

# Executive Summary

## Blueprint for Academic Excellence College of Engineering & Computing AY2021-2022

### Introduction

CEC offers 10 UG degrees, 7 UG minors, 9 PhD degrees, 11 MS degrees, 7 ME degrees, a Master of Health IT degree, and 3 graduate certificates. Enrollment for UG is currently 3168, up 27.8% from 2014. Enrollment for graduates is currently 516, up 3.8% from 2014. CEC has added 35 T/TT and 25 full-time instructors since 2016. The significant investments in student success, and expansion and modernization of facilities and curricula, have made CEC a destination of choice for students seeking a rigorous education, and successful post-graduation placement, as is evident below. CEC's Fall 2019 freshman class grew modestly to 768 (up 5.6%). Compared to the previous year, the number of entering undergraduate underrepresented minorities increased 14.7%, from 109 to 125. Capstone students entering CEC has increased by 15.6% since 2017, from 180 to 208. Total undergraduate enrollment has increased by 15.54%, from 2742 in 2015 to 3168 in 2020. Total enrollment of undergraduate URM's has increased by 42.3%, from 600 in 2015 to 854 in 2020.

### Highlights

- Professor Dryer was elected to the National Academy of Engineering (Prof. Monnier elected in 2018, Professor Sutton in 2020).
- USC Artificial Intelligence Institute has a new 10,000 sq. ft. home in the old Law School
- Sponsored Research Awards in FY20 were \$30M (\$18M in FY16).
- There are 412 Honors College Students in CEC. CEC has the third highest number of students in the SC Honors College (17%)
- The freshman-sophomore retention rate for first generation students in 2019 peer mentor cohort was 100%.
- 6-year graduation rate from CEC is up by 11 percentage points in only 4 years.
- Physical footprint of CEC has grown by 70,000+ sq. ft. since 2016.

Hossein Haj-Hariri , Dean  
USC Educational Foundation Distinguished Professor  
College of Engineering and Computing



A handwritten signature in blue ink, reading "Hossein Haj-Hariri".

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# Foundation for Academic Excellence

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## Mission Statement

We create and disseminate knowledge that advances the practice of engineering and computing. We are committed to working on complex projects that are inherently inter- and multidisciplinary. We leverage the comprehensive nature of the state's largest university to graduate liberally educated engineers and computer scientists capable of teaching themselves new knowledge beyond the boundaries of their education.

Updated: 03/01/2017

## Vision Statement

- **Teaching Excellence:** Our College will be the premier destination of choice in the Southeastern U.S. for engineering and computing students, as well as the companies that hire them.
- **Research/Scholarship:** Our research productivity will be internationally recognized based upon the reputation of our faculty scholarship and its impact upon society.
- **Service:** We will lead the university and the state that supports us in the advancement and dissemination of knowledge in our fields of expertise.

## Values Statement

We value innovation, societal relevance, inclusivity, and collaboration.

Updated: 03/01/2017

Updated: 03/01/2017

# Goals - Looking Back

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Goals for the previous Academic Year.

## **Goals - Looking Back**

**No goals have been entered for this section.**

# Goals - Real Time

Goals for the current Academic Year.

## Goal 1 - Student Success and Teaching Excellence

<b>Goal Statement</b>	Attract, inspire, and enable students to become innovative thinkers, life-long learners, and transformative leaders in engineering, computing, and related fields, through: promotion of active learning in the classroom and outside; focus on fundamentals; emphasis on rigor; use of state-of-the-art tools and equipment; leveraging the comprehensive nature of the university and her Carolina Core; and delivering a high-quality, student-centric educational experience.
<b>Linkage to University Goal</b>	<ul style="list-style-type: none"> <li>• Attract, inspire, challenge and enable our students to become innovative thinkers and transformative leaders.</li> <li>• Assemble and cultivate a world-class faculty and staff.</li> <li>• Create new pathways to research excellence to become AAU eligible.</li> <li>• Cultivate a more diverse, equitable, and inclusive campus culture where every individual, regardless of background, has the full opportunity to flourish and thrive.</li> <li>• Harness the power, attributes and institutional diversity of an integrated and interoperative university system that enhances access, success and affordability for every eligible SC student.</li> </ul>
<b>Alignment with Mission, Vision, and Values</b>	Fully aligned
<b>Status</b>	Progressing as expected (multi-year goal)
<b>Action Plan</b>	<ul style="list-style-type: none"> <li>• Ensure and monitor that the students show growth in critical analysis and thinking, analytical skills, leadership and communication skills, and problem solving             <ul style="list-style-type: none"> <li>◦ more open-ended hypothesis-based projects, lab/design/research experiences</li> <li>◦ injection of ethics and professional development throughout the curriculum</li> <li>◦ thoroughly document the progress, as needed for professional accreditation</li> </ul> </li> <li>• Expand the number of the faculty by hiring the best researchers and instructors, with interest and expertise in addressing grand-challenge problems, and mentoring them             <ul style="list-style-type: none"> <li>◦ to achieve an UG/TTT ratio of 20, at the current level of 3,200 UG students, the TTT faculty ranks need to grow to 160. CEC has settled at only 130 since 19-20 AY mainly because of the uncertainty in the budget model.</li> <li>◦ full-time instructor ranks need to be 15-20% of the total</li> </ul> </li> <li>• Ensure that the degrees are timely, rigorous, and sustainable:             <ul style="list-style-type: none"> <li>◦ Biomedical Engineering (BME) degrees are offered for 15 years</li> </ul> </li> </ul>

# Goals - Real Time

	<p>as a program, by faculty who have tenure home in other departments. During that period, almost all other BME programs in the US have become departments. We remain a true singularity, and as such at a disadvantage for recruiting of faculty and graduate students, which then affects the academic program.</p> <ul style="list-style-type: none"> <li>• Sustain (or expand) undergraduate Engineering and Computing Honors curricula tracks (5-6 HC specific courses per CEC major).</li> <li>• Continue to improve recruiting strategies that target underrepresented students.</li> <li>• Stay focused on improving retention and graduation rates, and post-graduation success.</li> </ul>
<p><b>Achievements</b></p>	<ul style="list-style-type: none"> <li>• Hired 35 TTT and 25+ full-time instructors, and addressed the ongoing large deficit of the college so that today the student/TTT is <math>(3200/130=)</math> 24.6 instead of <math>(3200/80=)</math> 40 that it would have been. Addition of instructors has been transformative.             <ul style="list-style-type: none"> <li>◦ need to have another 8+ TTT hires this AY, to allow the ratio to continue to lower, and to address the critical needs of aero, BME, and chemical.</li> </ul> </li> <li>• Significant investments in engineering and computing laboratory and classroom modernization and addition. Without such investment starting in 2016, receiving accreditation would not have been possible.</li> <li>• Have created multiple timely and rigorous degrees:             <ul style="list-style-type: none"> <li>◦ created an online BS in IIT, as well as a PhD informatics.</li> <li>◦ created the only aerospace program in the state (one of the largest in the US already)</li> <li>◦ created the first entrepreneurial engineering and technology innovation MS, aligned, and garnered NSF ICorps funding to create the only SC ICorps Site.</li> </ul> </li> <li>• Freshmen and sophomores are advise by 6 professional staff. Increased the staffing of Student Services by almost a factor of three.</li> <li>• Instituted peer mentoring (a quarter of the incoming freshmen have peer mentors).</li> <li>• Expanded undergraduate Engineering and Computing Honors curricula tracks (5-6 HC specific courses per CEC major). Modernized almost all of our curricula to ensure logical prerequisite sequencing, and create significant elective flexibility for taking advantage of the comprehensive nature of the university, including enabling the students to take advantage of timely minor sequences within or outside CEC. CEC continues to have significant recruiting and outreach activities throughout the year.</li> <li>• Upgraded distance education facilities.</li> <li>• Converted all courses, including physical labs, to virtual as needed. CEC has been essentially at full compliance with the</li> </ul>

# Goals - Real Time

	<p>proposed modalities of her courses.</p> <ul style="list-style-type: none"> <li>• Starting active teaching mentorship by resourcing a senior and accomplished instructor to assist our faculty become better instructors (in addition to the superb resources available to our faculty through CTE; they are a great resource for the university).</li> <li>• In 19-20 Received \$1M (Gatzke + Lyons) from NSF for URM undergraduate scholarships.</li> <li>• In 19-20 Received \$1M (Matthews (CEC) and Benitez Nelson (CAS)) from NSF to create Bridges to Doctorate, for 2-years of support for 12 minority PhD students (renewable every 2 years).</li> <li>• First-Scholars program has been created and students are being recruited for this summer.</li> <li>• The 6-year graduation rate is up 11 points.</li> <li>• CEC places 86% of its students, with an average starting salary of \$66,000, which is \$8,000 higher than it was in 2015.             <ul style="list-style-type: none"> <li>◦ more than 2/3rd of the students who did not go to graduate school have done an internship as an undergraduate!</li> </ul> </li> </ul>
<p><b>Resources Utilized</b></p>	<ul style="list-style-type: none"> <li>• Nearly tripled the staffing of Student Services.</li> <li>• Significantly invested in hiring of faculty and instructors.</li> <li>• Invested in improving all classrooms, hallways and public spaces, as well as student services.</li> <li>• The university invested in a cafe (very important!) and also improving the Career Services offices:             <ul style="list-style-type: none"> <li>◦ the latter improvement is likely correlated with the significant increase in the starting salaries and placement rates for bachelor degrees.</li> </ul> </li> </ul>
<p><b>Goal Continuation</b></p>	
<p><b>Goal Upcoming Plans</b></p>	<ul style="list-style-type: none"> <li>• Significant TTT hiring (net positive) is needed in order to lower the student-to-faculty ratio from mid 20's to 20-21. Peers and peer aspirants are in the high teens to 20.</li> <li>• CEC will continue investing heavily in laboratory upgrades and creation of collaborative and maker spaces.</li> <li>• Encourage the University to create more ~ 120 classrooms on the west side of campus (east tower of old law school).</li> </ul>
<p><b>Resources Needed</b></p>	<ul style="list-style-type: none"> <li>• Faculty growth needed to achieve UG/TTT=20:             <ul style="list-style-type: none"> <li>◦ Need 30 more TTT at a total startup of ~\$18M</li> <li>◦ Some of this are being rolled into the several multi-million-dollar/year research programs from the Navy.</li> <li>◦ Another portion could come from flowing the majority of SRNL match funds to CEC to allow it to attract and grow more world-class faculty as it has shown it is capable of doing.</li> <li>◦ We ask that the University does not tax the IDC from these programs for their first 5 years, and contribute those sums to the necessary startups.</li> </ul> </li> <li>• Instructional space, wet labs, and computer labs are areas where central help is needed.</li> <li>• <b><u>\$500K/year to continue to bring in a new cohort of</u></b></li> </ul>

# Goals - Real Time

	<p><b>minority STEM PhD students during the "off" years of the NSF funding for Bridges to Doctorate.</b> These students are supported for two years, and then are supported on research for 2 more years. But given that the program will alternate between UofSC and Clemson, the requested funds will allow the recruiting to continue uninterrupted.</p> <ul style="list-style-type: none"><li>• <b>To create the BME department,</b> 6 new positions are needed with 4 in CEC and 2 in SOM. --&gt; 6 salary/fringe lines (\$160Kx6=\$960K recurring) and 6 startups (\$600K*6=<b>\$3.6M one-time</b>) split 2/3rd-1/3rd with SOM. (These are already folded into the 30 number mentioned above)</li><li>• An improved ranking for CEC is one of the most direct enhancers of the reputation of UofSC as it aspires to become AAU eligible. In all public AAU's, the rank of the engineering college leads that of the university (the sole exception being UVA).</li></ul>
<b>Goal Notes</b>	

# Goals - Real Time

## Goal 2 - Excellence in Research and Scholarship

<b>Goal Statement</b>	Promote a culture of excellence, and the infrastructure, which attracts, cultivates, and retains world-class faculty and staff, and which provides all students and post-doctoral researchers with leading-edge opportunities in research.
<b>Linkage to University Goal</b>	<ul style="list-style-type: none"> <li>• Attract, inspire, challenge and enable our students to become innovative thinkers and transformative leaders.</li> <li>• Assemble and cultivate a world-class faculty and staff.</li> <li>• Create new pathways to research excellence to become AAU eligible.</li> <li>• Cultivate a more diverse, equitable, and inclusive campus culture where every individual, regardless of background, has the full opportunity to flourish and thrive.</li> <li>• Harness the power, attributes and institutional diversity of an integrated and interoperative university system that enhances access, success and affordability for every eligible SC student.</li> </ul>
<b>Alignment with Mission, Vision, and Values</b>	Fully aligned.
<b>Status</b>	Progressing as expected (multi-year goal)
<b>Action Plan</b>	<ul style="list-style-type: none"> <li>• Hire new faculty in targeted areas that build upon existing research strengths, or create timely areas of research, that develop high-value multidisciplinary research opportunities.             <ul style="list-style-type: none"> <li>◦ we will not cover all fields, but what we do, we will do extremely well. We will attract strong research faculty (possibly jointly appointed).</li> <li>◦ ensure the senior hires have a track record of effective mentorship, and continuously funded programs.</li> <li>◦ promote shared governance.</li> </ul> </li> <li>• Support and resource existing research active faculty.</li> <li>• Create critical mass in areas of strength.</li> <li>• Incentivize and support (inter-college and other) collaborative and large projects having high societal impact:             <ul style="list-style-type: none"> <li>◦ in materials, informatics, data science, robotics, AI, electrochemistry, catalysis, water resources and environment, education, assessment, etc.</li> </ul> </li> <li>• Invest in infrastructure and graduate student support through research startups.</li> <li>• Continue to offer and improve the PI Academy.</li> <li>• As much as possible, leverage existing equipment and capabilities to attract new faculty.</li> </ul>
<b>Achievements</b>	<ul style="list-style-type: none"> <li>• CEC is doing its part to make UofSC become AAU eligible.</li> <li>• Had a third faculty member elected to the NAE in as many years, and added a fourth one as special advisor to the dean.</li> <li>• Hired 35+ new TTT faculty (since 2016) in targeted areas that build upon existing research strengths, or create timely areas of</li> </ul>

# Goals - Real Time

	<p>research, that develop high-value multidisciplinary research opportunities.</p> <ul style="list-style-type: none"> <li>• Most of the graduate programs were reviewed externally through a virtual process of collecting data, and making videos for the labs and our research. We have a few more to complete.</li> <li>• The UofSC AI Institute is moving along:             <ul style="list-style-type: none"> <li>◦ Hired Professor Sheth, as the Founding Director of the UofSC AI Institute. (Per Google Scholar) <b>Professor Sheth has the highest impact of publication of all UofSC faculty</b>, helping elevate the university on that important metric.</li> <li>◦ Hired IBM Senior Data Scientist, Dr. Biplav Srivastava, and hired a diverse slate of junior faculty.</li> <li>◦ Added 10,000 sq. ft. iconic space atop the west tower of the old law school.</li> </ul> </li> <li>• Supported and incentivized large, multidisciplinary proposals:             <ul style="list-style-type: none"> <li>◦ Starting from \$18M/year in FY16, CEC finished FY20 at \$30M+ in research awards, and is on track for higher this year.</li> </ul> </li> <li>• Incentives through return of indirect funds, allocation of CEC-supported graduate students, and creation of central pool of funds for maintenance of large and shared</li> </ul>
<p><b>Resources Utilized</b></p>	<ul style="list-style-type: none"> <li>• Market-competitive startups, and adequate square footage:             <ul style="list-style-type: none"> <li>◦ CEC has acquired 70,000 additional square feet since 2016 (40,000 for CSE+IIT, 20,000 in SCRA building, and 10,000 atop the old Law School, with another 10,000 to follow).</li> </ul> </li> <li>• A third of the IDC is returned to the departments, for generous sharing with the PIs.</li> <li>• Significant proactive retention steps every year.</li> <li>• Continued position of Associate Dean for Research, with focus on coalescing and supporting large interdisciplinary teams and partners to put through large proposals, and increase awards.</li> <li>• New position of Proposal Development Director to coordinate proposals for large multidisciplinary research teams.             <ul style="list-style-type: none"> <li>◦ 3 NASA ULIs (\$5-6M), two large (\$10M/year) ONRs, etc.</li> </ul> </li> <li>• Significantly expanded pre-awards group from zero to four FTEs (identification of opportunities and teaming, preparation, submission).</li> <li>• Significantly expanded post awards group (awards management tools, including a real-time app for the PIs to monitor balances, burn-rates, encumbrances, and deadlines).</li> </ul>
<p><b>Goal Continuation</b></p>	
<p><b>Goal Upcoming Plans</b></p>	<ul style="list-style-type: none"> <li>• Once the actual details of the new budget model are known (including the rubrics for the allocation of the strategic funds), re-develop a hiring plan to build up the size of the faculty (across all ranks), similar to what was in place prior to the excellence initiative.</li> <li>• Continue to shepherd the large research programs that are near being awarded.</li> </ul>

# Goals - Real Time

	<ul style="list-style-type: none"> <li>• Continue to seed or identify new large initiatives for the College.</li> <li>• Work with the Architect to start on the Phase-2 10,000 sq.ft. space for the UofSC Artificial Intelligence Institute.</li> </ul>
<p><b>Resources Needed</b></p>	<ul style="list-style-type: none"> <li>• <b>Continuation of some form of matching funds is needed to provide for startups.</b> <ul style="list-style-type: none"> <li>◦ <u>every</u> hire in CEC requires a very significant startup. We are the <b>only</b> college which has this characteristic (whereas some chemistry or physics hires can be expensive, they add up to a much lower value when averages across CAS).</li> </ul> </li> <li>• FRIP and other similar incentives should be continued, and <i>not be taxed</i> under the new model.</li> <li>• Wet and specialized lab space remain at a premium and present a significant expense to the college. Continued help from the university and foundation is needed. There needs to be flexibility in the types of funds that can be used to pay rent for space in non-university property.</li> </ul>
<p><b>Goal Notes</b></p>	<ul style="list-style-type: none"> <li>• Our hiring has slowed down because of the <b>significant</b> uncertainty in the CEC budget under the new model.</li> </ul>

