USC Viterbi School of Engineering

Department of Astronautical Engineering

Mike Gruntman, Ph.D.
Professor of Astronautics

November 9, 2024

To: **Astronautics Students**
Students Enrolled in Astronautics Classes
Astronautics Program Instructors
Astronautics Program Supporters and Friends

Astronautics Master's Program Update

As always, this time of the year, we provide an update on the recent developments in the program ***Master of Science in Astronautical Engineering*** or **MS ASTE**.

USC Astronautics **celebrates its 20th anniversary**
as an independent department this year (pages 6, 7, 8).

1) The Master of Science program in astronautical engineering (MS ASTE) is in excellent shape (see statistics pp. 3, 4, 5). From humble beginnings and in a record short time since its founding in the summer of 2004, it has grown into a major, among the largest, internationally recognized space-engineering program. We reach students all over the United States and Canada as well as at military installations at home and abroad.

The Department awarded nearly one thousand Master of Science degrees in Astronautical Engineering from 2004-2024. During the last 4 years, it was on average more than 70 Master's degrees annually.

2) The required course **ASTE-575** in spacecraft propulsion has replaced ASTE-470. ASTE-575 is offered in the spring semesters. If you took ASTE-470 during your studies, there is no need to enroll in ASTE-575. It duplicates credit in ASTE-470.

3) We successfully restarted offering **ASTE-584** *Spacecraft Power Systems* last year. The course is now offered annually.

4) We also successfully restarted another Astronautics course last year, **ASTE-501a** *Physical Gas Dynamics*, after more than a decade of interruption. It will be offered again in the fall of 2025.

5) The newsletter provides program news, a long-term course schedule, and other information about coursework of interest to our current, past, and future students. Please always check with the ASTE Student Services Director about the near-term course schedule.

University of Southern California
3650 McClintock Ave., OHE-530G, Los Angeles, CA 90089-1451 · Tel: 213 740 5536 · mikeg@usc.edu

6) Meet ASTE staff (photos on the right).

(a) Please do not hesitate to contact Astronautics Business Manager Ms. **Dell Cuason** (OHE-500R; tel. 213-821-5817; cuason@usc.edu) should you have any questions about the program or department.

(b) Mr. **Luis Saballos** (OHE-500Q; tel. 213-821-4234; lsaballo@usc.edu); ASTE's Student Services Director.

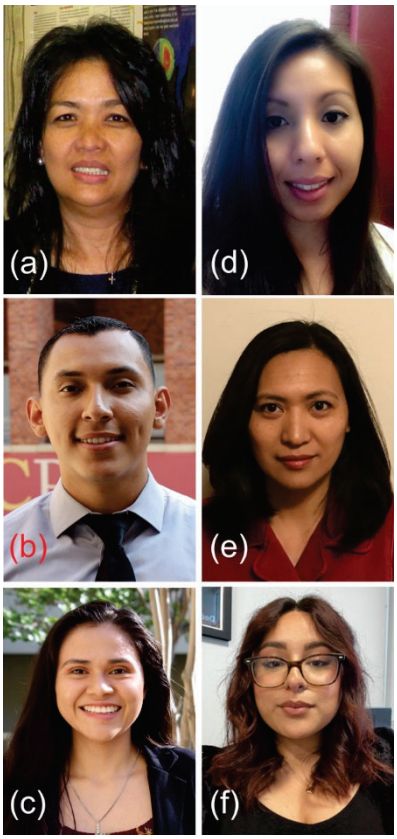
(c) Ms. **Prisila Vasquez** (OHE-500U; tel. 213-764-7919; prisilac@usc.edu); ASTE's Student Services Assistant Director.

(d) Ms. **Linda Ly** (OHE-530B; tel. 213-740-7228; lylinda@usc.edu); Associate Research Administrator supports research grants and contracts.

(e) Ms. **Marlyn Lat** (OHE-500V; tel. 213-740-4009; marlynlat@usc.edu); Budget and Business Analyst supports business and budget administration.

(f) Ms. **Shaya Olivares** (OHE-500S; tel. 213-740-5695; shanyaol@usc.edu), Administrative Assistant supports administrative operations.

Luis and Prisila are the first contacts for students on questions regarding class registration, schedule, and admission to programs in astronautics. Before your inquiries, check MS ASTE's frequently asked questions at http://astronauticsnow.com/msaste/faq.html.



ASTE Staff
(a) Dell Cuason; (b) Luis Saballos; (c) Prisila Vasquez; (d) Linda Ly, (e) Marlyn Lat; (f) Shanya Olivares

7) Please find below

Ad Astra,

Mike Gruntman
Professor of Astronautics
Director, *MS in Astronautical Engineering*

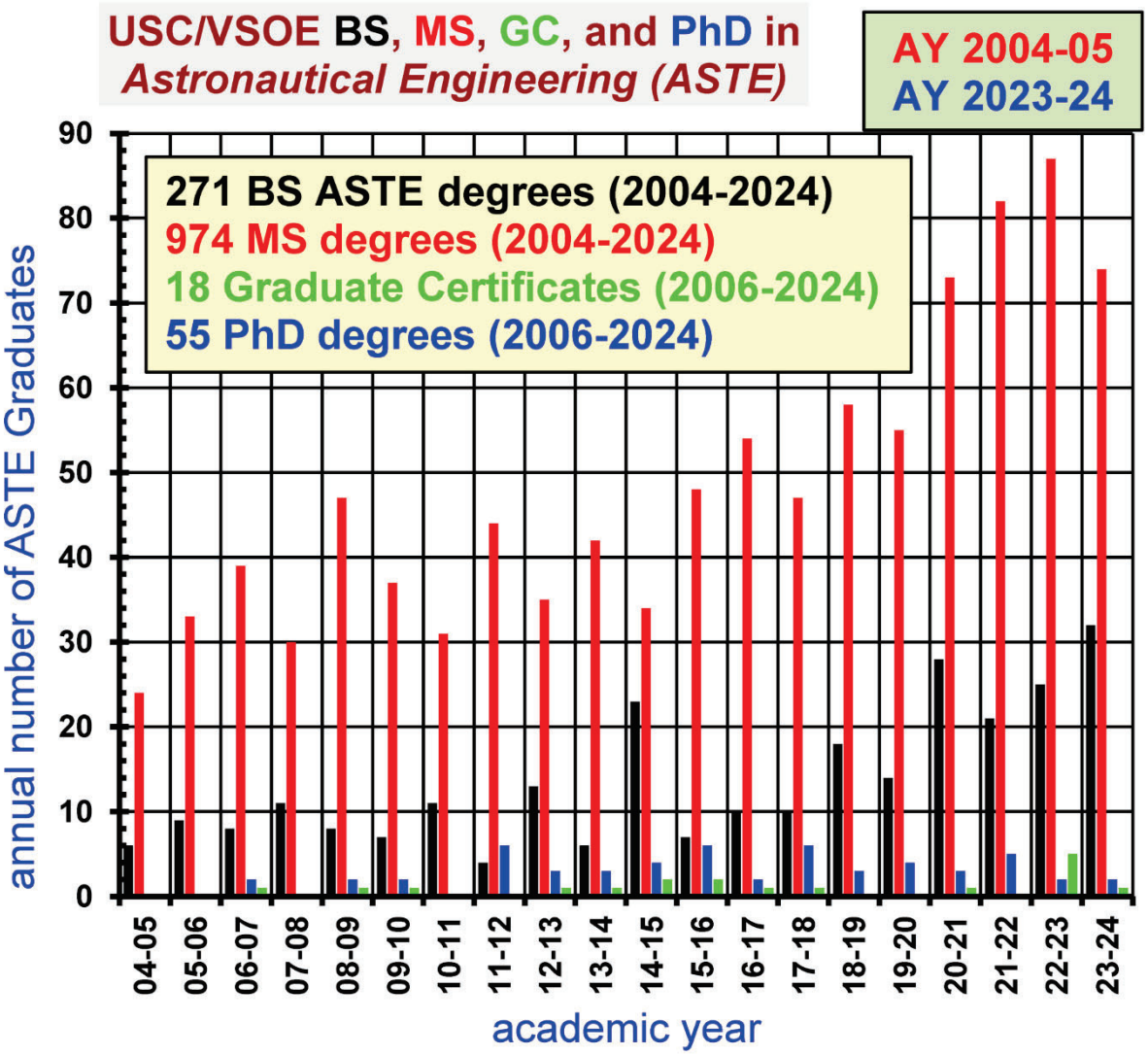
P.S. We amend our motto on reaching the stars as government and university regulations are becoming more and more bureaucratic, burdensome, and restrictive rather than inspirational and helpful.

