Agenda Item No. 6.4

AGENDA ITEM BRIEFING

Submitted by: M. Katherine Banks, Vice Chancellor for National Laboratories and National Security Strategic Initiatives
The Texas A&M University System

Subject: Establishment of the Texas A&M Semiconductor Institute

Proposed Board Action:

Establish the Texas A&M Semiconductor Institute as an organizational unit of The Texas A&M University System (the A&M System).

Background Information:

The widespread use of semiconductor chips is ubiquitous in modern daily life, supporting national defense, health, energy, manufacturing, automobile, communications, and computing applications. The nationwide chip shortage and an over-dependence on manufacturing in countries of concern is a national security risk that underscores the urgent need to increase domestic production of this critical technology.

Although the U.S. invented semiconductors and manufactured 37% of chips in 1990, today, just 12% of modern chips and *none* of the most advanced chips are manufactured in the U.S.

The national security risk is not just a product of the pandemic's impact on the supply chain, but also an issue of technical limitations in existing U.S. manufacturing capabilities. As a leader in semiconductor exports, Texas is poised to help fill domestic manufacturing capability gaps, solve research & development (R&D) challenges and train the future semiconductor manufacturing workforce in the U.S. It is essential not only to the state's economy, but to the nation's security.

In the summer of 2022, U.S. Congress passed the CHIPS and Science Act to strategically position the U.S. in this sector and ensure leadership in semiconductor manufacturing. Over $13 billion is available in federal R&D funds, and many states are seeking a portion of this funding. Texas must make a state-level investment in semiconductor R&D efforts to ensure chip independence, have a lead over the other competing states, and be well-positioned to submit strong winning applications for federal allocations toward cutting-edge fabrication technologies, as well as applicable professional workforce development programs for this industry and affiliated sectors. In March 2023, Governor Greg Abbott held a press conference with St. Rep. Greg Bonnen '88, MD and St. Sen. Joan Huffman. Together, they announced the Texas CHIPS Act, which will ensure a multi-billion investment to higher education institutions in Texas for semiconductor research and industry-recognized workforce development training.

As a key member of Governor Abbott's National Semiconductor Centers Texas Task Force (established October 2021), the A&M System has been asked by the Governor's Office to lead major U.S. CHIPS and Science Act proposals for the state aligned with two of the three major efforts that align with the national initiatives: (1) National Semiconductor Technology Center (NSTC) and (2) Manufacturing USA Institutes (MUSAI).

The Texas A&M Semiconductor Institute (TSI) at the A&M System will lead the proposal development process for NSTC and MUSAI on behalf of the state and also participate in semiconductor research and development, manufacturing, and supply chain resilience initiatives. NSTC will be a public-private consortium to conduct semiconductor research, provide prototyping capabilities, establish an investment fund and expand industry-recognized workforce development training programs. MUSAI will be a network of private, government, and academic organizations focused on research capacity and human capital resources for semiconductor manufacturing. These efforts are supported by weekly meetings underway, planned through the fall, with a variety of state private, public, and higher education stakeholders. The purpose is to be proactive in preparation for a forthcoming request for proposals (RFPs) from U.S. Department of Commerce, anticipated for release in fall 2023. TSI will enable the A&M System to support this endeavor, in partnership with Office of the Governor.

A&M System Funding or Other Financial Implications:

State and federal funding opportunities are expected to support the TSI, including, but not limited to, facilities, equipment, general operations, salaries, and other consortia-led initiatives. Funding will begin in fiscal year 2024. The A&M System will provide space in a new facility at the RELLIS Campus to house TSI.

Strategic Plan Imperative(s) this Item Advances:

Approval of this agenda item will advance the A&M System's strategic imperatives #4, #5 and #7, where #4: the A&M System will increase its prominence by building a robust and targeted research portfolio; #5: the A&M System will provide services that respond to the needs of the people of Texas and contribute to the strength of the state's economy; and #7: the A&M System will pursue pioneering/progressive opportunities to address national and global challenges.

Agenda Item No. 6.4

THE TEXAS A&M UNIVERSITY SYSTEM
Office of the Vice Chancellor for National Laboratories
and National Security Strategic Initiatives
April 5, 2023

Members, Board of Regents
The Texas A&M University System

Subject: Establishment of the Texas A&M Semiconductor Institute

I recommend adoption of the following minute order:

"The Texas A&M Semiconductor Institute is hereby established as an organizational unit of The Texas A&M University System."