# Goals - Real Time

## Goal 3 - Sustainability of CEC Mission

<b>Goal Statement</b>	Keep the College on sound financial and administrative footing to sustain the goals in teaching, research/scholarship, and service. This goal underpins all other goals.
<b>Linkage to University Goal</b>	<ul style="list-style-type: none"> <li>• Attract, inspire, challenge and enable our students to become innovative thinkers and transformative leaders.</li> <li>• Assemble and cultivate a world-class faculty and staff.</li> <li>• Harness the power, attributes and institutional diversity of an integrated and interoperative university system that enhances access, success and affordability for every eligible SC student.</li> </ul>
<b>Alignment with Mission, Vision, and Values</b>	Enables the Mission, and the Vision.
<b>Status</b>	Progressing as expected (multi-year goal)
<b>Action Plan</b>	<ul style="list-style-type: none"> <li>• Align with the new budget model.</li> <li>• Expand the number of TTT faculty significantly.</li> <li>• Continue investing in the undergraduate laboratories, pre-awards office personnel, professional advising and student services, TA support, lecturer support (moving toward elimination of TA-taught courses/sections).</li> <li>• Continue seeking and establishing national and international partnerships.</li> <li>• Return of 30% of the overhead to the department, and 1/3rd thereof to the faculty in further support of their research.</li> <li>• Finalize development of departmental budgets, with some elements of hybrid RCM.</li> </ul>
<b>Achievements</b>	<ul style="list-style-type: none"> <li>• Working to optimize the alignment with the new budget model.</li> <li>• While we have slowed down the hiring rate as we navigate through the budget model uncertainties, we are now interviewing for critical need areas.</li> <li>• Continued investing in the undergraduate laboratories, pre-awards office personnel, professional advising and student services, TA support, lecturer support (moving toward elimination of TA-taught courses/sections).</li> <li>• Finalizing the partnership with NUST in Oman.</li> <li>• Returned of 30% of the overhead to the department, and 1/3<sup>rd</sup> thereof to the faculty in further support of their research.</li> </ul>
<b>Resources Utilized</b>	<ul style="list-style-type: none"> <li>• Faculty lines</li> <li>• Competitive startups             <ul style="list-style-type: none"> <li>◦ graduate student support</li> <li>◦ summer salary</li> <li>◦ equipment</li> </ul> </li> <li>• Space, including investment to acquire, update, renovate, as the case may be</li> </ul>

# Goals - Real Time

<b>Goal Continuation</b>	This goal remains in effect every year.
<b>Goal Upcoming Plans</b>	<p>Detailed in the appropriate section but this year we have a specific goal:</p> <ul style="list-style-type: none"> <li>• Using our Biomedical Engineering Program as a springboard, create a Biomedical Engineering Department. <ul style="list-style-type: none"> <li>◦ <b>justification is provided under a separate goal</b></li> <li>◦ <b>Letters of support are located in Appendix 8</b></li> </ul> </li> </ul>
<b>Resources Needed</b>	<ul style="list-style-type: none"> <li>• In order to lower the UG/TTT to 20, a significant level of hiring of TTT faculty is needed (30+) with a startup of \$18M+: <ul style="list-style-type: none"> <li>◦ Central help, in direct form, or indirect form (returning of the IDC on large contracts/grants) would be needed.</li> </ul> </li> <li>• To cover 24 Honors specific sections need to hire more instructors: <ul style="list-style-type: none"> <li>◦ Central help with lab, office-space needs, and startups.</li> </ul> </li> <li>• <b>For creating Biomedical Engineering Department:</b> <ul style="list-style-type: none"> <li>◦ Six new hires (4 in CEC and 2 in SOM) with \$960K/yr recurring, and \$3.6M one-time startups.</li> </ul> </li> <li>• <b>Expand FRIP to very large multi-PI proposals</b>, so that colleges can afford to hire the personnel that are needed to ensure the success of the program, as well as building capacity to create new programs.</li> <li>• <b>Would be highly strategic and desirable if the IDC to the colleges was not figured into the tax for central services.</b> If the goal of the university is to grow research, then there need to be strategic decisions along these lines.</li> </ul>
<b>Goal Notes</b>	

# Goals - Real Time

## Goal 4 - Sustainability of the Mission: Converting the Biomedical Engineering Program into the Biomedical Engineering Department

<b>Goal Statement</b>	<p>Leverage the existing strengths of the Biomedical Engineering <b>Program</b>, coupled with a strategic hiring plan between the College of Engineering and Computing (CEC) and the School of Medicine (SOM) to create a Biomedical Engineering <b>Department</b> within CEC. The new department will enhance the research portfolios and national recognition of both CEC and SOM, and amplify ongoing efforts to improve the sustainability and educational mission of all four Biomedical Engineering degree programs.</p> <p>Benefits to the University and the State</p> <ul style="list-style-type: none"><li>• <b><i>It is vital for a successful SOM to have a vibrant Biomedical Engineering Department to interact.</i></b></li><li>• <b><i>Of the 63 AAUs with medical schools, all but one have a BME department.</i></b></li><li>• <b><i>A BME department, as opposed to a program, can attract much more diverse faculty and students.</i></b></li><li>• A Biomedical Engineering Department would have <b><i>increased stature at large funding agencies</i></b>: the perceived "environment" is a critical aspect of proposal reviews.</li><li>• Co-location of faculty will improve the quantity and quality of collaborative proposals, as well as awareness of funding opportunities.</li><li>• Appointing faculty within a Biomedical Engineering Department will <b><i>revitalize the Biomedical Engineering graduate program</i></b> in terms of student numbers and recruiting - we will be a more attractive destination</li><li>• A Biomedical Engineering Department <b><i>will create a consistent set of expectations for junior faculty</i></b>, which is missing in the current program structure. Such a change would increase the effectiveness of junior faculty in all areas. Mentoring of junior faculty would be vastly improved.</li><li>• A Biomedical Engineering Department would be a more attractive destination for talented junior hires and experienced senior hires.</li><li>• The administrative burden of a 260+ undergraduate student population could be streamlined, as service to the department would be well-defined in faculty contracts and easy to assign and assess; this streamlined administration would benefit the accreditation process.</li><li>• Formation of a department would naturally lead to a growth in faculty number, so we could effectively administer and manage a larger undergraduate student population.</li><li>• <b><i>We would become the first Biomedical Engineering department in the state</i></b>, Clemson has a Bioengineering Department, and we could use this as a college selling point.</li><li>• A Biomedical Engineering Department would be able to better establish formal partnerships with UofSC's colleges/departments</li></ul>
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# Goals - Real Time

	<p>such as Biology, Pharmacy, and Nursing in order to allow translation and integration of projects and ideas developed within Biomedical Engineering.</p> <ul style="list-style-type: none"> <li>• A stand-alone Biomedical Engineering Department will allow seamless collaborations and interactions between UofSC and Industry. These interactions could also facilitate the integration of industry and clinical educational components, such as graduate student rotations and fellowships at industry sites.</li> </ul> <p>A Biomedical Engineering Department would be a more visible and cohesive entity to engage clinical and provider partners in terms of applying and supporting Biomedical Engineering in strategic and thematic areas affecting South Carolina citizens: cardiovascular disease, neurodegenerative/cognitive disorders, and cancer.</p>
<p><b>Linkage to University Goal</b></p>	<ul style="list-style-type: none"> <li>• Attract, inspire, challenge and enable our students to become innovative thinkers and transformative leaders.</li> <li>• Assemble and cultivate a world-class faculty and staff.</li> <li>• Create new pathways to research excellence to become AAU eligible.</li> <li>• Cultivate a more diverse, equitable, and inclusive campus culture where every individual, regardless of background, has the full opportunity to flourish and thrive.</li> <li>• Harness the power, attributes and institutional diversity of an integrated and interoperative university system that enhances access, success and affordability for every eligible SC student.</li> </ul>
<p><b>Alignment with Mission, Vision, and Values</b></p>	<p>This goal aligns with the UofSC’s mission, vision, and values.</p>
<p><b>Status</b></p>	<p>Newly Established Goal</p>
<p><b>Action Plan</b></p>	<ul style="list-style-type: none"> <li>• Provide a biomedical-engineering tenure home so that the faculty will have:             <ul style="list-style-type: none"> <li>◦ undivided commitment, and</li> <li>◦ autonomy in creating research direction.</li> </ul> </li> <li>• Grow the faculty core, in strategic areas of focus, to achieve the critical mass to support:             <ul style="list-style-type: none"> <li>◦ collaborative research,</li> <li>◦ a strong graduate program, and</li> <li>◦ the teaching needs of the four degree programs.</li> </ul> </li> <li>• Hire jointly with SOM:             <ul style="list-style-type: none"> <li>◦ 4 in CEC and 2 in SOM: three with 100% FTE’s in home colleges, and three at 70-30.</li> <li>◦ There are currently:                 <ul style="list-style-type: none"> <li>▪ 13 TTT faculty, 3 instructors, and 2 admin staff in CEC</li> <li>▪ 7 TTT faculty, and 2 instructors in SOM</li> </ul> </li> </ul> </li> <li>• Enhance integration into existing UofSC initiatives by leveraging:             <ul style="list-style-type: none"> <li>◦ Artificial Intelligence Institute</li> <li>◦ Research Center for Transforming Health, and</li> </ul> </li> </ul>

# Goals - Real Time

	<ul style="list-style-type: none"> <li>◦ Cardiovascular Translational Research Center.</li> </ul> <p>Hiring areas:</p> <ol style="list-style-type: none"> <li>0) SmartState Advanced Tissue Biofabrication Endowed Chair (Full)</li> <li>1) Cardiovascular Mechanics / Modeling (Full/Associate/Assistant)</li> <li>2) Cardiotoxicity / Big Data (Full/Associate/Assistant)</li> <li>3) Biomaterials for Localized Delivery / Regenerative Medicine (Full/Associate/Assistant)</li> <li>4) Neuromodulation / Device (Full/Associate/Assistant)</li> <li>5) Protein Science / Diagnostics (Full/Associate/Assistant)</li> <li>6) Biomanufacturing (Full/Associate)</li> </ol>
<p><b>Achievements</b></p>	<p>We will focus on achievements made by the Biomedical Engineering <b>Program</b>, which have laid the groundwork for the future success of the <b>Department</b>. The Biomedical Engineering Program at UofSC was formed in 2006 in response to initiatives at the state and university levels requiring expertise in biomedical engineering. Creation of the program brought together a number of faculty throughout UofSC engaged in biomedical research to create an education infrastructure for BS, MS, and PhD degrees; an ME degree was added in 2014. Programmatic efforts have been supported internally as well as externally by a Research Infrastructure Improvement (RII) grant from the National Science Foundation, awarded in 2004, as well as an Institutional Development Award (IDeA) Networks of Biomedical Research Excellence (INBRE) grant from the National Institutes of Health, awarded in 2009. These grants were renewed in 2009 and 2015, respectively, providing additional support.</p> <p>Since 2006, <b><i>the faculty associated with the program has grown to include contributions of 20 tenure/tenure-track faculty and 5 instructors, who contribute to the program in varying degrees as a result of commitments to their home departments.</i></b> In parallel, enrollment at the undergraduate level has risen to over 260 students, while enrollment at the graduate level has grown to between 10 and 15 students. Faculty research expertise has developed in areas of <b><i>biomaterials, biocomputation, biomolecular, and biomechanics.</i></b></p> <p>The proposed goal to transition to a Department harnesses the existing faculty excellence at the SOM/CEC into more focused and productive research thematic areas that will enhance the clinical, academic and teaching missions, strengthen UofSC SOM, and address relevant health care issues affecting South Carolina citizens. <b><i>All top-ranked SOM's have affiliated with them a vibrant biomedical engineering department.</i></b></p>

# Goals - Real Time

	<p>Existing Strengths</p> <ol style="list-style-type: none"> <li>1. Collaborative teaching and research activities between SOM and CEC</li> <li>2. Complementary thematic research areas of interest in biomaterials (nanoparticles, gels), simulation and bioinformatics, biomarker identification and detection, and cardiovascular development and disease</li> <li>3. Motivated and relatively junior faculty with a collaborative mindset</li> </ol> <p>Areas of Research Competence</p> <ul style="list-style-type: none"> <li>• Cardiovascular engineering - with focus on biomechanics, mechanobiology, and development</li> <li>• Regenerative medicine - with focus on scaffolds and signaling</li> <li>• Protein science - with focus on diagnostics and disease pathogenesis</li> <li>• Computation - with focus on thermodynamic and mechanical theory</li> </ul> <p>While these areas certainly overlap and indeed faculty within these areas have successfully obtained joint funding, there is significant growth potential that is facilitated by the hiring plan. The formation of a department would foster increased collaboration among faculty, enhance our competitiveness for obtaining large grants, and facilitate the identification of gaps in expertise that hamper proposal competitiveness and thus guide future hiring initiatives to fill these gaps.</p>
<b>Resources Utilized</b>	There have been no resources directed toward this goal at this time.
<b>Goal Continuation</b>	This proposed goal is (officially) new.
<b>Goal Upcoming Plans</b>	We will initiate the hiring plan outlined in the "Action Plan" and "Notes" sections Faculty lines. Networks to be leveraged in this hiring plan, including those with the Cardiovascular Translational Research Center, the Artificial Intelligence Institute, and the Research Center for Transforming Health, have already been established.
<b>Resources Needed</b>	<ul style="list-style-type: none"> <li>• Faculty lines, as described in the hiring plan</li> <li>• Competitive startup funding</li> <li>• Laboratory space appropriate for biomedical research</li> <li>• Office space in which to consolidate Biomedical Engineering faculty</li> </ul>
<b>Goal Notes</b>	<p><b><u>External Support</u></b></p> <p>We attach four outside letters ( as Appendix 8) from nationally recognized Biomedical Engineering Department Chairs that supporting our efforts to transform Biomedical Engineering into a</p>

# Goals - Real Time

department at UofSC.

- Dr. Noshir Langrana from Rutgers
- Dr. Samir Ghadiali from The Ohio State University
- Dr. Kaiming Ye from Binghamton University, who is also Chair-elect of the Council of Chairs of the Biomedical Engineering Society
- Dr. Raphael Lee (NAE), University of Chicago

These letters outline the advantages of creating a Biomedical Engineering Department and the limitations to administration of Biomedical Engineering via a program. Some key points include:

- Biomedical Engineering is widely recognized as a separate engineering discipline, with numerous departments existing to represent this discipline.
- Programs (vs. departments) impede the ability to create autonomous research direction and to recruit top faculty, thus formation of a department is critical to the effective execution of a hiring plan.
- Programs (vs. departments) impede the ability to develop a strong graduate program.
- Formation of a department has been associated with increased enrollments, enhanced ease of accreditation, and elevated levels of collaboration.
- Formation of a department will elevate competitiveness for research funding, particularly NIH funding.
- Formation of a department will allow Biomedical Engineering at UofSC to become a nationally recognized and respected academic unit.

# Goals - Looking Ahead

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Goals for the next Academic Year.

## **Goals - Looking Ahead**

**No goals have been entered for this section.**

# Academic Programs

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## Program Rankings

*Academic programs that were nationally ranked or received external recognition during the Academic Year.*

The 2021 US News graduate rankings for the College are still not out. Last year we were ranked 102nd among PhD-granting universities. The level of noise to signal is quite high in our neighborhood of the rankings. Among public universities, we have risen from 79th to 67th. Our performance numbers would have us placed 20-30 places better. However, we continue to suffer from low peer and recruiter scores, mostly due to our past inadequate communications and marketing activities. This past year we had significant investment in our web (launched a completely revamped website) and communications and marketing, to broadcast the significant successes of the college, such as 4th NAE member in 4 years, which is Ivy-league territory. We will wait to see how/when these efforts will bear fruit. The highest-ranked programs in the College are chemical engineering (66th, 38th among publics) and nuclear engineering (21st, 17th among publics). Strategic investments (and partnerships) are envisioned to leverage the College in niche areas, such as nuclear and aerospace. The SRNL partnership will help nuclear engineering.

## Instructional Modalities

*Innovations and changes to Instructional Modalities in unit's programmatic and course offerings that were implemented during the Academic Year.*

- Lecture-capture facilities were incorporated into all classrooms and three instructional computer labs.
- A CEC task force was created and made recommendations for effective online delivery of CEC courses.
- All ITEC courses required for the BS IIT degree were approved for distributed learning delivery.
- Distributed learning delivery proposals have been submitted for most of the CSCE courses required for the BS degrees in CS, CIS and CE, and selected EMCH, ECHE, and ECIV course. We envision more of our summer course offerings will be online to assist students on internships or living at home.
- COVID-19 risk mitigation restricted class size. Some faculty choose online delivery to mitigate personal risk. Emphasis to offer both face-to-face and online instructional modalities was placed on progression-critical undergraduate classes.

## Program Launches

*Academic Programs that were newly launched during the Academic Year; those that received required approvals but which had not yet enrolled students are not included.*

- Artificial Intelligence Graduate Certificate
- Chemical Engineering Minor

## Program Terminations

*Academic Programs that were newly terminated or discontinued during the Academic Year.*

# Academic Programs

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None

# Academic Initiatives

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## Experiential Learning For Undergraduates

*Initiatives, improvements, challenges, and progress with Experiential Learning at the Undergraduate level.*

- Modernizing and upgrading the undergraduate laboratories and curricula (\$500K/year)
- Built and soft-opened a Rapid Prototyping Laboratory in Swearingen. This makerspace is scheduled for open access to all CEC students starting Fall 2021.
- Expanding on the existing required capstone-design experience of our students, by developing a college-wide capstone design experience which can address more complex and multi-disciplinary projects sponsored by companies. The teams will be drawn from multiple departments in CEC, or from other colleges as well. Today more than 50 of the projects are sponsored by funds from industry. The goal is to expand to over 90 next year.
- Pathways for Graduation with Leadership Distinction in Research are well-established and include applicable CEC coursework. This year we identified applicable coursework that we can offer that meets the expectations of other GLD pathways in all majors.
- Undergraduate Research: Many undergraduates participate in research but do not pursue GLD.
- Co-ops and Internships: CEC provides space and collaboration with the university Career Center to house a satellite office in Swearingen. This office focuses on engineering and computing students and the companies that hire them, and facilitates co-op and paid internship placements. An ongoing challenge is expanding the number and types of co-op and internship opportunities.
- McNair Junior Fellows Program: This highly selective program brings about 40-50 undergraduates into McNair Center and engages them in research for 5-10 hours per week. The students get real-world experience in research; many publish papers or give presentations and many also work closely with the sponsors of the research projects. The summer 2020 on-campus research experience was put to a halt because of COVID-19, but we had a mini MJF program where we supported about 15 students do remotes research.

## First Generation Students

- Created SPUR program for first-generation low-income engineering and computing students with \$1M grant support from the National Science Foundation. SPUR provides substantial scholarships and year-round support.
- Received private gift to initiate CEC Summer Start for 20 first-gen students (and another 20 next year) , which will include a three-week residential program including a Carolina Core class and activities promoting student engagement and success. These students will also each receive four years of scholarships (~\$1,000/year).

## Experiential Learning For Graduate Students

*Initiatives, improvements, challenges, and progress with Experiential Learning at the Graduate or Professional level.*

A graduate degree in engineering or computing, unless it is purely-course-based, by definition has a significant experiential learning component in the form of a thesis, dissertation, or project. As we continue to bring on board research active faculty who establish new research areas and new laboratories, we will continue to expand the options for our graduate students. Furthermore, we provide opportunities for collaborative research with international institutions.