Per aspera (et statuta) ad astra!

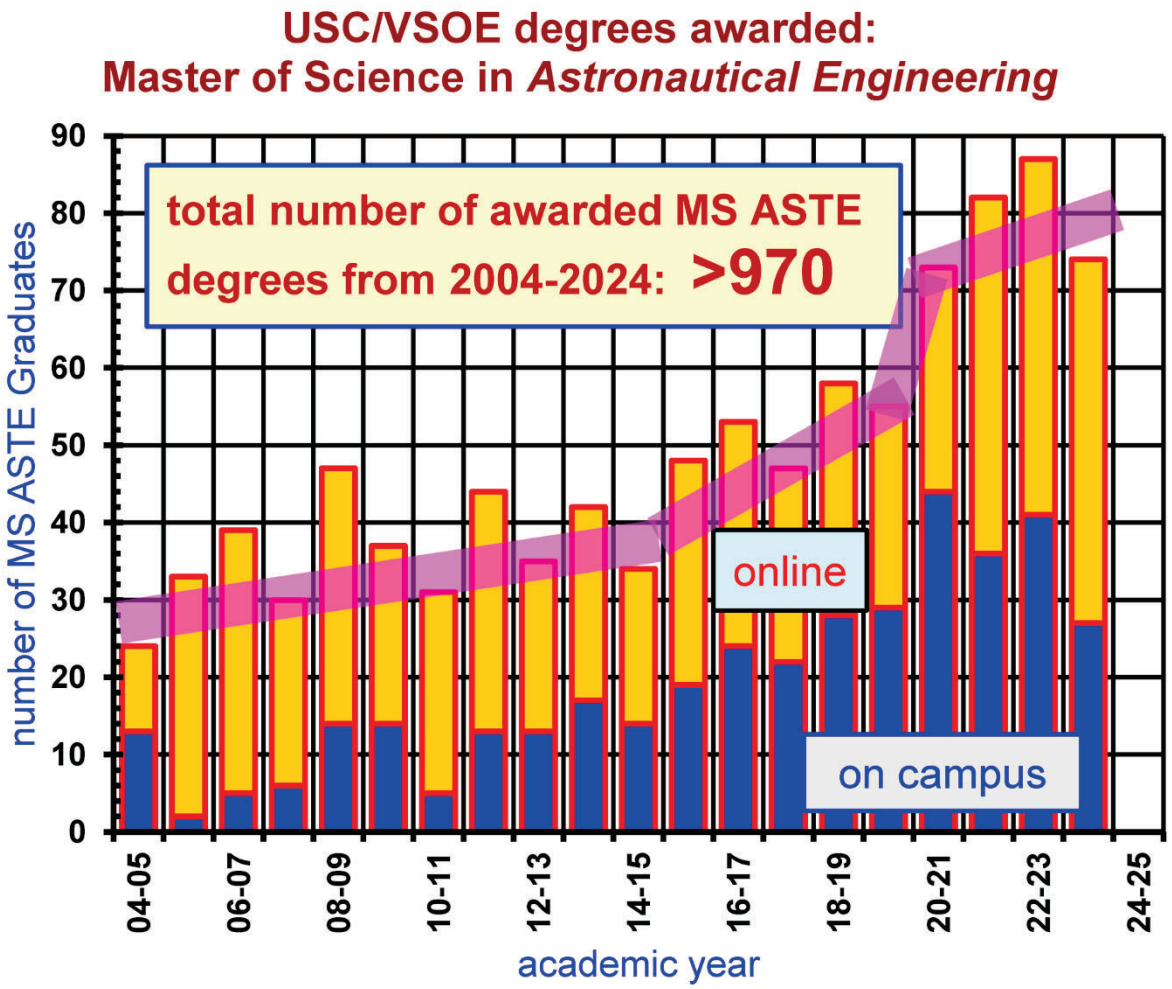
Through difficulties (and [unfortunately burdensome] regulations) to the stars!

Degrees in Astronautical Engineering – Statistics

Since its founding in 2004, the Astronautical Engineering Department offers the full set of degrees in *Astronautical Engineering* (ASTE) – see figure below.



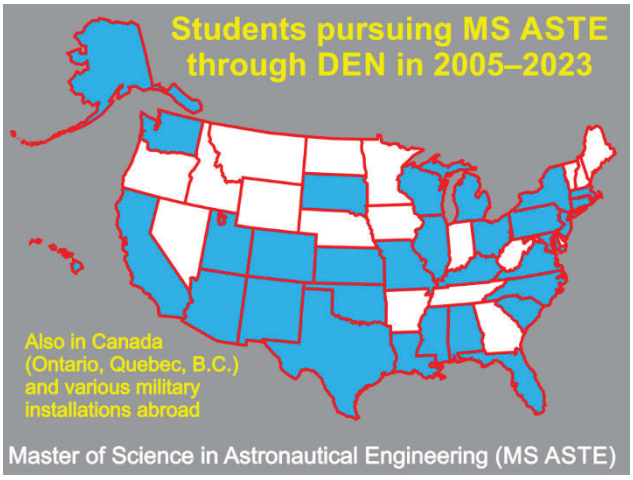
From AY 2004-2005 to AY 2023-2024, the Department has awarded more than **270** Bachelor of Science degrees, more than **970** Master of Science degrees, **55** PhD degrees, and **18** Graduate Certificates.



The Master of Science in Astronautical Engineering (MS ASTE) program awarded **more than 970** degrees from 2004-2024.

Full-time on-campus students earn now about one-half of the degrees. Online students account for the other half of the students.

The program reaches students all over the United States and Canada as well as at military installations at home and abroad through Viterbi's Distance Education Network (DEN).



MS ASTE flagship class, *Spacecraft Systems Design* (ASTE 520) More than **2400** graduate students enrolled in ASTE-520 since 1994.

USC Master of Science in Astronautics MS ASTE

National Standing

Latest available statistics

The statistics by the American Society for Engineering Education (ASEE) do not capture the separate numbers of awarded degrees in space-focused engineering. Therefore, one can only compare USC's MS ASTE program with other Master's programs in the broad aerospace-related field dominated by non-space areas.

One can only speculate how our program would have ranked in size if only space-engineering specializations were counted—clearly, it is among the largest.

