

March 19, 2018

**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**.

1) From humble beginnings and in a record short period of time, we have grown into a major nationally-recognized space-engineering Department. The flagship Master of Science (MS ASTE) degree program reaches students all over across the United States and Canada as well as at military installations at home and abroad. Since its founding the Department awarded more than **500 Master of Science ASTE degrees** (counting in 10 Graduate Certificates) from 2004–2017. During the last 11 years, it was on average **40 Master's degrees annually** (pp. 3,4).

2) The program description in the USC catalog (beginning from August 2018) is slightly modified to reflect introduction of a few new courses.

3) ***USC Astronautics Alumni, Students, Faculty, and Friends***.

This professional networking group on **LinkedIn** was established six years ago and it has more than 600 members now.

**USC  
Astronautics**

See [http://astronauticsnow.com/astrousc\\_linkedin/](http://astronauticsnow.com/astrousc_linkedin/) .

We welcome not only our current ASTE students and alumni but also other USC students who took Astronautics graduate courses as well as friends and supporters of the program from industry, government centers, and space advocacy groups.

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



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

Please do not hesitate contacting Astronautics Business Manager Ms. **Dell Cuason** (RRB-225; tel. 213-821-5817; [cuason@usc.edu](mailto:cuason@usc.edu)) should you have any questions about the program.

Ms. **Linda Ly** (RRB-230; tel. 213-740-7228; [lylinda@usc.edu](mailto:lylinda@usc.edu)) supports business operations of the department and research grants and contracts of the faculty.

Ms. **Marlyn Lat** (RRB-232; tel. 213-740-4009; [marlynlat@usc.edu](mailto:marlynlat@usc.edu)) supports various administrative and budgetary operations of the department.

We welcome Ms. **Nicole Valdez** (RRB-223; tel. 213-821-4234; [nicoleva@usc.edu](mailto:nicoleva@usc.edu)) who joined the department in January as new Director of student affairs. Nicole is your first contact on questions regarding class registration, schedule, and admission to the programs in astronautical engineering.

Before your inquiries, check the web site with the MS ASTE frequently asked questions at <http://astronauticsnow.com/msaste/faq.html> .

**7) Please find below**

- (a) ASTE program statistics (pp. 3, 4)
- (b) ASTE program, student, and faculty news (pp. 5-8)
- (c) student resources – *The Space Show*, YouTube (pp. 9, 10)
- (d) Astronautics program classes in Summer and Fall 2018 and Spring 2019 (pp. 11-16)
- (e) long-term class schedule (page 17, 18)
- (f) catalog description (**with highlighted changes**) of MS ASTE (pp. 19-21)
- (g) admission requirements, transfer to graduate degrees in Astronautical Engineering, GPA, leave of absence, and graduation (pp. 22-25)

**Ad Astra!**



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

P.S. We have to amend our motto on reaching to the stars as government and university regulations become more and more restrictive rather than inspirational.

