



# Tougaloo College

## Research and Development Foundation, Inc.

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## *Capability Portfolio*

*Interweaving HBCUs Research Value-Propositions*



*The Foundation serves as a military-centric pillar of success, dedicated to supporting the missions and visions of the National Defense Authorization Act (NDAA).*



## The Foundation's Methodology

TCRDF focuses on building – *Historically Black Colleges and Universities (HBCUs) Contracts and Research Capacity through Partnerships* – that provides a unique opportunity to implement a comprehensive program focused on closing the gap in the number of HBCUs participating in DoD and military services research, grants, contracts, cooperative agreements and other funding opportunities.

Our Consortium of HBCUs spark a new emphasis on collaboration among HBCUs, University Affiliated Research Center (UARCs), and Federally Funded Research and Development Centers (FFRDCs) with mentor and navigator methodologies of how these value-added research entities can collaborate on synchronizing their unique research capabilities and resources to build a DoD-centric research consortium that is better than the sum of its parts.

### **Disruptive-Innovation Navigator**

Our HBCUs Consortium serves as the “Disruptive-Innovation” for HBCUs research contracts opportunities in alignment with the array of DoD-wide contracting authorities’ solicitations.

Our team use “Best Practice” and experienced cross-functional proposal evaluation core competences to weigh the HBCUs research capabilities related to the government research solicitations’ Statement of Work (SOW) to isolate the scope of work required to complete a specific research project.

Based on our SOW analysis and understanding of each HBCU specific and unique capabilities, TCRDF generate proposals that clearly articulates and demonstrates the Consortium disruptive-innovation and significant commitment to providing the U.S. military with revolutionary new mission capabilities that enable significant increases in mission effectiveness and also dramatically reduce DoD research costs.

### **John Rosenthal President**

#### **ADVISORY BOARD**

- MG Abraham Turner, USA (Ret.)
- Dr. Maurice Nabritt
- Col. Anthony Howard, USA (Ret)
- Col. Janet Simmons, USA (Ret)
- Col. Doris Browne, USA (Ret)
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### **Universities Research and Development Funding**

Section 4201 – Research, Development, Test, and Evaluation of the 2017 National Defense Authorization Act quantifies the funding authorization for Defense-wide Universities R&D – at a \$33.5M (7%) carve-out for HBCUs.



## DoD Research Value Proposition

TCRDF's research team proposals will ensure the "best value-proposition" formation of HBCUs capabilities in response to the DoD research solicitations SOW by proposing HBCUs research capabilities focused on the integration, collaboration, demonstration, and evaluation of innovative solutions to DoD-centric critical systems components enabled by, and incorporating, new or emerging revolutionary technologies.



### HBCUs ALLIANCE

- Bethune-Cookman University
- Claflin University
- Dillard University
- Fisk University
- Florida A&M University
- Howard University
- Morgan State University
- Prairie View A&M University
- Southern University and A&M College
- Tennessee State University
- Tougaloo College
- Tuskegee University
- University of the District of Columbia

### RESEARCH STRENGTHS

- Advanced Materials, Nanoscience and Biotechnology Research
- Autonomous Vehicles, Intelligent Controls, Remote Sensing
- Cybersecurity and Big Data Analytics
- Advanced Visualization and Visual Simulation using CAVE VisCube 3D system

- Dynamic HBCUs alliances for empirical DARPA/TTO research and analysis that highlights HBCUs military tactical research capabilities, collaborative and diverse research and project management performance in supporting the National Defense Authorization Act .
- Thought Leader with DARPA/TTO and HBCUs on pursuing equitable opportunities for participation on "*forward-leaning*" revolutionary military-centric research projects within their interdisciplinary scope.
- Establish a streamline portfolio of defense-centric HBCUs and non-traditional commercial companies subject matter experts to take a systematic and evidence-based approach to tactical military research and deliver impartial guidance grounded in a thorough understanding of the tactical issues and solutions.
- Oversight of projects and technology maturation concept-to-realization milestones and the transition of DARPA-funded technologies into Department of Defense capabilities.

These strength-points will support the President's Executive Order by establishing and managing collaborative research partnerships between HBCUs and non-federal research entities including research institutions doing Defense work, Defense supported University Affiliated Research Centers and Federally Funded Research and Development Centers.



## Core Competencies

TCRDF does not directly perform research, however, we leverage our Consortium members combine capabilities. Our institutions consist of a diverse team of researchers who are accomplished technologists who has supported and managed a number of advanced development efforts for the Army Rapid Equipping Force (REF), Marine Corp Warfighting Lab and Air Force Research Laboratory (AFRL) in collaboration on; Battlefield Air Targeting Camera (BATCAM), Expendable-Unattended Ground Sensors (E-UGS), Persistent Ground Surveillance System (PGSS), and Transformational Satellite Communications System (TSAT).

In addition, our Consortium members has successfully completed numerous research and training projects sponsored by The Air Force of Office of Scientific Research (AFOSR), Army Research Laboratory (ARL), NASA, The National Science Foundation, the National Institutes of Health, and a number of private foundations. Research has included the development of chemical and biological sensors to detect nerve agents and explosives, and screening of the toxicity of organophosphate compounds.

The AFOSR supported Pulsed laser deposition of Hard and soft materials, while the Army Research Labs provided support for the development of energy harvesting materials. International collaboration around energy harvesting materials projects have also flourished. The University is also engaged in a Joint Work Statement (JWS), Cooperative Research and Development Agreements (CRADA), and EPA Educational partnership with both ARL and AFOSR for five years.

### Current

#### Funded Research

- Sensor Fusion
- Battery technology
- Health Monitoring
- Wireless Communication and networks
- Decision making using Robots, helicopters, and RF sensors
- Reliable communication in congested environments
- Cloud computing security
- Smartphone security
- Cyber Physical System security
- Bioinformatics

### Department of Defense

- Secretary Frank Kendall (Under Secretary of Defense), HBCU Strategic Engagement letter dated December 15, 2016 to Committee on Appropriations and Committee on Armed Service
- Chief of Naval Research Rear Admiral M.W. Winter letter to Committee on Appropriations and Committee on Armed Service
- United States Air Force Report to Congressional Committees dated March 2016
- Defense Threat Reduction Agency, Acting Director Major John P. Horner letter dated May 26, 2016 to Committee on Appropriations and Committee on Armed Service



# BETHUNE-COOKMAN UNIVERSITY

Bethune-Cookman University (B-CU) is a comprehensive liberal arts university with 36 undergraduate and seven graduate degree programs. Relevant faculty expertise at B-CU includes advanced sensors, behavioral sciences, bioinformatics, computer engineering, computer information systems, computer science, education, environmental systems, geographic information systems, health sciences, management information systems, mathematics, remote sensing and image processing, social sciences, statistics and visual analytics. Our capabilities fall into several major programs as outlined below:

## HEALTH SCIENCES

- Health Disparities and Health Equity
- Women's Health, Maternal and Child Health and Community Health
- Adaptive physical Activity
- Nutrition
- Environmental Health
- Chronic Pain, Disparities in Pain and Pain Treatment
- Aging and Health Disparities
- Diabetes
- Caregiver Advocacy and Health
- Sickle Cell
- Concussions, Sports Injuries and Spinal Cord Injuries

## STEM EDUCATION

- Engagement of underrepresented students in STEM disciplines by exploring the effects of argument-driven inquiry (ADI), socio-scientific issues (SSI) and scientific reasoning skills (SRS) on student's acquisition of mathematics and science content knowledge;
- Pedagogical pathways to utilizing big data to educate the next generation of mathematics and statistics undergraduates to confront new challenges in computational and data-enabled science and engineering;
- Using music to improve critical thinking skills in STEM;
- Remote Sensing Curriculum to Strengthen GEOINT Education
- Metacognition and robust learning

## NETWORKS AND DATA SCIENCE

- Robotics, Computer Vision, and Machine Learning;
- Bioinformatics;
- Cyber Security;
- Data Science Semantic Data Fusion/Data Mining Data Visualization;
- Delft3D Modeling;
- Visual Analytics Enabled Surveillance and Detection of Biological Threats from Large Microbial Bioinformatics Datasets;
- Performance Modeling and Simulation;
- Energy-aware routing in wireless ad-hoc sensor networks
- Computer networks communication protocols, reliability and performance evaluation
- Multiobjective genetic clustering algorithms as they apply to aspect mining;
- Back end Web programming languages.

