjects

Notes

- It is difficult to make apples-to-apples comparisons with semester-based systems and with (large) stand-alone Aerospace departments.
- Some universities combine their propulsion and/or vehicle dynamics into a single class covering both the air and space content
- Some universities (MIT and Stanford) offer notably more flexibility than our proposal
- The flexibility in Princeton's program is probably closest to what we are proposing