**Per aspera (et statuta) ad astra!**

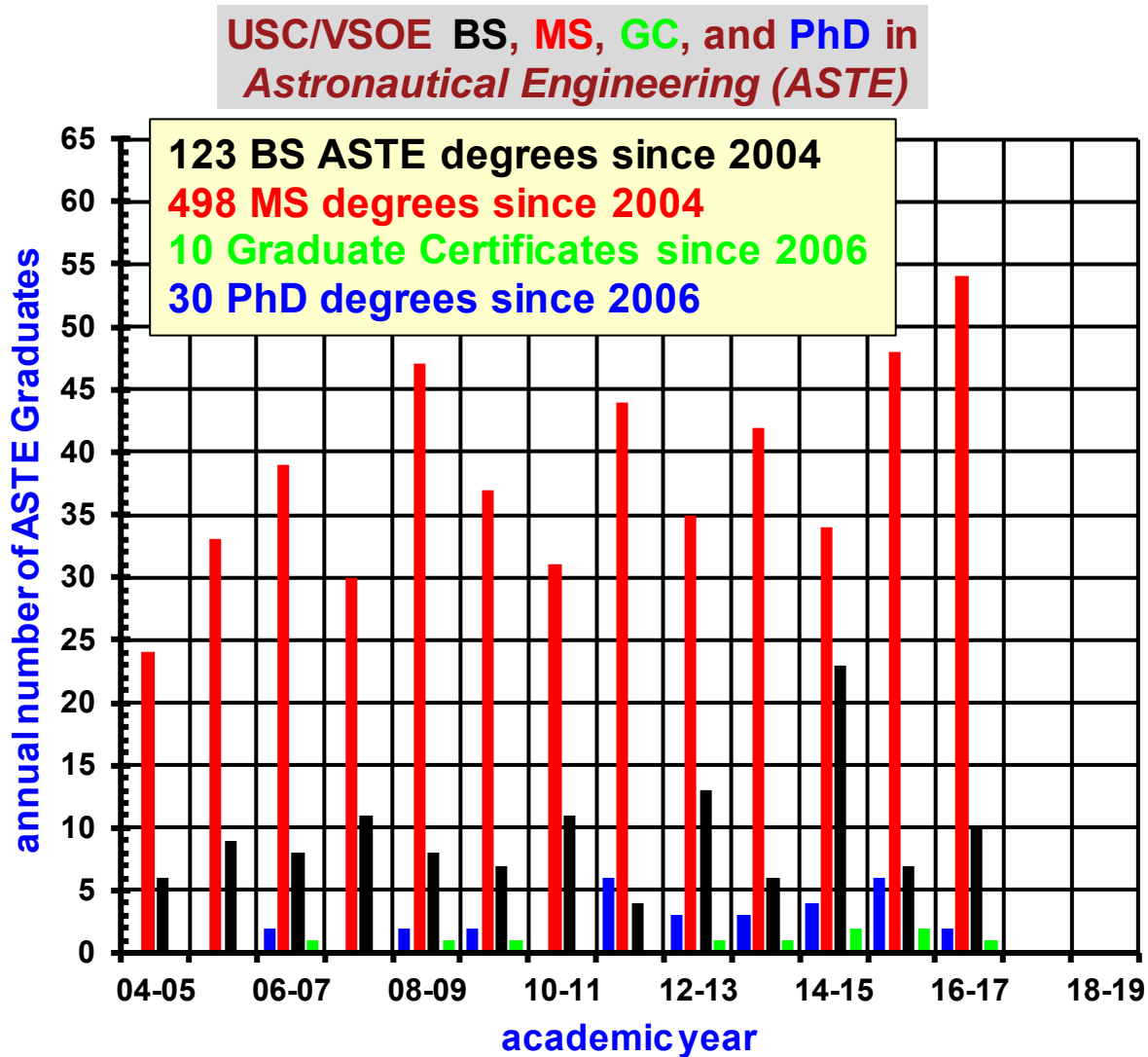
**Through difficulties (and [unfortunately] regulations) to the stars!**



**ASTE staff:**  
Dell Cuason  
(top),  
Linda Ly,  
Marlyn Lat,  
Nicole Valdez  
(bottom)

## Degrees in Astronautical Engineering – Statistics

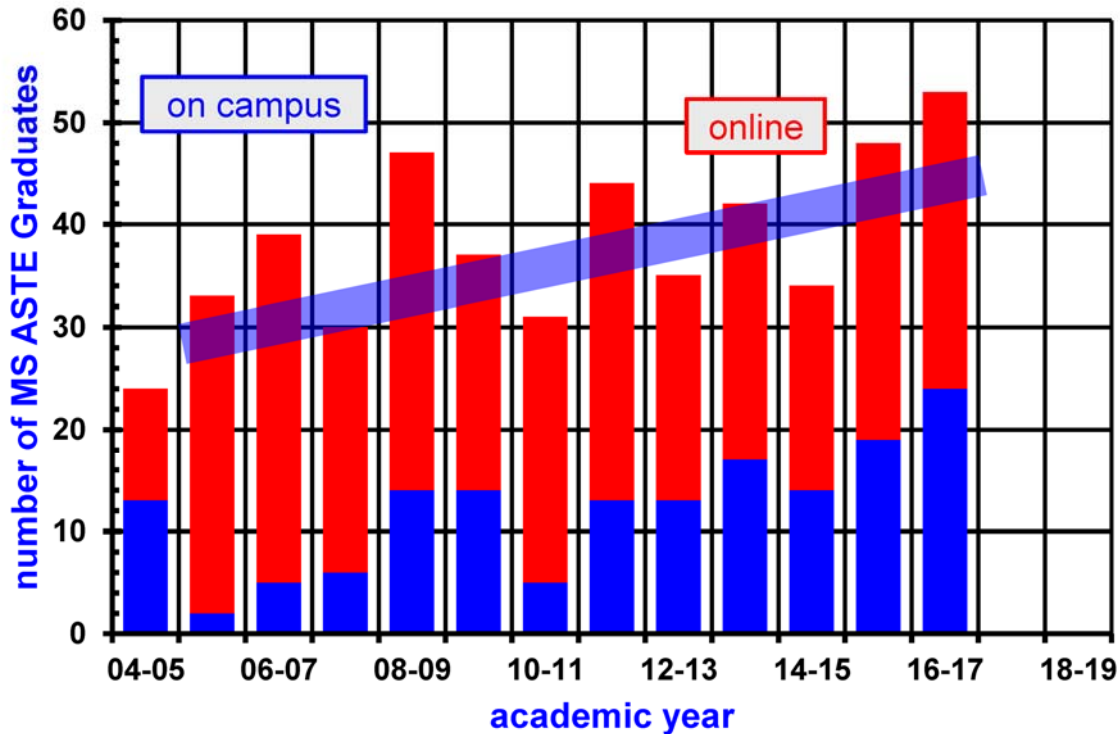
Since its founding in 2004, the Astronautical Engineering Department offers the full set of degrees in *Astronautical Engineering* (ASTE) – see figure below.