## **NATURAL SCIENCES AND ENVIRONMENTAL SYSTEMS**

- Analytical methods to mitigate health disparities in prostate cancer (pca) research and plant metabolomics for drug discovery;
- Techniques and methods in the areas of molecular biochemistry, structural enzymology, and synthetic biology;
- Use of HICO (Hyperspectral Imager for the Coastal Ocean) imaging to develop strategies for coastal management;
- Climate change science and impacts on underrepresented communities;
- Systems approach to environmental ecosystems management;
- Aquatic organism and the
- Physiological ecology, reproductive and environmental biology of aquatic organisms with an emphasis on the effects of long-term climate change
- Freshwater, marine, and upland coastal ecology and restoration
- Tree diseases / Forest Pathology and Plant Ecology
- Urban Biodiversity / Native Landscapes
- Microbial rhodopsins mediated signal transduction
- Stability and folding of membrane proteins
- Role of lipids & proteins as chaperone in expression, assembly of membrane proteins
- Critical thinking in Biochemical science

## **BEHAVIORAL AND SOCIAL SCIENCES**

- Chinese language and history;
- Impact of internal & external stressors on human behavior and capability;
- Sociocultural development through sustainable tourism;
- Organizational behavior including organizational communication, work place training and its effects, employee behaviors within the workplace, organizational change effects on employees, and employee retention;
- Cyberbullying and School Counselors
- Counseling and African-American Males
- Children in Foster Care: Impact of Group Therapy
- International communication
- Role of acculturation/assimilation in serious psychopathology/mental illness among individuals of African descent in systems of racism;
- Psychological effects of a strong ethnic identification and African Self Consciousness among individuals of African descent;
- Suicidal behavior and risk factors;
- Social and Restorative Justice;
- Sanctions-regimes against Iraq, Iran, Syria, Russia and Cuba
- International Security Studies, focusing in Middle East
- International political economy and international security
- International Relations and U.S. Foreign Policy
- Homeland security
- International trade and investment
- Regional economic integration
- Exchange rate volatility



## CLAFIN UNIVERSITY

Clafin University is located in Orangeburg, SC, a city of approximately 14,000 people about forty miles south of Columbia, SC. Clafin University has a population of approximately 2000 undergraduate and graduate students from 45 South Carolina counties, 24 States, and 11 countries. The student-faculty ratio is 13 to 1, with 83% of the faculty holding terminal degrees in their fields.

### INITIATIVES

Cyberinfrastructure Empowerment for Diverse Research, Scholarship and Workforce Development (CI Empower), HBCU-UP and SCAMP grants from NSF; UNCF-Lilly Foundation Grant, Gates Foundation grant, Mellon Foundation grant, Clafin University's Upward Bound Program is serving students in Calhoun and Orangeburg counties for the past 50+ years; Clafin Saturday Academy is an AmeriCorps program operating through, teachers in the public schools of South Carolina; and Call Me MISTER (acronym for Mentors Instructing Students Toward Effective Role Models) is a program to recruit, train, and certify elementary teachers in the public schools of South Carolina.

The University offers broad based education in liberal arts and sciences combined with internships and other career-focused programs. The University offers 36 undergraduate majors and three graduate majors.

Research projects and scholarly activities are active, with undergraduate student participation in the School of STEM, the School of Education, the School of Business and the School Clafin Humanities and Arts. The Research enterprise is a part of the curriculum in all departments in each one these schools and in the Center for Continuing and Professional studies.

### BIOLOGY

Evaluation of Plant Species as Potential Biofuel Feedstock with Maximal Energy Yield; Defensive, Physiological, and Ecological Roles of Phytochemicals; Prostate Cancer Research, HIV/AIDS Research, Virology & Immunology of HPV, and HIV. Genotyping and DNA Sequencing; Biofuel from Cellulosic Biomass; Development of Biochemical Markers to Combat Resistance to Biotic Stresses in Watermelon; and Developing and Applying New Methods and Technologies in Forensic DNA and Serology Protocols.

### CHEMISTRY

New Approaches to Inhibiting the Production of Cancerous Cells by Targeting Thymidylate Synthase; Detection and Remediation Response to Chemical Weapons of Mass Destruction; Study of the Intermolecular Interactions in Solution Phase Using the Combination of FIIR and NMR; Quantum Mechanical Calculations Performed by Gaussian 09; Study of the Thermodynamics in Hydrogen/Halogen Bonding or DNA Related Binding System using Isothermal Titration Calorimetry (ITC); Synthesis and Characterization of new solid state materials, such as Perovskites, metal organic frameworks and main-group inorganic-organic hybrid materials; Environmental Remediation of Mercury (Hg), Chromium (Cr), and Chlorinated organic Solvents, and Identifying the Changes in Metabolic Profiles due to Various Stimuli (e.g., Disease Development, Infection, Temperature Changes, Nutrient Availability).

## **MATHEMATICS & COMPUTER SCIENCE**

Cybersecurity; Mathematical Software Design, Computer Vision, Machine Learning and Pattern Recognition, Investigation of a Broad Range of Thermodynamic Heat Engine Applications, Dynamic Optimization, Differential Game, Computations, and Geometric Mechanics.

## **FACILITIES**

***James S. Thomas Science Center:** Lecture classrooms and Teaching and Research Laboratories. **The SC Center for Biotechnology Core Laboratory-** is also located in the James S. Thomas Science Center. The lab has a DNA Microarray, SNP Genotyping, MicroRNA Analysis, and Viral Quantification through both Real Time PCR and Thermal Cycle PCR among other equipment. **The Molecular Science Research Center MSRC):** The MSRC is a state-of-the-art research facility that has been designated as a CORE Research facility for the state of SC. **Major& Specialized Instrumentation-** The research equipment includes a Molecular Virology facility with an Imaging Suite, Sequencing Suite and a Tissue Culture Laboratory. It has a Spectroscopy Laboratory, Electron Spin Resonance Laboratory, X-Ray Diffractometer Laboratory and two NMR rooms (300 MHz and 700 MHz). The Chemistry faculty offices and research labs are located in the MSRC.*

## **PAST PERFORMANCE**

Clafin University has received research grants from the Department of Defense, National Nuclear Security Administration (NNSA), Department of Energy, Department of Education, National Science Foundation (NSF), National Aeronautics and Space Administration (NASA) and National Institutes of Health (NIH). Clafin University has a stellar record in managing grand funds within applicable rules and regulations.

## **GRANTING AGENCIES**

Clafin University has been receiving grants from federal agencies like Department of Defense, National Nuclear Security Administration (NNSA), Department of Energy, Department of Education, National Science Foundation (NSF), National Institutes of Health (NIH), Defense Advanced Research Projects Agency (DARPA), and National Aeronautics and Space Administration (NASA) to carry out various educational and research initiatives.

## **SCHOOL OF BUSINESS**

Consumer Social Identity, Cross Cultural Consumer Purchasing Behavior and Management, Social Entrepreneurship, Innovation, Small Business Development and Microfinance, Ethics and Corporate Social Responsibility, Cause Related Marketing, Retail Product Placement, Customer Service/Satisfaction, New Product Development, Quality Management, Leadership, Global and National Human Resource Development, Supply Chain and Operations Management, Organizational Behavior and Development, Organizational Conflict Resolution and Communication Strategies, Mergers & Acquisitions (M&As), Corporate Governance, Financial Market Efficiency.





## DILLARD UNIVERSITY

Dillard University was established in 1869 and is a private undergraduate Historically Black University. Dillard University has a distinctive strength in sciences. The Physics program, which is housed in the School of STEM and College of Arts and Sciences, is has been identified as one of the university's signature programs.

### RESEARCH CAPABILITIES

**Chemistry:** green organic synthesis

**Mathematics/Computer Science:** Nano-fluid modeling, algorithm development, math modelling

**Physics/Pre-Engineering:** Energy harvesting materials fabrication and characterization, nanocomposite materials, organic-in-organic thin film nanocomposite materials fabrication for optical, Bio and chemical sensors, superconducting, explosive detection and characterization, and modeling

**Health Disparities:** HIV/AIDS, Mental health, obesity, suicide prevention, substance abuse, social determinants of health

The department was established in 1940 and most recently was nationally recognized as second in the Nation for graduating African American Females in Physics, as noted by the Associated Press, Washington Post, and many other outlets across the country.

The physics department houses pre-engineering, medical physics, and material physics programs. The physics department offers the undergraduate degree in physics with emphasis on research in optics, materials science, medical physics, and electrical, mechanical, and bio-medical engineering.

Dillard students continue to excel academically, winning major awards such as the Luard Scholarship. Students also participate in DoD-sponsored research and earn placement in prestigious graduate programs throughout the nation. With 141 years of academic excellence to its name, Dillard University continues its historical commitment to excellence in education and strives to position itself as one of the nation's premier centers for undergraduate research.

### PAST PERFORMANCE

The University has successfully completed numerous research and raining projects sponsored by The Air Force of Office of Scientific Research (AFOSR), Army Research Laboratory (ARL), NASA, The National Science Foundation, the National Institutes of Health, and a number of private foundations. Research has included the development of chemical and biological sensors to detect nerve agents and explosives, and screening of the toxicity of organophosphate compounds.

