

# **Discover Viterbi: Biomedical Engineering** **with Prof. Kirk Shung**

Viterbi School of Engineering  
University of Southern California

**Fall 2019**

# WebEx Quick Facts

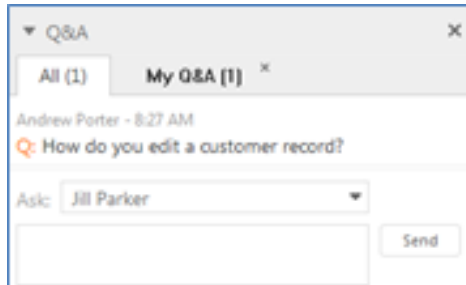
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Will I be able to get a copy of the slides after the presentation?

**YES!**

How can I ask a question during the information session?

1. Using the Q&A Panel, type a question in the box below the Ask drop-down menu.
2. Select a recipient from the Ask drop-down menu.



3. Click Send. We will respond as soon as we are able.

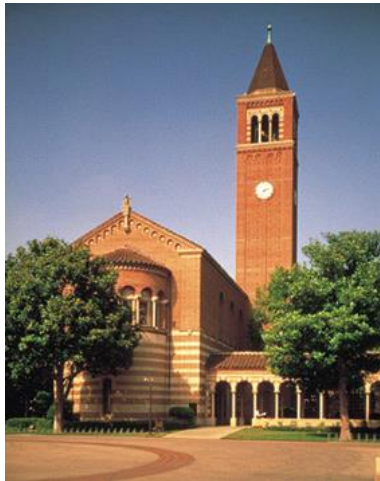
# Today's Program

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- University of Southern California
- USC Viterbi School of Engineering
- Graduate Programs in Biomedical Engineering
  - Program Overview
  - Application Criteria
- DEN@Viterbi
- Tuition & Fees
- Q&A



# UNIVERSITY OF SOUTHERN CALIFORNIA





# The University of Southern California

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- Oldest Private University in the western U.S.
  - Founded in 1880
- 47,500 Students
  - 20,000 Undergraduates | 27,500 Graduates
- 4,451 Full-time Faculty
- Diverse Student Population
- Located in Los Angeles

# Viterbi School at a Glance

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## Academic Departments

- 8 Academic Departments

## Faculty

- 188 tenure-track faculty
- 16 Full-time, TT NAE Members (30 Total)
- 70+ NSF CAREER, National & Presidential Young Investigator

## Student Populations (Fall 2018)

- 2,767 Undergraduate
- 5,922 Graduate students

## Research

- Leader in funded research
- 35+ Research Centers
- More than \$207M in research expenditures annually

# USC Engineering: Points of Distinction

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- International Reputation for Excellence
- The Trojan Family Network: 77,000+ (engineers) strong
- Unique engineering programs available:  
*Online, on site & on campus*
- Complete range of programs
  - Doctoral, Masters and Bachelors
  - Graduate Certificates
  - Short Courses
  - Custom Programs



# ***U.S. News & World Report, 2019***

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## **Best Engineering Graduate Schools**

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- **Top 10 Ranked Graduate Engineering Program**

## **Best Online Graduate Engineering Programs**

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- **Ranked #1 Online Graduate Computer Information Technology Program (Computer Science)**
- **Ranked #2 Online Graduate Engineering Programs**

## **Best Online Graduate Engineering Programs for Veterans**

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- **Ranked #1 Online Graduate Computer Information Technology Program (Computer Science) for Veterans**
- **Ranked #2 Online Graduate Engineering Programs for Veterans**

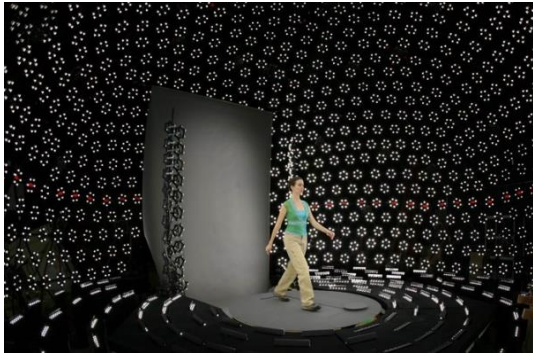


# The Viterbi School of Engineering: A Leader in Research

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Viterbi School is a consistent leader in funded research in the U.S.