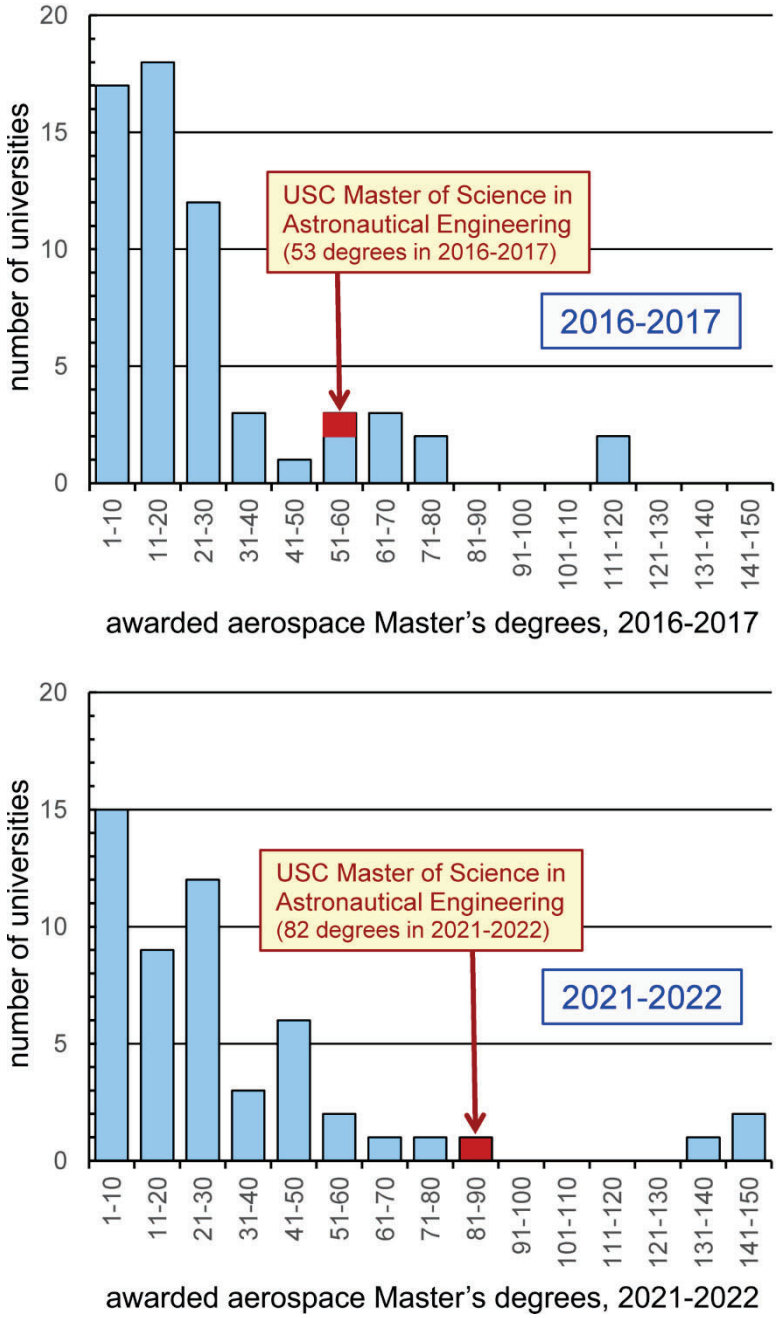
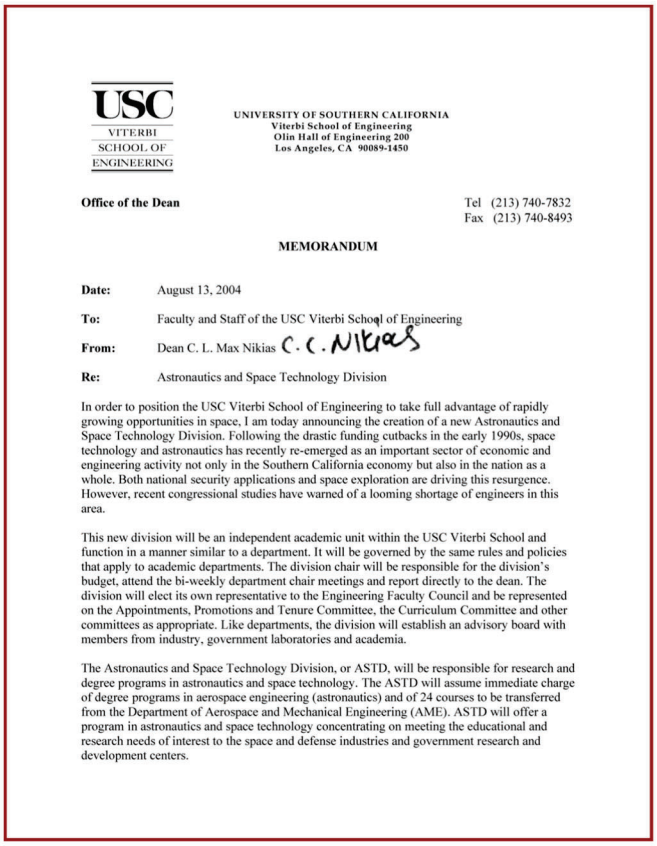


Figure. Distribution of the numbers of Master of Science degrees awarded by U.S. universities (that is sizes of Master's aerospace programs) in the broad aerospace area in the United States in academic years (top) 2016-2017 and (bottom) 2021-2022. The USC's M.S. ASTE program advanced from sharing the eighth and ninth places in size in 2016-2017 to the fourth pace in 2021-2022.

Figure and text: http://astronauticsnow.com/2024aste.pdf

20th Anniversary – Founding ASTE at USC

The University of Southern California established the new Department first as the Astronautics and Space Technology Division on August 13, 2004. From day one, the new academic unit operated as an independent department and introduced the full set of degree programs in Astronautical Engineering. The University formally renamed it the Department of Astronautical Engineering in 2010.



USC VITERBI SCHOOL OF ENGINEERING

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Office of the Dean

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MEMORANDUM

Date: August 13, 2004

To: Faculty and Staff of the USC Viterbi School of Engineering

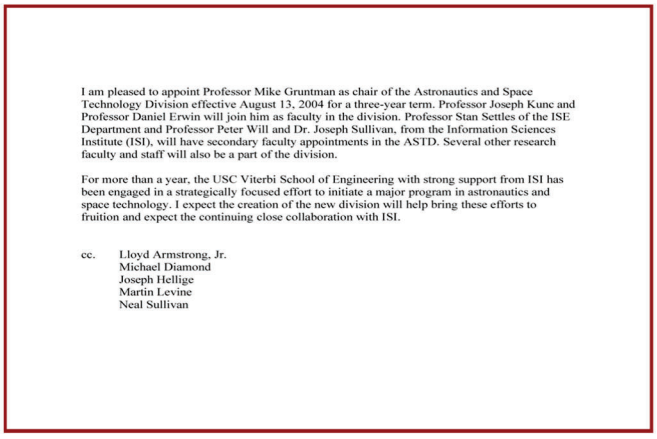
From: Dean C. L. Max Nikias C. C. Nikias

Re: Astronautics and Space Technology Division

In order to position the USC Viterbi School of Engineering to take full advantage of rapidly growing opportunities in space, I am today announcing the creation of a new Astronautics and Space Technology Division. Following the drastic funding cutbacks in the early 1990s, space technology and astronautics has recently re-emerged as an important sector of economic and engineering activity not only in the Southern California economy but also in the nation as a whole. Both national security applications and space exploration are driving this resurgence. However, recent congressional studies have warned of a looming shortage of engineers in this area.

This new division will be an independent academic unit within the USC Viterbi School and function in a manner similar to a department. It will be governed by the same rules and policies that apply to academic departments. The division chair will be responsible for the division's budget, attend the bi-weekly department chair meetings and report directly to the dean. The division will elect its own representative to the Engineering Faculty Council and be represented on the Appointments, Promotions and Tenure Committee, the Curriculum Committee and other committees as appropriate. Like departments, the division will establish an advisory board with members from industry, government laboratories and academia.

The Astronautics and Space Technology Division, or ASTD, will be responsible for research and degree programs in astronautics and space technology. The ASTD will assume immediate charge of degree programs in aerospace engineering (astronautics) and of 24 courses to be transferred from the Department of Aerospace and Mechanical Engineering (AME). ASTD will offer a program in astronautics and space technology concentrating on meeting the educational and research needs of interest to the space and defense industries and government research and development centers.



I am pleased to appoint Professor Mike Gruntman as chair of the Astronautics and Space Technology Division effective August 13, 2004 for a three-year term. Professor Joseph Kunc and Professor Daniel Erwin will join him as faculty in the division. Professor Stan Settles of the ISE Department and Professor Peter Will and Dr. Joseph Sullivan, from the Information Sciences Institute (ISI), will have secondary faculty appointments in the ASTD. Several other research faculty and staff will also be a part of the division.

For more than a year, the USC Viterbi School of Engineering with strong support from ISI has been engaged in a strategically focused effort to initiate a major program in astronautics and space technology. I expect the creation of the new division will help bring these efforts to fruition and expect the continuing close collaboration with ISI.

cc. Lloyd Armstrong, Jr.
Michael Diamond
Joseph Hellige
Martin Levine
Neal Sullivan

In his memo (left) in 2004, then Dean of Engineering, and now USC President, Prof. Max Nikias wrote:

In order to position the USC Viterbi School of Engineering to take full advantage of rapidly growing opportunities in space, I am today announcing the creation of a new Astronautics and Space Technology Division. Following the drastic funding cutbacks in the early 1990s, space technology and astronautics has recently re-emerged as an important sector of economic and engineering activity not only in the Southern California economy but also in the nation as a whole. Both national security applications and space exploration are driving this resurgence ...

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More about the history, rationale, and focus of ASTE in an article in *Acta Astronautica*, 103, 92-105, 2014 at http://dx.doi.org/10.1016/j.actaastro.2014.06.016 or http://astronauticsnow.com/2014aste.pdf .

Ten Year Ago on the 10th Anniversary of ASTE

On the occasion of the 10th anniversary of the **Department of Astronautical Engineering**, USC President Professor Max Nikias met with Astronautics faculty and staff on January 13, 2015.