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## FISK UNIVERSITY

Fisk University (FISK) is consistently recognized for quality and value, Fisk was ranked in the Top 10 by the 2017 U.S. News & World Report rankings of Historically Black Colleges and Universities and in the elite Tier One of all liberal arts institutions. Fisk was also ranked #1 by

### PAST PERFORMANCES

- Development of high power tunable lasers in the infrared using ZnSe:Cr<sup>2+</sup> laser materials, with support from US Air Force (AFRL, AFOSR), US Army (ARL) and NSF
- Development of Room Temperature Nuclear Radiation Detectors and imaging Systems, with support from DND, US Air Force, DTRA, DHS, NIH, NSF and DoE

The Washington Monthly for most awarded research grants in the 2016 rankings of National Liberal Arts institutions. According to the American Physical Society, Fisk is the #1 producer of underrepresented minority Master's in Physics degrees. Fisk has earned 4 R&D 100 Awards, the only HBCU to do so. Fisk produces most African American master's degrees in physics and graduates who go on to earn the PhD in physics.

### RESEARCH CAPABILITIES

The Materials Science and Applications Group (MSAG) at Fisk University is a research group specialized in the purification, crystal growth and characterization of novel materials used in fabrication of infrared lasers and radiation detectors and systems. Applications include astrophysics, remote sensing, nuclear nonproliferation, control of weapons of mass destruction, homeland security, medical imaging, biophotonics, aviation safety and defense.

Members of MSAG have been awarded six US patents for technologies in radiation detection and the team is a four-time winner (in 1998, 2001, 2010 and 2013) of the *R&D 100 Awards* (also nicknamed the "Oscars of Science") which honors the top 100 inventions of the year. The research group is responsible for operating state-of-the-art research facilities and we offer highly motivated students an opportunity to gain hands-on experience in this fast growing research field.

Through participation in the Fisk/Vanderbilt Master's-to-Ph.D. program (of which Dr. Burger is the founding co-director) students may continue their research at MSAG, through the completion of their Ph.D degree. Collaborations with national labs, other universities and industry are benefiting undergraduate and graduate students seeking summer internship and postgraduate employment opportunities.

## **FACILITIES**

The **Materials Science and Applications Group** has 3,500 sq. ft. of lab space and adequate facilities including capital equipment for materials purification, crystal growth and characterization of radiation detector materials, a clean room for detector fabrication and detector testing labs. The major instrumentation is organized into four core resource labs: Crystal Growth and Material Preparation; Materials Characterization; Optical Characterization and Spectroscopy; Radiation Detector Fabrication and Testing Laboratories, as outlined below:

### **Crystal Growth and Material Preparation Laboratory**

- Lindberg 1700°C box furnace (1), 1100°C box furnaces (2) for glass-making
- (6) High temperature Mellen furnaces and pullers
- 2 zone refiners, wafer cutting machines and polishers
- Kurt Lesker RF sputtering system and e-beam evaporator
- Varian and Edwards turbomolecular and diffusion vacuum systems,
- synthesis ovens, walk-in hood, two inert gas glove boxes (MBrown)

### **Optical Characterization and Spectroscopy Laboratory**

- Varian Cary 500 UV-VIS-NIR,
- MIDAC FTIR, SPEX Triplemate spectrophotometer,
- Oriel ¼ m spectrometer with MCT, InSb, PbS detectors for Near-IR emission
- Spex Model 1403 double monochromator with a Peltier cooled PMT detector.
- Multichannel Raman system, ARC spectrograph, Princeton Instruments LN2-cooled CCD.
- Lexel mode-locked Ti:sapphire laser, Continuum mode-locked Nd:YAG laser, LightAge Raman shifter (H2), Spectra Physics Model 164 argon ion laser having 4 watts total power.
- Coherent 20W Ar ion laser, Lexel CW Ti:sapphire laser, Lightwave Electronics CW diode pumped, Nd:YAG laser (300 mW @1.3 um), Coherent 6W Ar ion laser,
- APD dual compressor closed cycle He cryostat,
- LN2 Janis optical cryostat,
- Air Products closed-cycle helium cryostat.
- JOEL low vacuum SEM/ equipped with EDX analysis and cathodoluminescence
- Optical microscope with CCD and frame grabber,
- Jobin-Yvon LabRam Infinity Micro-Raman spectrometer,
- TA Instruments Differential Scanning Calorimeter,
- Electrical measurements (I-V, pulsed and DC photoconductivity),

### **Radiation Detector Fabrication and Testing Laboratories**

- Detectors are fabricated in-house in a dedicated class-100 cleanroom facility with wet bench, mask making equipment, photolithographic and thin film deposition equipment
- Radiation detection evaluation and testing: charge sensitive preamplifiers (PA 550 from eV Products and model RG-11 B/C from Princeton Gamma Tech) , multichannel analyzer PCA3 (Canberra), li-near amplifier (Tennelec TC 244), NIM BIN unit (Tennelec TC 909) and low noise high voltage power supply (Bertan Assoc, Model 303), environmental testing chambers for temperature, humidity and vibration testing.



# FLORIDA A&M UNIVERSITY

The Industrial and Manufacturing Engineering (IME) Department at FAMU-FSU College of Engineering is committed to providing longstanding educational objective and opportunities to our students.

## RESEARCH CAPABILITIES

- Optimization
- Advanced manufacturing & automation, Mixed multi-scale additive technology (MAT), intrinsic NDT/SHM, Product life-cycle management
- Composite materials and processing
- Polymer materials
- Multifunctional materials
- Process modeling
- Simulation for material processing
- Carbon nanotube based functional materials
- Processing-structure-property relationship of polymer and polymer nanocomposites
- Non-destructive optical characterization techniques
- Advanced composites and multiscale, multifunctional structures, transient dynamic behavior of engineered materials, energy harvesting and transport, vascular ceramics
- Quality Engineering, Statistics, Time Series Analysis
- Manufacturing process monitoring, Manufacturing system design, Process control and informatics
- Printed Electronics
- Composites for Electronics and Optics (CEO)
- Additive Thin-film Manufacturing (ATM)
- Polymeric materials processing,
- Nanomaterials,
- Composite Materials
- Nanomaterials processing and Applications

This means providing a solid industrial engineering curriculum coupled with a strong research program driven by the economic and technological development needs of society. Our graduate studies is organized into two tracks: (1) Manufacturing Systems and Engineering, and (2) Quality Engineering and Industrial Systems.

Additional emphasis is placed on a Specialization in Engineering Management MSIE and Orthotics/Prosthetics MSIE.

Through our relationship with **High-Performance Materials Institute (HPMI)**, we have access to approximately \$10M in latest research equipment and top personnel. HPMI strives to recruit, develop and retain top quality faculty and staff who will develop HPMI into a center of excellence for research and education in the field of advanced materials. Leading edge, revolutionary technology comes as the result of creativity, vision, talent, dedication and teamwork.

Currently, HPMI is involved in four primary technology areas:

High-Performance Composite and Nanomaterials, Structural Health Monitoring, Multifunctional Nanomaterials Advanced Manufacturing and Process Modeling.

HPMI has over 60 graduate and 30 undergraduate students working on various research projects each semester.

## **Materials, Composites and Nanocomposite**

### **Processing**

- Water jet cutter, OMAX 55100/30
- CNC, HAAS, VF2
- Additive manufacturing 3-D printer, Objet 30
- Hot presses (6"x6", 12"x12" and 24"x24")
- Autoclave, ASC, Econoclave EC3X6
- Ovens (various)
- RIDFT machines (various sizes)
- RTM Machine, Liquid Control-Twinflow
- VARTM process setups

### **Imaging and Microscopy**

- Atomic force microscope (AFM), Veeco Instruments Inc., Multimode with nanoscope V
- High resolution Field Emission Scanning Electron Microscope (FESEM), JEOL 7401F,
- Olympus BX40 with CCD camera
- CytoVivaTM Microscopy
- Microimaging SV-11 Apo, CCD camera, stereo/optical combination microscope, Carl Zeiss
- High resolution sputter coater, Polaron, SC 7640
- High-resolution TEM system, JEOL (shared)
- 3D Digitizer/Scanner, Minolta Vivid 910

### **Spectroscopy**

- Renishaw Confocal Research Raman Microscopy (upgraded InVia, 633 nm and 785 nm laser sources)
- SAXS/WAXS X-ray scattering, Bruker, Nanostar
- UV-Vis-NIR Spectrophotometer, Varian Cary 5000
- FT-IR with microscopy (4000-200 cm<sup>-1</sup>) Thermo Nicolet NEXUS 470
- Zeta Potential & Particle Size Analyzer, Beckman Coulter, Delsa Nano C
- Ultracentrifuge, Beckman Coulter, Optia Max XP
- Surface Area and Porosity Analyzer, Micrometrics Inc., Tristar
- EDAX GENESIS 7000 XMS EDAX, Super-UTW