# Academic Initiatives

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## Affordability

*Assessment of affordability and efforts to address affordability.*

- At the graduate level, with the exception of self-paid masters students (not large in number), the rest of the students receive some level of stipend and tuition support. The packages are competitive so that we can attract them to USC.
- At the undergraduate level, the good students from within or outside of the state have access to full-ride scholarships (some with stipends). In addition to many other university and state level scholarships, the College itself hands out close to \$500,000 in scholarships annually to over 500 students.
- UofSC CEC provides the top-ranked (by NRC) programs in the state, without being the most expensive: For CEC the tuition plus the fees are lower than the tuition alone for Clemson University, which has significant fees of its own.
- The average starting salary for CEC graduates has increased by nearly \$10K since 2016, now at \$68K, with near 90% placement, thereby making the CEC degree not only affordable, but a great investment. The salaries are exactly in line with those of Georgia Tech and NC State graduates.

## Reputation Enhancement

*Contributions and achievements that enhance the reputation of UofSC Columbia regionally and nationally.*

- Hiring world-class faculty, and attracting great students
- Nominating the faculty and students for awards, and winning these
- We had a third faculty member elected to the National Academy of Engineering (NAE). Three more are nominated currently, and we are in conversations with several more to attract them to USC.
- Engaging and partnering with local and regional industry, schools, and the state government
- Engaging and partnering with other universities, and national labs
- Development of national and international collaborations with institutions all over the globe to enhance reputation

## Challenges

*Challenges and resource needs anticipated for the current and upcoming Academic Years, not noted elsewhere in this report and/or those which merit additional attention.*

These were noted, but listed again:

- Startup in engineering is expensive. Also space is short on quantity and quality. More help is needed centrally.
- Short on lab space, and computer classroom space
- Insufficient large classrooms, or technologically-enhanced spaces to accommodate large classes, on the west side of the campus

# Faculty Population

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## Faculty Employment by Track and Title

The following data was provided by UofSC's Office of Institutional Research, Assessment, and Analytics.

**Table 1. Faculty Employment by Track and Title.**

	Fall 2020	Fall 2019	Fall 2018
<b>Tenure-track Faculty</b>	125	122	117
Professor, with tenure	56	53	50
Associate Professor, with tenure	43	44	44
Assistant Professor	26	25	23
Librarian, with tenure	0	0	0
<b>Research Faculty</b>	15	13	14
Research Professor	5	4	4
Research Associate Professor	1	1	0
Research Assistant Professor	9	8	10
<b>Clinical/instructional Faculty</b>	24	22	18
Clinical Professor	0	0	0
Clinical Associate Professor	0	0	0
Clinical Assistant Professor	0	0	0
Instructor	24	22	18
Lecturer	0	0	0
Visiting	0	0	0
<b>Adjunct Faculty</b>	23	22	24

# Faculty Population

## Faculty Diversity by Gender and Race/Ethnicity

Note: UofSC follows US Department of Education IPEDS/ National Center for Education Statistics guidance for collecting and reporting race and ethnicity. See this link: [https://nces.ed.gov/ipeds/Section/collecting\\_re](https://nces.ed.gov/ipeds/Section/collecting_re)

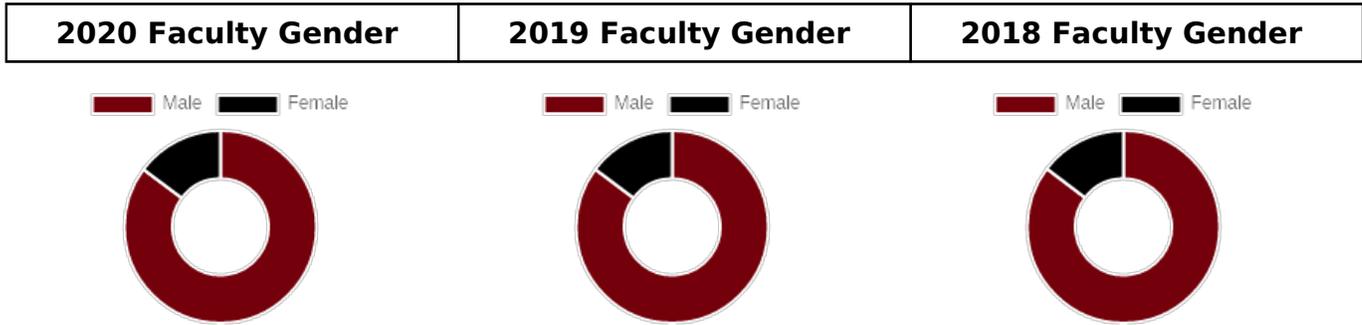
**Table 2. Faculty Diversity by Gender and Race/Ethnicity.**

	Fall 2020	Fall 2019	Fall 2018
<b>Gender</b>	189	169	150
Male	161	144	128
Female	28	25	22
<b>Race/Ethnicity</b>	189	169	150
American Indian/Alaska Native	0	0	0
Asian	48	48	46
Black or African American	4	3	2
Hispanic or Latino	6	7	5
Native Hawaiian or Other Pacific Islander	0	0	0
Nonresident Alien	35	17	12
Two or More Races	1	0	1
Unknown Race/Ethnicity	0	0	1
White	95	94	83

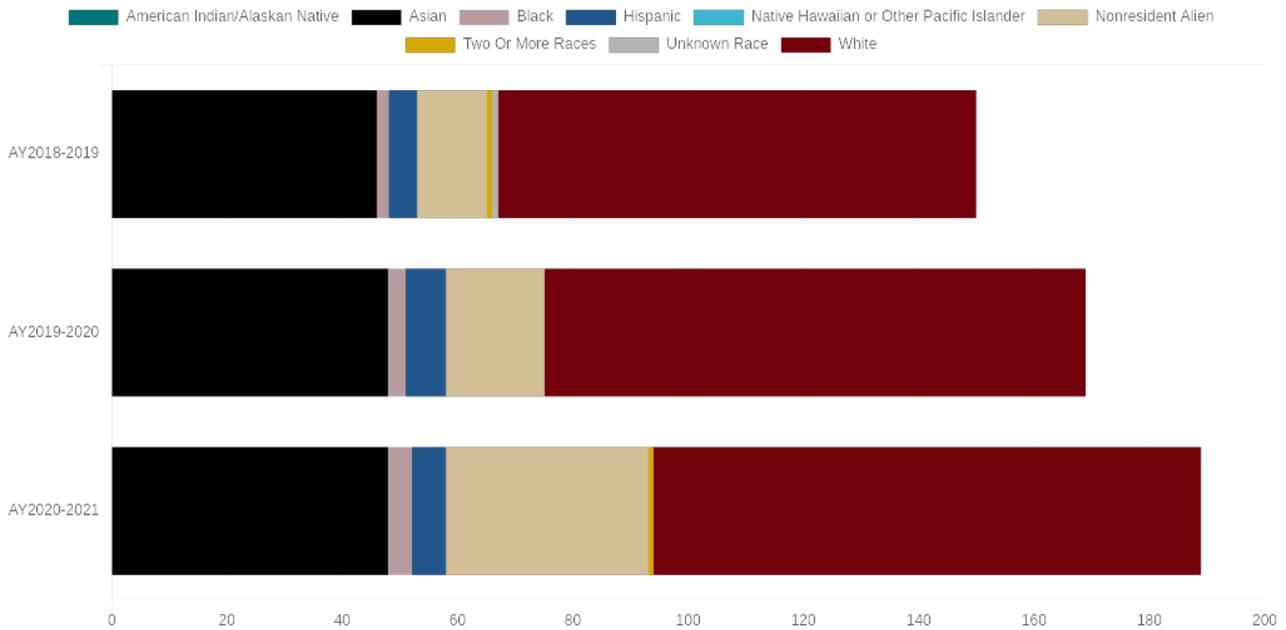
Illustrations 1 and 2 (below) portray this data visually.

# Faculty Population

**Illustration 1. Faculty Diversity by Gender**



**Illustration 2. Faculty Diversity by Race & Ethnicity**



# Faculty Information

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## Research and Scholarly Activity

*Please refer to Appendix 3, which provides detailed information from the Office of the Vice President for Research, department of Information Technology and Data Management, including:*

- 1) The total number and amount of externally sponsored research proposal submissions by funding source for the appropriate Fiscal Year.*
- 2) Summary of externally sponsored research awards by funding source for the appropriate Fiscal Year. Total extramural funding processed through Sponsored Awards Management (SAM) in the Fiscal Year, and federal extramural funding processed through SAM in the Fiscal Year. (Available at: <http://sam.research.sc.edu/awards.html>) Amount of sponsored research funding per faculty member for the appropriate fiscal year (by rank, type of funding; e.g., federal, state, etc., and by department if applicable).*
- 3) Number of patents, disclosures, and licensing agreements for three most recent Fiscal Years.*

## ACADEMIC ANALYTICS STUDY

Please see Appendix 1

## Faculty Development

*Efforts at Faculty Development, including investments, activities, incentives, objectives, and outcomes.*

The college continued its cross-departmental approach to faculty searches and hires in the prior year, with searches organized across technical focus areas. In particular, we retained a robust rate of hiring for USC AI Institute to continue to meet our commitments to that Institute. We are currently searching for aerospace faculty to support the nascent but well-subscribed aero BS program, which remains the sole aero program in the state. Also in two departments we have new internal chairs, and our BME program has a new director. **Two of the six chairs in CEC are female**, representing a significantly higher fraction compared with the make-up of the overall faculty. We are initiating another internal search for chair of electrical engineering.

CEC has continued efforts to form inter-college and inter-university teams to pursue large interdisciplinary research projects. Several pre-proposals have been submitted for significant multidisciplinary efforts including DoD MURIs, NSF MRIs, NSF ERCs, NSF COPE, NASA University Led Initiatives, NASA HiCAM, and others, as well as conversations with and real and virtual visits by DoD program managers, including the Office of Naval Research and the Army Futures Command. We have had several successes to date. In-person discussions with the National Center for Credibility Assurance have likewise been initiated and continue. The College organized a workshop for the Office of Naval Research that led to the establishment of a Naval-X Technology Bridge based at the Naval Information Warfare Center in Charleston. Professor Srihari Nelakuditti in the Department of Computer Science has been awarded an NSF Major Research Instrumentation grant to build a laboratory facility to allow investigators to ascertain “ground truth” measurements. A NASA ULI grant (\$5.7M) has been awarded with UofSC as the lead institution and a second has been awarded with UofSC as a supporting

# Faculty Information

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institution. A significant award (\$2M) has been received from the Army Research Office in the area of fundamental microscopy. JR Regalbuto of Chemical Engineering has submitted an NSF MRI. Dr. Kevin Huang has submitted a significant DOE EPSCoR proposal. Professor Amit Sheth received an NSF Planning Grant to enable pursuit of a significant Center proposal and has submitted a major NSF proposal (\$11M) as an outcome. Professor Chaudhry is proposing a significant award related to protection of levees and is in discussion with an established water institute. The college has hosted multiple meetings with various organizations from the U.S. Army and continues discussions about major initiatives in relation to energy.

## Supplemental Info - Faculty Information

*Any additional information on Faculty Information appears as 'Appendix 1. Faculty Information' (bottom).*

# Teaching

## Faculty to Student Ratio

The following data was provided by UofSC's Office of Institutional Research, Assessment, and Analytics.

The formula used to compute the ratio uses data from Faculty Population by Track and Title and Student Enrollment by Time Basis, as follows:

$$\frac{\text{(Total Full-time Students + 1/3 Part-time Students)}}{\text{((Total Tenure-track Faculty + Total Research Faculty + Total Clinical/Instructional Faculty) + (1/3 Adjunct Faculty))}}$$

## Analysis of Ratio

Analysis of the ratio, agreement with the data, and plans for the future to impact this ratio. The goal at the start of my deanship was to reverse the alarming trend in our student/faculty ratio. Using the nationally normed metric of undergrad students to TTT faculty our numbers from 2015, 2016, 2017, 2018, 2019, 2020 are: 24.5, 26.8, 27.0, 26.0, 26.2, and 24.6. In other words, our student enrollment increased faster than our net faculty growth. The college has also added 22 full-time instructors, so that the student to total faculty ratio is 21.1. But the nationally normed ratio is students to TTT faculty. Therefore CEC needs more resources to hire faculty. Incidentally, the formula used in the blueprint exercise has no relevance to CEC. Inclusion of adjuncts, research faculty, and part-time students are not relevant to how engineering and computing programs measure their student to faculty ratios.

**Table 4. Faculty-to-Student Ratio.**

	<b>Fall 2020</b>	<b>Fall 2019</b>	<b>Fall 2018</b>
<b>Analysis of Ratio</b>	01:17.4	01:21.6	01:21.8

# Student Recruiting and Retention

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## Student Recruitment

*Efforts, including specific actions, to recruit students into College/School programs.*

### **Undergraduate Recruitment:**

- Presentations to students at K-12 schools, in classrooms and at college and career fairs. Participation was done virtually as needed.
- Participation in high school Robotics competitions.
- Website, Flyers, and Brochures
- College “Daily Tours” provided throughout the year: Daily tours are led by CEC student ambassadors that are trained and supervised by the Director of Outreach and Recruitment.
- Virtual information sessions provided weekly.
- Three “Big Fridays” each semester: Big Fridays include presentations by the Dean and the Director of Outreach and Recruitment, a student panel Q&A, and tours of the departments led by faculty.
- College-Specific Admitted Student Yield Efforts:
  - Email sent to all admitted students by Director of Enrollment Management
  - Letters to families of admitted students sent by Associate Dean.
  - Postcards to Underrepresented Minority admitted students sent by CEC students.
  - Signed postcards to all female admitted students
  - Dean’s Letter to admitted students, crafted by the college’s Associate Dean for Academic Affairs and Director of Enrollment Management.
  - Dean, Associate Deans, Department Chairs, and Faculty participate in Admissions Office events, including Fall Open House, Admitted Student Days, Scholar Socials, Meet the Honors College Social, Carolina Top Scholars Weekend and Out of State Top Scholars Weekend (some done virtually)
- CEC provides hundreds of students with scholarships: Most target new freshmen.
- Articulation Agreements: Transfer student recruitment is facilitated through active articulation agreements with UofSC System campuses, SC Technical Colleges, and several 4-year regional institutions. Two more in the works with SC State University and Claflin University.

### **Graduate Recruitment:**

Senior Associate Dean Mike Matthews is co-PI and co-Director of a new NSF Bridge to the Doctorate award from the Louis Stokes Alliance for Minority Participation. This award, for \$1.075M, will support a cohort of twelve new STEM doctoral students who are from URM groups. The first cohort is now being recruited, for Fall 2020 matriculation. CEC supports recruitment with staff who prepare recruitment materials and who support outreach. CEC hosted a GEM GRAD lab in October 2019, with about 50 URM students in attendance who visited UofSC’s STEM graduate programs. Faculty and staff from across the college attended 10 regional or national meetings to recruit graduate students. These meetings included an annual graduate student fair at Oak Ridge National Laboratory, the National Society of Hispanic Engineers, and the National Society of Black Engineers. CEC welcomed one new GEM Fellow and two Affiliate Fellows in Fall 2019. Also, we have direct internal funds to be used as top-off stipend funding for highly-qualified U.S. citizens and permanent residents who are seeing PhDs in CEC. We call this the CEC Teaching Fellows program, and we recruited our first

# Student Recruiting and Retention

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cohort of 12 Teaching Fellows for Fall 2019.

## Student Retention

*Efforts at retaining current students in College/School programs.*

Undergraduate Retention:

- **New Student Orientation:** The presentation by Associate Dean for Academic Affairs to all incoming students and families is data-driven and focuses on academic success strategies and student engagement recommendations.
- **Hand-Off Advising Model:** CEC uses professional staff advisors for the first two years for freshmen and at least one semester for transfer students to help new students transition successfully. Faculty Advisors advise continuing students to help students connect with their fields of study and career opportunities.
- **Tutoring:** In collaboration with the Student Success Center, the college provides tutoring centers in Swearingen and in the Engineering and Computing Community. CEC currently has the only academic building with a satellite of the Student Success Center.
- **Engineering and Computing Community:** In collaboration with Housing, a CEC Faculty Advisor and the Assistant Dean for Student Services provide linked courses and beyond-the-classroom activities for this themed living-learning community.
- **Student Organizations:** College provides meeting rooms, storage, advisors, administrative, and other support to over 35 CEC-oriented student organizations.
- **Peer Mentorship program:** hundreds of new CEC students are matched with an upper class CEC Peer Mentor to help guide them through their transition into college and their major.
- **Big Wednesday:** The day before classes start, new students interact with representatives of over 30 CEC-orientated student organizations, with the intended outcome of improved student engagement.
- **Events for Current Students:** On-going student professional development and engagement events that are coordinated at the college-level include e-week events, a Women in Engineering and Computing Panel, Dean's Leadership Conversation, and CEC Organizational Leaders Workshop.

# Student Enrollment & Outcomes

The following data was provided by UofSC's Office of Institutional Research, Assessment, and Analytics.

Note: Student enrollment and outcomes data are calculated by headcount on the basis of primary program of student only.