In President's office: left-to-right USC President Professor Max Nikias, Professor Mike Gruntman, Professor Joseph Wang, Professor Joseph Kunc, ASTE business manager Ms. Dell Cuason (who had served in this position from the first days of the department), Professor Daniel Erwin, Dean of Engineering Professor Yannis Yortsos.

USC Astronautics program history, focus, rationale, and organization

Acta Astronautica
Advanced degrees in astronautical engineering for the space industry,
v. 103, 92–105, 2014

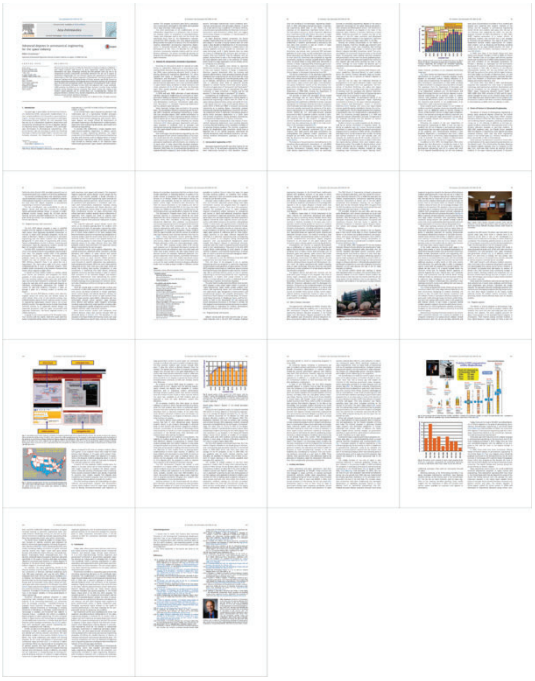
https://doi.org/10.1016/j.actaastro.2014.06.016

Article download
http://astronauticsnow.com/2014aste.pdf

Journal of Space Safety Engineering
Master of Science in Astronautical Engineering degree at the University of Southern California for the space industry,
v. 11, 2024

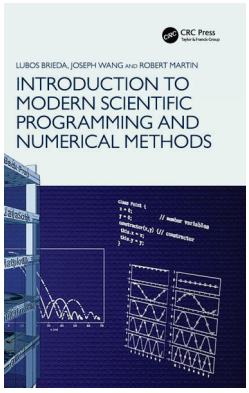
https://doi.org/10.1016/j.jsse.2024.07.007

Article download
http://astronauticsnow.com/2024aste.pdf



Other publications about the program – http://astronauticsnow.com/aste.pdf

Recent Books by Astronautics Instructors

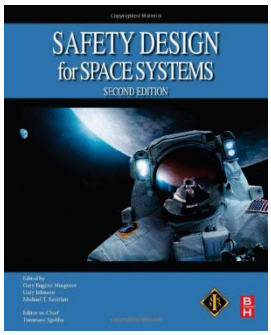


Lubos Brieda, Joseph Wang, Robert Martin

Introduction to Modern Scientific Programming and Numerical Methods Example

CRC Press, 2024

ISBN 978-0367671914 (hardcover)

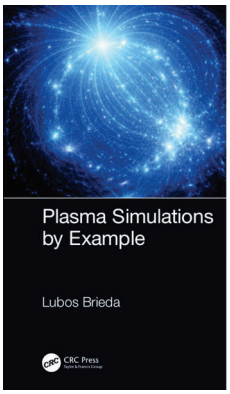


Editors: T. Sgobba, G. E. Musgrave, G. Johnson, and Michael Kezirian (ASTE)

Safety Design for Space Systems (2nd edition)

Butterworth-Heinemann, 2023 (1188 pages)

ISBN 978-0323956543



Lubos Brieda

Plasma Simulations by Example

CRC Press, 2021

ISBN 978-1032176147 (paperback)

Don Edberg and Willie Costa

Design of Rockets and Space Launch Vehicles

AIAA, 2020

ISBN 978-1624105937

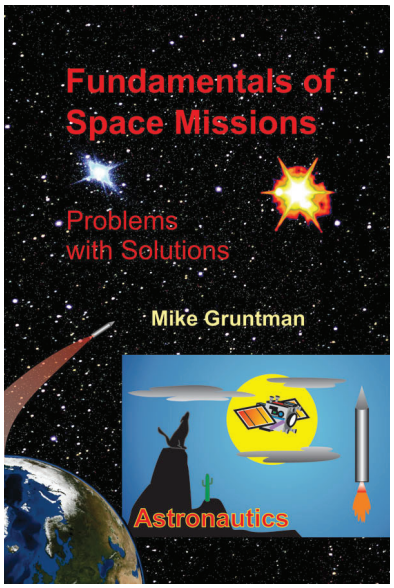
Recent Books by Astronautics Instructors

Fundamentals of Space Missions:

Problems with Solutions

Mike Gruntman

Interstellar Trail Press, 2022



ISBN 979-8985668742 478 pages with 175+ figures

160+ typical homework and exam problems that *were* given, *could* have been given, or *should* have been given (had the time allowed) in ASTE-520.

Complete list of problems at http://astronauticsnow.com/fsm2022/

Books by Astronautics faculty and instructors

USC Astronautics at IAC in Milan (Oct. 2024)

The **75th International Astronautical Congress (IAC)** in Milan, Italy October 14-18, 2024) attracted more than **11,200 participants from 120 countries**. They included nearly twenty *USC Astronautics* students (and many former students).

Liquid Propulsion Laboratory (LPL) students at IAC.

Left to right: **Tolou Pharokhipanah**, **Seb Bouckenooghe**, Mike Gruntman, **Rohin Pathak**, **Connor Zook**, **Nikki Swensen**.

Former USC Astronautics students **Nick Orenstein** and **Adarsh Rajguru**.

USC Astronautics at IAC in Milan (Oct. 2024)

Astronautics PhD Student **Ulubilge Ulusoy** was selected as one of the final six finalists for the prestigious *Young Pioneer Award* of the International Astronautical Federation (IAF). The award is given to a young scientist below 30 years of age who has contributed significantly to the advancement of aerospace science.

Photo: **Ulu** (left) next to IAF President Clay Mowry and IAF Executive Director Christian Feichtinger. (Photo credit: IAF)

Astronautics PhD student **Kristina Andreyeva**

The Space Show – Resource for Students

The Space Show has been on the air for more than 20 years and it is heard in more than 50 countries around the world.

http://thespaceshow.com

The host and USC Astronautics supporter, **Dr. David Livingston** (right), broadcasts a few times each week. In contrast to many radio talk shows, the discussions with guests last 1.5 hours or longer which allows for in-depth coverage of various topics.

This is one of the best informative and educational programs on the radio that brings problems and challenges of our vast space enterprise to a diverse audience of listeners across the globe. Stellar guest specialists discuss policies and politics; science, technologies, and education; entrepreneurial endeavors and innovations; and "new" and "legacy" space.

The Space Show focuses on timely and important issues influencing the development of outer-space commerce, space tourism, space exploration, and space development. The Space Show is committed to facilitating our becoming a space-faring nation and society with a growing and self-sustaining space-faring economy.

While the Space Show primarily focuses on the “new” space ventures, it also covers traditional areas of the space enterprise. Many leading specialists including former NASA administrators, top scientists and technologists, space entrepreneurs, authors, and leaders of space advocacy groups were among its guests. **The list also includes at least six USC Astronautics (ASTE) instructors.**

All shows – **more than 4000** – are archived and conveniently accessible through Show’s flashy website **http://thespaceshow.com**. One can search for various topics and guests, download mp3 files (usually 30-50MB), and listen on computers or other devices. Many listen to programs live on the Internet and call in with questions.

The Space Show is a great resource for Astronautics students.

Schedule of Astronautics Courses

When you plan your coursework, please always check in advance with the ASTE Student Adviser about the availability of the chosen courses.

While we carefully plan our course offerings, it is the Dean's Office that makes the final scheduling decision. Then, there is a challenge of the availability of DEN studios. You may call it, using the language of physics and mathematics, the "boundary conditions" or "constraints." Also, sometimes our instructors from industry and government centers cannot offer scheduled courses due to work-related or personal emergencies.

We try to minimize such occurrences, but they are outside our direct control. Please always check in advance with the ASTE Student Adviser about the availability of the chosen courses.