### **Materials Synthesis**

- Chemical Vapor Deposition System, EasyTube 3000
- E-Beam evaporator, 6" Torvac and 6" Veeco dual system
- MTI GSL-1600X, High-temperature vacuum tube furnace (1500°C, Φ50 mm×1000 mm)
- Specialty coating systems G3P-8 spin coater w/ hot-stage
- Cole-Palmer vacuum ovens (~350°C)
- UV curing machine, 15"×15", FS600, Fusion UV

## **Thermal Analysis**

- Differential Scanning Calorimeter , DSC Q100, TA Instrument
- Thermomechanical Analyzer, TMA2940, TA Instrument
- Thermogravimetric Analyzer, TGA Q50, TA Instrument
- Dynamic Mechanical Analyzer, DMA2980, TA Instrument
- Dynamic Mechanical Analyzer, Q800, TA Instrument
- Rheometer, ARES-LS2, TA Instrument
- Laser flash thermal conductivity measurement system, Netzsch LFA 457 Microflash
- Integrated IR Camera-Analyzer, IR Instruments

### **Electrical Conductivity Measurement**

- Four-probe, two-probe, and surface electrical resistivity measurement setups (four Keithley 2002 MEM multimeters and HP power supplies)
- Janis Research VPF-100 cryostat system

### **Mechanical Property Testing**

- himadzu AGS-J micro test frame (500 N and 1 kN load cells)
- MTS 858 table top test machine (25KN, hydraulic grips, laser strain gauge)
- MTS Landmark Servo-hydraulic System
- Sumazu video extensometer system (DVE-201 video extensometer system and TH229 pneumatic grips, Accuracy: +/- 0.01 mm)

### **Environmental Property Testing**

- Temperature/humidity test chamber, GD-16-3-3, (working space: 30"×30"×30", -68°C – 177°C), Russells

### **Modeling and Simulation**

- Thermal analysis software (ABAQUS, ANSYS, MARC)
- Molecular dynamics modeling of interfacial bonding and load transfer (Materials Studio (SGI Origin 300), LAMMPS (Teragold IBM p-Series 690))
- Modeling of conductive network-electrical property relationships for polymer/carbon nanotube composites
- Simulation software for composite materials processing (RTMSim, etc.)



# HOWARD UNIVERSITY

## PAST PERFORMANCE

**Chemical Engineering:** DOE Chair of Excellence Professorship in Environmental Disciplines, **SRNS (DOE):** Chemical and Biological Approaches for Organic and Inorganic Waste Remediation; **SRNS (DOE):** Development and Characterization of Iodate-Reducing Biofilms; **NSF:** Small Molecule Inhibitors of the Phosphoenolpyruvate-Phosphotransferase System; **NSF:** Mechanism of Assembly of DNA Nanoshells; **EPA:** Surfactant Assisted Bioremediation of trichloroethylene (TCE). 2

**Civil and Environmental Engineering:** **NSF:** Passive Seismic Protective Systems (PSPS); **DOT:** The Howard University Transportation Research Center (HUTRC); **DOE, NSF:** Center for Environmental Implications of NanoTechnology (CEINT); **DOE:** Consortium for Risk Evaluation with Stakeholder Participation (CRESP)

**Electrical Engineering & Computer Science:** **NSF:** ERC - Electro-Thermal System; **U.S. Army Research Office:** Center for Bayesian Imaging and Advanced Signal Processing for Landmine and IED Detection Using GPR; **NSF:** Leveraging Wireless Virtualization for Enhancing Network Capacity, Coverage, Energy Efficiency and Security; **NSF:** ROAR - A Research Infrastructure for Real-time Opportunistic Spectrum Access in Cloud based Cognitive Radio Networks; **NSF:** Emerging Frontiers of the Science of Information; **NSF:** Collaborative Research: Developing Course Modules to Teach Service-Oriented Programming through Visualization.

**Mechanical Engineering:** Several research projects have been funded through the following agencies: **NSF, DOD, NASA, Sandia National Laboratories, Army Research Office, Air Force OSR, Griffith laboratories, Filter Sensing Technology Inc.**

## HOWARD UNIVERSITY

Founded in 1867, Howard University (HU) is a private, research university comprised of 13 schools and colleges. Students pursue studies in more than 120 fields leading to undergraduate, graduate and professional degrees. Howard is a leader in STEM fields.

The National Science Foundation has ranked Howard as the top producer of African-American undergraduates who later earn science and engineering doctoral degrees.

**College of Engineering and Architecture (CEA)** continues to play a vital role in producing our nation's top engineers and architects., and ranks among the top producers of African American engineers.

CEA is a thriving teaching and research institution committed to training the next generation of architects and engineers of color. CEA's core mission is to provide learning environments and curricula, which foster students' ability to formulate and solve problems, manage complexity and uncertainty, develop sensitivities to interpersonal relations, and to support the acquisition of strong technical competencies for the solution of national and global problems through research, teaching and learning.

The CEA offers accredited undergraduate and graduate, degrees in Architecture, Computer Science, and Chemical, Civil & Environmental, Electrical, Computer, and Mechanical Engineering.

## RESEARCH CAPABILITIES

**Chemical Engineering:** water and hazardous waste treatment, bioenvironmental engineering, separation & purification processes, catalysis & reaction engineering, sustainable fuels & chemicals from renewable resources, food process engineering, drug-delivery, biomolecular tissue engineering, dynamic computational models for polymers solutions and frame structures, multiscale mechanics, cartilage bioengineering, development and implementation of screening assays, development and characterization of physiologically relevant biofilm models, assessment of cytotoxicity and pharmacokinetics parameters, validation of antimicrobial drug targets.

**Civil and Environmental Engineering:** geotechnical aspects of renewable energy systems, development of high-performance, multifunctional materials, full-scale testing and modeling of dynamic interaction of structural systems under seismic conditions, transportation data acquisition and analysis, water quality and treatment, and nanotechnology.

**Electrical Engineering & Computer Science:** cybersecurity, unmanned aerial vehicles and networks, motion control and drives for cyber physical systems, computation intelligence (smart commissioning) applied to building automation systems, wireless communications for internet of things, artificial intelligence and big data analytics, building automation and smart homes, power system automation.

**Mechanical Engineering:** applied mechanics and materials, fatigue/failure, digital manufacturing (3-D printing), CAD/CAM, MEMS and sensors, surface engineering and nanofluids, combustion and reactive CFD, rocket propellants, IC engines and alternative fuels.

## FACILITIES:

**Chemical Engineering:** Chemical engineering research facilities include (i) Environmental Labs for Physical, Chemical and Biological Processes, equipped with Agilent GC (ECD & FID), GC/MS, HPLC, AA and UV-Vis spectrophotometer; (ii) Biofilm Engineering and Drug Discovery Lab, equipped with TECAN microplate reader system for multimode & kinetic fluorescence, luminescence, and absorbance assays, Fluxion BioFlux Automated system for high-throughput cellular phenomena under shear flow, Zeiss AXIO Observer Inverted Microscope equipped for epi-fluorescence illumination with Cy 3.5, HE GFP and DAPI filters, DIC and phase contrast (10X, 20X, 40X, 63X oil objectives), Z™ Series COULTER COUNTER® Cell Counter, BUXTON Model 9200 GP Sterilizer, REDISHIP Purifier Logic+ Class II A2 Biosafety Cabinet, Parallel plate flow chambers, Perkin-Elmer UV-Vis spectrophotometer, and (iii) Biomolecular Assemblies and Nanomechanics Lab equipped with Atomic Force Microscopy, Osmometry, Dynamic Light Scattering and Zeta Potential, Mammalian Cell Culture.

**Civil and Environmental Engineering:** Environmental Engineering facilities include resources for analyzing air, water and soil samples, instrumentation for measuring organic & inorganic pollutants and wet chemistry contaminants, and preparing biological samples. Shared instrumentation for nanoscience and membrane research includes Howard's Nanomaterials Characterization Science Center, Howard Nanoscale Science and Engineering Facility, and the Interdisciplinary Research Building, which houses over 3,000 ft<sup>2</sup> of space for environmental analysis. Resources include state-of the art clean rooms, instrumentation for water quality and nanotechnology analyses including SEM, TEM, XPS, NMR, NSOM, FTIR, X-ray facilities, AFM and variations (e.g. cryo-TEM, flow through AFM, etc.).



## MORGAN STATE UNIVERSITY

Founded in 1867, Morgan State University is designated as Maryland's preeminent public urban research university by the Maryland Legislature. The campus is located in Baltimore, MD on more than 143 acres.

Morgan State University offers a comprehensive range of academic programs in engineering, architecture, sciences, public health, liberal arts, global communication and journalism, social work, and business and management. The School of Engineering was founded in 1984, offering ABET-accredited undergraduate and graduate programs in electrical and computer engineering, civil engineering, industrial and systems engineering, and transportation and urban infrastructure studies.

Morgan State University, an HBCU, is the only university in the state of Maryland to offer industrial and systems engineering undergraduate and graduate degrees.