Respectfully submitted,

[ORIGINAL SIGNED BY]

M. Katherine Banks, Ph.D.
Vice Chancellor for National Laboratories
and National Security Strategic Initiatives

Approval Recommended:

[ORIGINAL SIGNED BY]
John Sharp
Chancellor

[ORIGINAL SIGNED BY]
Billy Hamilton
Deputy Chancellor and
Chief Financial Officer

[ORIGINAL SIGNED BY]
James R. Hallmark, Ph.D.
Vice Chancellor for Academic Affairs

Approved for Legal Sufficiency:

[ORIGINAL SIGNED BY]
Ray Bonilla
General Counsel

THE TEXAS A&M UNIVERSITY SYSTEM

TEXAS A&M SEMICONDUCTOR INSTITUTE

EXECUTIVE SUMMARY

1. Rationale for the Creation of the Institute

The manufacturing of semiconductors in the United States has decreased significantly. China aims to lead global chip manufacturing by 2030 and has heavily subsidized its semiconductor industry. Semiconductors are crucial to modern industrial, commercial, and military systems, and losing access to them would have significant consequences for economic and U.S. national security. In the summer of 2022, Congress passed the CHIPS and Science Act to strategically position the U.S. in this sector and ensure leadership in semiconductor manufacturing. Over $13 billion is available in federal R&D funds, and many states are seeking a portion of this funding.

As a key member of Governor Abbott's National Semiconductor Centers Texas Task Force (established October 2021), the A&M System has been asked by the Governor's Office to lead major U.S. CHIPS and Science Act proposals for the state aligned with two of the three major R&D efforts that align with the national initiatives: (1) National Semiconductor Technology Center (NSTC) and (2) Manufacturing USA Institutes (MUSAI).

Additionally, Texas is planning to make a state-level investment through the Texas CHIPS Act. This is currently in legislative review and supported by the state legislature and Governor's office. If enacted, the Texas CHIPS Act will establish a Texas Semiconductor Innovation Consortium (TSIC), which will manage a fund supporting semiconductor R&D efforts throughout the state to ensure chips independence and allow Texas to be competitive for federal allocations toward cutting-edge fabrication technologies and semiconductor workforce development. As currently proposed, the A&M System would serve a major role in TSIC.

A system institute dedicated to semiconductor manufacturing is necessary to coordinate our responses to state and federal CHIPS initiatives and to coordinate system member research, workforce training, and collaborations with companies. The Texas A&M Semiconductor Institute (TSI) will consist of:

1. **Focused Expertise**: An institute dedicated to semiconductor manufacturing will have focused expertise in this specific area, which can enable it to guide and oversee research in this field more effectively.
2. **Facilitation of Collaboration**: The Institute can facilitate collaboration between researchers from different system agency members and departments within the system universities, as well as with external organizations, including industry partners. This collaboration can help ensure that research is relevant to real-world applications and can lead to more significant breakthroughs.
3. **Access to Resources**: The Institute can also provide access to resources that individual researchers may not have, such as specialized facilities, equipment, funding, and expert staff. This can enable researchers to carry out more complex and impactful projects.
4. **Increased Visibility**: Having a dedicated institute can also increase the visibility of the university's research in semiconductor manufacturing, which can help attract students, talented faculty, and more funding from federal and state agencies, as well as industry partners.

5. **Long-term Planning**: The Institute can provide long-term planning and vision for the systems' research efforts in semiconductor manufacturing. This can ensure that the systems' research agenda is aligned with industry needs and is sustainable in the long run.

2. General Description of the Institute Vision, Mission, and Goals

The Texas A&M Semiconductor Institute is a multidisciplinary research organization that focuses on advancing semiconductor manufacturing technology and promoting workforce development in the semiconductor industry. The Institute serves as a hub for research collaboration between academic researchers, industry, and government partners to develop innovative solutions to complex semiconductor manufacturing challenges. The Institute also coordinates education and training programs to help develop the next generation of the semiconductor workforce, including undergraduate and graduate courses, professional development programs, and continuing education opportunities. In addition, the Institute is committed to providing secure production of semiconductors for the defense department, ensuring the integrity and reliability of the semiconductor supply chain for national security purposes. Overall, the Texas A&M Semiconductor Institute aims to promote the growth and competitiveness of the semiconductor industry in Texas and beyond.