Special arrangements for some courses in
the **spring, summer, and fall semesters of 2025** (subject to change)

Spring 2025

We offer for the first time one new course, **ASTE 599 Contamination Control of Space Systems and Planetary Protection** (instructor Dr. Lubos Brieda).

Another ASTE 599 course, **ASTE 599 Safety of Space Operations** (instructor Prof. Michael Kezirian), is offered again this semester.

Summer 2025

ASTE 580 Orbital Mechanics I
Offered in the summer semester.
Instructor: Prof. R. Park (JPL)

ASTE-599 Contamination Control of Space Systems and Planetary Protection

Spring 2025

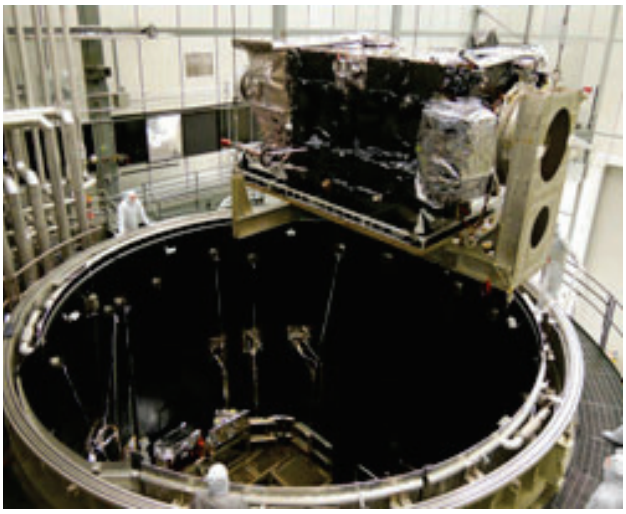
Overview:

The familiar “new car” smell arises from the outgassing of volatile gases out of plastic (organic) materials making up the car interior. Similar process occurs on spacecraft.

Molecular contaminants diffuse out of electronic boards or adhesives and subsequently deposit on sensitive surfaces such as telescope lenses or thermal surfaces, leading to a degraded mission performance. Other contaminants include water vapor, dust particulates, lunar regolith, and biological burden.

This course provides a comprehensive engineering review of contamination control of space systems and planetary protection. Students will learn about contaminant characterization, contamination impact on spacecraft components, material science and polymer chemistry, contaminant sources, mitigation strategies, contamination budgets and I&T cleanliness requirements, purging, thermal vacuum bakeouts, launch site processing, and contamination transport analysis.

Topics:



- Contamination sources
- Impact of contamination on sensitive surfaces
- Contamination control plans
- Spacecraft integration and test
- Cleanrooms and gowning protocols
- Contamination quantification
- Mechanical and acoustic testing
- Thermal vacuum bakeouts
- Scavenger plates and QCM data analysis
- Planetary protection and surface sterilization
- Transport and bagging
- Launch site processing
- Polymer chemistry, diffusion
- Molecular transport
- Spacecraft charging and photoionization
- Lunar regolith and orbital debris

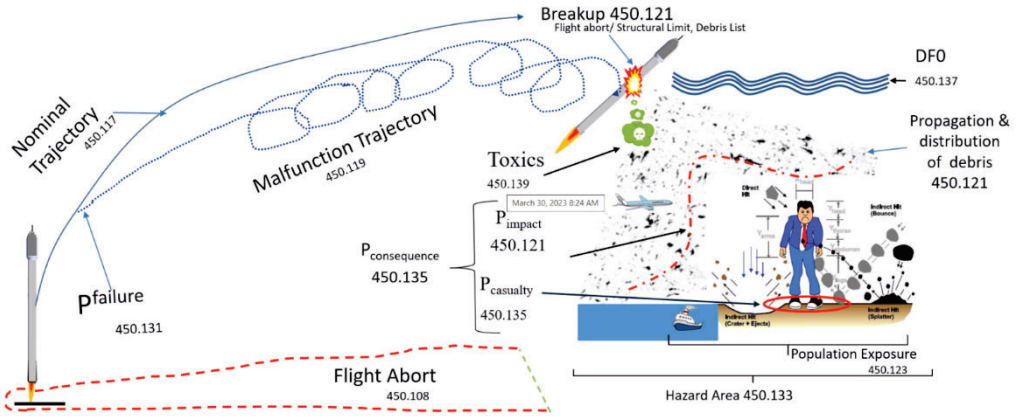
Supplemental reading: A. Tribble, Fundamentals of Contamination Control, SPIE, 2000.

Instructor: Dr. Lubos Brieda, PIC-C and USC (brieda@usc.edu)

ASTE 599 *Safety of Space Operations*

Spring 2024 Scientific and engineering fundamentals of safety of space operations

The course focuses on the risks of spacecraft and launch vehicle operations, the regulatory requirements for managing these risks, and the technology to implement the risk management regime. The course begins with the Scientific and engineering fundamentals of the operation of space activities.



The first part of the course explores on-orbit risk management. It considers environmental hazards, specifically the threats posed by micrometeoroid and orbital debris. It also explores key issues of space traffic management and space situational awareness, critical to the operation of spacecraft and constellations of spacecraft working collectively.

The second part of the course addresses launch and reentry risks. It begins with introducing the engineering bas ics associated with understanding, analyzing, and managing these risks. Important elements include understanding risk measures, risk drivers and the levels of fidelity of data development and analysis that may be required in order to ensure operations are “safe-enough”. The course considers sources of risks (normal vehicle operations, vehicle malfunctions), resulting hazards (debris – inert and explosive), populations and assets at risk, propagation of hazards to populations at risk, quantifying risk and designing risk mitigation strategies, as needed.

Topics

- **Mission Operations of Spaceport and On-Orbit Operations**
- **Orbital Environment**
  - Space Surveillance
  - Conjunction Assessment
  - Collision Avoidance Maneuvers
- **Considerations for Operations of Mega-Constellations**
- **Space Traffic Management / Space Situational Awareness**
- **Launch & Reentry**
  - Flight Safety Analysis Risk Acceptability
  - Impact Dispersions of Normal and Malfunctioning Vehicles Risk Analysis and Reentry Risk
  - Range Safety Risk Management

Course notes, NASA and FAA Documents will be provided to students.

Recommended reading material

F. A. Allahdadi, I. Rongier, and P. D. Wilde, Safety Design for Space Operations, 2013

Lead instructor: Prof. Michael Kezirian, IAASS, kezirian@usc.edu

Instructors of *Astronautics* courses in Spring 2025 (alphabetically)

Dr. Lubos Brieda (PIC-C)

ASTE 599
Contamination Contr. Space Sys. & Planet. Protection

Prof. Michael Kezirian (IAASS)

ASTE 599
Safety of Space Operation

Prof. Don Edberg (Cal Poly Pomona)

ASTE 574
Space Launch Vehicle Design

Steve Lapen (Northrop Grumman)

Co-Instructor
ASTE 584
Spacecraft Power Systems

Prof. Keith Goodfellow (Aerojet Rocketdyne)

ASTE 572
Advanced Spacecraft Propulsion

Dr. David E. Lee (Northrop Grumman)

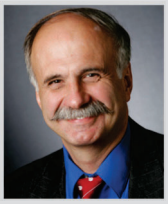
Co-Instructor
ASTE 584
Spacecraft Power Systems

Dr. Troy Goodson (Jet Propulsion Laboratory)

ASTE 586
Spacecraft Attitude Dynamics

Prof. Ryan Park (JPL)

ASTE 580
Orbital Mechanics I



Prof. Mike Gruntman (USC)

ASTE 575
Rocket and Spacecraft Propulsion

Dr. G. P. Purohit (The Aerospace Corp.)

ASTE 570
Liquid Rocket Propulsion

Instructors of *Astronautics* courses in Spring 2025 (alphabetically; cont.)

Prof. Garrett Reisman
(Univ. of Southern California

ASTE 562
Spacecraft Life Support Systems

Prof. James Wertz
(Microcosm)

ASTE 523
Design of Low Cost Space Missions

Madhu Thangavelu
(AAA Visioneering)

ASTE 527
Space Studio Architecting

Prof. Joseph Wang
(Univ. of Southern California)

ASTE 535
Space Environments and Spacecraft Interactions

University of Southern California

Department of Astronautical Engineering (ASTE)

Astronautics Classes offered in the spring semester, 2025

Core Requirements

ASTE 535 (3)	–	Space Environment and SC Interactions	campus-and-DEN
Instructor:		**Prof. Joseph Wang** (USC)	
ASTE 575 (3)	–	Rocket and Spacecraft Propulsion	campus-and-DEN
Instructor:		**Prof. Mike Gruntman** (USC)	
ASTE 580 (3)	–	Orbital Mechanics I	campus-and-DEN
Instructor:		**Prof. Ryan Park** (Aerospace Corp.)	

