

Texas State University Capability Statement

Institution: **Texas State University, College of Science and Engineering**

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Certificates, Registrations, Accreditations: **SACSCOC; ABET; ACCE; ACS; ASBMB; ATMAE; FEF**

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OVERVIEW

The College of Science and Engineering (CoSE), the largest college with an enrollment of 6,613, is notably diverse with a 39.7% Hispanic, 39.1% White, 9.86% Black, 4.19% Asian, 3.84% Non-resident International, 2.27% Multi-race, and 1.04% Other/Unknown student demographic (fall 2020 data). CoSE prepares undergraduate and graduate students for careers in the natural and physical sciences, mathematics, computer science, engineering, and technology. The college is committed to nurturing the talents of young scientists and engineers by immersing students in a robust curriculum and applied learning experiences in laboratory research, field study, and cutting edge technology. Comprised of over 370 faculty in six departments and a school of engineering, CoSE has a triple mission of (1) preparing students for careers in STEM and STEM education and imparting core knowledge in science and mathematics to all students; (2) providing an environment in which faculty can develop and sustain internationally prominent research programs; (3) serving the citizens of Texas and the nation with educational and research programs that facilitate innovation and economic development. CoSE offers 34 STEM degree programs, including four Ph.D. degrees: Materials Science, Engineering, and Commercialization focuses on applied research, industrial outreach, and entrepreneurial training; Aquatic Resources and Integrative Biology integrates scientific, technical, and socioeconomic elements to provide sustainable aquatic resources; Mathematics Education prepares doctoral students to become leaders in mathematics education research; and Computer Science combines the application of computer science practice and theory with entrepreneurial and commercialization skills. Faculty and graduate students are highly engaged in relevant research. CoSE faculty have been recognized with prominent awards including the Presidential Early Career Award for Scientists and Engineers, NSF CAREER Award, and Cottrell Scholar Award.

RESEARCH CAPABILITIES

Biology: microbial ecology (host-associated microbiomes, bacterial biofilms, bacterial symbioses; host-parasite dynamics), climate change biology, ecosystem-level processes (nutrient cycling and organic matter flows), toxicology

Chemistry and Biochemistry: cancer research (novel strategies to treat human diseases that stem from defects or deregulation in DNA repair, aptamer-based responsive nanostructures that can be activated by disease-specific molecules for use in targeted drug delivery, nanoparticle-based near infrared contrast agents for optical detection and treatment of cancer, novel synthetic organic chemistry for anticancer drug discovery), nanomaterials (nanoscale chemical and biological sensors, environmental applications of nanostructured materials), electrochemistry (intercalation electrodes, solid-state ion conductors, electrocatalysts, batteries, supercapacitors, fuel cells)

Computer Science: high performance computing (program performance auto-tuning, multi-core computing, computing with GPUs, energy-aware scheduling, and program performance optimization), human computer interaction (eye-tracking based biometric identification and eye tracking for software usability assessment), information and data innovation (data mining, databases, information retrieval, bioinformatics, and Web service integration), networking and cyber security (mobile cyber-physical systems, security in networks and systems, network protocol design, mobile and ad-hoc networks, and wireless sensor networks), software engineering

Engineering Technology: concrete industry management (sustainable materials in concrete, ultra-high strength concrete), construction science and management (virtual reality in construction & safety training, asphalt pavement), engineering technology and management (AI in design and manufacturing, micro & nano manufacturing, ontology engineering, vehicle dynamics & control, robotics & autonomous systems, cast aluminum alloys)

Ingram School of Engineering: renewable energy, electrical (micro and nano devices and systems, networks and communications), computer (AI, VR/AR, sensors), industrial (sustainable and intelligence, digital twins, analytics and

simulation, healthcare systems), manufacturing (smart manufacturing, additive manufacturing, robotics, polymers), civil (sustainable water resources management, wastewater treatment, environmental chemistry and toxicology, multifunctional construction materials for technology-enhanced infrastructure, transportation engineering)

Mathematics: model theory (to identify common causes of similar phenomena across mathematics and to transport techniques from one area to another), number theory, graph theory, combinatorics