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Institute for Creative Technologies



Biomimetic Microelectronic Systems Engineering Research Center



National Center for Metropolitan Transportation Research

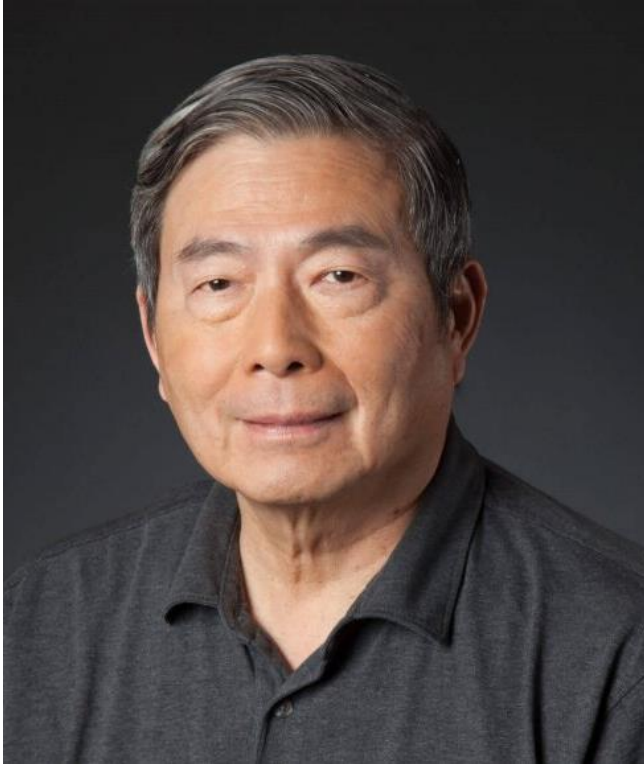


CREATE Homeland Security Center

- Highly interdisciplinary research environment
- Diverse research areas such as robotics, software engineering, sensor networks, vision sciences, automated construction and photonics
- Over 35 research centers
- Industrial partnerships and collaboration

# Meet Professor Kirk Shung

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## ■ Professor Kirk Shung

- Department Chair of Biomedical Engineering
- Ph.D. in Electrical Engineering, University of Washington
- 2016 IEEE Biomedical Engineering Award
- 2011 IEEE Engineering in Medicine and Biology Society Professional career achievement award
- 2010 American Institute of Ultrasound in Medicine Joseph Holms Pioneer Award in Basic Science
- 2008 VSoE, USC VSoE Senior Research Award

# Department of Biomedical Engineering – Quick Facts

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- Founded 1976 (celebrating 43 years!)
- Core Faculty:
  - 24 (2019 with new hire Profs. Jennifer Treweek from Caltech and Maral Mousavi from Harvard)
- Affiliated Faculty: >50
- Staff: 12
- Undergraduate students: 250
- M.S. students: 124
- Ph.D. students: 117

# Department of Biomedical Engineering – Faculty

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- 1976: 4 faculty
- 1996: 9 faculty
- 2019: 24 faculty and growing!



**Prof. Jennifer Treweek**

Joined in Spring 2019

Physiological function of stress-related neuropeptide circuits using advanced neuroscience techniques.



**Prof. Maral Mousavi**

Joined in Fall 2019

Point-of-care diagnostics, electrochemical sensors



# Department of Biomedical Engineering – Faculty Areas of Specialization

Area	Core and Research Faculty
Bio-signals and Systems	D'Argenio, Khoo, Marmarelis, Yamashiro
Neural Engineering	Berger, <a href="#">Boutellier</a> , Humayun <sup>^</sup> , <a href="#">Lee</a> , Loeb, Mel, Sanger <sup>^</sup> , <a href="#">Song</a> , Valero-Cuevas <sup>^</sup> , Treweek*
Devices and Imaging	Liu, Maarek, Meng, Shung, Yen, Zavaleta*, Zhou <sup>^</sup> , Mousavi*
Cellular/Molecular Bioengineering	Chung*, Finley*, Fraser <sup>^</sup> , Kay <sup>^</sup> , McCain*, Shen*

Color Code:    Core Faculty    [Research Faculty](#)  
\* Assistant Professors  
<sup>^</sup> Joint Appointments