From AY 2004-2005 to AY 2016-2017, the Department awarded **123** Bachelor of Science degrees, **498** Master of Science degrees, **30** PhD degrees, and **10** Graduate Certificates.

## Master of Science – MS ASTE

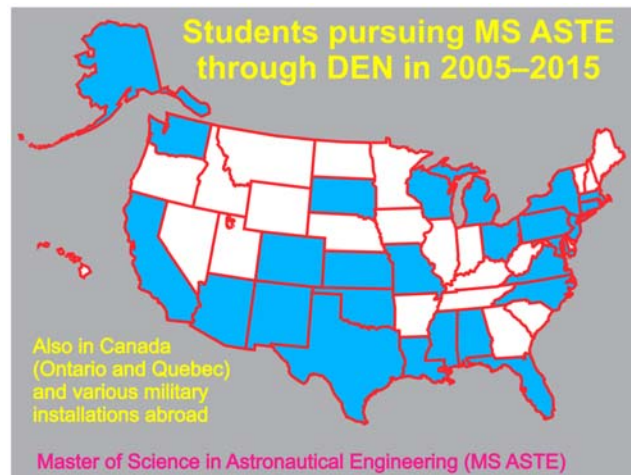
### USC/VSOE degrees awarded Master of Science in Astronautical Engineering



The Master of Science in Astronautical Engineering (MS ASTE) program awarded more than **40** degrees annually during the last 11 years.

Full-time on-campus students earn one-third of the degrees. Online students account for two-thirds of the students.

The program reaches students all over across 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 **1800** graduate students enrolled in ASTE-520 since 1996.

## LPL Successful Static Fire Test of *Blue Steel*

On December 2, 2017, ASTE's student Liquid Propulsion Lab (LPL) had a successful first static fire of their prototype rocket engine.

The 2.2-kN thrust liquid propulsion engine, named "Blue Steel," and its versatile test stand "Hydra" were designed and built by students pursuing master of science degree in astronautical engineering. The engine prototype operates on kerosene as the fuel and gaseous oxygen as the oxidizer. The flight version of the engine will use liquid oxygen.



More than 25 students participated in the test firing in California's Mojave Desert. In Spring, LPL plans to test USC's first ever 3D printed liquid-propellant rocket engine.

Student development of liquid-rocket engines by LPL and solid-propellant rockets by the Rocket Propulsion Lab (RPL) provides hands-on experience for USC astronautical engineering students in space technology.

## Zelman Lecture: Breakthrough Prize Foundation at USC

On February 7, 2018, the USC **Eighth Annual Vladimir Zelman Distinguished Lectureship** featured Chairman of the Breakthrough Prize Foundation **Dr. Pete Worden**. The USC *Keck School of Medicine* organizes this annual event to honor accomplishments of Professor Vladimir Zelman, former Chairman of Anesthesiology at USC.

This year speaker was Dr. Pete Worden, a distinguished specialist in civilian and national security space and former director of NASA Ames Space Center. Today Dr. Worden heads the Breakthrough Prize Foundation. He is also a friend of *USC Astronautics* and gave a lecture to our students in the past.



Several Astronautics students attended Dr. Worden's lecture at the USC Health Sciences Campus.

The event featured a link to the **Expedition 54** cosmonauts and astronauts on the **International Space Station**, who greeted Dr. Zelman and participants of the meeting.

At the event (right-to-left):  
NASA JPL Director (1991-2001) **Ed Stone**;  
Chair of Anesthesiology **Holly A. Muir** (USC);  
**Pete Worden**;  
**Vladimir Zelman** (USC);  
Executive Director Emeritus of the Planetary Society **Louis Friedman**;  
**Mike Gruntman** (USC).



## Viterbi School Joins International Astronautical Federation

On September 25, 2017, the General Assembly of the *International Astronautical Federation* (IAF) voted to admit the Viterbi School of Engineering to its membership. The Assembly took place during the last annual International Astronautical Congress (IAC) in Adelaide, Australia.



The Viterbi School joined about 440 members of the Federation which include main national space agencies, leading space and rocket industrial companies, space operators, world renowned research and development centers, professional and learned societies, and a few dozen universities across six continents and more than 65 countries.