The School of Engineering offers several graduate degrees: 1) Master of Engineering (M.Eng.), 2) Master of Science in Electrical Engineering (M.S.E.E.), 3) Master of Science in Transportation (M.S.), 4) Doctor of Engineering (D.Eng.), and 5) Doctor of Philosophy (Ph.D.) in Transportation and Urban Infrastructure Systems. Exceptional undergraduate students may qualify for our B.S. to D.Eng. option.

Post-baccalaureate certificates in Urban Transportation and Cybersecurity are also offered. Morgan State University produces the most African-American engineers in the state of Maryland, and historically ranks among the top public campuses nationally in the number of black graduates receiving doctorates.

### PAST PERFORMANCE

**Civil Engineering:** NSF funded research on high-performance green bridges; NASA on geospatial technologies and equipment-funded grants; Maryland State Highway Administration (SHA) on water quality impairment, stormwater utility, ecosystem assessment, durability assessment of stainless steel strands and rebar and prefabricated bridge elements and systems; DOE on land movement, aquifer mechanics, and land subsidence due to groundwater withdrawal

**Electrical and Computer Engineering:** DOE/DOD/United States Army/ARL/ONR/Boeing/NASA/DHS on high performance algorithms and models, visualization, embedded systems security, internet of things, high frequency device modeling (RF/microwave), cybersecurity, and hardware assurance

**Industrial and Systems Engineering:** DOE/NSF/Maryland Energy Administration (MEA) on biomass process technology, automatic feedback control, renewable energy research; NASA on microsatellite design

**Transportation and Urban Infrastructure Studies:** Maryland State Highway Administration (SHA) on transportation modeling and behavior, traffic safety and intelligent transportation systems (ITS), bikeshare, public transportation operations, urban rail transit, and non-motorized transportation



## RESEARCH CAPABILITIES

**Civil Engineering:** applied mechanics, environmental engineering, geomechanics, geotechnical engineering, groundwater hydrology, hydrology, infrastructure planning and engineering, structural engineering, structural mechanics and dynamics, bridge engineering, earthquake engineering, transportation engineering, and construction management

**Electrical and Computer Engineering:**

electrophysics, communications and signal processing, and computer engineering, power, cybersecurity, internet of things, visualization, data analytics and decision support, embedded systems design and security, and high frequency device modeling

**Industrial and Systems Engineering:** manufacturing systems and processes, environmental and energy systems, engineering management and operations research, ergonomics and human engineering (robotics), quality control, six sigma and reliability, knowledge and distributed information systems, data mining and statistical modeling, and systems engineering and management

**Transportation and Urban Infrastructure Studies:** traffic operations engineering, transportation planning, transportation management, freight transportation and logistics, travel behavior, safety, and transportation economics

## FACILITIES

**Civil Engineering:** seismic simulator/shake table (3m x 3x); strong floor-strong wall for large-scale structural testing, environmental engineering labs, two dynamic triaxial apparatus, one static triaxial apparatus, one soil resonant column system, one triaxial hollow shear apparatus, direct shear system, Rowe consolidation system, GIS and GPS systems, state-of-the-art software Static Triaxial apparatus

**Electrical and Computer Engineering:** Tektronix DPO-7104C Digital Phosphor Oscilloscope for signal analysis, Agilent N9030 PXA Signal Analyzer for real-time spectrum measurements and countermeasure analysis, embedded system platforms include a variety of Xilinx Zynq based system-on-chip application boards: pico-Zed, Zedboard, software defined radio (SDR), Smart Home IoT Testbed includes: IRIS home automation system and devices: hub, smart lighting, sensors, smart garage door opener, smart door locks, etc., Smart Grid IoT Testbed are advanced metering infrastructure (AMI) devices which includes: smart meter, gatekeeper (collector), AMI access point to communicate with monitoring station, Linksys WiFi router, computers with dual monitors, side Channel Analysis and Differential Fault Analysis System, and Diode Laser Station;

Motorman HP3 Performer robot, Scorbot ER-9 and ER-4u robots, Jupiter SCARA robot, AS/RS warehousing robot, eXpertMill 0600 CNC milling machine, proLight 3000 CNC turning center, and assembly and quality control vision inspection stations, inspection stations, A.R. Done robots, Robotino robot, iRobot Create/ASUS robots, Vex Autonomous/RC robots, and Lego Mindstorms NXT 2.0 robots.

**Transportation and Urban Infrastructure Studies:** driving simulator for safety and behavior analysis (SABA) and state-of-the-art transportation software.



## PRAIRIE VIEW A&M UNIVERSITY

Founded in 1876, Prairie View A&M University (PVAMU) is a comprehensive public institution of higher education and a land-grant university as part of the Texas A&M University System. It is one of the Historically Black Colleges and Universities (HBCU). PVAMU offers baccalaureate degrees in 50 academic majors, 37 master's degrees and four doctoral degree programs through nine colleges and schools. The student enrollment is around 8,400 in 2016.

### PAST PERFORMANCE

- Center for Big Military Data Intelligence: Funded by Air Force Research Laboratory, the Center conducts research in predictive analytics to address and solve complex problems posed by big data.
- Center for Energy and Environmental Sustainability: Funded by NSF, the Center conducts research in Biofuels, Wind Energy, and Energy and Environment including sustainable nuclear energy, emissions control, and life cycle.
- Center for Radiation Engineering and Science for Space Exploration: Funded by NASA JSC, the Center conducts radiation research, instrumentation, environmental modeling, material research and electronic components.
- Composite Material Laboratory: Sponsored by the Air Force and other projects, the capabilities of the lab include composite processing and fabrication, material characterization, and testing.

### UNIVERSITY MISSION

Prairie View A&M University is dedicated to excellence in teaching, research and service. It is a state-assisted institution by legislative designation, serving a diverse ethnic and socioeconomic population, and a land-grant institution by federal statute.

### CORE COMPETENCIES

The Roy G. Perry College of Engineering at PVAMU has technical expertise in Electrical and Computer Engineering, Mechanical Engineering, Computer Science, Civil and Environmental Engineering, Chemical Engineering and Engineering Technology. The specific technical fields include Radiation for Space Exploration, Telecommunications, Virtual Reality, Sensor/Detector Applications for Nuclear Materials, Thermal Science, Nanocomposite Materials Characterization and Testing, Computational Fluid Dynamics, Computer Aided Design and Virtual Prototyping, Finite Element Analysis, Data Compression, Energy and Environmental Sustainability, Biochemical and Bioprocess, Tertiary Oil Recovery, Structure Engineering, Water Resource, Visualization and 3D Animation, Data Mining and Bioinformatics, Cloud Computing, and Computer Storage Systems for Energy Efficiency and Reliability.

## OTHER PAST PERFORMANCE

- CRI Center for Computational Systems Biology: *Discovery of individualized therapeutic vulnerability in cancer, enabled by single cell transcriptomic profiling, Reprogramming of Transcriptional Circuitry to Control Pancreatic Cancer (SU2C), Credentialing murine models for glioblastoma preclinical drug development.*
- Center for Communication Systems: Funded by TI and other projects, the Center conducts research in DSP solutions, Image Processing, Mixed Signal Systems, and High Speed Communications Systems.
- Thermal Science Research Center: Funded by Sandia Laboratory and other projects, the Center conducts research in Heat Transfer for Subcooled Flow Boiling and Conjugate Problems.
- Texas Gulf Coast Environmental Data Center: Funded by NASA and other projects, conducts research in bioremediation using biological agents such as earthworms and soil microorganisms.
- Virtual Prototyping Laboratory: Funded by NSF and General Motors, use virtual reality techniques to improve product design including haptic interface in large-scale virtual environment, nanotube, etc.
- Software Simulation Laboratory: Funded by L-3 Communication and NASA JSC, the capabilities include conducting tasks for space exploration using TRICK, and finite element analysis using ANSYS.
- Biochemical and Bioprocess Engineering: Applied biocatalysis/biotransformations for the synthesis of chiral synthons of interest to the chemical and pharmaceutical industries using genetically engineered biocatalysts.
- Tertiary Oil Recovery Research: Chemical and biological processes for improving oil extraction, simulation of oil and gas extraction processes.
- Control System, Robotics, and Instrumentation Research