# Department of Biomedical Engineering – Noteworthy Events

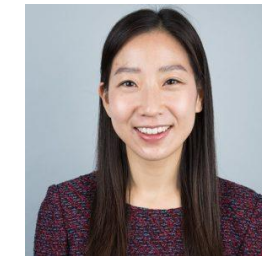
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- Instructional lab (DRB351) has been revamped
- Instructional wet lab (BHE 18) is ready
- A full time technician is hired to run these labs
- A Maker Space (8,000 SF) for project design and fabrication located at Seaver Science and Engineering Library will open in Jan, 2020
- BME's own maker space is now functional

# Noteworthy Biomedical Engineering News




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- Prof. Vasilis Marmarelis received a 5 year \$10M NIH grant on model-based diagnosis of early Alzheimer's disease which is a joint effort of 3 universities
- Prof. Eun Ji Chung Receives 2019 IEEE Nanomedicine New Innovator Award
- Profs. Ellis Meng and Dong Song received a 5 year \$6M Brain Initiative Award from NIH.



# Biomedical Engineering: Program Offerings

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- MS in Biomedical Engineering 
- MS in Biomedical Engineering (Medical Imaging & Imaging Informatics) 
- MS in Biomedical Engineering (Neuroengineering)
- MS in Medical Device and Diagnostic Engineering 



Available online via DEN@Viterbi








# MS in Biomedical Engineering – Program Details

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*Program Requirements: 28 units*







 Available online via DEN@Viterbi

## Required Courses (15 units)

- BME 501 | Advanced Topics in Biomedical Systems (4 units) 
- BME 502 | Advanced Studies of the Nervous System (4 units) 
- BME 511 | Physiological Control Systems (3 units) 
- BME 513 | Signal and Systems Analysis (3 units) 
- BME 533 | Seminar in Bioengineering (1 unit) 

## Elective Courses (13 units)

*BME approved technical elective courses; please see the program page for a full list of approved elective courses*

- BME 525 | Advanced Biomedical Imaging (3 units) 
- BME 527 | Integration of Medical Imaging Systems (3 units) 
- BME 528 | Medical Diagnostics, Therapeutics and Informatics Applications (3 units) 
- BME 535 | Ultrasonic Imaging (3 units) 
- BME 650 | Biomedical Measurement and Instrumentation (3 units) 
- CSCI 561 | Foundations of Artificial Intelligence (4 units) 








# MS in Biomedical Engineering (Medical Imaging & Imaging Informatics) – Program Details

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*Program Requirements: 29 units*





 Available online via DEN@Viterbi

## Required Courses (23 units)

- BME 501 | Advanced Topics in Biomedical Systems (4 units) 
- BME 513 | Signal and Systems Analysis (3 units) 
- BME 525 | Advanced Biomedical Imaging (3 units) 
- BME 527 | Integration of Medical Imaging Systems (3 units) 
- BME 528 | Medical Diagnostics, Therapeutics and Informatics Applications (3 units) 
- BME 535 | Ultrasonic Imaging (3 units) 
- EE 569 | Introduction to Digital Image Processing (4 units) 

## Elective Courses (2 courses required - 6 units)

*BME approved elective courses; please see the program page for a full list of approved elective courses*

- BME 502 | Advanced Studies of the Nervous System (3 units) 
- BME 511 | Physiological Control Systems (3 units) 
- BME 650 | Biomedical Measurement and Instrumentation (3 units) 
- CSCI 530 | Security Systems (4 units) 

# MS in Biomedical Engineering (Neuroengineering) – Program Details

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*Program Requirements: 28 units*

## Required Courses (21 units)

- BME 501 | Advanced Topics in Biomedical Systems (4 units)
- BME 502 | Advanced Studies of the Nervous System (4 units)
- BME 511 | Physiological Control Systems (3 units)
- BME 513 | Signal and Systems Analysis (3 units)
- BME 533 | Seminar in Bioengineering (1 unit)
- BME 552 | Neural Implant Engineering (3 units)
- BME 575 | Computational Neuroengineering (3 units)

## Approved Technical Elective Courses (7 units)








# MS in Medical Device and Diagnostic Engineering – Program Details

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*Program Requirements: 28 units*