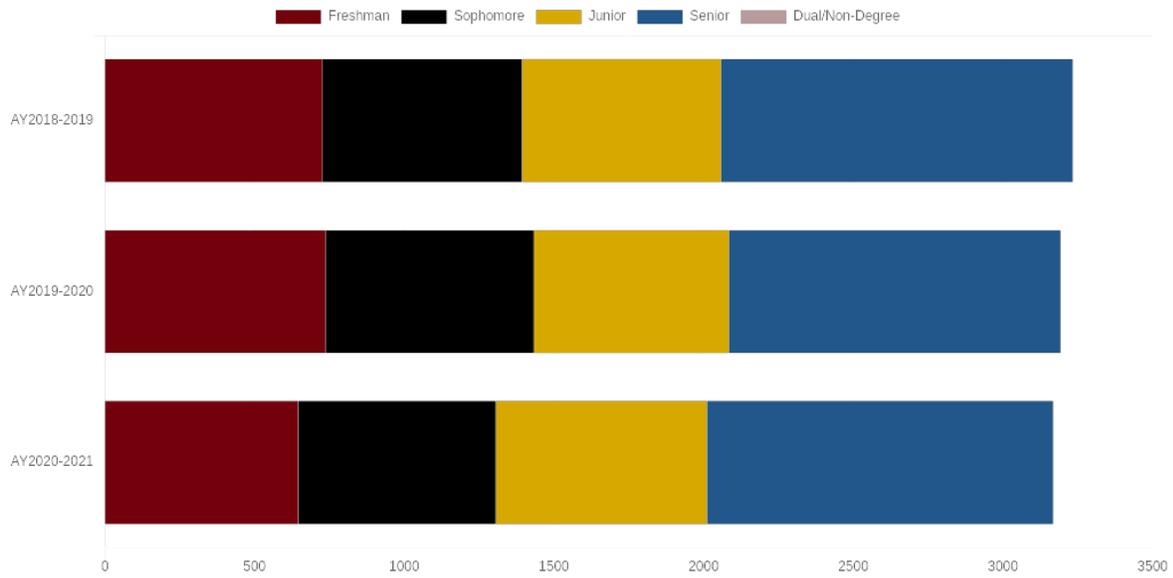
## Student Enrollment by Level & Classification

**Table 5. Student Enrollment by Level & Classification.**

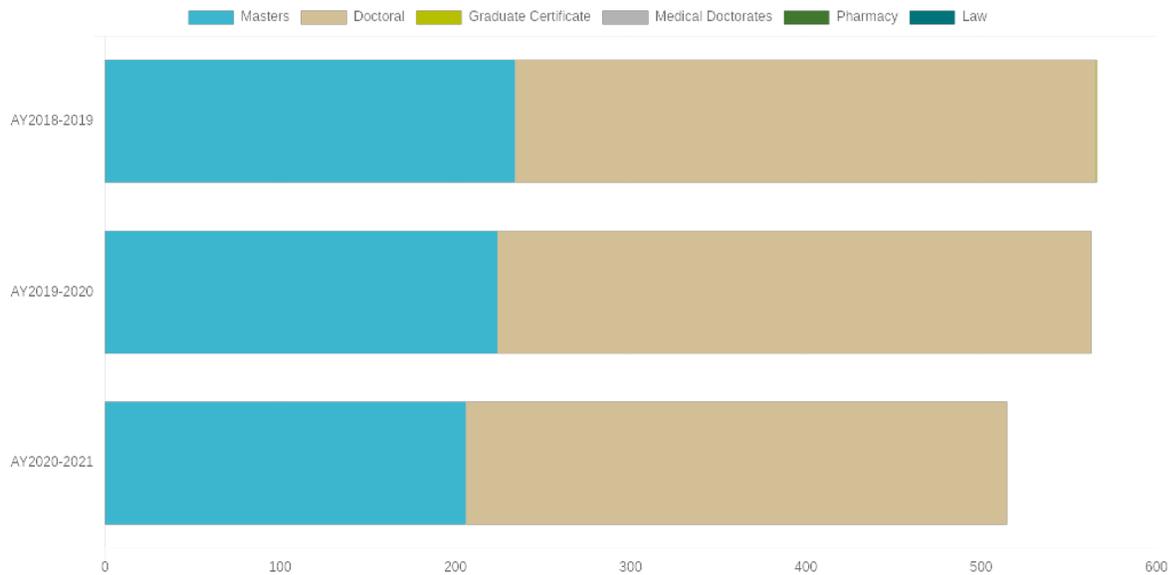
	Fall 2020	Fall 2019	Fall 2018
<b>Undergraduate Enrollment</b>			
Freshman	646	737	727
Sophomore	660	696	666
Junior	705	652	665
Senior	1157	1107	1175
Dual/Non-Degree	0	0	1
<b>Sub Total</b>	3168	3192	3234
<b>Graduate Enrollment</b>			
Masters	206	224	234
Doctoral	309	339	331
Graduate Certificate	0	0	1
<b>Sub Total</b>	515	563	566
<b>Professional Enrollment</b>			
Medicine	0	0	0
Law	0	0	0
PharmD	0	0	0
<b>Sub Total</b>	0	0	0
<b>Total Enrollment (All Levels)</b>	3683	3755	3800

# Student Enrollment & Outcomes

### Illustration 3. Undergraduate Student Enrollment by Classification

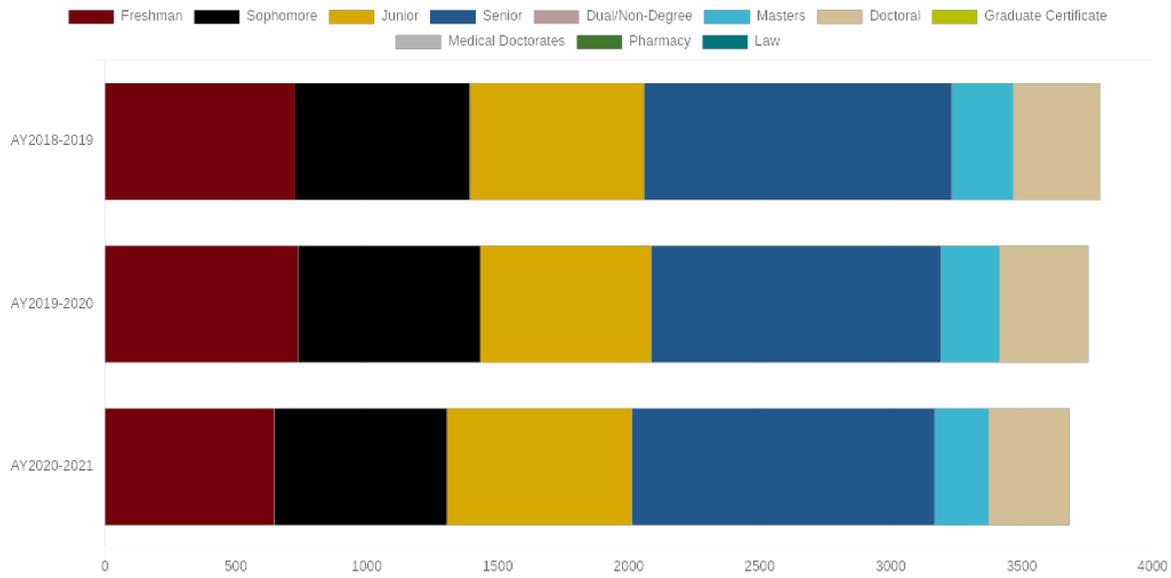


### Illustration 4. Graduate/Professional Student Enrollment by Classification



# Student Enrollment & Outcomes

**Illustration 5. Total Student Enrollment by Classification (All Levels)**



## Enrollment by Time Status

**Table 6. Student Enrollment by Level and Time Status**

	Fall 2020	Fall 2019	Fall 2018
<b>Undergraduate</b>	3168	3192	3234
Full-Time	3030	3056	3091
Part-Time	138	136	143
<b>Graduate/Professional</b>	515	563	566
Full-Time	407	433	410
Part-Time	108	130	156
<b>Total - All Levels</b>	3683	3755	3800
Full-Time	3437	3489	3501
Part-Time	246	266	299

# Student Enrollment & Outcomes

## Student Diversity by Gender

Table 7. Student Enrollment by Gender.

	Fall 2020	Fall 2019	Fall 2018
<b>Undergraduate</b>	3168	3192	3234
Female	684	680	682
Male	2484	2512	2552
<b>Graduate/Professional</b>	516	563	566
Female	142	146	125
Male	374	417	441

Illustration 6. Undergraduate Student Diversity by Gender

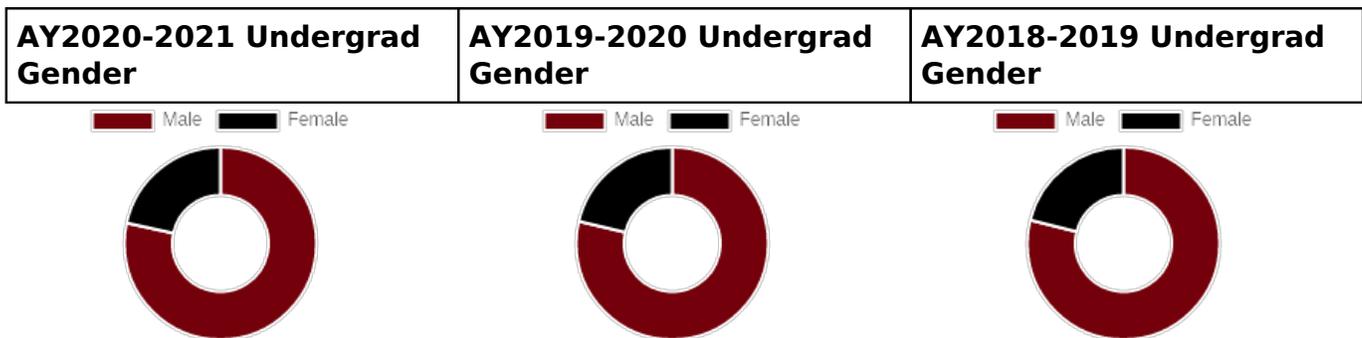
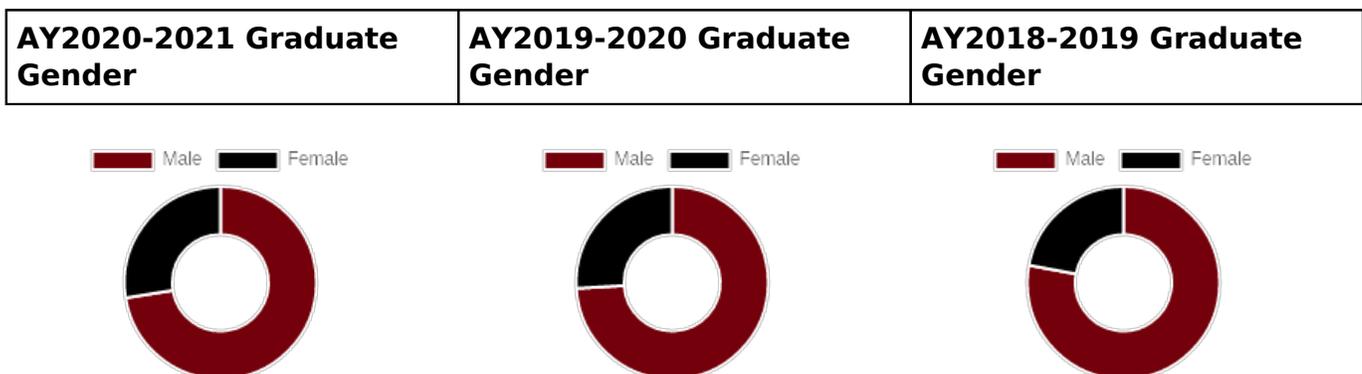


Illustration 7. Graduate/Professional Student Diversity by Gender



# Student Enrollment & Outcomes

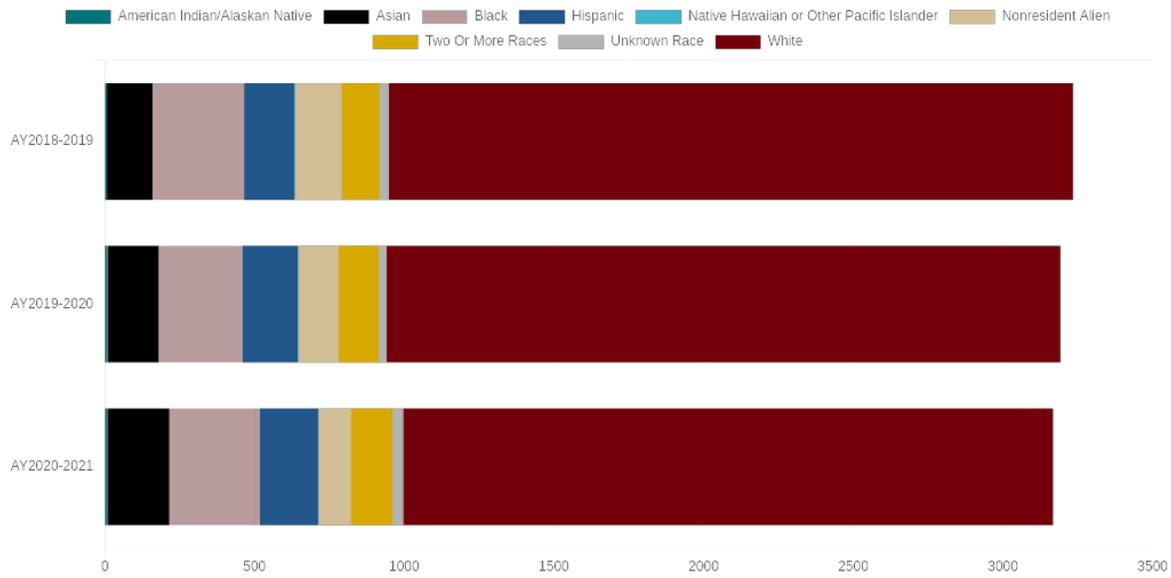
## Student Diversity by Race/Ethnicity

**Table 8. Student Enrollment by Race/Ethnicity**

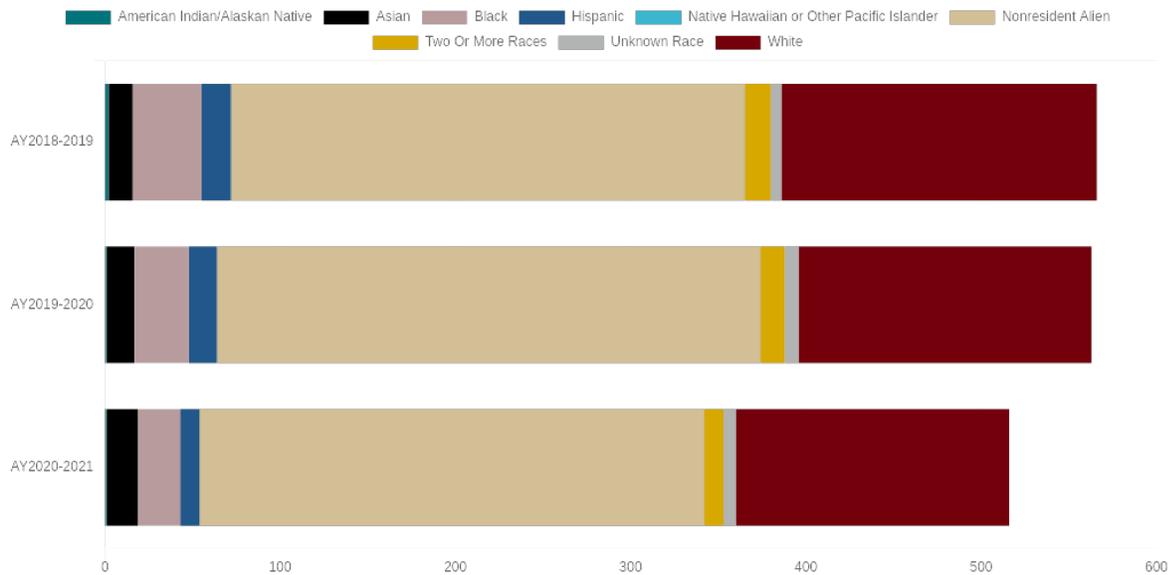
	<b>Fall 2020</b>	<b>Fall 2019</b>	<b>Fall 2018</b>
<b>Undergraduate</b>	3168	3192	3234
American Indian/Alaska Native	8	9	7
Asian	208	172	153
Black or African	302	278	305
Hispanic or Latino	195	186	168
Native Hawaiian or Other Pacific Islander	2	3	4
Nonresident Alien	107	132	153
Two or More Races	139	135	128
Unknown Race/Ethnicity	35	26	30
White	2172	2251	2286
<b>Graduate/Professional</b>	516	563	566
American Indian/Alaska Native	1	1	2
Asian	18	16	14
Black or African	24	31	39
Hispanic or Latino	11	16	17
Native Hawaiian or Other Pacific Islander	0	0	0
Nonresident Alien	288	310	293
Two or More Races	11	14	15
Unknown Race/Ethnicity	7	8	6
White	156	167	180

# Student Enrollment & Outcomes

**Illustration 8. Undergraduate Student Diversity by Race/Ethnicity**



**Illustration 9. Graduate/Professional Student Diversity by Race/Ethnicity**



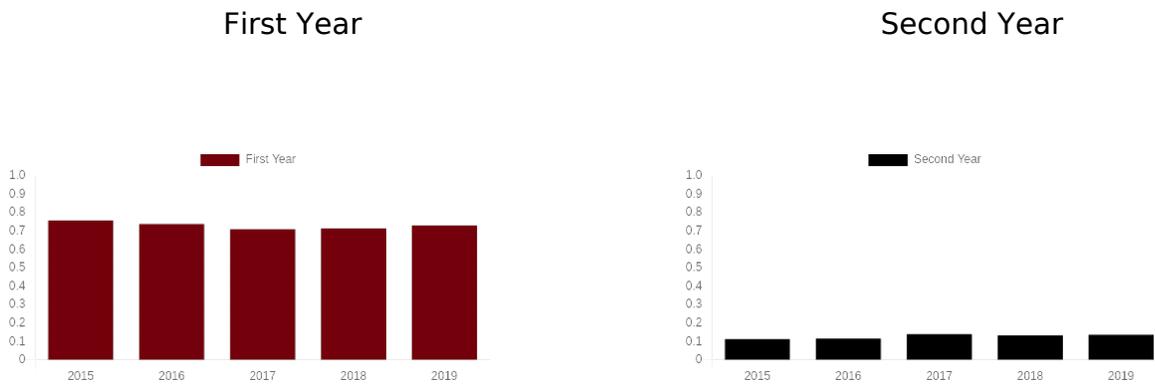
# Student Enrollment & Outcomes

## Undergraduate Retention

**Table 9. Undergraduate Retention Rates for First-time Full-time Student Cohorts**

	<b>First Year</b>	<b>Second Year</b>
<b>Fall 2019 Cohort</b>	73.1%	13.8%
<b>Fall 2018 Cohort</b>	71.5%	13.4%
<b>Fall 2017 Cohort</b>	71.2%	14.2%

Illustration 10. Undergraduate Retention, First and Second Year



## Student Completions

### Graduation Rate - Undergraduate

**Table 10. Undergraduate Graduation Rates for First-time Full-time Student Cohorts at 4-, 5-, and 6 Years.**

	<b>Fall 2020</b>	<b>Fall 2019</b>	<b>Fall 2018</b>
<b>4-Year Same Cohort</b>	27.9%	34.6%	39.3%
<b>4-Year Diff Cohort</b>	9.1%	15%	12.8%
<b>4-Year Total Cohort</b>	37%	49.6%	52.1%
<b>5-Year Same Cohort</b>	41.3%	49.2%	52.5%
<b>5-Year Diff Cohort</b>	18.3%	19.7%	17%
<b>5-Year Total Cohort</b>	59.6%	68.9%	69.5%
<b>6-Year Same Cohort</b>	44%	50%	54.3%

# Student Enrollment & Outcomes

<b>6-Year Diff Cohort</b>	20%	20.7%	17.8%
<b>6-Year Total Cohort</b>	64%	70.7%	72.1%

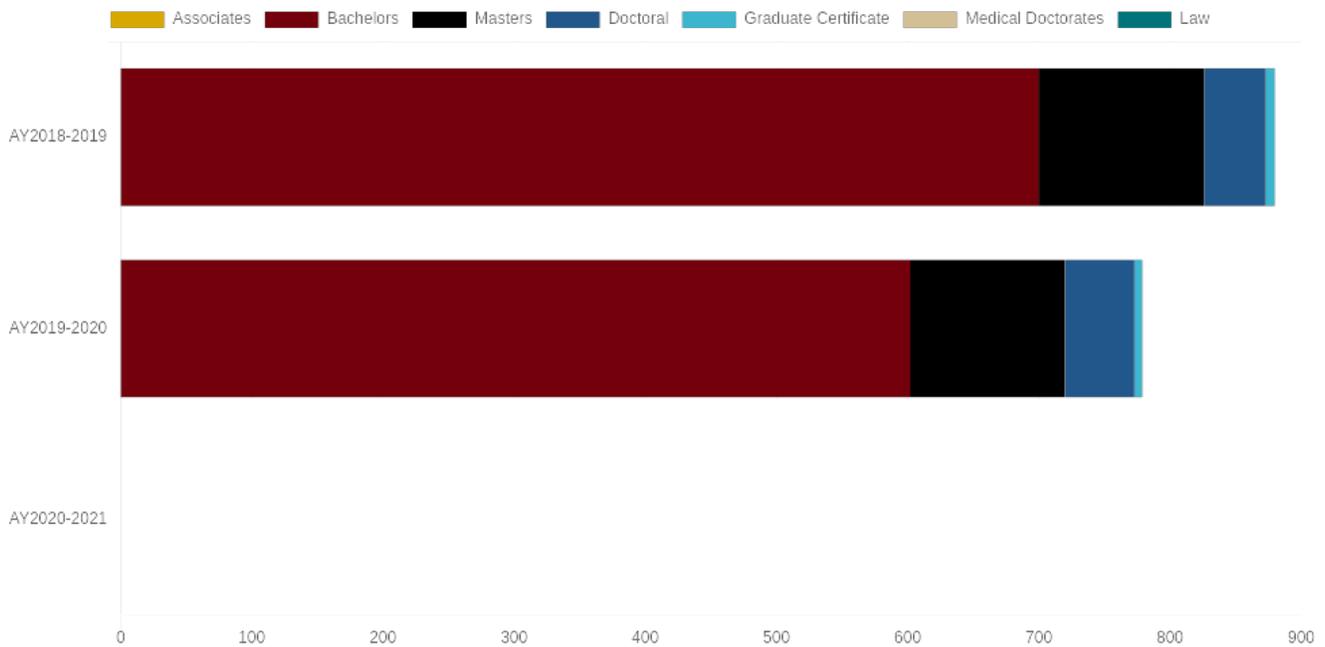
# Student Enrollment & Outcomes

## Degrees Awarded by Level

Table 11. Degrees Awarded by Level.