Core Elective and Elective Requirements

ASTE 523 (3)	–	Design of Low Cost Space Missions	
Instructor:		**Prof. James Wertz** (Microcosm)	DEN-webcast
ASTE 527 (3)	–	Space Exploration Architect Concept Studio	campus-and-DEN
Instructor:		**Madhu Thangavelu** (AAA Vis) limited enrollm (6 on-camp + 6 online)	
ASTE 562 (3)	–	Spacecraft Life Support Systems	
Instructor:		**Prof. Garrett Reisman** (USC)	campus-and-DEN
ASTE 570 (3)	–	Liquid Rocket Propulsion	campus-and-DEN
Instructor:		**Dr. G. P. Purohit** (Aerospace Corp.)	
ASTE 572 (3)	–	Advanced Spacecraft Propulsion	campus-and-DEN
Instructor:		**Prof. Keith Goodfellow** (Aerojet Rocketdyne)	
ASTE 574 (3)	–	Space Launch Vehicle Design	campus-and-DEN
Instructor:		**Prof. Don Edberg** (Cal Poly Pomona)	
ASTE 584 (3)	–	Spacecraft Power Systems	campus-and-DEN
Instructors:		**Steve Lapen and Dr. David E. Lee** (NGC)	
ASTE 586 (3)	–	Spacecraft Attitude Dynamics	DEN-webcast
Instructor:		**Dr. Troy Goodson** (JPL)	
ASTE 599 (3)	–	Safety of Space Operations	DEN-webcast
Lead Instructor:		**Prof. Michael Kezirian** (IAASS)	
ASTE 599 (3)	–	Contamin. Contr. Space Sys.& Planet. Protec.	campus-and-DEN
Instructor:		**Dr. Lubos Brieda** (PIC-C)	

The schedule is preliminary – always check with the student adviser. For more information on the *Master of Science* degree program in *Astronautical Engineering* (MS ASTE) please check http://gapp.usc.edu/graduate-programs/masters/astronautical-engineering and contact ASTE Student Services Director Mr. Luis Saballos (tel. 213–821–4234; lsaballo@usc.edu).

MS ASTE Frequently Asked Questions are at http://astronauticsnow.com/msaste/faq.html

University of Southern California

Department of Astronautical Engineering (ASTE)

Astronautics Classes offered in the summer semester, 2025

Required course

ASTE 580 (3) – Orbital Mechanics I campus-and-DEN
Instructor: **Prof. Ryan Park** (JPL)

Prof. Ryan Park
(Jet Propulsion Laboratory)

ASTE 580
Orbital Mechanics I

The schedule is preliminary – always check with the student adviser. For more information on the *Master of Science* in *Astronautical Engineering* (MS ASTE) program please check https://viterbigradadmission.usc.edu/programs/masters/msprograms/astronautical-engineering/ and contact ASTE Senior Administrator Ms. Dell Cuason (OHE–500U; tel. 213–821–5817; cuason@usc.edu) or ASTE Student Services Director Mr. Luis Saballos (OHE–500Q; tel. 213–821–4234; lsaballo@usc.edu).
MS ASTE Frequently Asked Questions are at http://astronauticsnow.com/msaste/faq.html.

Instructors of *Astronautics* courses in Fall 2025 (alphabetically)

University of Southern California

Dr. Mohamed Abid
(Jet Propulsion Laboratory)

ASTE 554
Spacecraft Sensors

Dr. Justin Bailey
(Space Environment Techn.)

ASTE 535
Space Environments and Spacecraft Interactions

Prof. Keith Goodfellow
(LM Aerojet Rocketdyne)

ASTE 501
Physical Gas Dynamics I

Prof. Mike Gruntman
(Univ. of Southern California)

ASTE 520
Spacecraft Systems Design

Co-instructor
to be announced

ASTE 528
Reliability of Space Systems

Instructor
to be announced

ASTE 583
Space Navigation: Principles and Practice

Co-instructor
to be announced

ASTE 528
Reliability of Space Systems

Prof. Ryan Park
(Jet Propulsion Laboratory)

ASTE 580
Orbital Mechanics I

Dr. G. P. Purohit
(The Aerospace Corp.)

ASTE 552
Spacecraft Thermal Control

Prof. Garrett Reisman
(Univ. of Southern California)

ASTE 524 ***Human Spaceflight***

Instructors of *Astronautics* courses in Fall 2025 (alphabetically; cont.)

Prof. Garrett Reisman
(Univ. of Southern California)

ASTE 561 ***Human Factors of Spacecraft Operations***

Prof. Joseph Wang
(Univ. of Southern California)

ASTE 505a
Plasma Dynamics I

Prof. Anita Sengupta
(Hyperloop)

ASTE 577
Entry and Landing Systems for Planetary Exploration

Dr. Brett Willams
(Boeing/Facebook)

ASTE 556
Spacecraft Structural Materials

Madhu Thangavelu
(AAA Visioneering)

ASTE 527
Space Studio Architecting

University of Southern California

Department of Astronautical Engineering (ASTE)

Astronautics Classes offered in the fall semester, 2025

Core Requirements

ASTE 520 (3)	–	Spacecraft System Design	campus-and-DEN
Instructor:		**Prof. Mike Gruntman** (USC)	
ASTE 535 (3)	–	Space Environment and SC Interactions	campus-and-DEN
Instructor:		**Dr. Justin Bailey** (Space Environment Techn.)	
ASTE 580 (3)	–	Orbital Mechanics I	campus-and-DEN
Instructor:		**Prof. Ryan Park** (JPL)	

Core Elective and Elective Requirements

ASTE 501a (3)	–	Physical Gas Dynamics I	campus-and-DEN
Instructor:		**Prof. Keith Goodfellow** (LM Aerojet Rocketdyne)	
ASTE 505a (3)	–	Plasma Dynamics I	campus-and-DEN
Instructor:		**Prof. Joseph Wang** (USC)	
ASTE 524 (3)	–	Human Spaceflight	campus-and-DEN
Instructor:		**Prof. Garrett Reisman** (USC)	
ASTE 527 (3)	–	Space Exploration Architect Concept Studio	campus-and-DEN
Instructor:		**Madhu Thangavelu** (AAA Vis) limited enrollm (6 on-camp + 6 online)	
ASTE 528 (3)	–	Reliability of Space Systems	campus-and-DEN
Instructors:		to be announced	
ASTE 552 (3)	–	Spacecraft Thermal Control	campus-and-DEN
Instructor:		**Dr. G.P. Purohit** (Aerospace Corp.)	
ASTE 554 (3)	–	Spacecraft Sensors	campus-and-DEN
Instructor:		**Dr. Mohamed Abid** (JPL)	
ASTE 557 (3)	–	Spacecraft Structural Strength and Materials	DEN only
Instructor:		**Dr. Robert Williams** (Boeing/Facebook)	
ASTE 561 (3)	–	Human Factors of Spacecraft Operations	campus-and-DEN
Instructor:		**Prof. Garrett Reisman** (USC) limited enrl (11 on-campus + 10 online)	
ASTE 577 (3)	–	Entry and Landing Systems for Planetary Exploration	
Instructor:		**Prof. Anita Sengupta** (Hyperloop)	campus-and-DEN
ASTE 583 (3)	–	Space Navigation: Principles and Practice	
Instructor:		to be announced	DEN-webcast

The schedule is preliminary – always check with the student adviser. For more information on the *Master of Science* degree program in *Astronautical Engineering* (MS ASTE) please check http://gapp.usc.edu/graduate-programs/masters/astronautical-engineering and contact ASTE Student Services Director Mr. Luis Saballos (tel. 213–821–4234; lsaballo@usc.edu)
MS ASTE Frequently Asked Questions are at http://astronauticsnow.com/msaste/faq.html.