Vision: The A&M System to become a leader in semiconductor technology and enable national independence in semiconductor manufacturing.

Mission: The mission of the Institute is to advance the development and production of semiconductors through cutting-edge research, collaboration with industry and government, and education and workforce development.

Goals:

1. Conduct research and development in semiconductor manufacturing, including materials, processes, and device structures, to enable the next generation of semiconductor devices.
2. Collaborate with industry partners to transfer technology from research to commercialization and to identify industry needs for future research.
3. Seek federal and state funding to support research, development, and workforce development in the semiconductor industry.
4. Provide education and training opportunities for students, researchers, and industry professionals to advance their skills and knowledge in semiconductor manufacturing.
5. Foster a culture of innovation and entrepreneurship by encouraging the formation of startup companies based on semiconductor technologies.
6. Establish a secure semiconductor fabrication capability to support the needs of the defense department.
7. Address the national need to regain U.S. leadership and security in semiconductor manufacturing.

3. Potential Faculty Associated with the Institute and Potential Intersystem and Other Collaborations

Over 85 A&M System faculty have been identified with an interest in semiconductor manufacturing. These include Texas A&M University, College Station; Texas A&M Engineering Experiment Station (TEES); Texas A&M University-Corpus Christi, Prairie

View A&M University, Texas A&M University-San Antonio, and RELLIS. See **Appendix A** for a listing of faculty.

Furthermore through the National Semiconductor Centers Texas Task Force and A&M System led 'CHIPS for Texas' working groups, 52 public and private collaborators have been identified. See **Appendix B** for a listing of partnering entities.

4. Potential Activities

Activities that the Texas A&M Semiconductor Institute would partake in:

1. **Research and Development**: The Institute would seek funding and conduct research in areas such as new semiconductor materials, device structures, and manufacturing processes. This could involve both fundamental and applied research aimed at developing new technologies that can be commercialized. The proposed research activities can be organized to align with the NSTC and MUSAI federal initiatives. Specifically, these include:
   - **FOCUS AREA #1 – NSTC Aligned – R&D in Semiconductor Wafer Scale Manufacturing Processes**
     - **Disruptive Technologies -** A new facility and research program that explores new technologies and production methods, such as advanced lithography and exotic chemistries that will be integrated into next-generation semiconductor fabs through technology-transfer agreements.
     - **Quantum and AI Chip Fabrication -** A new state-of-the-art R&D facility designed specifically to reduce barriers to innovation in the processing and tool development of plasmonics and hybrid semiconductor/quantum device manufacturing for businesses and universities.
     - **Fab Tool Education and Innovations Lab: Semiconductor Processing Degrees and Certificate Programs -** Expanding existing facilities to provide a hands-on fabrication training facility that prepares students to take innovative approaches to fabrication – both in the equipment used and the process followed. Through courses offered at this lab, students will achieve degrees, certificates, and concentrations in Semiconductor Processing Technology.

   - **FOCUS AREA #2 – MUSAI Aligned – R&D with shorter term industry impact**
     - **Smart-Fab Manufacturing Innovation -** Expanded facilities and focused programming will drive research, development, and implementation of smart and resilient manufacturing technologies across the semiconductor processing supply chain.
     - **Semiconductor Facility Operations Efficiency -** Enhanced assessment and training facilities will help the industry maintain safety and reduce the costs of operations and environmental impact associated with the subfab, manufacturing infrastructure, and supply chains.
     - **Hardened Fabrication Technologies -** Expanded facilities and research that targets manufacturing and evaluation of radiation-resistant circuits and space-hardened electronics with applications in nuclear safety, defense, and space exploration.
     - **Secure Fabrication–** Adjacent facilities and research efforts to enable fabrication and testing in a secure environment for national security-related supply chains and

research projects, including fieldable fab-in-a-box and on-chip electronic warfare countermeasures.

- **Center for Microdevices and Systems -** State-of-the-art R&D infrastructure that expands existing capabilities to enable university researchers and small to midsize businesses to conduct prototyping, R&D testing, and validation of new designs and devices, such as microsensors, micro-electro-mechanical systems, and application specific integrated circuits. The center will also provide a training ground for hands-on professional workforce development training.