	Fall 2020	Fall 2019	Fall 2018
<b>Associates Degree</b>		0	0
<b>Bachelors</b>		602	700
<b>Masters</b>		118	126
<b>Doctoral</b>		53	47
<b>Medical</b>		0	0
<b>Law</b>		0	0
<b>Pharmacy Doctorate</b>		6	7
<b>Graduate Certificate</b>			

Illustration 11. Degrees Awarded by Level



# Faculty Awards Nominations

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*Faculty nominated for the following awards in the categories of Research, Service, Teaching, or Other.*

## **Faculty Research Awards Nominations**

**No Award Nominations have been entered for this section.**

## **Faculty Service Awards Nominations**

**No Award Nominations have been entered for this section.**

## **Faculty Teaching Awards Nominations**

**No Award Nominations have been entered for this section.**

## **Faculty Other Awards Nominations**

**No Award Nominations have been entered for this section.**

# Faculty Awards Received

Faculty were recognized for their professional accomplishments in the categories of Research, Service, Teaching, or Other.

## Research Awards

Recipient(s)	Award	Organization
Downey, Austin	Young Investigator Research Program (YIP) Award	Air Force Office of Scientific Research (AFOSR)
Sheth, Amit	Technical Committee on Services Computing (TCSVC) Research Innovation Award	IEEE
Roger, Dougal	Talent and Technology for Navy Power and Energy Systems	ONR/DOD
Lingyu, Yu (Lucy)	Research Progress Award	CEC
Matalok, David	Research Achievement Award	CEC
Luo, Lisa	Young Investigator Research Award	CEC
Kidane, Addis	Young Researcher Award for Excellence in Scientific Research (YESR)	South Carolina Academy Of Sciences
Cacuci, Dan	Presidential Citation	American Nuclear Society
Knight, Travis	Breakthrough Leadership in Research	UofSC
Cacuci, Dan	Fred C. Davidson Distinguished Scientist	Citizens for Nuclear Technology Awareness
Lee, Dongkyu	ORNL Director's award for collaboration excellence	Oak Ridge National Lab
Yu, Lingyu (Lucy)	Breakthrough Star	UofSC
Farouk, Tanvir	Senior Fellow, Summer Faculty Program	Office of Naval Research
Farouk, Tanvir	SC Governors Young Researcher Award for Excellence in Scientific Research	SC Governor's office
Farouk, Tanvir	IEEE Nuclear and Plasma Science Society Early Career Award	IEEE
Wang, Yi	Breakthrough Star Award	UofSC

# Faculty Awards Received

Sutton, Michael	Member of the Slovenia Academy of Engineering	Government of Slovenia
Dryer, Frederick	Elected member	National Academy of Engineering

# Faculty Awards Received

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## Service Awards

<b>Recipient(s)</b>	<b>Award</b>	<b>Organization</b>
Gatzke, Ed	Samuel Litman Distinguished Professor	CEC
Deng, Xiaomin	Joseph M. Biedenbach Distinguished Service	CEC
Banerjee, Sourav	Fellow	American Society of Mechanical Engineering

# Faculty Awards Received

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## Teaching Awards

Recipient(s)	Award	Organization
Matthews, Michael	Mungo Graduate Teaching Award	UofSC

# Faculty Awards Received

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## **Faculty Other Awards Nominations**

**No Awards have been entered for this section.**

# Alumni Engagement & Fundraising

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## Alumni

*Substantial activities, engagements, and initiatives with alumni, focusing on relationships and activities with alumni.*

In FY 20, the Alumni Office was very productive with virtual engagements that included Homecoming and “Alumni and Corporate Lunch and Learns” with prominent alumni. The office significantly increased its communication strategy to increased touch points with alumni when on-campus and in-person visits were not possible. This resulted in many new alumni and corporate connections and helped with job connections for students who had lost a job or internship opportunity but due to the pandemic and an increase in our annual fund revenue dollars. The College launched its first Linked In Page and currently has over 2,000 followers and launched an Alumni/Student Platform called CEC Connect via Graduway which enables our alumni to post jobs and internships and mentor our current students. This also has over 1,000 followers and is growing. In the Spring 2021, the College was awarded the National Graduway Impact Award Winner 2021 for its launch and implementation of the platform. Overall, the College’s alumni presence on web/social media nearly doubled. The Alumni Office also assisted in the creation of video presentations of the school highlighting the College and the Departments. These video’s will be used strategically for development and student recruitment efforts.

## Development, Fundraising and Gifts

*Substantial development initiatives and outcomes, including Fundraising and Gifts.*

Despite the pandemic, the College of Engineering and Computing has been able to secure significant resources for several of the College’s top priorities including undergraduate scholarship, graduate fellowships and the initial funding for the First-Generation Bridge Program to be piloted in the Fall of 2021.

1. Fellowships
2. \$370,000 7 donors/7 new endowed funds
3. Undergraduate Scholarships
4. \$610,000 9 donors/5 new endowed funds/4 donors made additional major gifts to existing funds
5. First Generation Program
6. \$250,000 Total 6 donors

We saw an increase in new major gift donors and a steady revenue growth of retained and new annual donors through the telefunding program. Our donor stewardship effort increased in lieu of our Annual Donor Scholar event that could not take place in person. There has been continued efforts of the College’s principal gift and major gift prospects with emails and virtual meetings to continue conversations that were started in FY 19 in the hopes that these gifts will see closures over the next 12 months when in-person engagement can resume. The development office also did a thorough clean-up of the University of South Carolina Education Foundation Accounts merging many accounts and negotiating new gifts agreements for accounts that had been inactive for many years due to outdated gift agreements or deceased donors. This created a new revenue stream of money of over \$2M for undergraduate scholarships and fellowships and reignited past relations with individual and corporations. The College will continue to increase its revenue growth in the year to come and when travel and

# Alumni Engagement & Fundraising

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campus visits resume we will continue with activities that were put on hold including engaging development prospects in key regions including South Carolina, North Carolina, Georgia, California and Texas and the Northeast. The College will continue to fundraise for its top priorities which include Professorships, Fellowships, Scholarships, and center and programs including the Artificial Intelligence Center. Over the next six months, the College will be working on a strategy to celebrate the 10th Anniversary of the McNair Institute (Fall 2021) and the official opening of the Artificial Intelligence Institute (renovated space completed 2/21).

# Community Engagement

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## Community Engagements and Community - Based Activities

*Community engagement and community based research, scholarship, outreach, service or volunteerism conducted, including activities at the local, state, regional national and international levels.*

### **Personnel**

- Senior Associate Dean for Academic Affairs
- Assistant Dean for Student Services
- Director of Precollege Education
- Director of Enrollment Management
- Inclusive Programs Coordinator
- Graduate Recruitment Coordinator

### **Outreach**

- Develop and maintain partnerships with various companies: MEBA, K-12 Schools, Southern Regional Education Board and Department of Education
- Deliver Cost effective teacher professional development workshops, virtual and in person, that increase awareness of and interest in engineering and computing careers among K-12 teachers.
- Enhance engineering and computer science related education through events.
  - E-Week Open House during National Engineers Week that celebrates professionals in all fields of engineering and computing. CEC in non-pandemic times hosts an Open House geared toward k-12 students. This free event features dozens of interactive exhibits that highlight our academic programs and research.
  - Engineering Competitions are held during UofSC's spring break each year. Competitions varies from K-12 and with robotics and engineering competitions.
  - Visiting K-12 Classrooms, Career Fairs, and Robotics Competitions throughout the state and region.
  - Daughter Date Night invites middle school age girls to collaborate, design and test a hands-on engineering activity and dinner with current CEC students and alumni. This event takes place during the National Engineers week "Introduce a Girl to Engineering" day.
  - Virtual Summer Camp, offered due to COVID-19 during summer 2020, for middle school aged students interested in engineering and computing fields.
- Increase engineering and computing academic content in K-12 with engaging, rigorous and relevant hands-on content.
  - Lead Academy is provided by our college for high school students to be engaged in hands-on project-based learning all day. This one-day experience is designed to work in conjunction with the SC educational standards to provide students with experiences in a particular area of engineering and computing.
  - Duke Tip is open to current 5-6 grade students. UofSC is a partnership with Duke Tip as the only university in the state of South Carolina authorized to offer Academic Adventures

# Community Engagement

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to students who have participated in the Duke TIP search.

- Open to rising 6-12 grade students, Carolina Master Scholars Summer Camps are engaging, challenging and fun in these innovative week-long educational courses. Our summer camps included gaming, engineering, aerospace, VEX robotics, and 3D Printers.
- Middle School day is a free event held during UofSC's fall break each year. It is open to any middle school class that want to be engaged and learn experiences from our faculty and students that cover various fields of engineering and computing.
- Created a LIVE Academy Studio to offer high quality content to delivery from the UofSC Campus to K-12 schools. This studio's goal is to increase awareness of and interest in the fields of engineering and computing with a combination of video conferencing technology and resources delivered to participating schools. While motivated by pandemic risk mitigation efforts, LIVE Academy will enable us to feasible reach underserved schools far into the future.

## Community Perceptions

*How unit assesses community perceptions of engagement, as well as impact of community engagement on students, faculty, community and the institution.*

The Engineering and Computing Open House is a great community event that draws close to 1000 visitors to our College campus in February.

## Incentivizing Faculty Engagement

*Policies and practices for incentivizing and recognizing community engagement in teaching and learning, research, and creative activity.*

There are many different ways that the faculty of CEC engages with the community. As such we do not have a uniform policy to address all possible means of interaction and engagement. For engagements that are substantial and impactful, we will count it as a substantial element for the service that each faculty member needs to do. For more significant levels of engagement, we can consider other incentives. We will address on a case by case basis.

# Collaborations

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## Internal Collaborations

*Our most significant academic collaborations and multidisciplinary efforts characterized as internal to the University.*

- Administration and Finance
- Arnold School of Public Health (Environmental Health Sciences; Exercise Science; Health Promotions, Education and Behavior; Health Service Policy and Management; Epidemiology and Biostatistics)
- College of Arts and Sciences (Biological Sciences; Chemistry and Biochemistry; Mathematics; Physics & Astronomy; Geography; Archeology & Anthropology; Earth and Ocean Sciences; Statistics)
- College of Education (Educational Studies; Instruction and Teacher Education)
- College of Hospitality, Retail and Sports Management (Retailing)
- College of Information and Communication (Journalism and Mass Communication)
- College of Nursing
- College of Pharmacy (Drug Discovery & Biomedical Sciences; Clinical Pharmacy and Outcomes Sciences)
- College of Social Work
- For Masters in Engineering Management:
  - Darla Moore School of Business; Law School; College of Journalism and Mass Communications
- Office of Economic Engagement
- Healthy Carolina Initiatives
- Information Technology (High Performance Computing)
- School of Earth, Ocean and Environment
- School of Medicine (Cell Biology & Anatomy; Pathology, Microbiology & Immunology; Neuropsychiatry)
- Student Success Center
- President
- University Advising Center
- University Libraries
- USC Aiken

## External Collaborations

*Our most significant academic collaborations and multidisciplinary efforts characterized as external to the University.*

- AccuStrata, Inc
- Advanced Research Projects Agency-Energy
- American Cancer Society
- American Institute of Chemical Engineers
- Ames Laboratory
- Apache Corporation
- Arizona State University
- Association of Environmental Engineering and Science Professors (AEESP) Foundation
- BASF Corporation
- Battelle Energy Alliance, LLC
- Boeing
- Bristol-Myers Squibb Foundation, Inc.

# Collaborations

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- Carnegie Mellon University
- C&B Tech
- CDF Research Corporation
- Chalmers University, Sweden
- City of COlumbia
- Claflin University
- Clemson University
- Coastal Carolina University
- College of Charleston
- Compact Membrane Systems, Inc
- Concurrent Technology Corporation
- Duracell
- Electric Power Research Institute
- Emera Technologies, LLC
- Environmental Research and Education Foundation
- Florida State University
- General Atomics
- General Motors
- Georgia Institute of Technology
- Golder Associates Ltd.
- Greenville Health System
- Gulfstream
- Hitron Technologies
- Idaho National Laboratory
- Iraqi Embassy (DC)
- Jacobs Engineering
- Korea Army Academy
- Lockheed Martin Corporation
- Los Alamos National Security, LLC
- Medical University of South Carolina
- Michigan State University
- Midlands Technical College
- Ministry of Higher Education and Research, Iraq
- Morgan State University
- National Energy Technology Laboratory
- Navy Surface Warfare Center
- Nuclear Regulatory Commission
- Oak Ridge National Laboratory
- Ohio State University
- Pacific Northwest National Laboratory
- Pennsylvania State University
- Physical Sciences Incorporated
- Radiation Monitoring Devices, Inc
- Reaction Engineering International
- Samsung Electronics America, Inc.
- Savannah River National Laboratory
- Savannah River Nuclear Solutions
- SC Research Authority
- SC Space Grant Consortium

# Collaborations

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- SC Spinal Cord Injury Research Fund
- Siemens Energy, Inc.
- Skyre Inc.
- Solvay S.A.
- Spirit AeroSystems
- Texas Research Institute-Austin
- The Citadel
- TIGHITCO
- Toray
- Transportation Technology Center, Inc
- Trident Technical College
- University of Luisiana
- University of Puerto Rico, Mayaguez
- Universal Technology Corporation (UTC)/ Air Force Research Laboratory (AFRL)
- University of Central Florida
- University of Kansas
- University of Puerto Rico
- UOP LLC
- US Army Corps of Engineers (Charleston District; South Atlantic Division; ERDC Vicksburg)
- US Geological Survey
- Vanderbilt University
- Volvo (Charleston)
- W.L. Gore & Associates
- Westinghouse Electric Company LLC
- Yunnan University

## Other Collaborations

*Our most significant academic collaborations and multidisciplinary efforts that are not otherwise accounted for as Internal or External Collaborations.*

## Supplemental Info - Collaborations

*Any additional information on Collaborations appears as 'Appendix 2. Collaborations' (bottom).*

# Equity and Diversity Plan

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## Improve Under-Represented Minority (URM) Student Enrollment

**Undergraduate outreach and recruitment activities aim to 1) increase participation of URM and female K-12 students in college-level outreach and recruitment initiatives, 2) increase applications to CEC programs from URM and female population, and 3) convert “admitted URM and female” students to “enrolled URM and female” students. Related activities include:**

- Develop and maintain partnerships with K-12 educational organizations, such as K-12 schools, Department of Education, Midlands Education and Business Alliance (MEBA).
- Facilitate on-campus educational programs for K-12 students, such as Lead Academy, Duke TIPs, Carolina Master Scholars camps, and Partners for Minorities in Engineering and Computer Science.
- Promote engineering and computing through community outreach events, such as eWeek Open House, career fairs, and engineering competitions, and volunteer work with organizations such as Boys and Girls Club.
- Engage Students, Faculty, and Staff in recruitment efforts, such as daily college tours, and other regional recruitment events.
- Identify targeted high schools with high percentage of minority students and high average SAT scores for recruitment.
- Offer scholarships and incentives for admitted students. CEC recently received nearly \$1 million in funding through a grant from the National Science Foundation Scholarships in Science, Technology, Engineering and Mathematics Program (S-STEM) to support academically-talented engineering and computing students based on financial need.
- Promote Engineering and Computing to transfer students, including regional technical colleges and historically black colleges and universities (HBCUs).
- Adopt diversity-aware faculty search practices to increase hiring of minority and female faculty; thus appeal to URM and female students.

**Graduate outreach and recruitment efforts aim to attract URM and female graduate students to apply to CEC.**

- Promote Graduate Education for Minorities (GEM) opportunities for CEC undergraduate and graduate students. Actively participate in GEM events. In 2019, CEC hosted GEM Lab.
- Visit and conduct recruitment events in regional HBCUs and minority serving universities.
- Hold recruiting events at diversity conferences, such as National Society for Black Engineers (NSBE), Grace Hopper Celebration (GHC) conference, Society of Hispanic Professional Engineers (SHPE) National Convention, Society of Women Engineers (SWE) conference, and Richard Tapia Celebration of Diversity in Computing conference.
- Facilitate access to research scholarships and awards. UofSC has recently received \$1 million grant from the National Science Foundation (NSF) to establish a Bridge to Doctorate (G2D) fellowship program. The program is funded through the NSF Louis Stokes Alliance for Minority Participation (NSF-LSAMP). The B2D fellowship program, will be administered through UofSC’s College of Engineering and Computing (CEC) and the College of Arts and Sciences (CAS).
- Adopt diversity-aware faculty search practices to increase hiring of minority and female faculty; thus appeal to URM and female students.