Physics: spectroscopy of exoplanet-forming disks (with focus on infrared spectra of molecular emission from the inner 10 astronomical units), fundamental and applied properties of semiconductors (with applications for high-power transistors, light-emitting and laser diodes, photovoltaics, photodetectors), growth and simulation of new semiconductor materials, material property characterization in nanometer scale, novel energy materials (solar cell efficiency, silicon photonics, laser materials and devices, tunneling field effect transistors)

STEM Education: discipline-based education research in biology, chemistry/biochemistry, mathematics, and physics

FACILITIES

- **Edwards Aquifer Research & Data Center** provides water analysis services for a variety of chemical and biological constituents found in wells, springs, rivers, municipalities, and wastewater treatment facilities.
- **Mathworks** is a center for innovation in mathematics education whose mission is to research and develop model programs that engage students in doing mathematics at a high level.
- **Shared Research Operations (SRO)** consists of several laboratories across campus that host more than 50 pieces of sophisticated equipment with technical staff providing the SRO user base in-depth training and assistance with unique research challenges. SRO Research Service Center (RSC) facilities include:
 - Analysis RSC hosts electron and optical microscopy equipment utilized to probe the structure, composition, and electrical/magnetic properties of matter from metal/concrete castings to bacteria to nanoparticles. Various photon energies are utilized for spectroscopic interrogation from infrared to x-ray wavelengths revealing information such as bond energy, crystal structure, and stoichiometry.
 - Nanofabrication RSC is a 2000 ft² multi-user clean room facility where researchers fabricate films, structures, and devices at the micrometer and nanometer scale. The RSC houses high temperature furnaces, physical vapor deposition systems, wet chemical benches, electrical test equipment, metrology equipment, and lithography process equipment.
 - Epitaxy RSC contains heteroepitaxy equipment designed to grow crystalline thin films. Equipment include a high vacuum Molecular Beam Epitaxy multi-chamber cluster and a high temperature Metalorganic Chemical Vapor Deposition reactor, which allow researchers to experiment with a large portion of the periodic table in search of new functional semiconductor and oxide materials.
- **Xiphophorus Genetic Stock Center** is a national resource for research animals housing 24 of 26 species of the freshwater fish genus *Xiphophorus* used in cancer related and other research projects.
- **Ingram Hall Makerspace** is a 11,000sqft facility offering the latest in manufacturing and prototyping technology in a hands-on environment, with over 140 pieces of equipment used in 3-D printing, laser cutting/etching, CNC machining, sheet working, metal working, welding, machining, and wood shopping.
- **System Modeling and Renewable Technology (SMART) Lab** is a multidisciplinary lab that focuses on sustainable and renewable energy technology (smart systems, sensors, smart grids).

PAST PERFORMANCE

Over the past three years, CoSE faculty secured over \$33 million in external funding for 222 research projects. Notable federal funding agencies, with sample research project, include: **U.S. Army Core of Engineers** (Predicting Ecological Futures in Texas \$4,398,979); **US Army ONRRO San Diego** (Heterogeneous Integration of Diamond and Ultrawide-Bandgap Semiconductors \$660,000); **U.S. Dept. of Defense** (Enhanced Optical, Electrical, and Magnetic Measurement Capabilities for Materials and Device Studies in Research and Education \$278,778); **Office of Naval Research** (Bifunctional Membrane Electrode Assemblies for Unitized Regenerative Fuel Cells \$449,980); **NASA** (Polymicrobial Biofilm Growth and Control During Spaceflight \$288,905); **National Science Foundation** (Using Technology to Capture Classroom Interactions: The Design, Validation, and Dissemination of a Formative Assessment of Instruction Tool for Diverse K-8 Mathematics Classrooms \$1,984,657); **National Institutes of Health National Cancer Institute** (Molecular and Therapeutic Mechanisms of Differentiation-Inducing MicroRNA MiR-50 \$448,620); **National Institutes of Health** (DNA Repair Pathways Preserve Cellular Homeostasis \$448,620); **National Institute of Environmental Health Sciences** (Functions of the DNA/RNA Motor Protein AQR in R-Loop Resolution, \$344,378); **U.S. Dept. of Agriculture Natural Resources Conservation Service** (Bluewater: A Smart Circular Economy for Integrated Organic Hydroponic-Aquaponic Farming to Empower an Underrepresented Workforce \$249,980). One example of corporate funding is **Facebook Technologies LLC** (Eye Movement Prediction on Virtual Reality Platforms \$255,787).