2. **Collaboration with Industry**: The Institute could partner with semiconductor companies to develop new technologies and products, provide access to research expertise and facilities, and offer workforce development and training programs.

3. **Workforce Development and Education**: The Institute could coordinate education and training programs among multiple system members throughout Texas to develop the skills and knowledge needed for careers in the semiconductor industry. This could include courses and workshops on topics such as semiconductor materials, device physics, and manufacturing processes.

4. **Outreach and Community Engagement**: The Institute could engage with the local community and stakeholders to raise awareness of the semiconductor industry's importance and the Institute's role in advancing this field. This could involve public lectures, workshops, and other events aimed at promoting science and technology education.

5. **Secure Production**: As mentioned, the Institute could work on developing technologies and processes for the secure production of semiconductors for the defense department. This could involve collaborating with defense contractors, government agencies, and academic researchers to develop new materials, devices, and manufacturing processes that meet the unique requirements of the defense industry.

5. Impact on Education and Training of Students

Significant workforce development is needed to reestablish and maintain U.S. leadership and security in semiconductor manufacturing. Serving this national need is part of the mission and goals of the Institute. The Texas A&M Semiconductor Institute can have a significant impact on the education and training of students. By collaborating with the system member university engineering and science departments, the Institute can provide opportunities for students to work on cutting-edge research projects related to semiconductor manufacturing, which can help prepare them for careers in this field.

Additionally, through the Institute’s corporate partners, the Institute can offer internships, co-op programs, and other educational opportunities for students to gain hands-on experience in the semiconductor industry. This can help students develop the practical skills and knowledge necessary to succeed in the industry and provide them with networking opportunities that can help them secure future employment.

Furthermore, the Institute can work with local high schools and community colleges to promote STEM education and encourage more students to pursue careers in semiconductor manufacturing. By doing so, the Institute can help build a pipeline of talent for the semiconductor industry, which is important for the industry's growth and competitiveness.

The Institute will organize existing courses and programs in semiconductor manufacturing and also in related supporting areas such as safety, construction, energy efficiency and resource management, and manufacturing. This will be done in collaboration with other A&M System universities, agencies, centers, and institutes to promote the semiconductor industry workforce development.

For a summary of these proposed activities, see **Appendix C**: Texas A&M University System Workforce Development - Supporting Semiconductor Manufacturing and Construction.

6. Resource Requirements

The Texas A&M Semiconductor Institute would require a variety of resources to achieve its goals, including:

1. **Funding**: The Institute would require significant funding to carry out research, develop new technologies, and provide educational programs. This could come from a variety of sources, including federal and state grants, industry partnerships, and private donations. As discussed in Section 7, between $200M and upwards of $1B in funding could be expected for the Institute.
2. **Facilities**: The Institute would need access to state-of-the-art research facilities and equipment to conduct cutting-edge research and development. This could include clean rooms, semiconductor testing equipment, and specialized fabrication tools. The anticipated cost of this is at least $144M.
3. **Faculty and Staff**: The Institute would require a team of experienced researchers, educators, and support staff to oversee its various programs and initiatives. This could include professors, postdoctoral researchers, engineers, and administrative personnel. Annual costs for this are anticipated to be at least $26.5M.
4. **Industry Partnerships**: The Institute would need to establish partnerships with semiconductor manufacturers, technology firms, and other industry players to facilitate collaborations, joint research, and workforce development initiatives.

A summary of the budgetary requirements for the first five years of the Texas A&M Semiconductor Institute is given in the table below.

Facility Construction	Start-up		$ 84,100,000
Fab Equipment	Start-up		$ 51,697,202
Major Utility Systems	Start-up		$ 8,500,000
Faculty Lines	Start-up		$ 17,700,000
Operational Staff	5 years		$ 8,806,400
Maintenance / Upkeep	5 years		$ 29,196,398
Grand Total			**$ 200,000,000**

7. Sources and Future Expectations of Financial Support

Several sources of funding are anticipated to significantly support the Institute.

The A&M System has proposed funding from the state in the amount of $200M to support the establishment of the Texas A&M Semiconductor Institute. It is expected that this will be funded by the state of Texas through the aforementioned Texas Semiconductor Innovation Consortium or similar state funding. TSIC, as currently proposed, would have a sustaining fund for long-term

R&D investments in semiconductor manufacturing. Texas A&M Semiconductor Institute would seek sustained funding beyond the initial scope listed in section 6 through the TSIC.