# Equity and Diversity Plan

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## Improve The Number Of Full-Time URM Faculty Across Academic Units

**The College of Engineering and Computing aims to increase diversity of faculty candidate pools; thus increase the potential of recruiting URM and female faculty. Related activities include: Recruitment**

- College-level oversight of faculty position posting for diversity-conscious job description and placement.
- Adopt and require university-level diversity training for search committees and the designation of a diversity advocate for each search committee.
- Establish metrics in the hiring process for diversity contribution and standard questions for each candidate.
- Make active recruitment a requirement for each CEC department and require diversity statement from faculty candidates.
- Develop diversity-aware information booklet for CEC/UofSC and provide this information to each faculty candidate.
- Facilitate meeting between Associate Dean for Diversity, Engagement, and Inclusion and faculty candidates with questions regarding diversity climate of CEC.

### Retention

- Establish multi-level faculty mentoring for academic success.
- Establish measurement for diversity contribution within the tenure and promotion process.
- Identify and support unique research support needs of URM and women faculty.
- Reduce service load for URM and women faculty at all rank.
- Provide mentoring and promotion guidance/training for post-tenure URM and women faculty.

## Enhance Outcomes For URM Undergraduate and Graduate/Professional Students

**Undergraduate retention is built on three pillars: 1) Academically: provide education resources to the students to make the path to graduation as smooth as possible, 2) Socially: help students feel connected to UofSC and CEC, and 3) Professionally: offer development opportunities to the students via the Career Center.**

- Improve academic advising by focusing on individual student's needs and establishing a positive relationship with the academic advisors.
- Ensuring faculty and staff knowledge of course curricula and special needs, such as transfer credits and inclusive classroom resources.
- Focus staff advising on transitional issues and faculty advising on career planning and professional development.
- Promote student success center, supplemental instructions and tutorial for students. Identify academically at-risk students to develop appropriate intervention.
- Develop peer-mentoring for undergraduate students to help with both academic and social

# Equity and Diversity Plan

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progress. Monitor success of students through academic applications.

- Develop onboarding programs for new freshman, such as summer bridge program to prepare students for the academic work at the college.
- Build support structures, such as Engineering and Computing Living and Learning Community. Develop programs and events to connect students with faculty and each other.
- Provide resources for URM and women student chapters, such as NSBE, SPHE, SWE, Women in Computing (WiC), Minorities in Computing (MIC), and Alpha Omega Epsilon (AOE).

## **Graduate retention addresses progress towards M.S. and Ph.D. graduations.**

- Department-level academic oversight of progress towards graduation.
- Financial support in forms of fellowship and scholarships, graduate teaching and research assistantship.
- Unit and university-level support for scholarship applications, such as NSF graduate scholarship and GEM support.
- Provide support to participate in diversity conferences, such as NSBE, GHC, Richard Tapia, etc.
- Organize social events to facilitate meeting with faculty and other graduate students.

## **Improve Post-Graduate Outcomes For URM Undergraduate and Graduate/Professional Students**

**The Career Center of CEC provides support for students, faculty, alumni, and potential employers. Special workshops on these services are provided at URM student chapter meetings. The following services are available for CEC students from the Career Center:**

- support career planning: career coaching, assessment tools, online career management platform (Handshake).
- Facilitate internship, co-op, and job shadowing opportunities.
- Provide resume writing and interview preparation workshop.
- Support job searching activities, including interviewing skills, salary negotiation, and preparation of “elevator pitch.”
- Provide information about graduate education and scholarship information.
- Support preparation for Career Fair and successful job negotiation.

## **Increase the engagement of students, faculty, staff, administrators in Equity and Inclusion**

**CEC aims to increase engagement of students, faculty, staff, administrators in equity and inclusion activities. The current activities focus on overcoming the following challenges: 1) limited engagement between faculty and URM/female students, 2) limited diversity and cultural awareness of faculty and instructors, 3) lack of motivation/know how of tenure-track and tenured faculty to support gender and ethnic diversity initiatives. The current and planned activities include:**

- Require diversity commitment by each department and make it part of the annual evaluation for the departments.
- Generate diversity support materials for research funding, including broader impact write up

# Equity and Diversity Plan

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and broadening participation. Distribute these resources for all CEC researchers and administrators.

- Connect student chapters and faculty by organizing joint events, such as CEC women power lunch, leadership forum, and invited speakers series.
- Engage alumni of CEC to serve as mentors for organizations and individual students.
- Increase faculty awareness about the benefit of diverse work environment. Promote diversity seminars organized by the UofSC Center for Teaching Excellence.
- Host workshops/presentations/meetings with minority universities and colleges.
- Improve visibility of diversity activities and their impact on improved educational and research productivity.

## Improve The Sense Of Inclusion Amongst All University Community Members

**CEC aims to develop an inclusive academic environment where discrimination and bias against any of the members of our community are not tolerated. Related activities include:**

- Assessment of the diversity knowledge and perception of CEC students, faculty, and employees. This leads to the understanding of key challenges faced by faculty, staff, and students with respect to diversity and inclusiveness. Assessment is performed via 1) discussions with student chapters/students, 2) discussions with departments/faculty/staff, 3) feedback on accessibility and usage of diversity training resources, such inclusive classroom environment, cultural awareness, hidden bias.
- Increase the knowledge about discrimination and bias of CEC students, faculty, and staff by 1) promoting training programs, 2) facilitating access to resources to report inclusive academic environment.
- Organize college-wide events to provide interaction between all students, faculty and staff.

# Dashboard Metrics and Narrative

## Metrics

### Student Information Narrative

***Our student enrollment numbers are stable, CEC is the third largest college on campus with about 10% of total students.***

***CEC is financially stable.***

Colleges deliver services to head count, not FTEs (when we have to procure PPE's or set up access to IT infrastructure or software or lab equipment, we do not order based on FTEs). Moreover, there is usually great discrepancy when it comes to the counting of graduate students who are undertaking research and not registering for many credit hours. Below is a table of head counts from OIRAA (Fall 2018) and Data Warehouse Enrollment report for Fall 2020. Notice especially the large discrepancy (FTE compared to headcount) for graduate students.

Student Information	Numbers from Dashboard	Headcount Numbers
Undergraduate Student # 2018	3,228	3234
Undergraduate Student # 2021	3,213	3190
Undergraduate Student 2021/2018	100%	99%
Masters Student # 2018	145	234
Masters Student # 2021	127	234
Masters Student 2021/2018	88%	100%
PH.D/Professional Student # 2018	172	331
PH.D/Professional Student # 2021	175	318
PH.D/Professional Student 2021/2018	102%	96%
Resident Student # 2018	2,291	2391
Resident Student # 2021	2,265	2407
Resident Student 2021/2018	99%	101%
Non-resident Student # 2018	1,254	1409
Non-resident Student # 2021	1,249	1341
Non-resident Student 2021/2018	100%	95%
Total Student # 2018	3,545	3800
Total Student # 2021	3,514	3748

# Dashboard Metrics and Narrative

Total Student 2021/2018	99%	99%
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On its face the obvious observation is that the enrollment numbers at all levels (BS/MS/PhD) are extremely stable. But the stability of these numbers belies some notable undercurrents:

1. The numbers include the bumper crop freshman class that we experienced a few years ago. Our freshman classes have been smaller since then (and closer to the planned numbers). However, the total headcount (or FTE if you wish) has remained the same. This is the case because of the significant and conscious investment of the College in our student services (nearly tripling the staffing, adding professional advisers for 1st and 2nd years, starting a peer mentoring program, and recently, funding a First-Generation summer program). As a result, we have made great strides in our graduation and retention rates (well over 10 points), and diversity. And we will strive for much higher; we want to set the gold standard for USC.
2. Included in our numbers is a very stable and healthy flow of transfers from Midlands Tech. We also have MOU's with SCSU, Claflin which have not borne fruit, but are in the process of creating 3+2 with Benedict and Columbia colleges which offer the advantage of geographic proximity.
3. The stability of the PhD numbers is a negative because PhD students require external funding, a key to improving national rankings. With the recent injection of new DoD projects, and more than doubling of the research of the College awards, as well as the expected \$40M match from the Governor for the SRNL management and operations proposal, we will greatly enhance the number of PhD students.
  - a. The budget model can help resource the growth and quality of graduate programs at USC by leaving the full IDC and graduate tuition (at least for non-self-paying students) out of calculation of subvention amounts. This alone in CEC will enable the college to essentially support nearly 50% more graduate students!!

## Finances:

- We are stable.
- But engineering and computing are expensive and need significant real-estate (rent) and startup packages (for new faculty).
- There always needs to be subvention to the college.
  - While the job market may suggest that students can afford to pay the full cost, through even higher fees, there is the question that increased fees beyond the current level will likely affect access adversely.
- With COVID and the plunge into the virtual world, while engineering remains a very hands-on and high-touch field, we will continue to explore whether we can serve a larger population of students, while continuing to enhance the quality of the programs.
  - The main focus is access, but it may also lead to additional revenue.
  - The new IIT BS and Informatics PhD are perfect examples.
  - Also, the new dual-degree agreement with NUST in Oman is another great example.
  - Other similar (but much larger scale) cooperative agreements are in the works.
- Growth of student numbers at undergraduate level will come from two sources: retention, and enhanced admissions yield. We have been, are, and will continue to work on both fronts, with continued focus on access (philanthropy, two \$1M NSF scholarship programs, etc.). And again with the expected match from the Governor for the SRNL management and operations proposal, we will provide additional scholarship support for undergraduate

# Dashboard Metrics and Narrative

students as well as PhD students.

## Contribution (Per Student) Narrative

***Tuition revenue and costs are stable, but increases in support unit allocations and fluctuations in subvention values make it difficult to plan strategically.***

The table below provides clear details and puts the numbers in context:

	2018		2019		2020	
	Amount	Total	Amount	Total	Amount	Total
Revenue	38,029,715	38,029,715	41,367,361	41,367,361	41,118,445	41,118,445
Model adjustment (tuition, appropriations...)	21,891,260	59,920,975	21,565,492	62,932,853	31,295,651	72,414,096
Expenses	(40,535,216)	19,385,759	(44,842,253)	18,090,600	(47,685,879)	24,728,217
Contra/Transfer	2,589,072	21,974,831	3,839,927	21,930,527	6,148,370	30,876,587
Model Allocations	5,187,256	27,162,087	8,007,493	29,938,020	2,241,753	33,118,340
Support Unit Allocations	(27,078,516)	83,571	(29,381,879)	556,141	(32,988,541)	129,799
w/ subvention	3,545	24	3,553	157	3,514	37
w/o subvention		(1,440)		(2,097)		(601)
w/o subvention but at 2018 support unit allocation		(1,440)		(1,449)		1,081

The revenue is quite constant (around \$41M) because of our extremely stable number of students (the number in smallest font). The slight growth is due to the fees ramping up over three years and reaching their full value in 2019. The model adjustment was quite constant in 2018 and 2019, and then increased by \$10M. Our total expenses (expense minus contracts/transfers) are also extremely stable (around \$41M). Therefore, given the constancy of revenues and expenses, plus the \$10M inflation of the model adjustment, the college would be in great shape, as shown in the final row, which assumes that the support unit allocations are constant at the 2018 level, and there is no subvention. What is distressing is the tremendous growth in support unit allocations from \$27M in 2018 to \$33M in 2020. Only a little is due to COVID-19. The various excellence and strategic initiatives are taking a toll and

# Dashboard Metrics and Narrative

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eating into the budget faster than the innovative activities of the college can lead to additional unrestricted (i.e. not sponsored research) resources.

The subvention numbers shown have been provided, not strategically but to hold college harmless in the face of the random and rapidly increasing support unit allocation. In 2018 it was \$5.1M, in 2019 it was \$8.0M, and in 2020 it is \$2.2M. Perhaps this was necessary as the university budget was examined and the new model implemented. However, if the same (unpredictable) approach to subvention is continued the budget model will not deliver on its premise of providing a platform based on which the colleges could plan for the next few years. The result for CEC has been that the robust hiring rate of years 2 and 3 of my deanship have ground to a halt in years 4 and 5 because each set of numbers take the college across the spectrum of feast to famine. As I mentioned from the outset, the budget model should not be expected to come from the budget office; that model will always balance the books and hold everyone harmless at the level of today. The budget model provides the opportunity for the university to make strategic decisions to prioritize its investments and be intentional about it. The subvention numbers need to be frozen at some level for a few years so that the colleges can plan by building on the model, as opposed to succeeding despite the historical unpredictability of the model.

## Model Allocations (Per Student) Narrative

Identical to the previous narrative.

## Faculty Information Narrative

***The recent ability to increase faculty count is the result of increased student fees.***

The FTE-based counts provided here are not nationally normed. What matters in engineering and computing is the ratio of undergraduate students to TTT faculty. So, we address those, and only for 2020.

Today CEC has 125 TTT and 22 instructors, for a total of 147. This number is despite hiring about 36 TTT and 33 instructors over the past 5 years. Retirements and departures have slowed down the rate of growth. The original plan when the fees were calculated was to get the TTT faculty count to 145 so that the UG/TTT ratio would be in the lower 20's as opposed to closer to 40 that it would have been without the fees. However, several excellence and strategic cuts by the university, plus the reality that the colleges pay for much of their infrastructure services, have caused the college to add more full-time instructors and fewer TTT faculty than planned originally. The picture is far superior to pre 2016 when for example many of the CS classes were taught by TA's. But our UG/TTT number is now at 25-26, which remains notably higher than the low 20's and high teens that distinguishes the top flagships. While CEC may afford the salary burden of adding TTT faculty, the main hurdle remains the expensive startups which average to about \$550K (junior to senior, and theoretical to experimental; and still on the low side of our competition). Thus, the growth of faculty in CEC is a strategic decision for the university. One notes that for all highly ranked public universities, the rank of their engineering college is uniformly higher than that of the university (with the exception of UVA), and lift the rank of the university, hence the strategic value of the investment in startups.

# Dashboard Metrics and Narrative

## Credit Hours Taught Narrative

***We have worked to decrease the student-faculty ratio to improve teaching and learning.***

We note again that these numbers are calculated based on FTE's, and not headcount. But the trend of average credit hours per faculty is exactly in the right direction. Engineering and computing are very high-touch majors involving laboratories, design courses, or computer labs. The ideal average class size is 20 students, or 60 credit hours per section. A fully loaded average faculty member would then be teaching 360 hours (equivalent of 6 sections per year), which is exactly where CEC is today. Of course, the average is not representative of all the faculty. Given that our research awards have more than doubled from 5 years ago, a great deal of the faculty time goes to research and education of graduate students.

## College/School Financial Information Narrative

***The blending of restricted (research) funds with non-restricted (operating) funds in the budget model remains problematic.***

While we have pointed out from the first meeting on the budget model that there is significant difference between restricted (sponsored research) funds and unrestricted operating funds, we continue to find these two blended together at every presentation. And therein lies the difficulty for a research-active college such as CEC. The indirect cost (central services), which when ratioed to the total of operating and restricted funds would appear to be only 33%, is in fact 49% when ratioed against the actual unrestricted operating funds. The growth of over \$6M in these allocated costs over two fiscal years is tantamount to a 10% reduction in the operating budget of the college over that period. This is as great a cut as the potentially catastrophic scenario for which the university was bracing for in response to COVID-19. The fact that the college continues to not just survive, but thrive, is testimony to the dedication of the staff and faculty who continue to innovate and dedicate selflessly.

The restricted funds (sponsored programs) cannot be spent on anything other than the budgeted items in a grant or contract, and they have their own schedule, unrelated to the USC FY. For that reason, they should not be included in budget documents used to make decisions about resource allocation to colleges. Moreover, we (CEC) count IDC returns from sponsored research in the same "restricted" category: these funds are used in support of research, and also remain the sole reliable source for the significant startup packages needed for recruiting new faculty, or the rent needed to house their labs offsite. These startup packages are not signing bonuses, but in fact are investments in the research infrastructure of the college and the university (new computers, equipment, graduate students, etc.). Hiring world-class faculty allows CEC to provide unparalleled research opportunities for undergraduate students.

	dashboard	%	actual		%
		restricted/	DC	unrestricted	unrestricted
Revenue	90,336,076		25,150,792	67,133,879	
direct costs	62,479,325	69%			67%

# Dashboard Metrics and Narrative

				44,983,248	
indirect costs	30,214,330	33%		32,988,541	49%
total costs	92,693,655	103%		77,971,789	116%

## Student Outcomes Narrative

***CEC graduates are gainfully employed or admitted to graduate schools at a high rate.***

We present CEC’s own data on salaries. The table of information was collected by the University of South Carolina Career Center from College of Engineering and Computing graduates in alignment with the recommended standards of the National Association of Colleges and Employers (NACE). This recent graduate data was self-reported, collected within 6 months of graduation, and compiled to provide comparable year-over-year information from August, December, and May graduates of a particular academic year. For example, Academic Year 2016-2017 data includes information from graduates from August 2016, December 2016, and May 2017. By using this information, the CEC narrative is then based on consistent data sources that utilize the same collection standards across academic years. This avoids potential conflicts from using the average salary data (from NACE standards, within 6 months of graduation) and the median salary data (from the College Scorecard, from data 2-years post-graduation) in comparisons across different academic years.

Academic Year	Mean	Median	Max	Min
2016-17	\$63,944	\$63,000	\$110,000	\$25,000
2017-18	\$62,549	\$61,000	\$101,000	\$24,000
2018-19	\$65,613	\$65,000	\$124,000	\$20,000

There are several important points worth mentioning.

By using both sources in their data, the USC dashboard creates inequitable comparisons and conflicts. The Department of Education’s Scorecard data is based on a subset of graduates (those who received federal financial aid, have full-time employment, and are two years postgraduation). These specifications narrow the data set and exclude graduate or professional school pathways. Our NACE salary data is based on first-destination responses within 6 months of graduation and includes students who have or have not used federal financial aid, as well as those in full-time employment, graduate school, military or volunteer service, etc. which comprises over 20% of each graduating class.

The ratio of the debt to the starting salary is not the best proxy for post-graduation success. It would be critical to look at career earnings beyond one or two years, as most students will not have been able to pay off debt within that time. The Career Center is actively attempting to acquire longitudinal data to better understand the career and economic mobility of our

# Dashboard Metrics and Narrative

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graduates at 5- and 10-years post-graduation. 2020 is their first year conducting this study.

Salary should not be the primary indicator of Return on Investment (ROI) of a USC education. Students who pursue less financially lucrative but more personally fulfilling roles (military or volunteer service, non-profit, or government agency work, etc.) may find a different ROI value from their USC education. The dashboard is too low-dimensional to account for programs that offer debt forgiveness, like military service, public service loan forgiveness, etc. Also, an undergraduate going to graduate school in STEM will receive a salary (academic stipend), the reporting of which explains the annual minima mentioned and which skews the starting salary data, but which indeed will lead to much higher lifetime earnings because of the advanced degree. Despite all this, the salary trend in CEC is up, but especially so when considering the max values, which are not affected by the military or graduate school starting salaries.