The Federation, together with the *International Academy of Astronautics* (IAA) and the *International Institute of Space Law* (IISL), organizes International Astronautical Congresses.

## For IAF New members

As a new member, the Viterbi School received an IAF flag (figure, top left corner) that “have flown in space for 444 days on the missions using all human space launch systems and all space stations available at the time.” It is known as the *IAF 60th Anniversary Flag*.



### Flag Flight History

The flag was launched aboard **Soyuz TMA-20** on 15 December 2010 to the **International Space Station**. It flew aboard **ISS** from 17 December 2010 to 30 May 2011 and returned to Earth aboard **Endeavour STS-134** on 1 June 2011.

The flag was then launched aboard **Tiangong-1** on 29 September 2011 into low-Earth orbit. It returned to Earth aboard **Shenzhou-9** on 29 June 2012.

## History of IAF

The First International Astronautical Congress opened in September 1950 in Paris in effort to reestablish international cooperation in space exploration after World War II.

*Blazing the Trail, 2004* describes the events that followed:

“The Second International Astronautical Congress opened in September of the next year [1951] in London. The American Rocket Society pledged support for the [new] international astronautical organization and sent its representatives Andrew G. Haley and Frederick C. Durant, III, to the gathering. In addition to ARS, three other American groups were among the founding members: Pacific Rocket Society, Detroit Rocket Society, and Reaction Research Society.

On 4 September 1951, the International Astronautical Federation (IAF) was born. Eugene Sanger became the first president and G. Loeser and A.G. Haley vice presidents.”



## The Space Show – Resource for Students



**The Space Show** has been on air for 15 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 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 diverse audience of listeners across the globe. Space policies and politics; science, technologies, and education; entrepreneurial endeavors and innovations; "new" and "legacy" space – all are discussed by stellar guest specialists.

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.

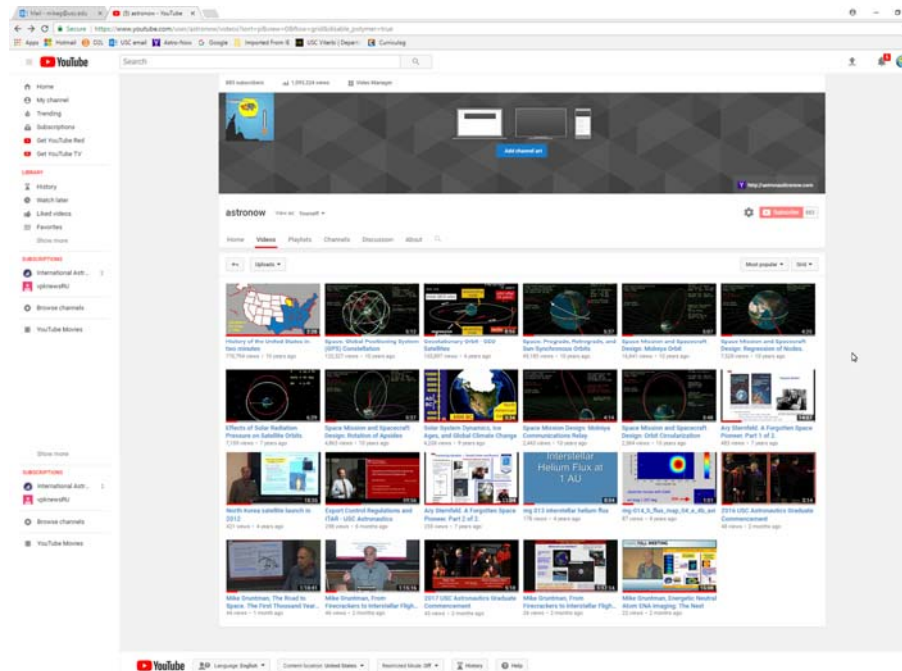
While the primary focus of the Space Show is on the “new” space ventures, it also covers traditional areas of the space enterprise. Many leading specialists including former NASA administrators, top scientists and technologists, space entrepreneurs, authors, and leaders of space advocacy groups were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

All shows – **more than 2500** – are archived and conveniently accessible through the new flashy web site <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 programs live on the Internet and call in with questions.

**The Space Show is a great resource for Astronautics students.**

## More than 1,000,000 views on YouTube

Mike Gruntman's video channel on YouTube features more than a dozen short videos primarily focused on satellite orbits, space missions, and space and rocket history. Many instructors use these videos in their classes all over the world. Last year, the video channel reached a milestone: more than **1,000,000** views. Yes, **>10<sup>6</sup>**.