Once established, the Texas A&M Semiconductor Institute will competitively propose to the U.S. Department of Commerce to gain a portion of the $13B in CHIPS Act's R&D funding. Department of Commerce funding is expected to be solicited in fall 2023 and to last five years. Texas should be competitively placed for a share of the federal dollars as Texas is currently a national leader in semiconductor manufacturing, U.S. Sen. John Cornyn, R-Texas, helped lead the effort to pass the CHIPS semiconductors legislation, and Texas A&M already has strong ongoing semiconductor research.

Additionally, the funding for the Institute can come from a variety of sources, including government grants, industry partnerships, industry-sponsored research, corporate sponsorships, and private donations. Many of these funding avenues are already active within the system universities and agencies.

8. Governance and Advisory Structure

The Vice Chancellor for National Laboratories and National Security Strategic Initiatives will provide administration of the Texas A&M Semiconductor Institute. The administration and organizational strategy of the proposed Institute will be structured such that it subscribes to A&M System Policy *11.02, Creation of Centers and Institutes*. The Institute will have a director, who will report both to the Vice Chancellor for National Laboratories and National Security Strategic Initiatives and the Vice Chancellor for Research. The primary report will be the Vice Chancellor for National Laboratories and National Security Strategic Initiatives. The director will additionally be supported with input by an External Advisory Committee and an Internal Advisory Committee. These two committees will be expected to meet at least annually to provide input in the advances and success of the Institute. The External Advisory Committee will be comprised of leading semiconductor industry professionals from associations, private individuals, companies, foundations, and national or international institutions. The Internal Advisory Committee will comprise administrators and subject matter experts from A&M System members.

9. Mechanisms for Periodic Review

The Institute director will be responsible for preparing annual progress reports to present to the Vice Chancellor for National Laboratories and National Security Strategic Initiatives. This will also be shared with the Vice Chancellor for Research, the Vice Chancellor and Dean of Engineering, and the Vice President for Research, Texas A&M University, College Station, for comment. The Institute will be evaluated by the Vice Chancellor for National Laboratories and National Security Strategic Initiatives annually.

The annual report will summarize the following aspects of the Institute:

- Administrative structure
- External and Internal Advisory Committee summaries
- Annual budget
- Research activities, including input (grants, contracts, etc.) and output (publications, reports, etc.) metrics
- Research Security and Compliance Review
- Workforce development and Outreach activities
- Industry relationships summary
- Goals for the upcoming year

APPENDICES

A: List of Faculty Experts across The A&M System in Semiconductor Research and Manufacturing