The graduation rates in CEC are on the rise because of near tripling of investment and personnel in our student services, which includes first and second year advising, peer mentoring, and summer bootcamp. Additionally, we have just raised philanthropic funds (\$160K/year) to bring on 20 First Generation students each summer for three weeks, and provide them \$1K/year of scholarship. We have also brought in \$1M from NSF for URM undergraduate scholarships, and jointly with CAS brought in \$1M from NSF for URM PhD fellowships. CEC also has dedicated staff for outreach to schools, and recruiting. All of these efforts over the past 5 years have been leading to an improvement in graduation rate. We will continue to think of other ways to also close the achievement gap between Pell and non-Pell students.

## HERD Research Expenditures Narrative

***CEC since 2016 has been in an unprecedented period of growth in all its facets, but especially in research activity.***

CEC since 2016 has been in an unprecedented period growth in all its facets, but especially in research activity. Dean Haj-Hariri stated during his interview the need for the college and the university to operate and manage SRNL, to increase DoD (2 significant ONRs at \$15M/yr) and other large research activities (leading two NASA ULIs at >\$1M/yr), and to get faculty members elected to the NAE (4.5 today, up from zero in 2016). We closed the first 6 months of FY21 at \$19.6M of awards, compared with the total for FY16 of \$18.1M (greater than a factor of 2). As such, we will not be providing any commentary into 1-year fluctuations of the numbers, as they constitute noise superposed on a very enviable upward trend.

## Other Information Narrative

# Concluding Remarks

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## Quantitative Outcomes

*Explain any surprises regarding data provided in the quantitative outcomes modules throughout this report.*

## Cool Stuff

*Describe innovations, happy accidents, good news, etc. that occurred within your unit not noted elsewhere in your reporting.*

Professor Dryer got elected into the NAE. Vice Admiral (ret.) Gaffney (NAE) is affiliated with the college.

AI Institute is up and running. We have hired a senior practitioner from IBM, to go along with our Founding Director, Professor Sheth. The top floor of the old Law School is renovated and houses this Institute.

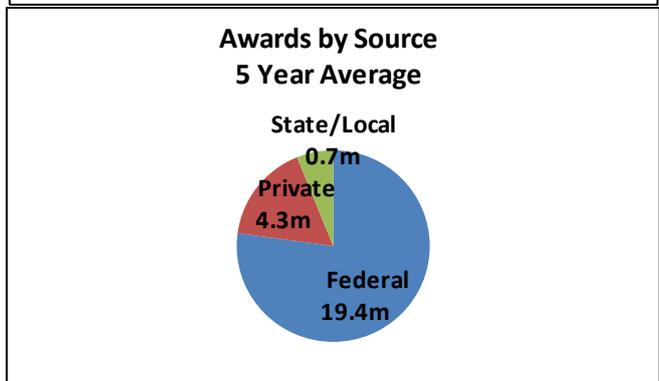
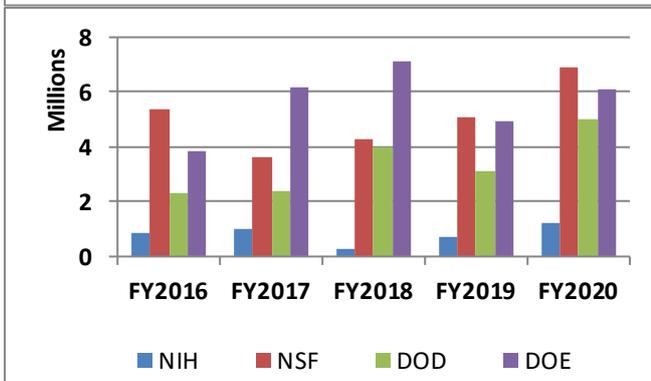
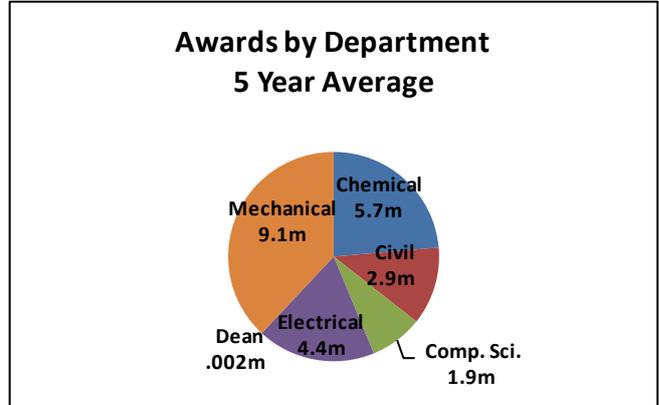
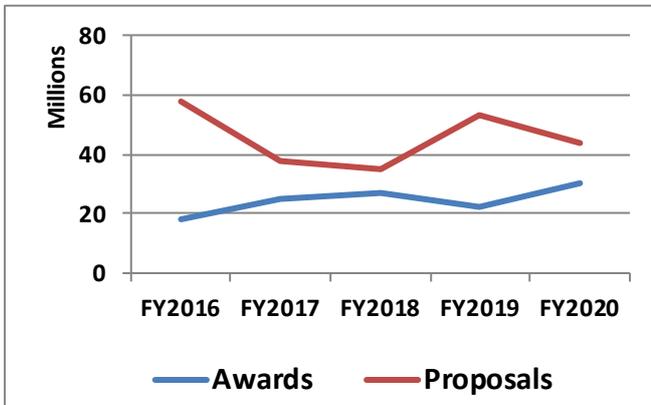
Several large DoD initiatives are in progress this year as well.

## Appendix A. Research & Scholarly Activity

# Office of Research IT and Data Management Office

## College of Engineering and Computing Summary of Awards

SAM ACTIVITY	FY2016	FY2017	FY2018	FY2019	FY2020	% Change Avg. (16-19) & 2020
<b>Division Award Totals</b>	<b>18,102,611</b>	<b>24,769,514</b>	<b>27,055,385</b>	<b>22,398,581</b>	<b>30,229,806</b>	<b>31.0</b>
<b>Unit Totals</b>						
Chemical Engineering	4,994,201	5,859,555	5,371,003	4,781,264	7,298,070	39.0
Civil & Environmental Engineering	1,655,138	3,377,993	1,727,180	2,526,009	5,138,916	121.4
Computer Science & Engineering	1,823,971	2,453,729	831,752	1,796,625	2,839,355	64.5
Electrical Engineering	1,894,689	3,495,582	7,625,747	3,628,483	5,129,756	23.3
Engineering & Computing, College of	3,363	4,557	0	0	0	(100.0)
Mechanical Engineering	7,731,249	9,440,109	10,906,114	8,442,376	9,098,400	(0.3)
<b>Source</b>						
Federal	14,956,082	20,159,582	19,522,796	17,186,506	25,342,880	41.1
Private	2,844,906	4,191,085	6,913,808	4,051,176	3,734,174	(17.0)
State/Local	301,623	418,847	618,781	1,160,899	1,152,752	84.4
<b>Proposals</b>						
Submissions	260	244	282	353	324	13.8
Dollars Requested	57,708,851	37,636,384	34,942,599	52,800,444	43,663,273	(4.6)



# COLLEGE OF ENGINEERING & COMPUTING

	Invention Disclosures	Provisional Patent Applications	Non-Provisional Patent Applications	Issued Patents
<b>TOTALS:</b>	<b>35</b>	<b>30</b>	<b>49</b>	<b>14</b>
<b>Department Breakdown</b>				
Chemical Engineering	<b>11</b> (ID nos. 1423, 1436, 1440, 1442, 1451, 1459 <i>(shared w/ Arts and Sciences)</i> , 1463, 1469, 1470, 1471 <i>(shared w/ Arts and Sciences)</i> , 1436 <i>(shared w/ Biomedical Engineering)</i> )	<b>7</b> (ID nos. 1423, 1436 (2) <i>(shared w/ Biomedical Engineering)</i> , 1442, 1469, 1471 <i>(shared w/ Arts and Sciences)</i> , 1440)	<b>20</b> (ID nos. 1282 (Div), 1273, 1282 (Div), 1246, 1240, 1309, 1345, 1354, 1364, 1362, 1366, 1363, 1372, 1391, 1396, 1408, 1350, 1414, 1393, 1421)	<b>6</b> (ID nos. 1067, 1219 <i>(shared w/ Biomedical Engineering)</i> , 1282, 1257, 1073, 1279)
Civil & Environmental Engineering	<b>3</b> (ID nos. 1467, 1473, 1437 <i>(shared w/ Mechanical Engineering)</i> )	<b>4</b> (ID nos. 1383, 1467, 1473, 1437 <i>(shared w/ Mechanical Engineering)</i> )	<b>2</b> (ID nos. 1353, 1388)	<b>0</b>
Computer Science & Engineering	<b>3</b> (ID nos. 1477, 1431 <i>(shared w/ Electrical Engineering)</i> , 1445 <i>(shared w/ Electrical Engineering)</i> )	<b>3</b> (ID nos. 1359, 1431 <i>(shared w/ Electrical Engineering)</i> , 1445 <i>(shared w/ Electrical Engineering)</i> )	<b>0</b>	<b>1</b> (ID no. 1037 <i>(shared w/ Mechanical Engineering)</i> )
Electrical Engineering	<b>10</b> (ID nos. 1480, 1431 <i>(shared w/ Computer Sciences)</i> , 1433, 1434, 1435, 1439, 1441, 1444, 1445 <i>(shared w/ Computer Sciences)</i> , 1476)	<b>9</b> (ID nos. 1385, 1441, 1439, 1431 <i>(shared w/ Computer Science)</i> , 1434, 1435, 1433, 1445 <i>(shared w/ Computer Science)</i> , 1444)	<b>9</b> (ID nos. 1200, 1252, 1285, 1357, 1387, 1394, 1395, 1356, 1392 <i>(shared w/ Arts and Sciences)</i> )	<b>2</b> (ID nos. 1119, 1200)
Mechanical Engineering	<b>10</b> (ID nos. 1437 <i>(shared w/ Civil Engineering)</i> , 1443, 1446, 1447, 1448, 1452, 1464, 1468, 1474, 1425 (copyright))	<b>10</b> (ID nos. 1420, 1413, 1437 <i>(shared w/ Civil Engineering)</i> , 1443, 1349, 1446, 1227, 1312, 1422, 1447)	<b>18</b> (ID nos. 1272, 1207, 1262, 1343 (Utility), 1342, 1368 (2) (trademarks) <i>(shared w/ School of Medicine)</i> , 1368 <i>(shared w/ School of Medicine)</i> , 1343 (PCT), 1367, 1351, 1292, 1413, 1198, 1207, 1420, 1422, 1147 <i>(shared w/ School of Medicine)</i> )	<b>6</b> (ID nos. 1193 (Utility), 1193 (Div), 1037 <i>(shared w/ Mechanical Engineering)</i> , 1179, 1281)
Biomedical Engineering	<b>1</b> (ID no. 1450 <i>(shared w/ School of Medicine)</i> , 1436 <i>(shared w/ School of Medicine)</i> )	<b>2</b> (ID nos. 1436 (2) <i>(shared w/ Chemical Engineering)</i> )	<b>0</b>	<b>1</b> 1219 <i>(shared w/ Chemical Engineering)</i>

	<i>Chemical Engineering)</i>			
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# **Appendix 1. Academic Analytics Report**

## ACADEMIC ANALYTICS STUDY

### Peers for the College of Engineering and Computing

We examined the Full-Field “Engineering” database within Academic Analytics (AA), which contains 231 listings. Of these we excluded programs that are not ranked by US News and World Report (USNWR) in their “Top Engineering Graduate Schools” listing. We also excluded schools that are not Carnegie Very High Research or that have a USNWR ranking below UofSC CEC. We also excluded UNC-Chapel Hill (no engineering college, only an environmental engineering program); Emory University (AAU, but only an UG program offered by transfer to Georgia Tech), University of Oregon (no engineering college), and the University of Southern Mississippi (ocean engineering only). There remain 33 public AAU institutions and 24 private AAU institutions having traditional engineering colleges; all AAU universities are Very High Research. Of the non-AAU universities, the AA database has an additional 44 public engineering colleges and 8 private universities that are Carnegie Very High Research and ranked equal to or above the 2019 USNWR ranking for CEC. These 119 universities comprise the global set of schools from which UofSC CEC should select its peers and aspirants.

### Academic Analytics Broadfield Gauge

This tool compares UofSC CEC to all 231 institutions in the AA database. As explained above, many of these institutions are less than Carnegie Very High; others are specialty “one major” institutions or otherwise not considered peers or peer aspirants. So this particular AA tool actually sets a fairly low bar for comparison. Nevertheless we can learn something from the Broadfield Gauge.

Figure 1 presents the Z scores from the Broadfield Gauge for several metrics. A positive Z score means UofSC CEC is above the national mean. CEC faculty score well on the percentage of faculty with a citation, article, or grant; this means a higher-than-national average fraction of the faculty are research active. CEC scores low on the size of federal grants (dollars per grant), federal grant dollars per faculty member, and on number of honorifics (awards) such as Fellow of a society or Academy membership. CEC is near the national average on the other metrics such as citations per publication and citations per faculty member.

### Peers and Near-Peers, including AAU Institutions

Based on input from our departments, suggestions from the VPR, and geographic and cultural considerations we selected 26 programs as peers or aspirants from the list of 119 universities described above. The list of peers and aspirants is shown in **Table 1** and includes AAU and non-AAU institutions and a mix from EPSCoR and non-EPSCoR states. Table 1 covers a broad range of faculty sizes. The table also shows the most recent USN & WR ranking; the ranking is dated 2019 but it is based on data submitted by colleges as of Fall 2018. We are interested in how the USNWR rankings correlate with actual quantitative performance data.

<b>Table 1. UofSC CEC PEERS AND ASPIRANTS</b>						
<b>University</b>	<b>USNWR Rank (2019)</b>	<b>ASEE Fac Count</b>	<b>Private</b>	<b>Land Grant</b>	<b>AAU</b>	<b>EPSCoR State</b>
NC State U	24	384		Y		
<b>U Cal-Santa Barbara</b>	24	131			Y	

<b>Ohio State U</b>	27	371		Y	Y	
<b>U Washington</b>	27	339			Y	
<b>Rice Y</b>	27	112	Y		Y	
<b>U Virginia</b>	41	161			Y	
Arizona State U	44	412				
<b>U Florida</b>	45	312		Y	Y	
U Mass-Amherst	58	152		Y		
U Tennessee	58	231		Y		
U Connecticut	67	146		Y		
Clemson	69	203		Y		Y
Oregon State U	73	191		Y		
U Central Florida	75	149				
U New Mexico	85	141				Y
<b>U Cal-Santa Cruz</b>	87	79			Y	
U South Florida	89	123				
UofSC CEC	<b>95</b>	124				Y
U Kentucky	95	135		Y		Y
U Nebraska	95	192		Y		Y
<b>U Missouri</b>	95	106		Y	Y	
<b>U Kansas</b>	95	113			Y	Y
U Oklahoma	106	132				Y
Oklahoma State U	106	165		Y		Y
LSU	106	116		Y		Y
<b>Tulane U</b>	106	22	Y		Y	Y

For the following analyses we consulted the following recent sources of data:

- Academic Analytics: data on articles published and citations to articles, and metrics related to publications and citations. Database AAD2018.04.01458.
- ASEE and USNWR: ASEE data tables are self-reported by colleges, the latest available data are for Fall 2018. These data include doctoral, masters, and bachelors enrollments and degrees granted; total research expenditures, and percentage of NAE members. The USNWR rankings employ ASEE data as well as reputational surveys of peers (other engineering administrators) and employers (people in industry).
- NSF HERD survey: Data on total federal R&D expenditures for 2018, the latest AY available.

Table 2: EPSCoR + AAU Comparison

There are only four AAU universities in EPSCoR states that have engineering schools. Two of these were chosen for comparison: Tulane/Louisiana and the U of Kansas/Kansas. (The other two EPSCoR/AAU engineering schools are Dartmouth and Brown, private Ivy League schools in small states that are not comparable in any sense to UofSC). **Table 2** shows the performance of UofSC CEC to these EPSCoR/AAU schools and to Clemson University School of Engineering and Applied Sciences. Some data come from

the ASEE F 2018 data set and other data from Academic Analytics. Table 2 also shows the USNWR ranking for 2019 (based on Fall 2018 data). We include the faculty count as a point of reference; note that the ASEE and AA have different methodology for faculty counts thus do not match. We report the totals in each category (the total impact of a college) as well as the per-faculty metric (a measure of faculty productivity).

The shaded entries in Table 2 are those quantitative metrics where UofSC CEC is NOT the top performer. Clemson tops all metrics in total size (impact), with a faculty nearly twice the size of UofSC CEC. CEC far outperforms the AAU+ EPSCOR schools Kansas and Tulane in almost every category. Tulane outperforms UofSC in the per-faculty productivity of PhD students, research expenditures, and articles published. Tulane has only three programs in its engineering college (Biomedical, Chemical, and Materials Engineering) and has much lower teaching loads.

A discussion of USNWR rankings is in order. Table 2 includes eight of the USNWR metrics, indicated by an asterisk \*. Clemson is ranked 69 by USNWR, UofSC 95. The primary reason for this disparity is the USNWR peer score (given by a survey of academics) and recruiter score (given by a survey of companies that hire advanced degree candidates). The Peer and Recruiter scores are subjective. Note that the USNWR rankings do not include any measure of scholarly output/impact such as publications and citations.

Conclusions and Actions-Table 2

- On a total performance basis and on most per-faculty metrics, UofSC CEC outperforms the two AAU+EPSCOR Engineering colleges, while supporting higher enrollments and per-faculty teaching loads. On all per-faculty metrics, with the exception of Master’s student teaching, UofSC CEC outperforms Clemson.
- USNWR peer and recruiter scores do not reflect the overall better performance of UofSC in the “countable” metrics. The USNWR graduate ranking methodology does not take into account support of teaching undergraduate students.
- CEC must continue to find ways to promote its identity and the actual performance of its faculty in research and teaching. CEC has built up its internal communications staff significantly in an effort to get out the “good news” about the college and its programs. CEC needs to continue seeking strategic communications opportunities, and it needs the support of UofSC central communications.