## FACILITIES

- Computer cluster with CFD codes (STAR-CD, FDNS, CHEM, Gridgen, & Field View)
- Scanning electrical microscope (SEM)
- X-ray diffractometer (XRD)
- Atomic force microscope (AFM)
- Scanning tunneling microscope (STM)
- Autoclave, Heated platen press, and RTM
- C-scan
- Fourier Transform infrared spectrophotometer (FTIS)
- Dynamic mechanical analysis (DMA)
- Thermogravimetric analysis (TGA)
- Differential scanning calorimetry (DSC)
- Various environmental durability testing ovens/furnaces
- Instron testing machine
- Plasma-enhanced chemical vapor deposition
- Chemical vapor deposition system
- Virtual reality equipment: head-mounted display, data glove, motion tracker.
- PowerWall Virtual Reality System, Phantom Haptic Device, 3D Printer
- Mixed Signal Testing and Evaluation Facility (including TI's VLCT Tester)
- Digital Signal Processing (DSP) Testing and Evaluation Facility
- Broadband Systems Research Facility
- Avaya telecommunication network system
- xDSL Network Emulation Facility for Test and Evaluation
- Various Simulation Facilities (OPNET, MATLAB, FEMLAB, LabView, CADENCE, etc.)
- Linux Server and Client facility
- TOC, HPLC, GC-MS, Ion chromatograph, UV/Vis spectrophotometer, CHNOS analyzer, TGA, etc..
- Micro-Pyrolyzer
- Flash 2000 CHNSO Analyzer
- Micro-Balance
- Fabricated Fixed Bed and Fluidized Bed Biomass Pyrolyzers
- Air Quality Equipment
- Hi-Vol Air Sampler, URG Air Sampling system, Fog Collector, and Ozone, CO<sub>2</sub>, CO, Ammonia, NO<sub>x</sub>, SO<sub>2</sub> analyzer
- dSPACE DSP real-time control system;
- Power Converter, Motors (PMSM, Induction, PMDC);
- Supporting instruments, including oscilloscope, spectrum analyzer, etc.

**HISTORY**

Southern University and A&M College is a comprehensive institution offering four-year, graduate, professional, and doctoral degree programs. The University is part of the only Historically Black Land Grant University System in the United States. It offers bachelor's degrees in 33 areas as well as 23 masters, five doctoral programs. The Baton Rouge campus is located on Scott's Bluff overlooking the Mississippi River in the northern section of the City of Baton Rouge. The campus encompasses 512 acres, with approximately 60 acres for agricultural instruction, research and outreach. An average of 6,500 students are enrolled each year at the Baton Rouge campus.

**UNIVERSITY MISSION**

Southern University serves a unique and diverse population of Louisiana, the nation, and the world through the nurturing, creation and the holistic development of its students by Creating Leaders that are entrepreneurs, negotiators, visionaries, collaborators, and lifelong learners ready to meet the needs and contribute to the success of the global workforce.

**CORE COMPETENCIES**

The college of Sciences and Engineering at Southern University has degree program offerings include nine bachelor's degree programs: biology, chemistry, computer science, physics, electronic engineering technology, civil engineering, electrical engineering, mechanical engineering, and mathematics. We offer five master's degree programs: engineering, computer science, biology, mathematics, and physics. We also offer doctoral degree programs in environmental toxicology and science and math education. All the engineering and computer science programs are accredited by the Accreditation Board for Engineering and Technology Engineering's respective commissions.

**RESEARCH CAPABILITIES**

With support of the National Science Foundation Southern University has established "Next Generation Composites CREST Center (NextGenC3)"; with the following focus areas of research Subproject 1. Development of Multifunctional Composites and Structures: Sensing, Damage Tolerance, and Vibration Damping; Subproject 2. Grid Confined Shape Memory Particulate Composites for Impact Mitigation and Self-Healing; and Subproject 3. Synthesis of the Next-Generation Composites: Cure-On Demand Coatings, Self-Healing and Sensing Polymers.

**PAST PERFORMANCE**

- An Integrated Topology and Multi-Scale Optimization of Protective Structures, -funded by Army Research Office
- Testing and Modeling of Blast Response of Functionally Graded Composite Armor, -funded by the Department of Defense
- High Strength and Impact Damage Tolerant Syntactic Foam for High Performance Sandwich Structures, - funded by Army Research Office/Short Term Innovative Research (STIR) program
- Carbon Dioxide Removal Assembly Materials Accelerated Life Testing and Experimental Characterization on Mass, Volume, and Density of Non-Metallics Materials Provided by Boeing and Incubated for 30, 60, and 90 Days Respectively, - funded by The Boeing Company, Space Exploration Houston, TX, International Space Station (ISS) Program D684-15347-01
- Advanced Materials Research laboratory projects on Novel Nano Structured Thermal Barrier Coatings - funded by NASA Cooperative Agreement NNX09AP72A and DOE Clean Power and Energy Research Consortium
- Development of Heterogeneous Concrete to Analyze RC Roof Structure under Impact Loading - funded by ONR Naval Facilities Engineering Service Center,
- Bio-inspired Shape Memory Polymer Fiber Reinforced Thermosetting Polymer Composite for Self-healing Structural-length Scale Damage - funded by Army Research Office

**FACILITIES AND EQUIPMENT**  
**COMPOSITE MATERIALS AND STRUCTURES LABORATORIES**

We currently have Composite Materials and Composite Structures Labs at SUBR. They host a number of fabricating, testing, and characterization equipment and devices for composite materials and structures. Representative equipment available to investigators in the Composite Materials and Structures Laboratories are highlighted below:

- Transmission Electron Microscope (awarded NSF #DMR-0959105 ),
- Phantom Scanning Electron Microscope
- FTIR spectroscope
- Nanoindenter with AFM capabilities, optical fiber spectrometer, and establishment of a wet chemistry lab with chemical synthesis and analytical chemistry instrumentation tools
- Instron MTS 810 system (for various static tests of materials and structures)
- Instron QTEST 150 system (for various static tests of materials and structures)
- GRC DYNATUP Model 8250HV Impact Machine and accompanying data acquisition system (for low velocity impact test; speed up to 14m/s and hammer weight up to 100lb)
- Home-made Split Hopkinson Pressure Bar (for determining the stress-strain relationship of materials at high strain rate, up to 3000/s)
- 16mm/40mm Two Stage Light Gas Gun by Physics Applications Inc. (capable of velocity of 8,000m/s using hydrogen or 4,000m/s using helium) (for high velocity impact tests)
- A Cordin 550 High Speed Imaging System (up to 1.5 million frames per second, assist the Split Hopkinson Pressure Bar test and high velocity impact test in capturing deformation and fragmentation during impact)
- UltraPAC Ultrasonic Imaging System (for non-destructively determine damage within materials or structures); x Sonic Model VC-750 ultrasonic mixer (for mixing nanotubes or nanoparticles in polymer matrix);
- NETZSCH type 50 bench-top three-roll mill (for mixing nanotubes or nanoparticles in polymer matrix)
- Nanotrak 150 particle size analyzer (down to 8nm, for analyzing the size and size distribution of nanotubes or nanoparticles)
- Airtech Vacuum Assisted Resin Infusion Molding (VARIM) System (for fabricating composite structures including sandwich panels); x Abbess builds vacuum chambers and systems(for removing air bubbles in syntactic foam)
- Instron 3200 series internal pressure tester (for internal pressure testing of tubular structures);
- Hysitron TI 900TribolIndenter (for nanoindentation testing of polymers); OTF1200 Split-table Single Zone Tube Furnace (for manufacturing carbon nanotubes); x Phenom ProX Desktop Scanning Electron Microscope with EDS & ProSuite
- RAZ-IR Infrared Camera (for capturing surface temperature change due to internal or external heating, loading, etc.)
- A Cooper LVDT system (for recording displacement change during static testing of various specimens)
- Perkin-Elmer DSC4000 (for determining glass transition temperature of polymers and miscibility between polymers)
- RSA III Dynamic Mechanical Analyzer (for determining glass transition temperature, loss modulus, and storage modulus)
- Laser Flash Line 5000 (for determining thermal conductivity of materials)



## TENNESSEE STATE UNIVERSITY

Founded in 1912, Tennessee State University (TSU) is a comprehensive, urban, co-educational, HBCU in Nashville, Tennessee. TSU is recognized by the Carnegie Foundation for the Advancement of Teachers as an R3 Doctoral/Research University, a designation which highlights high quality research and graduate programs which serve the students, the state, the nation, and the world. TSU has been consistently listed in the U.S. News & World Report's "Guide to America's Best Colleges" for more than 20 years. TSU offers 77 majors in eight undergraduate and graduate colleges and schools.

TSU is engaged in scholarly research that covers biological science, chemical science, agricultural science, social science, engineering, physics, astronomy, health sciences agriculture, consumer sciences, nursing, public service and urban affairs. TSU graduates the highest number of African-American bachelor degree holders in Agriculture, Agriculture Operations and Agriculture-related sciences.

The University's sponsored research new awards for FY2016 exceeded \$54 million. TSU's outreach to other universities and agencies extends to local, regional, national, and global partnerships to produce the next generation of global researchers.

### Core Competencies: Engineering

The College of Engineering faculty has been conducting research in many national and critical technology areas. Areas that are of interest are signal/image processing, bioinformatics, sensor fusion, applied intelligent systems, unmanned mobile robotics, and unmanned air vehicles, decision making processes, health monitoring (prognosis and diagnosis) of air craft engines, wireless communication, robust control systems, cyber-security, renewable energy sources, virtual reality. Additional faculty interests include high performance computing, data analytics and chemical sensing detection systems.