The channel URL -- <https://www.youtube.com/user/astronow/>

## Export Control Regulations and ITAR



The International Traffic in Arms Regulations, or ITAR, play an important role in the U.S. space enterprise, controlling many research and development programs in space exploration, space technology, space applications, and rocketry. These national security regulations will remain

in place for a foreseeable future. USC Astronautics recently organized a special lecture by Director of Research Compliance at USC Mr. Daniel Shapiro on export control regulations with the emphasis on their application in the university environment.

Lecture webcast at <http://astronauticsnow.com/itar/> .

## Schedule of Astronautics Courses

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

While we carefully plan our course offerings, it is the Dean's Office that makes the final decision on course offering. Then, there is a challenge of availability of DEN studios. You may call it, using the language of physics and mathematics, the "boundary conditions" or "constraints." In addition, sometime our instructors from industry and government centers cannot offer scheduled courses due to work-related emergencies. We try to minimize such occurrences, but they are outside our direct control.

Special arrangements for some courses in the summer and fall semesters of 2018 and spring semester 2019 (subject to change)

### Summer 2018

**ASTE 585**    **Spacecraft Attitude Control**    DEN-webcast  
Instructor:    Prof. Henryk Flashner (USC)    MS ASTE core elective course

### Fall 2018

**ASTE 527**    **Space Architecting Studio**  
Instructor:    Madhu Thangavelu (AAA Vis.)    enrollment limited to 10 students:  
5 on-campus; 5 DEN-webcast

**ASTE 599**    **Human Factors of spacecraft Operation**    DEN-webcast  
**new class**  
Instructor:    to be announced (USC)  
No prerequisites; details to be available in July

### Spring 2019

**ASTE 566**    **Ground Communications for Satellite Operations**  
Instructor:    Prof. David Barnhart (USC)    enrollment limited to 12 students  
on-campus students only

**ASTE 599**    **Engineering Principles for Human Spaceflight**  
**new class**  
Instructor:    to be announced (USC)

## University of Southern California

### Department of Astronautical Engineering (ASTE)

#### Astronautics Classes offered in the Summer semester, 2018

#### Core Elective and Elective Requirements

**ASTE 585 (3)** – Spacecraft Attitude Control DEN-webcast  
Instructor: **Prof. Henryk Flashner** (USC)



**Prof. Henryk Flashner**  
**(USC)**  
**ASTE 585**  
***Spacecraft Attitude Control***

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 (RRB-225; tel. 213-821-5817; [cuason@usc.edu](mailto:cuason@usc.edu)) or Student Director Ms. Nicole Valdez (RRB-223; tel. 213-821-4234; [nicoleva@usc.edu](mailto:nicoleva@usc.edu)).

MS ASTE Frequently Asked Questions are at <http://astronauticsnow.com/msaste/>.

## University of Southern California

### Department of Astronautical Engineering (ASTE)

#### Astronautics Classes offered in the Fall semester, 2018

##### Core Requirements

<b>ASTE 470 (3)</b> Instructor:	– Spacecraft Propulsion <b>Prof. Mike Gruntman</b> (USC)	DEN-webcast
<b>ASTE 520 (3)</b> Instructor:	– Spacecraft System Design <b>Prof. Mike Gruntman</b> (USC)	DEN-webcast
<b>ASTE 535 (3)</b> Instructor:	– Space Environment and SC Interactions <b>Dr. Kent W. Tobiska</b> (Space Environment Techn.)	DEN-webcast
<b>ASTE 580 (3)</b> Instructor:	– Orbital Mechanics I <b>Prof. Ryan Park</b> (JPL)	DEN-webcast

##### Core Elective and Elective Requirements

<b>ASTE 505a (3)</b> Instructor:	– Plasma Dynamics I <b>Prof. Joseph Wang</b> (USC)	on-campus only
<b>ASTE 524 (3)</b> Instructor:	– Human Spaceflight <b>Prof. Bruce Cordell</b> (21st Century Waves)	DEN-webcast
<b>ASTE 527 (3)</b> Instructor:	– Space Exploration Architectures Concept Studio <b>Madhu Thangavelu</b> (AAA Visioneering) limited enrollment (5 on-campus and 5 DEN students)	DEN-webcast
<b>ASTE 553 (3)</b> Instructor:	– Systems for Remote Sensing from Space <b>Steven Matousek</b> (JPL)	DEN-webcast
<b>ASTE 556 (3)</b> Instructor:	– Spacecraft Structural Dynamics <b>Dr. Oscar Alvarez-Salazar</b> (JPL)	DEN-webcast
<b>ASTE 577 (3)</b> Instructor:	– Entry and Landing Systems for Planetary Exploration <b>Prof. Anita Sengupta</b> (Hyperloop)	DEN-webcast
<b>ASTE 589 (3)</b> Instructor:	– Solar System Navigation <b>Prof. Gerald Hintz</b> (Aerospace Corp.)	DEN-webcast
<b>ASTE 599 (3)</b> Instructor:	– Human Factors of Spacecraft Operations <b>to be announced</b> (USC)	DEN-webcast

For more information on *Master of Science* degree program in *Astronautical Engineering* (MS ASTE) check <http://gapp.usc.edu/graduate-programs/masters/astronautical-engineering> and contact ASTE Student Director Ms. Nicole Valdez (tel. 213–821–4234; [nicoleva@usc.edu](mailto:nicoleva@usc.edu))

MS ASTE Frequently Asked Questions are at <http://astronauticsnow.com/msaste/>.