Preliminary Astronautics Class Schedule (as of Oct 2024)

(subject to change – always check with *ASTE Student Adviser*)

					2024	2025	2025	2026	2026	2027	2027	2028
Required Courses					Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
ASTE 520	Spacecraft Design	1	D	R	▼		▼		▼		▼	
ASTE 535	Space Environment and Spacecraft Interactions	2	D	R	▼	▼	▼	▼	▼	▼	▼	▼
ASTE 580	Orbital Mechanics I	2	D	R	▼	▼	▼	▼	▼	▼	▼	▼
	Orbital Mechanics I		D	R	also offered in summers -- see next page							
ASTE 575	Rocket and SC Propulsion	1	D	R		▼		▼		▼		▼
Elective Courses												
ASTE 501a	Physical Gas Dynamics I	Ir	D	C			▼				▼	
ASTE 505ab	Plasma Dynamics I, II	1#		C	a		a	b-cwi	a	b-cwi	a	b-cwi
ASTE 523	Design Low Cost Sp Missions	#	D	C		▼				▼		▼
ASTE 524	Human Spaceflight	1	D	C	▼		▼		▼		▼	
ASTE 527	Space Studio Architecting	1	D	C	▼	▼	▼	tbc	▼	tbc	▼	Tbc
ASTE 528	Reliability of Space Systems	#	D	C			▼				▼	
ASTE 529	Safety Space Sys. & Missions	#	D	C				▼				▼
ASTE 546	Comp. Plasma Dynamics	#	N	E				cwi		cwi		cwi
ASTE 552	Spacecraft Thermal Control	#	D	C			▼				▼	
ASTE 553	Sys Remote Sensing Space	#	D	C	▼				▼			
ASTE 554	Spacecraft Sensors	#	D	C			▼				▼	
ASTE 555	Space Cryogenic Sys & Applic	#	D	C		see next page						
ASTE 556	SC Structural Dynamics	#	D	C	▼				▼			
ASTE 557	SC Structural Materials	#	D	C			▼				▼	
ASTE 561	Human Factors Spacecraft Ops	1	D	C	▼		▼		▼		▼	
ASTE 562	Spacecraft Life Support Sys	1	D	C		▼		▼		▼		▼
ASTE 566	Ground Comm Satellite Ops	1	D	C				▼		▼		▼
ASTE 570	Liquid Rocket Propulsion	1	D	C		▼		▼		▼		▼
ASTE 571	Solid Rocket Propulsion	#	D	C	▼				▼			
ASTE 572	Advanced SC Propulsion	1	D	C		▼		▼		▼		▼
ASTE 574	Space Launch Vehicle Design	1	D	C		▼		▼		▼		▼
ASTE 577	Entry & Landing Planet. Sys.	1	D	C	▼		▼		▼			
ASTE 581	Orbital Mechanics II	1	D	C				▼		▼		▼
ASTE 583	Space Navigation	#	D	C			▼				▼	
ASTE 584	SC Power Systems	1	D	C		▼		▼		▼		▼
ASTE 585	SC Attitude Control	1	D	C		offered in summers -- see next page						
ASTE 586	SC Attitude Dynamics	#	D	C		▼				▼		
ASTE 589	Solar System Navigation	#	D	C	▼							
ASTE 599	Safety of Space Operations	#	D	E		▼				▼		
ASTE 599	to be announced			E								
ASTE 683	Adv. Spacecraft Navigation	Ir	D	E		see next page						

See the next page

Required course in spacecraft propulsion

ASTE-575 has replaced ASTE-470 as a required course for MS ASTE.
If you have taken ASTE-470, then there is no need for ASTE-575.
(ASTE-470 duplicates the credit for ASTE-575).

Courses in summer

					2025 summer	2026 summer	2027 summer	2028 summer
Required Courses								
ASTE 580	Orbital Mechanics I	2	D	R	▼	▼	▼	▼
Elective Courses								
ASTE 585	Spacecraft Attitude Control	1	D	C		tbc	tbc	tbc

Courses listed but not offered (due to availability of instructors)

Elective Courses												
ASTE 555	Space Cryogenic Sys & Applic	#	D	C								
ASTE 683	Advanced Spacecraft Navigation		D	E								

Table notation

SC = spacecraft
2 = course offered in both fall and spring each year
1 = course offered each year
# = course offered every second year
Ir = course offered irregularly
▼ = planned (subject to School approval)
tbc = to be confirmed

R = required MS ASTE
C = core elective MS ASTE
E = technical elective
D = webcast through DEN
N = on campus; not available through DEN
? = uncertain, check with the ASTE Student Adviser
cwi = check with the instructor directly

The course schedule is subject to change. Please check with ASTE Student Adviser.

Master of Science in Astronautical Engineering

This degree is in the highly dynamic and technologically advanced area of astronautics and space technology. The program is designed for those with B.S. degrees in science and engineering who work or wish to work in the space sector of the defense/aerospace industry, government research and development centers and laboratories and academia. The program is available through the USC Distance Education Network (DEN).

The general portion of the Graduate Record Examinations (GRE) and two letters of recommendation are required.

Required courses: 27 units

CORE REQUIREMENT (12 units)		**Units**
ASET 575	Spacecraft Propulsion	3
ASTE 520	Spacecraft System Design	3
ASTE 535	Space Environment and Spacecraft Interactions	3
ASTE 580	Orbital Mechanics I	3

CORE ELECTIVE REQUIREMENT (9 units - choose three courses)		**Units**
ASTE 501ab	Physical Gas Dynamics	3-3
ASTE 505ab	Plasma Dynamics	3-3
ASTE 523	Design of Low Cost Space Missions	3
ASTE 524	Human Spaceflight	3
ASTE 527	Space Exploration Architectures Studio	3
ASTE 528	Reliability of Space Systems	3
ASTE 529	Safety of Space Systems and Space Missions	3
ASTE 552	Spacecraft Thermal Control	3
ASTE 553	Systems for Remote Sensing from Space	3
ASTE 554	Spacecraft Sensors	3
ASTE 555	Space Cryogenic Systems and Applications	3
ASTE 556	Spacecraft Structural Dynamics	3
ASTE 557	Spacecraft Structural Strength and Materials	3
ASTE 561	Human Factors of Spacecraft Operations	3
ASTE 562	Spacecraft Life Support Systems	3
ASTE 566	Ground Communications for Satellite Operations	3
ASTE 570	Liquid Rocket Propulsion	3
ASTE 571	Solid Rocket Propulsion	3
ASTE 572	Advanced Spacecraft Propulsion	3
ASTE 574	Space Launch Vehicle Design	3
ASTE 577	Entry and Landing Systems for Planetary Surface Exploration	3
ASTE 581	Orbital Mechanics II	3
ASTE 583	Space Navigation: Principles and Practice	3

ASTE 584	Spacecraft Power Systems	3
ASTE 585	Spacecraft Attitude Control	3
ASTE 586	Spacecraft Attitude Dynamics	3
ASTE 589	Solar System Navigation	3

TECHNICAL ELECTIVE REQUIREMENT (6 Units)

Two 3-unit courses. Students are advised to select these two elective courses from the list of core electives or from other courses in astronautical engineering or from other science and engineering graduate courses, as approved by the faculty adviser. No more than 3 units of directed research (ASTE 590) can be applied to the 27-unit requirement. New courses on emerging space technologies are often offered; consult the current semester's course offerings, particularly for ASTE 599 Special Topics.

At least 21 units must be at the 500 or 600 level.