The college offers an M.S. in Engineering with concentrations in Biomedical, Environmental, Civil, Electrical, Mechanical and Manufacturing Engineering, as well as M.S. and Ph.D. degrees in Computer, Information and Systems Engineering, which is an interdisciplinary program that integrates concepts from computer science, electrical and mechanical engineering. There is also undergraduate Aviation Flight Training curriculum and an Aviation Management curriculum designed to prepare and provide students with the skills and expertise in the commercial aviation field as pilots or as aviation management professionals.

### PAST PERFORMANCE

- Sensor Fusion
- Battery technology
- Health Monitoring
- Wireless Communication and networks
- Decision making using Robots, helicopters, and RF sensors
- Reliable communication in congested environments
- Cloud computing security
- Smartphone security
- Cyber Physical System security
- Bioinformatics

### FACILITIES & EQUIPMENT

- Engineering Research Institute
- TSU Interdisciplinary Graduate Engineering Research (TIGER) Institute
- Center for Battlefield Sensor Fusion
- Intelligent Tactical Mobility Laboratory
- Intelligent Control Systems Laboratory
- Robotics and Intelligent Systems Laboratory
- Computer Integrated Manufacturing Laboratory
- Mobile Robotics Laboratory: About 35 mobile and all terrain robots with cameras and lasers
- Automatic Target Recognition Testbed: Combination of seven IR and ER cameras mounted on building along with unmanned ground robots, and unmanned electric helicopter for military exercises.



## TOUGALOO COLLEGE

Established in 1869, Tougaloo College is an independent, historically black, liberal arts institution with a sustaining legacy of excellence, relevance, and influence.

Tougaloo has an identifiable distinction in higher education for academic excellence and social commitment.

Through its diverse curricula and scholarly inquiry, the College prepares its students to be imaginative, self-directed, lifelong learners who are committed to ethical leadership and service in a global society.

Tougaloo produces graduates prepared, committed and empowered to lead, and make significant contributions in their respective professions, communities and the world.

The College is cited among the best colleges in The Princeton Review, Washington Monthly and U. S. News and World Report. Tougaloo is accredited by the Southern Association of Schools and Colleges, Commission on Colleges (SACSCOC).

Tougaloo College has a distinguished and racially, ethnically and gender diverse faculty, of whom 70% hold terminal degrees and are nationally, recognized subject matter experts. The student population is nearly 1,000.

The student to faculty ratio is 15:1. Tougaloo ranks among the top 10 HBCUs with a graduation rate over 50%. Historically, more than 60% of our graduates enter graduate or professional schools immediately after graduation.

Often referred to as the civil rights institution, the College's commitment to social justice and service in the interest of the larger society is an indelible part of its history. Situated on almost 500 acres of land on the northern border of Jackson, Mississippi, Tougaloo offers a vibrant and engaging living and learning environment that extends into the community.

Our campus environment embraces inclusivity, promotes independent, creative and innovative thinking and provides access to technologies required for 21st century knowledge mastery and application.

### PAST PERFORMANCE

Tougaloo College has established national prominence and earned recognition for its past performances representing a standard of excellence.

Funding from both the public sector and private organizations has allowed the College to collaborate and excel in administering quality and outcome-based research, programs and services. Since 2008, Tougaloo has been awarded 1,926 public sector funding transactions worth over \$114.8 million in federal financial performance.

These public sector opportunities include: 27 federal contracts for basic biomedical research totaling \$9.1 million; 353 federal grants totaling \$68.3 million; and, 1,546 transactions of other federal funding totaling \$37.3 million.

Tougaloo's past performance is attested by federal government grants and contracts from the Department of Homeland Security, National Institutes of Health, National Science Foundation, Department of Justice, Department of Health & Human Services, Department of Education and the Department of Agriculture among others; and, numerous private foundations, including, but not limited to, the Andrew Mellon Foundation, W.K. Kellogg Foundation, and the Howard Hughes Medical Institute.

## **TOUGALOO COLLEGE: AN EPICENTER OF EXCELLENCE AND OPPORTUNITY**

Tougaloo College places high priority on creating a learning environment that expands and enhances the scholarship and intellectual life of its students and faculty. Our top academic centers and externally funded research projects and programs include:

- Bennie G. Thompson Academic and Civil Rights Research Center
- Biomedical Nanotechnology Laboratory
- The Center for International Studies and Global Change
- Department of Homeland Security Coastal Resilience
- Center of Excellence
- The Institute for the Study of Modern Day Slavery
- Jackson Heart Study Undergraduate Training and Education Center
- George A. & Ruth B. Owens Health and Wellness Center
- The National Science Foundation Robert NOYCE Teacher
- Scholarship Program
- The National Science Foundation Science, Technology,
- Engineering and Mathematics (STEM) Scholarship Program
- The Undergraduate Research Symposium

### **PARTNERSHIPS**

Collaborative partnerships with the University of Mississippi Medical Center, Warren Alpert Medical School at Brown University, Tufts Medical and Dental Schools, Boston College, Duke University, Vanderbilt University, and Mississippi State University offer further opportunities for student/faculty exchanges, three-plus-two academic programs and joint research. Moreover, within the last ten years Tougaloo has been sub-awarded 24 public sector funding transactions valued over \$2.1 million in federal financial performance. These sub-grantee opportunities include alliances with the Mississippi State Department of Health, University of Mississippi, University of Southern Mississippi, Mississippi State Department of Education, Mississippi Department of Transportation and the Mississippi Department of Archives and History, among others. Most recently, the College formed a UNCF Career Pathway Initiative consortium with Oakwood University and Talladega College to increase college completion and career readiness in high demand fields.

### **CORE COMPETENCIES**

Tougaloo is most renowned for its Science, Technology, Engineering and Mathematics (STEM) curriculum and professional programs using interdisciplinary approaches. Over 60% of its Natural Science Division's (NSD) faculty members have received funding to mentor students and conduct research in their various campus based laboratories. Sixty (60) papers have been published in peer-reviewed journals and approximately 600 local and national presentations have been made by NSD faculty. More than 100 STEM students have benefitted from research mentoring provided by faculty. Additionally, the College offers bachelor degrees in 29 majors in the areas of education, humanities, social sciences and natural sciences; two master's degrees in Child Development and Teaching; and, the associate of arts degree in Child Development, Early Childhood Education, and Religious Studies.





### PAST PERFORMANCE

**Aerospace:** NSF funded major instrumentation awards for experimental measurements of vortex dominated flows e.g. wing-body juncture flow, wake three-dimensionality of three-dimensional bluff bodies; computational fluid dynamics analysis of cavity flows; collision avoidance of unmanned aircraft system in a limited airspace; **ARL** on terrain visualization training; **NASA** on Above-Real-Time-Training.

#### **Mechanical:**

- **DOD** on hypervelocity impacts of aerospace materials; nanostructured coatings; composite materials. **DOE** on the effect of harsh environments on the mechanical integrity of epoxy and polyurethane systems.
- **Raytheon Co.** on test and validation of connector hardware for use in extreme environments.
- **FRA** on surface defects welding repair of railheads.
- **Nucor Steel** on effect of zinc galvanization on the fracture behavior of structural steel.
- **Boeing Co.** on mitigation of tin whisker growth using nanostructured conformal coatings.
- **NSF** on laser and ion beam bombardment of high Z materials; dislocation dynamics.

Tuskegee University (TU) is a national, independent, and state-related institution of higher learning, located in the State of Alabama. TU has distinctive strengths in the sciences, architecture, business, engineering, health, and other professions. The College of Engineering offers four undergraduate programs in Aerospace Science, Chemical, Electrical, and Mechanical Engineering that are accredited by the Accreditation Board for Engineering and Technology (ABET). Our Aerospace Engineering is the only ABET-accredited program at an HBCU. Graduate programs are available at the Masters level in Chemical, Electrical, and Mechanical Engineering. A Doctor of Philosophy and a Master are also offered in Materials Science and Engineering (MSEG).

### RESEARCH CAPABILITIES

**Aerospace:** experimental aerodynamics, computational fluid dynamics vortex-dominated flows, flight simulation, configuration aerodynamics, human interface, small satellites, spacecraft dynamics, autonomous robotics, turbulence and fluid measurements, aircraft engine measurements.

**Chemical:** CO<sub>2</sub> capture and storage, membrane separation, physico-chemical water and biological waste water treatment, microfluidics for materials processing, pulp and paper process engineering, biodiesel from vegetable oils with honeycomb monolithic catalysts, nanocomposites of graphene aerogel for energy storage applications.

**Electrical:** power systems, multiresolution signal/image analysis, target detection and tracking, artificial intelligence in control systems, big data, machine learning, micro and nanofabrication, computational intelligence, portable sensors, data analytics, security and privacy, wireless networks, cyber physical systems, portable energy storage, advanced materials for photonics.