## Instructors of *Astronautics* courses in Fall 2018 (alphabetically)



**Dr. Oscar Alvarez-Salazar**  
(JPL)

**ASTE 556**  
*Spacecraft Structural Dynamics*

**to be announced**  
(Univ. of Southern California)

**ASTE 599**  
*Human Factors of Spacecraft Operation*



**Prof. Bruce Cordell**  
(21st Century Wave)

**ASTE 524**  
*Human Spaceflight Systems*



**Prof. Anita Sengupta**  
(Hyperloop)

**ASTE 577**  
*Entry and Landing Systems for Planetary Exploration*



**Prof. Mike Gruntman**  
(Univ. of Southern California)

**ASTE 470**  
*Spacecraft Propulsion*  
**ASTE 520**  
*Spacecraft Systems Design*



**Madhu Thangavelu**  
(AAA Visioneering)

**ASTE 527**  
*Space Studio Architecting*



**Prof. Gerald Hintz**  
(The Aerospace Corp.)

**ASTE 583**  
*Space Navigation: Principles and Practice*



**Prof. Kent Tobiska**  
(Space Environment Technologies)

**ASTE 535**  
*Space Environments and Spacecraft Interactions*



**Steven Matousek** (JPL)

**ASTE 553**  
*Systems for Remote Sensing from Space*



**Prof. Joseph Wang**  
(Univ. of Southern California)

**ASTE 505a**  
*Plasma Dynamics*



**Prof. Ryan Park** (JPL)

**ASTE 580**  
*Orbital Mechanics I*

## University of Southern California

### Department of Astronautical Engineering (ASTE)

#### Astronautics Classes offered in the Spring semester, 2019

##### Core Requirements

- |                                    |   |             |
|------------------------------------|---|-------------|
| <b>ASTE 535 (3)</b><br>Instructor: | – Space Environment and SC Interactions<br><b>Prof. Joseph Wang</b> (USC) | DEN-webcast |
| <b>ASTE 580 (3)</b><br>Instructor: | – Orbital Mechanics I<br><b>Prof. Gerald Hintz</b> (Aerospace Corp.)      | DEN-webcast |

##### Core Elective and Elective Requirements

- |                                     |   |  |
|-------------------------------------|---|--|
| <b>ASTE 505b (3)</b><br>Instructor: | – Plasma Dynamics II<br><b>Prof. Joseph Wang</b> (USC)                                | on-campus only                                     |
| <b>ASTE 523 (3)</b><br>Instructor:  | – Design of Low Cost Space Missions<br><b>Prof. Jim Wertz</b> (Microcosm.)            | DEN-webcast  |
| <b>ASTE 529 (3)</b><br>Instructor:  | – Safety of Space Systems and Space Missions<br><b>Prof. Michael Kezirian</b> (IAASS) | DEN-webcast  |
| <b>ASTE 566 (3)</b><br>Instructor:  | – Ground Communications for Satellite Operations<br><b>Prof. David Barnhart</b> (USC) | on-campus only<br>limited enrollment – 12 students |
| <b>ASTE 570 (3)</b><br>Instructor:  | – Liquid Rocket Propulsion<br><b>Dr. G. P. Purohit</b> (Aerospace Corp.)              | DEN-webcast  |
| <b>ASTE 572 (3)</b><br>Instructor:  | – Advanced Spacecraft Propulsion<br><b>Dr. Keith Goodfellow</b> (Aerojet Rocketdyne)  | DEN-webcast only                                   |
| <b>ASTE 574 (3)</b><br>Instructor:  | – Space Launch Vehicle Design<br><b>Prof. Don Edberg</b> (Cal Poly Pomona)            | DEN-webcast  |
| <b>ASTE 552 (3)</b><br>Instructor:  | – Orbital Mechanics II<br><b>Prof. Ryan Park</b> (JPL)                                | DEN-webcast  |
| <b>ASTE 599 (3)</b><br>Instructor:  | – Engineering Principles for Human Spaceflight<br><b>to be announced</b> (USC)        | DEN-webcast  |

For more information on *Master of Science* degree program in *Astronautical Engineering* (MS ASTE) check <http://gapp.usc.edu/graduate-programs/masters/astronautical-engineering> and contact ASTE Student Director Ms. Nicole Valdez (tel. 213-821-4234; [nicoleva@usc.edu](mailto:nicoleva@usc.edu)). MS ASTE Frequently Asked Questions are at <http://astronauticsnow.com/msaste/>.