 Available online via DEN@Viterbi

## Required Courses (19 units)

- BME 501 | Advanced Topics in Biomedical Systems (4 units)  or
- BME 502 | Advanced Studies of the Nervous System (4 units) 
- BME 513 | Signal and Systems Analysis (3 units) 
- BME 650 | Biomedical Measurement and Instrumentation (3 units) 
- MPTX 511 | Introduction to Medical Product Regulation (3 units) or
- BME 416 | Development and Regulation of Medical Products (3 units) 
- MPTX 515 | Quality Systems and Standards (3 units)
- ISE 527 | Quality Management for Engineers (3 units) 
- ISE 545 | Technology Development and Implementation (3 units) 

## Technical Elective Course (3 units)

## Required Specialization Track (6 units)

*Complete 6 units from the Regulation, Medical Technology & Device Science or  
Product Development Track*



# Application Criteria for Master's Programs

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Each program has unique application requirements – please be sure to review specific information for your program(s) of interest:

<https://viterbigradadmission.usc.edu/programs/masters/msprograms/biomedical-engineering/>

## General Application Criteria

- Undergraduate degree in engineering, math or a hard science from a regionally-accredited university (*official transcripts submitted*)
- To be competitive, a cumulative undergraduate GPA Of at least 3.0 on a 4.0 scale is recommended (*not required*)
- Satisfactory scores on the general portion of the Graduate Record Examination (GRE) General Test that are less than 5 years old
- CV/Resume Required
- Statement of Purpose Required
- 3 Letters of Recommendation Required
- TOEFL (International Applicants)

# Application Deadlines

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## Application Deadlines

### Fall 2020

- Deadline to submit all required materials: January 15, 2020\*
- Deadline for Scholarship Consideration (on-campus only): December 15, 2019

### Spring 2021

- Deadline to submit all required materials : September 15, 2020\*
- Deadline for Scholarship Consideration (on-campus only): August 31, 2020

*\* A deadline extension for DEN@Viterbi applicants may be available. Please email [DEN@Viterbi.usc.edu](mailto:DEN@Viterbi.usc.edu) for more information.*

#### Helpful Links:

List of DEN@Viterbi Programs  
<http://viterbi.usc.edu/DENDegrees>

USC Graduate Application:  
<https://usc.liaisoncas.com>

# Where Our Alumni Are Working

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## Sample Company

Abbott  
Amgen  
Apple  
Applied Medical  
Boston Scientific  
Edwards Lifesciences  
Genentech  
Google  
Johnson & Johnson  
Kaiser Permanente  
Medtronic  
Stryker

## Sample Job Titles

Quality Engineer, Process Engineer, Senior Clinical Specialist  
Engineer, Director of Corporate Strategy  
Biomedical Engineer, Sensor Calibration & Instrumentation Engineer  
R&D Software Engineer  
Principal Scientist; Senior R&D Engineer  
Medical Device Engineer, R&D Manager, Technical Dvlpt Program Engineer  
Project & Manufacturing Engineer, Regulatory Program Manager  
Software Engineer  
Regulatory Affairs  
Imaging Solutions Architect  
Sr. Biomedical Engineer, Principal R&D Engineer, Sr. Quality Engineer  
Sr. Design Engineer, Director, Mechanical Design Engineer

**Alumni Company List:** <https://1otylmrj2pd20xsmv2kci0wn-wpengine.netdna-ssl.com/wp-content/uploads/2018/02/Alumni-Companies.pdf>

# Course Delivery Methods

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## Methods of Course Delivery

- **On-campus, full time**  
3 classes per semester  
1.5 – 2 years to complete
- **Online delivery via DEN@Viterbi**  
1-2 classes per semester  
2.5 – 3 years to complete degree

# How DEN@Viterbi Works

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The Viterbi School of Engineering uses a state-of-the-art, proprietary web-based delivery system that enables students from around the world to access classes live or on-demand.

## DEN@Viterbi Students:

- View the same lectures as on-campus students, with fresh content every semester
- Participate in highly interactive discussions with professors and peers
- Submit homework electronically
- Take exams at proctored testing centers near their home or work (or at USC if in the Los Angeles area)

# DEN@Viterbi Overview

	DEN@Viterbi Student	On-Campus Student
Program Admission	USC Graduate Application & required materials	USC Graduate Application & required materials
Weekly Course Lectures	Online with Interactivity	On USC's Campus
Online Course Archives (Lectures & Course Documents)	✓	✓ *
Assignments	Submit electronically according to course deadlines	Submit during lecture or lab according to course deadlines
Exams	Proctored location	USC's campus
Courses per Semester (Average)	1-2	3-4
Degree Completion Requirements	27-37 units with a 3.0 GPA or above	27-37 units with a 3.0 GPA or above
USC Diploma (No Distinction)	✓	✓