<b>Table 2. Peers that are (EPSCoR + AAU) , plus Clemson University</b>				
<b>Metric</b>	<b>UofSC CEC</b>	<b>Tulane</b>	<b>Kansas</b>	<b>Clemson</b>
# ASEE FT Fac	121	36	128	227
# Acad Analytics Fac	124	22	113	203
<b>USNWR rankings and selected metrics</b>				
Rank 2019	95	106	95	69
<b>Peer score*</b>	2.4	2.4	2.5	3.0
<b>Recruiter score*</b>	2.8	3	3.33.4	
<b>Percent NAE members*</b>	0.8	0	0.8	0.4
<b>Total Size (Impact)</b>				
PhD enrolled	300	91	231	533
<b>PhD graduated*</b>	57	11	32	91

<b>Tot Res Expenditures*</b>	\$24.1M	\$8.6M	\$14.0M	\$40.2M
Total Articles	1415	262	1012	2071
Total Citations	24,474	2,561	16,540	26,597
MS Enrolled	167	14	167	591
BS Enrolled	3,085	526	2,217	5,331
<b>Per Faculty (Productivity)</b>				
<b>PhD enrolled/FT Fac*</b>	2.48	2.53	1.80	2.35
PhD degrees/FT Fac	0.47	0.31	0.25	0.40
<b>Res Expend/FT Fac*</b>	\$199,363	\$238,039	\$109,583	\$176,963
Articles/FT Fac	11	12	9	10
Citations/Article	14	8	13	10
<b>MS enrolled/FT Fac*</b>	1.38	0.39	1.30	2.60
BS enrolled/FT Fac	25.5	14.61	17.32	23.48
<b>* Indicates USNWR ranking metric</b>				

Table 3. Scholarly Metrics from Academic Analytics

<b>Table 3. Relative Rankings for Selected Academic Analytics Scholarly Metrics</b>	
<b>Metric</b>	<b>UofSC CEC Outranks These Schools</b>
Articles published per faculty member	<b>UC Santa Cruz</b> , Clemson, Kentucky, U Mass-Amherst, <b>Missouri</b> , Nebraska, Oklahoma State, South Florida, <b>Kansas</b>
Total Citations	Kentucky, LSU, <b>Missouri</b> , Oklahoma State, South Florida, Tulane, <b>Kansas</b>
Citations per faculty member	Clemson, Kentucky, LSU, <b>Missouri</b> , Nebraska, Oklahoma State, South Florida, <b>Tulane, Kansas</b>
Citations per article published	Central Florida, Clemson, <b>Florida</b> , Kentucky, LSU, <b>Missouri</b> , Nebraska, Oklahoma State, South Florida, <b>Tulane, Kansas</b>

Table 4: USNWR most recent rankings

UofSC CEC is ranked #102 by USNWR. Its individual departmental and program rankings are as follows: Biomedical Engineering, 93; Chemical Engineering, 66; Civil Engineering, 75. Computer Engineering, 97; Electrical Engineering, 97; Mechanical Engineering, 94; Nuclear Engineering, 21.

The US News & World Report 2021 graduate (PhD-granting) program ranking for the College as a whole is #102 (tie). Graduate rankings are based on data quantitative submitted in Spring 2020. There are 23 private engineering colleges ranked above us by U.S. News. The two most important metrics that bring down the college is the low ratings given by Peers (other academic engineering deans and associate deans) and by Recruiters (non-academic leaders who hire advanced degree candidates). These two metrics together account for 40% of the total USNWR ranking score.

The US News & World Report 2021 undergraduate program ranking for the College as a whole is also #102 (tie). Undergraduate rankings are based solely on a reputation survey conducted in Spring 2020.

US News also conducts a reputational survey of individual graduate programs (See Appendix 1 for the engineering programs/departments). The highest-ranked programs in the College are nuclear engineering (21), chemical engineering (66th) and civil engineering (75th). Each program is ranked higher than 100, and so the overall college ranking is lower than the individual ranking of any program. Our lowest-ranked graduate programs (Electrical Engineering and Mechanical Engineering) were actually two of the highest-ranked programs in the 2010 National Research Council rankings: Electrical Engineering at # 10 and Mechanical Engineering at # 34. While NRC data are quite dated now, the fact remains that the USNWR rankings are unreasonably skewed by the reputational rankings.



# **Appendix 2. Collaborations**

**Kaiming Ye, PhD**  
**Professor and Chair**  
**Department of Biomedical Engineering**  
**Thomas J. Watson School of**  
**Engineering and Applied Sciences**  
**Director, Center of Biomanufacturing for Regenerative Medicine**

**PO Box 6000**  
**Binghamton, New York 13902-6000**  
**(607) 777-5887 Fax: (607) 777-5780**  
**kye@binghamton.edu**  
**Web: binghamton.edu/bme**

*February 16, 2020*

Mark J. Uline, Ph.D.  
Associate Professor  
Department of Chemical Engineering  
Undergraduate Director, Biomedical Engineering Program  
University of South Carolina  
301 Main Street Room 3C17  
Columbia, SC 29208

Dear Dr. Uline,

I am very pleased to write this letter to support your plan of launching a new Department of Biomedical Engineering.

As Chair-Elect of the Council of Chairs of Bioengineering and Biomedical Engineering, I am leading a team to plan for the 2022 Biomedical Engineering Summit focused on developing a national strategy for biomedical engineering education and workforce training. We realize that Biomedical Engineering is a field at the interface of engineering, medicine and biological sciences. It combines the practical problem-solving ability of engineering to diagnostic, monitoring, and therapy needs of medical sciences. The evolution of academic disciplines often follows the sequence of first being a multi-disciplinary program evolving into an interdisciplinary program and then becoming a discipline in itself with a variety of sub-disciplines. Biomedical Engineering has followed that path and is now widely recognized as a separate discipline within engineering. We witnessed more and more universities launched a new department of biomedical engineering in the last several years.

This is certainly true based on my own experience. In 2012, I helped launch a new Department of Biomedical Engineering from a program homed at the Department of Biological and Agriculture Engineering at University of Arkansas. The launching of the new department was very successful. The enrollment of the first class reached 100 when we launched the new department. The department kept growing in both enrollment and faculty numbers. After joining Binghamton University, State University of New York (SUNY), I renamed our department from Bioengineering to Biomedical Engineering. The name change led to 75% increase in student enrollment in the first year. It also made easier for ABET accreditation, due to a clear and simple administration in curriculum development and student outcome assessment.

I had a chance to visit your program in April 2019. I observed your rapid growth and expansion. I also felt your pain in growth. The designation as a program limits your ability to grow, your

ability to recruit talent students who consider BME as the one of the fast-growing professional choices, and your ability to recruit top faculty members to help further grow and expand your program. The establishment of a new department will remove these burdens and streamline your administration and curriculum development. It will eliminate competing interests between two programs within one department, which will fundamentally streamline faculty hiring and tenure and promotion processes. It will help faculty to compete for NIH funding which views a favor for biomedical engineering faculty due to a consideration of research environment.

Finally, I would like to offer my assistance in helping you to plan for and eventually to launch a new department if needed.

I strongly support your plan of establishing a new Department of Biomedical Engineering.

Yours faithfully,

A handwritten signature in black ink, appearing to read 'Kaiming Ye', with a stylized flourish at the end.

Kaiming Ye, Ph.D.  
Professor and Department Chair  
Director, Center of Biomanufacturing for Regenerative Medicine

February 24, 2020

Dr. Tayloe Harding  
Interim Executive Vice President for Academic Affairs and Provost  
Office of the Provost  
University of South Carolina  
102 Osborne Admin Building  
Columbia, SC 29208

Dear Dr. Harding,

At the request of Dr. Mark Uline, I am submitting my support for the establishment of a Biomedical Engineering Department at your university. I have been at Rutgers, The State University of New Jersey, for over 40 years. In my tenure at Rutgers, I have observed a tremendous growth in Biomedical Engineering (BME) at Rutgers as well as many other universities. I am an ABET (Accreditation Board for Engineering and Technology) program evaluator and team leader; in this capacity, I have observed the advantages of being in a “department” compared to “program”. I am very familiar with the process of going from a program to a department and what it takes to make a department successful. Let me first state what we went through in our development and then I will comment on Mark’s proposal.

The Biomedical Engineering program at Rutgers University was initially established in 1965 as a track within Electrical Engineering, offering M.S. degrees with a Biomedical Engineering emphasis. In 1986, the State of New Jersey formally chartered the Rutgers Department of Biomedical Engineering as an independent entity within the School of Engineering (SoE) with exclusive responsibility for granting M.S. and Ph.D. degrees in biomedical engineering.

The undergraduate program in Biomedical Engineering was inaugurated in 1991 under the “Applied Sciences” option within the School of Engineering; a formal undergraduate B.S. degree in BME was approved by the University in 1997. In Fall 1999, our BME department started an official undergraduate degree program. In order to qualify for a BME leadership award (which was instrumental in getting a new BME-dedicated building), Former SoE Dean, Michael Klein, requested six SoE faculty from other established departments to have a joint appointment in BME and their home department. The department faculty grew over the next few years from eight to fourteen. In addition, ten new faculty members were hired in a span of seven years. The first BS degree class was four (4) students in May 2000. The class of 2020 is one-hundred twenty-two (122). Our BME undergraduate program initially received ABET accreditation in 2005 and has been successfully renewed since.

A BME building was dedicated on April 18, 2007. The 80,000-square-foot education and research facility featuring state-of-the art micro fabrication, tissue culture, and microscopy laboratories, including small animal facilities. The 2<sup>nd</sup> and 3<sup>rd</sup> floors are “open lab space” concept with no walls. We have seen tremendous advantages of collaborative research work and sharing of resources because of the environment that has been created. Currently, we are 25 BME core and 71 graduate faculty, over 300 undergraduate students (4<sup>th</sup> largest in the country) and over 100 graduate students. I strongly believe this type of growth cannot occur with a “program” alone; it has to be through a “department”.

Having said that here are my comments on the proposal by the College of Engineering and Computing (CEC) at the University of South Carolina (UofSC):

1. Biomedical Engineering at the University of South Carolina should be administered as a department. They have been functioning as a program, but now this step is necessary to have an impact on the program as well to the university. Currently, there are 13 faculty members, 3 instructors, and 2 administrative staff members who are supporting the BME program. There is a need to strengthen the activity of BME by creating a department and developing a critical “core” faculty size. The department will get firm commitments from the residing faculty and they will share the resources and develop collaborative research programs.
2. The hiring proposal is modest, and it is developed with the consideration of three existing research centers: The Artificial Intelligence Institute, the Research Center for Transforming Health, plus the Cardiovascular Translational Research Center. With the addition of five faculty members, the department will be a decent size of eighteen faculty members. This will make BME comparable to existing departments at other universities. One of the Accreditation criteria is faculty size and expertise. The current hiring plan will avoid the concern about the small faculty size. The department of 18 faculty members will be able to handle advising, teaching, research and mentoring all BME undergraduate students.
3. The faculty hiring plan is designed by your internal functioning and expertise to acquire. It is a fact that that hiring plan will be severely hampered if a BME department is not established. Based on experience, we can state that we have been able to attract excellent faculty because we are a full BME department and we have built an environment with a collaborative culture. I am certain that you will observe a significant amount of collaborative activities which will result into successful funding, research growth and the ability to attract new junior, as well as senior, faculty members.
4. In the UofSC College of Engineering and Computing (CEC), Biomedical Engineering exists as a program, rather than a department. Once the program becomes a department, it should become a nationally respected academic unit. Clemson University is the only other university in South Carolina with a similar yet distinct academic unit, a Bioengineering Department. The University of South Carolina’s Biomedical Engineering Program has reached the stage now to become a department to its own identity and build a unified autonomous entity. This will allow BME to create a research direction and make a name for their own challenges. The next set of hiring in Cardiovascular Mechanics & Modeling; Cardiotoxicity; Big Data; Biomaterials for Localized Delivery; Regenerative Medicine; Protein Science; Diagnostics; and Biomanufacturing will enhance the current strength, plus the teaching, training and clinical practice should address relevant health care issues affecting SC citizens.
5. The department will be able to further outreach the local universities and build partnerships in biomedical engineering related devices.
6. The undergraduate and graduate student population will have a home; they will be your assets and ambassadors of your department and they will become part of your complete endearment as they provide valuable services to the department. It is possible that Biomedical Engineering may become the largest degree granted program in the CEC. All faculty will be in close vicinity which will enhance faculty collaboration. All-in-all, it will be a win/win situation.

I wish you all best of luck in the formulation of the department and look forward to constructive progress in Biomedical Engineering at the University of South Carolina.

Warm regards,

A handwritten signature in black ink, reading "Noshir A. Langrana". The signature is written in a cursive style with a large initial 'N' and a long, sweeping underline.

Noshir A. Langrana, Ph.D, .P.E.  
Distinguished Professor  
Interim Undergraduate Program Director  
Former Chairman of BME Department, 2005-2017

February 24, 2020

Dear Dr. Uline:

I am writing regarding the pending formation of a Biomedical Engineering department at the University of South Carolina. As you can see from my comments below, I am very supportive of this effort and know first-hand how important the formation of a BME department can be to the growth of our discipline. To provide some context, let me first describe my background. After completing my PhD in Biomedical Engineering from Tulane University and post-doctoral training at the University of Pittsburgh, I was recruited to Lehigh University in 2003 as an Assistant Professor in Mechanical Engineering and part of my job description was to co-develop a Bioengineering program at the undergraduate level. I helped develop the curriculum and structure for this program, which rapidly became a very popular undergraduate major. However, there were several limitations as a program, the primary of which was that tenure-line faculty needed to be hired in other engineering departments and that limited our ability to specifically hire the faculty needed for the Bioengineering undergraduate program. The lack of a department also hindered the development of a Bioengineering graduate program. Although I moved to Ohio State University in 2007, I am happy to note that Lehigh now has a strong Bioengineering department with tenure-line faculty.

I am currently, Chair of the Biomedical Engineering (BME) department at the Ohio State University (OSU) and the history of BME at OSU is typical of many BME programs. It was initially a research center that offered graduate degrees (MS and PhD) for many years before becoming a full department in ~2006 with an undergraduate program. Simply stated, becoming a department has been transformational for BME at OSU. In the past 14 years, we have grown to be a large department (~550 undergraduates, ~100 graduate students and 30+ faculty members) that offers a large range of services to our students. The most critical aspect of becoming a department was the ability to directly hire tenure-line faculty in areas where we wanted to grow. Specifically, our department has very strong ties to the OSU Medical Center and particularly strong ties with several hospitals and research institutes on campus (e.g. James Cancer Center, Davis Heart & Lung Research Institute, Spine Research Institute, etc.). As an independent department, we were able to target our faculty recruitments in these areas and cost-share these lines with Institutes and Divisions in the Medical Center. As a result, we have recruited outstanding faculty members who are making significant impacts on both engineering research and clinical care. The department has also been able to provide outstanding resources to our students which have allowed them to excel in many areas as evidence by the recent winning of "chapter of the year" award to our undergraduate student society at BMES. Being a full department has also helped us enhance our graduate programs, obtain better access to larger scale funding resources and develop the resources needed to deliver high quality teaching, research and service in BME. It has allowed BME to be a full partner with other departments in the college of engineering and this can be most visibly seen in our new state-of-the-art building that will go online this summer (<https://engineering.osu.edu/bmec>). This building will house two departments, BME and Material Science and Engineering, and will foster new collaborative efforts in the area of biomaterials development and significantly enhanced resources for our undergraduate and graduate students. Development of this type of collaborative facility would not have been possible if Biomedical Engineering did not have full departmental status.

Department of Biomedical Engineering  
Bevis Hall, Room 270, 1080 Carmack Road  
The Ohio State University  
Columbus, OH 43210  
[ghadiali.1@osu.edu](mailto:ghadiali.1@osu.edu), 614-292-7742

In summary, although I recognize the significant effort and resources that are required to form a new BME department, the benefits of this effort will be significant and likely out-weigh the costs. BME is now a very mature discipline and in my opinion, Universities and Colleges that do not have a department structure are at a significant disadvantage when it comes to national recognition, the ability to recruit faculty members/students and provide the collaborative resources required by our discipline. It sounds like a very exciting time at the University of South Carolina and I am excited to hear about your plans for forming a department. I wish you the best in this endeavor and would be happy to answer any questions you have about our department at Ohio State or this letter.

Sincerely,



Dr. Samir N. Ghadiali, PhD  
Professor and Department Chair  
Department of Biomedical Engineering  
The Ohio State University

Professor (Joint Appointment)  
Department of Internal Medicine  
Division of Pulmonary, Allergy and Critical Care Medicine  
Dorothy M. Davis Heart & Lung Research Institute  
Ohio State University Wexner Medical Center

*Raphael C. Lee, MD, ScD, FACS*  
*Paul and Allene Russell Professor*  
*Director, Center for Molecular Regeneration Therapeutics*

Friday, February 28, 2020

Dr. Tayloe Harding  
Interim Executive Vice President for Academic Affairs and Provost  
Office of the Provost  
University of South Carolina  
102 Osborne Admin Building  
Columbia, SC 29208

**RE: USC DEPARTMENT OF BIOMEDICAL ENGINEERING**

Dear Provost Harding,

I am delighted to learn that the University of South Carolina's College of Engineering is proposing the establishment of a Department of Biomedical Engineering. While there are several structural advantages of establishing a departmental structure around biomedical engineering, there are even more important scientific and academic reasons to do so. Thus, I am writing to strongly encourage in the strongest terms the University of South Carolina to create a department of biomedical engineering, especially one that links the School of Medicine with the College of Engineering.

Decades ago when I was a graduate student in engineering, there was general skepticism regarding the concept of biomedical engineering as a distinct intellectual discipline. At that time there was no unique intellectual skillset that either defined biomedical engineering pedagogy or justified biomedical engineering as a distinct academic discipline. Now the situation has completely changed.

Today, the application of engineering systems science to biology and medical research is resulting in the discovery of new engineering design principals for self-organizing, and even living, materials that have performance capabilities not achievable with other materials. These new biomaterials are robust and adaptive. They self-repair and manifest emergent behaviors that define structure-function-property relationships which are new to engineering science. It seems most likely that the future of engineering science and pedagogy will be heavily influenced by investigating and learning the rules of biological systems. Increasingly public and private engineering research dollars are being directed toward biomedical engineering research. Today, biomedical engineering is rapidly becoming the flagship engineering department within colleges of engineering.

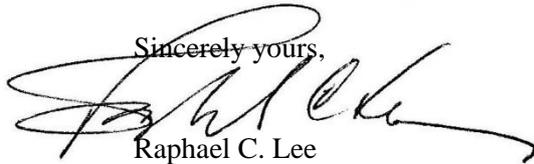
It is also becoming clear that engineering science is of fundamental importance to the advancement of biology and medicine. The scientific questions being addressed by biologists today are increasing about how cellular systems behave. In medicine a patient is seen as a robust and adaptive complex feedback-controlled closed-loop homeostatic system, and disease is a malfunction resulting from a disorder in that system. The goal of medical research now is to move away from population-based validation of drugs and

devices and move towards personalized therapies based on the genetics and regulating epigenetic factors for each patient..

Success in accomplishing personalized medicine inexorably requires a working knowledge of how to accomplish a steady-state beneficial change in the behavior of closed-loop control systems which is a skillset unique to engineering. Thus there is a fundamental need to converge engineering and medical pedagogies to train tomorrow's physicians.

I wish to congratulate the USC College of Engineering on increasing the investment in biomedical engineering. I am totally confident that this will prove to be a wise investment that will not only benefit future students, but the future of both engineering and medicine as well.

Sincerely yours,

A handwritten signature in black ink, appearing to read 'Raphael C. Lee', with a long horizontal flourish extending to the right.

Raphael C. Lee