## Instructors of *Astronautics* courses in Spring 2018 (alphabetically)



**Dr. David Barnhart (ASTE  
and ISI; University of  
Southern California)**

**ASTE 566**  
***Ground Communications for  
Satellite Operations***



**Prof. Ryan Park (JPL)**

**ASTE 581**  
***Orbital Mechanics II***



**Dr. Don Edberg  
(Cal Poly Pomona)**

**ASTE 574**  
***Space Launch Vehicle  
Design***



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

**ASTE 570**  
***Liquid Rocket Propulsion***



**Dr. Keith Goodfellow  
(Aerojet Rocketdyne Corp.)**

**ASTE 572**  
***Advanced Spacecraft  
Propulsion***

**to be announced  
(Univ. of Southern California)**

**ASTE 599**  
***Engineering Principles for  
Human Spaceflight***



**Prof. Gerald Hintz  
(The Aerospace Corporation)**

**ASTE 580**  
***Orbital Mechanics I***



**Prof. Joseph Wang  
(Univ. of Southern California)**

**ASTE 505b**  
***Plasma Dynamics II***  
**ASTE 535**  
***Space Environment and  
Spacecraft Interactions***



**Prof. Michael Kezirian  
(IAASS)**

**ASTE 529**  
***Safety of Space Systems and  
Space Missions***



**Prof. James Wertz  
(Microcosm)**

**ASTE 523**  
***Design of Low Cost Space  
Missions***



# Preliminary Astronautics Class Schedule (as of Mar 2018)

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

Required Courses					2018	2019	2019	2020	2020	2021	2021	2022
					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	▼	▼	▼	▼	▼	▼	▼	▼
ASTE 470	Spacecraft Propulsion	1	D	R	▼		▼		▼		▼	
Elective Courses												
ASTE 501ab	Physical Gas Dynamics I,II	1r	N	C								
ASTE 505ab	Plasma Dynamics I, II	1#	N	E	a	b	a		a	b	a	
ASTE 523	Design Low Cost Sp Missions	#	D	C		▼				▼		
ASTE 524	Human Spaceflight Systems	1	D	C	▼		▼		▼		▼	
ASTE 527	Space Studio Architecting	1	D	C	▼		▼		▼		▼	
ASTE 528	Reliability of Space Systems	#	D	C				▼				▼
ASTE 529	Safety Space Sys. & Missions	#	D	C		▼				▼		
ASTE 546	Comp. Plasma Dynamics	#	N	E				▼				
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				▼				▼
ASTE 556	SC Structural Dynamics	#	D	C	▼				▼			
ASTE 557	SC Structural Materials	#	D	C			▼				▼	
ASTE 566	Ground Comm Satellite Ops	1	N	E		▼		▼		▼		▼
ASTE 570	Liquid Rocket Propulsion	#	D	C		▼				▼		
ASTE 572	Advanced SC Propulsion	1	D	C		▼		▼		▼		▼
ASTE 574	Space Launch Vehicle Design	#	D	C		▼				▼		
ASTE 577	Entry & Landing Planet. Sys.	1r	D	E	▼				▼			
ASTE 581	Orbital Mechanics II	#	D	C		▼				▼		
ASTE 583	Space Navigation	#	D	C			▼				▼	
ASTE 584	SC Power Systems	1r	D	C								
ASTE 585	SC Attitude Control	1r	D	C	▼smr	?	smmr	?	smmr			
ASTE 586	SC Attitude Dynamics	#	D	C				▼				▼
ASTE 589	Solar System Navigation	#	D	C	▼				▼			
ASTE 599	Solid Rocket Propulsion	#	D	E				▼				▼
ASTE 599	Human Factors SC Operation	1r	D	E	▼		?					
ASTE 599	Eng Prcps Human Spacflight	1r	D	E		▼		?				
ASTE 599	to be announced			E								
ASTE 683	Adv. Spacecraft Navigation	1r	D	E								