\*DEN@Viterbi Sections Only



# DEN@Viterbi's E-Learning System

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DEN@Viterbi Classroom

# DEN@Viterbi's E-Learning System

The screenshot displays the DEN@Viterbi E-Learning System interface. At the top, a breadcrumb trail shows 'Table of Contents > Week 4 > Lecture Video 09/13/2017'. Below this, the title 'Lecture Video 09/13/2017' is displayed. The main content area shows a video player with a pull-out tab on the left for easy weekly content access. The video content includes handwritten mathematical equations:  $\frac{\partial u}{\partial t} = \alpha \nabla^2 u$  and  $\nabla^2 u = \frac{1}{r} \frac{\partial}{\partial r} \left( r \frac{\partial u}{\partial r} \right) + \frac{1}{r^2} \frac{\partial^2 u}{\partial \theta^2} + \frac{\partial^2 u}{\partial z^2}$ , along with a diagram of a cylinder in a coordinate system. The video player controls at the bottom include play/pause, forward/rewind 30 seconds, and a progress bar. Below the player, there are buttons for 'Play HD (1.5MB)', 'Play SD (750KB)', and 'Android / IOS'. Callouts provide additional information: 'Breadcrumbs for easy navigation' points to the top trail; 'Bookmark needed content areas' points to a bookmark icon; 'Navigate to the next item or previous' points to navigation arrows; 'Pull-out tab for easy weekly content access' points to the left sidebar; 'Player controls include play/pause, and forward/rewind 30 seconds' points to the video controls; and 'Stream in HD, SD, or on your mobile device' points to the format selection buttons.

Table of Contents > Week 4 > Lecture Video 09/13/2017

Lecture Video 09/13/2017

Breadcrumbs for easy navigation

Pull-out tab for easy weekly content access

$\frac{\partial u}{\partial t} = \alpha \nabla^2 u$

$\nabla^2 u = \frac{1}{r} \frac{\partial}{\partial r} \left( r \frac{\partial u}{\partial r} \right) + \frac{1}{r^2} \frac{\partial^2 u}{\partial \theta^2} + \frac{\partial^2 u}{\partial z^2}$

Bookmark needed content areas

Navigate to the next item or previous

Player controls include play/pause, and forward/rewind 30 seconds

Play HD (1.5MB) Play SD (750KB) Android / IOS

Stream in HD, SD, or on your mobile device

# DEN@Viterbi's E-Learning System

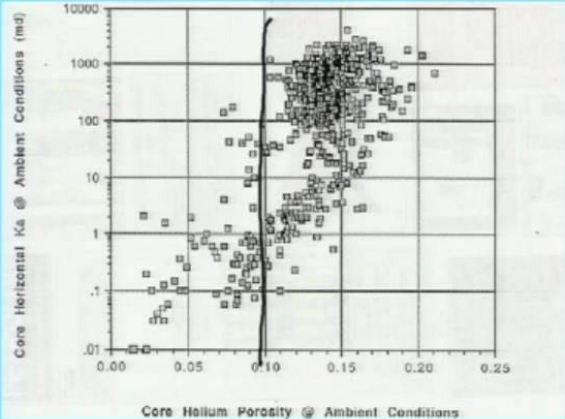
2017 USC Sec 03 Petrophysics Slides.pdf - Adobe Acrobat Reader DC

File Edit View Window Help

Home Tools 2017 USC Sec 03 P... 2017 USC Sec 03 I... 2017 Sec 03 Frn W... 2017 Section 19-A ...

23 / 74 97.6%

## Helium Porosity vs. Air Permeability



Core Helium Porosity @ Ambient Conditions

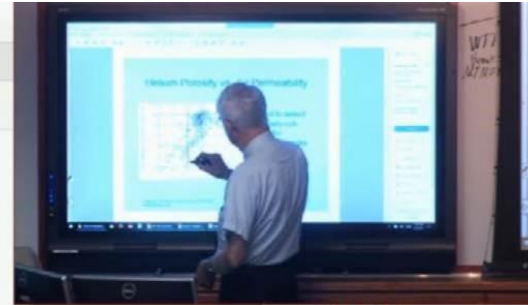
Core Horizontal  $K_a$  @ Ambient Conditions

- Used to select porosity cut-offs, for reservoir rocks.
- Based on permeability values.