Areas of concentration:

Students choose core elective and technical elective courses that best meet their educational objectives. Students can also concentrate their studies in the desired areas by selecting corresponding core elective courses. Presently, ASTE faculty suggests the following areas of concentration:

Spacecraft propulsion Choose two core electives from

ASTE 501ab	Physical Gas Dynamics	3-3
ASTE 505a	Plasma Dynamics	3
ASTE 570	Liquid Rocket Propulsion	3
ASTE 571	Solid Rocket Propulsion	3
ASTE 572	Advanced Spacecraft Propulsion	3
ASTE 574	Space Launch Vehicle Design	3
ASTE 584	Spacecraft Power Systems	3

Spacecraft dynamics Choose two core electives from

ASTE 556	Spacecraft Structural Dynamics	3
ASTE 557	Spacecraft Structural Strength and Materials	3
ASTE 581	Orbital Mechanics II	3
ASTE 583	Space Navigation: Principles and Practice	3
ASTE 585	Spacecraft Attitude Control	3
ASTE 586	Spacecraft Attitude Dynamics	3
ASTE 589	Solar System Navigation	3

Space system design Choose two core electives from

ASTE 523	Design of Low Cost Space Missions	3
ASTE 524	Human Spaceflight	3
ASTE 527	Space Exploration Architectures Studio	3
ASTE 528	Reliability of Space Systems	3
ASTE 529	Safety of Space Systems and Space Missions	3

ASTE 557	Spacecraft Structural Strength and Materials	3
ASTE 562	Spacecraft Life Support Systems	3
ASTE 574	Space Launch Vehicle Design	3
ASTE 577	Entry and Landing Systems for Planetary Surface Exploration	3

Spacecraft systems and operations

Choose two core electives from

ASTE 524	Human Spaceflight	3
ASTE 529	Safety of Space Systems and Space Missions	3
ASTE 552	Spacecraft Thermal Control	3
ASTE 553	Systems for Remote Sensing from Space	3
ASTE 554	Spacecraft Sensors	3
ASTE 555	Space Cryogenic Systems and Applications	3
ASTE 561	Human Factors of Spacecraft Operations	3
ASTE 562	Spacecraft Life Support Systems	3
ASTE 566	Ground Communications for Satellite Operations	3
ASTE 584	Spacecraft Power Systems	3

Space applications Choose two core electives from

ASTE 524	Human Spaceflight	3
ASTE 527	Space Exploration Architectures Studio	3
ASTE 553	Systems for Remote Sensing from Space	3
ASTE 554	Spacecraft Sensors	3
ASTE 555	Space Cryogenic Systems and Applications	3

Safety of Space Systems Choose two core electives from

ASTE 528	Reliability of Space Systems	3
ASTE 529	Safety of Space Systems and Space Missions	3
ASTE 561	Human Factors of Spacecraft Operations	3

Human Space Flight Choose two core electives from

ASTE 524	Human Spaceflight	3
ASTE 529	Safety of Space Systems and Space Missions	3
ASTE 561	Human Factors of Spacecraft Operations	3
ASTE 562	Spacecraft Life Support Systems	3

Note to students:

Please note that tracks, or areas of specialization (concentration), within the program do not appear in transcripts or have separate post-codes. Faculty uses tracks to advise students on different routes to the degrees meeting their educational objectives. The tracks are usually listed in the catalog to help describe the program to prospective students.

Admission Requirements for Graduate Degrees

in *Astronautical Engineering* – Code ASTE

The Department of Astronautical Engineering (ASTE) of the **USC Viterbi School of Engineering** offers degrees in **astronautical engineering**, code **ASTE**. The admission to the Master of Science degree program (MS ASTE) is based on the totality of the applicant's record which includes GPA, GRE (temporarily suspended), and two letters of recommendation.

Required items:	Send To
Application	Office of Grad. and Int'l Admission
Official Transcript(s)	Office of Grad. and Int'l Admission
General Record Exam	Office of Grad. and Int'l Admission
TOEFL (international students only)	Office of Grad. and Int'l Admission
Financial Statement	Office of Grad. and Int'l Admission
Recommendation Letters	Office of Grad. and Int'l Admission

Application

All applications should be submitted online at http://www.usc.edu/admission/graduate/apply/

Official Transcript(s)

The University requires official transcripts from the accredited colleges or universities the applicant has attended. The MS Degree Program in Astronautical Engineering (Code ASTE) requires a minimum GPA of 3.0.

USC now accepts official electronic transcripts, provided they meet the following guidelines:

1. The transcript originates from a secure site formally linked to the sending institution.

2. The school is located in the United States. We do not accept electronic transcripts from any institution overseas.

General Record Exam (temporarily suspended)

The Department of Astronautical Engineering requires the general GRE. The GRE must be taken within five years of the application date. USC's ETS school code is 4852. Applicants taking the GRE should use this code to ensure the official submission of test scores.

English Language Proficiency for International Applicants

In addition to the general admission criteria listed above, international students whose first language is not English are required to take the TOEFL or IELTS examination to be considered a candidate for admission. There is no minimum TOEFL or IELTS score required for admission to the Viterbi School. For possible exemption from additional language requirements, you must achieve an Internet Based TOEFL (iBT) score of 90, with no less than 20 on each section, or an IELTS score of 6.5, with no less than 6 on each band score.

For more details on English Proficiency Criteria for the University of Southern California, please visit https://www.usc.edu/admission/graduate/international/englishproficiency.html.

Recommendation Letters

Please provide two professional letters of reference (former instructors, supervisors, professional colleagues, advisers, etc.) to be filed through the online application process.

Mailing addresses, if needed

Office of Graduate and International Admission
University of Southern California
3601 S. Flower St, Room 112
Los Angeles, CA 90089-0915

Department of Astronautical Engineering
ASTE Graduate Program, 3650 McClintock Ave, OHE-500
University of Southern California
Los Angeles, CA 90089-1451

Department Application deadline

15 January for fall; 1 October for spring; 1 February for summer.

Please note that verification and processing of materials by the Office of Graduate and International Admission may take four to six weeks.

Limited Status Enrollment

Limited enrollment is to provide strong candidates for admission the opportunity to get started, without having to wait for the next admissions cycle. Strong candidacy is indicated by a B.S. in engineering or science from a regionally accredited institution with a GPA of 3.0 or above. Students who do not meet these standards must apply for admission where their GPA, transcripts, GRE scores, and letters of recommendation will be evaluated by admissions officers and faculty.

Limited-status students can take up to three (3) courses. These courses will be credited, after formal admission to the program, toward the Master's degree in Astronautical Engineering (MS ASTE).

Students who are interested in pursuing a graduate degree should not delay their application. We have many limited-status students in the program.

Admission

Admission decisions are based on the totality of the applicants' records, including academic performance, test scores, letters of recommendation, and other supporting materials. Applicants will be notified once an admission decision has been reached. Admitted applicants will receive further information about advisement, housing, orientations, and campus tours.

Conditional Admission

Applicants who do not meet admission qualifications may be granted conditional admission. Conditionally admitted students will be notified in writing of their admission status and of the conditions that must be satisfied to gain regular student status. Students must satisfy the admission conditions typically during the first semester of study.

Other Questions:

Please contact ASTE Senior Administrator Ms. Dell Cuason (OHE-500U; tel. 213–821–5817; cuason@usc.edu) and ASTE Student Services Director Mr. Luis Saballos (OHE-500Q; tel. 213–821–4234; lsaballo@usc.edu) and visit http://astronautics.usc.edu.

Student Transfer to Degrees

in Astronautical Engineering – Code ASTE

Transfer Process – Viterbi Engineering Students

Please refer to the VSOE change of major form and contact ASTE Student Services Director Mr. Luis Saballos (OHE-500Q; tel. 213–821–4234; lsaballo@usc.edu) for further details of the process.

Transfer Process – Non-Engineering Students

Transfer to a program in Astronautical Engineering, Code ASTE, requires a non-engineering student to file the USC application for graduate admission to the program in Astronautical Engineering. Processing of the application does not require the re-submission of supporting documents (e.g., transcripts) that have been previously submitted to USC. Check with ASTE Student Services Director Mr. Luis Saballos (OHE-500Q; tel. 213–821–4234; lsaballo@usc.edu).

Restrictions

Transfer to a program in Astronautical Engineering, Code ASTE, cannot be requested during the first semester of student studies at USC.

Questions?

Please contact ASTE Senior Administrator Ms. Dell Cuason (OHE-500U; tel. 213–821–5817; cuason@usc.edu).

GPA, Leave of Absence, and Graduation

Grade Point Average

Students must maintain an overall 3.0 GPA on 400-level and above work attempted at USC beyond the bachelor's degree to graduate. A minimum grade of C (2.0) is required in a course to receive graduate credit. Transfer units count as credit (CR) and are not calculated in the GPA.

Leave of Absence

There are times when students suspend their studies for a semester due to heavy workload or personal matters. Students must file for leave of absence within the department, and withdraw from classes before the last day to drop classes without a mark of W (see in the Schedule of Classes). Students who miss the deadline for LOA may still withdraw from classes with a mark of W but must apply for readmission to the program.

Graduation

At the beginning of the last semester, students should file an Application for a Master's Degree and contact the Student Affairs staff. This will initiate the degree check process, verifying that all academic and administrative requirements are met.

Questions?

Please contact ASTE Senior Administrator Ms. Dell Cuason (OHE-500U; tel. 213–821–5817; cuason@usc.edu) and visit http://astronautics.usc.edu.