## Table notation

SC = spacecraft

**2** = course offered twice each year

**1** = course offered each year

**#** = course offered every second year

**Ir** = course offered irregularly

**▼** = planned (subject to School approval)

**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 ASTE Student Adviser

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

# Master of Science in Astronautical Engineering

**Changes in catalog description effective August 16, 2018 are in blue**

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

<b>CORE REQUIREMENT (12 units)</b>		<b>Units</b>
ASET 470	Spacecraft Propulsion	3
ASTE 520	Spacecraft System Design	3
ASTE 535	Space Environment and Spacecraft Interactions	3
ASTE 580	Orbital Mechanics I	3
<b>CORE ELECTIVE REQUIREMENT (9 units - choose three courses)</b>		<b>Units</b>
ASTE 501ab	Physical Gas Dynamics	3-3
ASTE 523	Design of Low Cost Space Missions	3
ASTE 524	Human Spaceflight	3
ASTE 527	Space Studio Architecting	3
<a href="#">ASTE 528</a>	<a href="#">Reliability of Space Systems</a>	<a href="#">3</a>
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
<a href="#">ASTE 555</a>	<a href="#">Space Cryogenic Systems and Applications</a>	<a href="#">3</a>
ASTE 556	Spacecraft Structural Dynamics	3
ASTE 557	Spacecraft Structural Strength and Materials	3
ASTE 570	Liquid Rocket Propulsion	3
ASTE 572	Advanced Spacecraft Propulsion	3
ASTE 574	Space Launch Vehicle Design	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 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:

<b>Spacecraft propulsion</b>	Choose two core electives from	
ASTE 501ab	Physical Gas Dynamics	3-3
ASTE 570	Liquid Rocket Propulsion	3
ASTE 572	Advanced Spacecraft Propulsion	3
ASTE 574	Space Launch Vehicle Design	3
ASTE 584	Spacecraft Power Systems	3
<b>Spacecraft dynamics</b>	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
<b>Space system design</b>	Choose two core electives from	
ASTE 523	Design of Low Cost Space Missions	3
ASTE 524	Human Spaceflight	3
ASTE 527	Space Studio Architecting	3
<a href="#">ASTE 528</a>	<a href="#">Reliability of Space Systems</a>	3
ASTE 529	Safety of Space Systems and Space Missions	3
ASTE 557	Spacecraft Structural Strength and Materials	3
ASTE 574	Space Launch Vehicle Design	3
<b>Spacecraft systems</b>	Choose two core electives from	
ASTE 552	Spacecraft Thermal Control	3
ASTE 553	Systems for Remote Sensing from Space	3
ASTE 554	Spacecraft Sensors	3
<a href="#">ASTE 555</a>	<a href="#">Space Cryogenic Systems and Applications</a>	3
ASTE 584	Spacecraft Power Systems	3
<b>Space applications</b>	Choose two core electives from	
ASTE 524	Human Spaceflight	3
ASTE 527	Space Studio Architecting	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** Take both courses

ASTE 528	Reliability of Space Systems	3
ASTE 529	Safety of Space Systems and Space Missions	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 in advising 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 applicant's record which includes GPA, GRE, and two letters of recommendation.

## Required items:

	<u>Send To</u>
<b>Application</b>	Office of Grad. and Int'l Admission
<b>Official Transcript(s)</b>	Office of Grad. and Int'l Admission
<b>General Record Exam</b>	Office of Grad. and Int'l Admission
<b>TOEFL (international students only)</b>	Office of Grad. and Int'l Admission
<b>Financial Statement</b>	Office of Grad. and Int'l Admission
<b>Recommendation Letters</b>	Office of Grad. and Int'l Admission

## Application

All applications should be submitted on-line 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

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 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 on-line 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, 854 W. Downey Way  
University of Southern California  
Los Angeles, CA 90089-1192

## 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 3.00 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 a number of limited-status students in the program.

## Admission

Admission decisions are based on the totality of the applicants' records, including academic performance, tests 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 tour.

## Conditional Admission

Applicants who do not meet admission qualifications may be granted conditional admission. Conditionally admitted student will be notified in writing of their admission status and of the conditions which 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 (RRB-225; tel. 213-821-5817; [cuason@usc.edu](mailto:cuason@usc.edu)) and Student Director Ms. Nicole Valdez (RRB-223; tel. 213-821-4234; [nicoleva@usc.edu](mailto:nicoleva@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 VSOE change of major form and contact ASTE Student Director Ms. Nicole Valdez (RRB-223; tel. 213-821-4234; [nicoleva@usc.edu](mailto:nicoleva@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 re-submission of supporting documents (e.g., transcripts) that have been previously submitted to USC. Check with ASTE Student Director Ms. Nicole Valdez (RRB-223; tel. 213-821-4234; [nicoleva@usc.edu](mailto:nicoleva@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 (RRB-225; tel. 213-821-5817; [cuason@usc.edu](mailto: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 students suspend their studies for a semester due to heavy work load 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 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 (RRB-225; tel. 213-821-5817; [cuason@usc.edu](mailto:cuason@usc.edu)) and visit <http://astronautics.usc.edu>.