Donald G. Hill, Ph.D., R.Gp, R. G., R.P.G., L.P.Gp.  
dgh@hillpetro.com

PTE-461: Fall 2017 Section 3: Petrophysics

Slide No.: 23



Select PDF File

2017 USC Sec...cs Slides.pdf

Convert to

Microsoft Word (\*.docx)

Document Language: English (U.S.) Change

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Combine Files

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Fill & Sign

Send for Signature

Send & Track

Store and share files in the Document Cloud

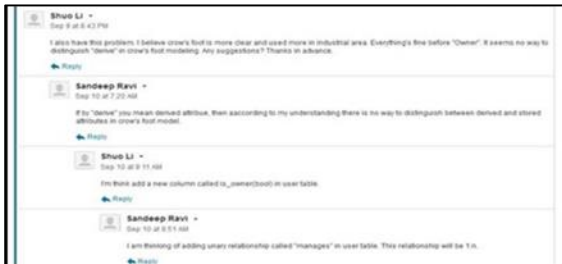
Learn More

USC Viterbi

# Student Interactivity & Group Meetings



- All DEN@Viterbi students are provided access to their own meeting rooms which can be used for several purposes:
  - Enable video communication (web and mobile)
  - Integrate phone conferencing
  - Integrate fixed room IP video systems
  - Desktop sharing
  - Set up meetings with faculty, teaching assistants and peers



- Call in during live lectures
- Participate in live chats and threaded discussion boards

**Question: Is there any difference between earning a Master's degree on campus vs. via DEN@Viterbi?**

**Answer: NO.** DEN@Viterbi is a delivery method. Students adhere to the:

- Same Admission Criteria
- Same Curriculum
- Same Exams and Homework
- Same Academic Standards and Graduation Requirements

**Therefore...**

You earn the same diploma whether you earn the degree on-campus or online through DEN@Viterbi.



# DEN@Viterbi Additional Info

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## Limited Status

- Allows strong candidates to begin coursework before formal admission.
- Courses (*maximum of 12 units*) can be applied toward degree program once admitted but *limited status does not guarantee admission*.
- Get Started this Spring 2020:  
<https://viterbigradadmission.usc.edu/denviterbi/getting-started/>

## Employer Reimbursement Deferment

Students supported by a company can defer payment of up to 90% of tuition until after the semester is over.

### Program Eligibility

- Your employer reimburses you for tuition at the end of each term.
- Your student account is current.

For additional information: <https://sfs.usc.edu/payment/employer-reimbursement/>



# Tuition & Fees (2019-2020)

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## Example of tuition and fees for a DEN@Viterbi Student

PER-COURSE FEES	Unit Cost	Tuition for 3-Unit Course	Tuition for 4-Unit Course
Tuition for 500/600 level course	\$2,075	\$6,225	\$8,300

PER-SEMESTER FEES	Cost	Total per semester
Engineering Access Fee	\$35	\$35
Norman Topping Student Aid Fund	\$8	\$8

*\* Additional fees include textbooks (\$150 - 200) and exam proctoring fees (\$40 - 100)*

# Getting Started

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For those interested in taking classes on campus:

- Visit USC campus
- Start your application: <https://gradadm.usc.edu/apply/>

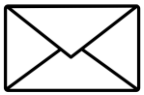
For those interested in taking classes online via DEN@Viterbi:

- Start your application: <https://gradadm.usc.edu/apply/> -or-
- Start as a Limited Status Student as early as Spring 2020  
Complete the DEN@Viterbi Profile: [viterbi.usc.edu/denprofile](https://viterbi.usc.edu/denprofile)

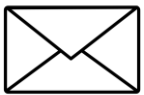
# Contact Us

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## USC Viterbi School of Engineering Admission & Student Engagement



**On Campus: [viterbi.gradadmission@usc.edu](mailto:viterbi.gradadmission@usc.edu)**



**DEN@Viterbi: [DEN@Viterbi.usc.edu](mailto:DEN@Viterbi.usc.edu)**



**213.740.4488**



**<http://viterbi.usc.edu/gradprograms>**