**Mechanical:** electric propulsion, fracture and failure analysis, corrosion, additive manufacturing, dislocation dynamics, degradation of nano-phased materials, processing and characterization of nano-phased composites, fuel cell science and technology, flow diagnostics, aeroacoustics, flow control, microfluidic actuator design.

**Materials Science & Engineering:** thermoset polymers, static and dynamic characterization, fiber reinforced composites, nanocomposites, foam core sandwich, nondestructive evaluation, durability of nano-phased polymeric composites, nano biomaterials, polymer composites, carbon materials, high temperature polymeric materials, computational mechanics, experimental and finite element analysis.

## OTHER PAST PERFORMANCE

**Chemical: DOE** on synthesis and electrochemical characterization of graphene-metal/metal oxide nanocomposites; optimization of Fenton's oxidation conditions for removal of chrysene in aqueous solutions; biochar production and its application to remove Cr (VI) and ammonium-nitrogen from aqueous solution; identification of novel corrosion inhibitors; detection of total organic carbon in crude oil; GC/MS profiling of hopane biomarkers in crude oil; alternative methods for CO<sub>2</sub> capture from flue gas.

**Electrical: DOD** on high efficiency flexible solar cells and energy storage devices. **NASA** on micro shutter design for the James Webb Space telescope and analog synthesis of mixed-signal application specific integrated circuits for flight electronics. **DHS** on portable sensors for the detection of biological pathogens and chemicals. **NSF** on advanced materials and their growth methods for optoelectronics.

## FACILITIES

**Aerospace:** 2ft x 3ft low speed wind tunnel, 32-channel solid state pressure measurement system, 6-component pyramidal balance, 15in x 20in water tunnel, volumetric particle image velocimetry system, UAV manufacturing facility (CNC foam hot-wire-cutter/mill, 3D printer, vacuum bagging), electric propulsion (motor, propeller, battery) test facility, CubeSat magnetic characterization, 4-node dual core cluster computer.

**Chemical:** total organic carbon and nitrogen analyzer (Shimadzu TOC-L), non stirred stainless steel pressure reactor with heater assembly (Parr Instruments)/Biochar pyrolysis unit, potentiostat (Gamry), Lab Companion oven, Memmert oven (programmable), Labconco freeze dryer, Zeta potential analyzer, Shimadzu GC-MS equipped with autosampler (GC-MS Q2010), FTIR, graphite furnace atomic absorption spectrophotometer, HACH spectrophotometer (Model: DR-2800), SPEX 8000M mixer/mill, Cilas particle size analyzer (Model: CILAS-1064)

**Electrical:** Microelectronics Lab with cleanroom facility for semiconductor thin film processes, bulk and surface micro-machining, micro- and nano-fabrication, additive manufacturing, a characterization facility for electrical, optical, and surface studies.

**Mechanical:** additive manufacturing lab, flow diagnostic lab, Nucor Education Center of Excellence in steel research, fracture and failure analysis lab, corrosion testing equipment, environmental aging chambers, scanning and atomic force microscopes, welding research lab, etc.

**Materials Science & Engineering:** composite materials processing, nano and bio nano materials processing, morphological characterization, mechanical and thermal characterization, nondestructive evaluation, polymer characterization capabilities: DMA, DSC, TGA, DTA, FTIR, rheology, Raman spectroscopy, NDE capability: ultrasonic and thermography, 3D printing of films, particle size analyzer.

## UNIVERSITY OF THE DISTRICT OF COLUMBIA

### School of Engineering and Applied Sciences

#### PAST PERFORMANCE

- *NSF Advanced Technological Education (ATE) Grant for Nanotechnology Education Workforce Development*"
- *NASA, "Adaptive Cooperation and Communication Paradigms in Multi-robot Systems"*
- *National Science Foundation, "Integrating virtual 3-D lab modules for flood modeling studies in civil engineering"*
- *Army Research Office-DoD Research "Performance Data-Driven Methods and Tools for Computer Network*
- *National Institute of Standards and Technology SURF Grants*
- *DoD Grant Acquisition of a Laser Rapid Manufacturing System, Adv. Manufacturing*
- *DOD Grant on "Designing Robust Closed Loop Intrusion Detection Model in Cloud Computing Environment"*
- *NSF "Enhancing Undergraduate Programs in Environmental Science and Sustainability"*
- *Department of Energy Grant Advanced Manufacturing*

#### OTHER ONGOING PROJECTS

- *Application of Nanotechnology for Creating Next Generation Devices*
- *Hardware-in-the-loop, hybrid, and real-time simulation and analysis of major Army missile systems*
- *Competence Areas in Nano Technology & Materials Research*
- *Zero Power RF MEMS Sensor Networks Detection and Classification*
- *Target Echoes on Noninvasive Penetrating Radar (NPR) Data Using Advanced Neural Network*
- *Biosensors Applications in medical nanotechnology.*

The University of the District of Columbia is a pacesetter in urban education that offers affordable and effective undergraduate, graduate, professional and workplace learning opportunities. The institution is the premier gateway to postsecondary education and research for all residents of the District of Columbia. As a public, land-grant institution, the university's responsibility is to build a diverse generation of competitive, civically engaged scholars and leaders. As the nation's only urban land-grant institution, the University's mission is to foster the education, critical thinking and intellectual growth of its students, and the creation and application of new knowledge and the effective engagement with the surrounding world.

#### OVERVIEW

The School of Engineering and Applied Sciences (SEAS) offers nationally competitive and fully accredited professional programs at the baccalaureate and graduate levels. **SEAS curriculum focuses on three basic values: technological and scientific competence, balance between theory and practice, and consideration of societal and holistic aspects of engineering.** The School offers strong, ABET-accredited Bachelor degree programs in Civil, Electrical, Mechanical Engineering and Computer Science. SEAS also offers Bachelor degree program in Information Technology and Biomedical Engineering. In addition, the School is transitioning from knowledge-based education to foster the entrepreneurial mindset in its graduates.

#### RESEARCH CAPABILITIES

Research capabilities include Cyber Security, Cloud Computing Information Assurance, High Performance Computing, Wireless and Sensor Networks, Computational Intelligence, Computational Geometry, Robotics & Autonomous System, Mechatronics, Energy Conversion, Modeling and Simulation, Advanced Manufacturing, Product Design, Nanotechnology, Thermal Science, Optical Engineering, Renewable Energy, Rehabilitation Engineering and Bio-assisted devices, Structural Engineering, Intelligent Transportation System, Water Resources Engineering and Construction Engineering.

## Undergraduate Degrees

B.S. Biomedical Engineering (new)  
B.S. Civil Engineering  
B.S. Electrical and Computer Engineering  
B.S. Mechanical Engineering  
B.S. Computer Science  
B.S. Information Technology

## Graduate Degrees

M.S. Computer Science  
M.S. Electrical Engineering  
M.S. in Mechanical Engineering (new)  
M.S. in Civil Engineering (new)

## Specialized Facilities

| Class 1000 certified clean room  | Nanotechnology research   |
|--|---|
| MJB3 Karl Suss Mask Aligner  | Photolithography for micro-scale patterning and device preparation  |
| Newport Mask Aligner   | This apparatus holds the photomask in place to allow the UV light to shine on the substrate.  |
| AJA International Sputtering machine<br>2DC powered and 3 RF powered guns.<br>Along with plasma oxidation capabilities | Used for thin film deposition by the process of sputtering.   |
| Kurt J. Lesker Company Thermal depositor   | Used for thin film deposition by using an electric resistance heater to melt the material and deposit onto a substrate.   |
| NanoSurf NaioAFM   | An atomic force microscope that can measure the topography and several other properties of a sample with nanometer resolution.  |
| NanoSurf Naio STM  | Scanning tunneling microscope allows students to study objects at the atomic level.   |
| SEMICONSOFT MProbe thin film measurement   | Uses spectral reflectance to measure the thickness of thin films in the nano to micro scale.  |
| VersaSTAT 4  | Useful for electrochemical deposition.  |
| Air Science Purair Fumehood  | Fume hoods used in the clean room to filter chemical vapors.  |
| Micromanipulator Microscope  | Used for getting a magnified view of objects.   |
| Vibrating sample magnetometer  | Magnetization study   |
| Keithley Source meter 4200   | This equipment conduct current-voltage studies to fA sensitivity and capacitance measurement  |
| Keithley 6430 Source Meter   | I-V measurement upto femto amp level precesion  |
| Low temperature current-voltage measurement system   | Measure transport properties up to 4K   |
| Holistic Transport measurement System  | This integrated system is designed to conduct current-voltage studies as a function of temperature, magnetic field, and variable wavelength light. We plan to do Raman spectroscopy along with current-voltage studies in some cases. |
| Bruker 400 MHz NMR   | Molecule characterization   |
| EOS 280  | Specialized Metal Additive Manufacturing Machine for rapid prototyping  |