PIName	Contact	Campus	CollegeAndDepartment	Expertise	Interests_Proposals
Abdullah Muzahid	abdullah.muzahid@cse.tamu.edu	College Station	College of Engineering, Department of Computer Science and Engineering	Computer Architecture, Accelerator Design, Hardware Security, Synchronization and Parallelism	Hardware accelerator design for machine learning, secure processor design by redesigning hardware and software stack, distributed machine learning system, parallel computer architecture.
Amy Vance	amyvance@tamu.edu	College Station,TEES	Engineering Workforce Development, Director of Strategic Initiatives for Workforce Programs	K-12 and higher education teaching and curriculum development, teacher professional development, engineering workforce	Workforce Developemnt
Andrea Ogilvie	aogilvie@tamu.edu	College Station	College of Engineering, Assistant Dean for Student Success	Engineering Education Higher Education Policy Issues Workforce Development Broadening Participation in STEM	Semiconductor MAnufacturing, Research, & Testing (SMART) Scholars: Creating Pathways for Community College Students to Four-Year Engineering Degrees to Meet Workforce Needs
Aravind Krishnamoorthy	akrishnamoorthy@tamu.edu	College Station,TEES	Assistant Professor, Mechanical Engineering	Atomistic Simulations and Multiscale Modeling Computational Synthesis of Materials and Structures Machine Learning for Mechanical Materials Predictive Design and Manufacturing of Materials, Surfaces, and Interfaces	DMREF: DOSSI - Data-driven co-design of Semimetal-Semiconductor hetero-Interfaces for high-performance and energy-efficient computing
Arum Han	arum.han@tamu.edu	College Station,TEES	Electrical & Computer Engineering	Microfluidics and lab-on-a-chip systems High-throughput systems approach to enabling microbial bioenergy and cell-based biomanufacturing High-throughput systems accelerating drug/vaccine development against emerging infectious diseases Organ-on-a-chip & microphysiological	Texas Defense Microelectronics Commons
Bani Mallick	bmallick@stat.tamu.edu	College Station	Statistics Department	Bayesian hierarchical Modeling Nonparametric Regression and classification Bioinformatics Spatio-temporal Modeling Machine learning Functional Data analysis Bayesian nonparametrics Petroleum reservoir characterization Uncertainty analysis of Computer Model	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Bimal Nepal	nepal@tamu.edu	College Station,TEES	Engineering Technology & Industrial Distribution	Data Science in Distribution and Supply Chain Management Distribution Operations Management Lean Six Sigma Manufacturing Systems Optimization Engineering Education and Workforce Development	Semiconductor MAnufacturing, Research, & Testing (SMART) Scholars: Creating Pathways for Community College Students to Four-Year Engineering Degrees to Meet Workforce Needs
Bryan Rasmussen	brasmussen@tamu.edu	College Station,TEES	Mechanical Engineering	research focuses on dynamic modeling and control of thermo-fluid energy systems, building HVAC control, and industrial energy efficiency.	Cooling of Racks through Active control, Two-phase on-chip cooling, and thermal Emission (CRATE) for a modular EDGE data center
Byul Hur	byulmail@tamu.edu	College Station	Engineering / Department of Engineering Technology & Industrial	Mixed signal IC design / RF circuit design / IC Testing / BIST	IC designs for testing (BiST)
Chabum Lee	cblee@tamu.edu	College Station	College of Engineering, Department of Mechanical Engineering	Wafer/Reticle/Pellicle metrology and inspection (MI) and MI equipment development	Semiconductor metrology, inspection and review system, FREEFORM SURFACE METROLOGY TOOL PATH PLANNING BY ITERATIVE LEARNING-EXTREMUM SEEKING CONTROL FOR REVERSE ENGINEERING, TSV METROLOGY AND INSPECTION
Clint Patterson	capatterson@tamu.edu	College Station	Center for Teaching Excellence (CTE)	Transformative Doctoral Education Model, Graduate Education Model, Science of Team Science, Program (Re)Design, mentorship	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Cynthia Hipwell	cynthia.hipwell@tamu.edu	College Station,TEES	Mechanical Engineering	Nanoscale thermal energy transport Nanoscale tribology Surface and interface physics in the finger-device interface for human machine interfaces and haptics Micro/nanoscale sensor and actuator integration and characterization for human-	Cooling of Racks through Active control, Two-phase on-chip cooling, and thermal Emission (CRATE) for a modular EDGE data center
Daniel A. Jimanez	djimenez@cse.tamu.edu	College Station	College of Engineering, Department of Computer Science & Engineering	Computer Architecture, Microarchitecture, Low-Level Compiler Optimization	Processor Design
David De Sousa Jr	ddesousa@tamu.edu	College Station	Associate Director, Engineering Academies	Workforce Development	Semiconductor MAnufacturing, Research, & Testing (SMART) Scholars: Creating Pathways for Community College Students to Four-Year
David Staack	dstaack@Tamu.edu	College Station,TEES	College of Engineering, Department of Mechanical Engineering	Plasma Discharges, Plasma Processing, Lasers, Pulsed Power	Semiconductor Procesing Tool Development, Training
Debjyoti (Deb) Banerjee	dbanerjee@tamu.edu	College Station,TEES	College of Engineering (COE), College of Engineering Medicine (EnMed),Department of Mechanical Engineering, Department of Petroleum Engineering, Mary Kay OÃ¢â‚¬â„¢Connor Process Safety Center, Energy Institute, Gas & Fuels Research Center;	Thermo-Fluidics (multi-phase flows, boiling-condensation, thermal management), micro/ nano-technology (nano/micro/bio-sensors, MEMS, nanolithography/ DPN, nanosynthesis), nanofluids (complex fluids), nano-calorimeter (explosives sensing), phase change materials (PCM)/ energy-water nexus, energy storage, solar power, numerical simulations (lumped/ network models, Finite Elements Analyses/ FEA,	thermal management (electronics chip cooling), packaging, design, manufacturing, uncertainty quantification, risk management, ethics
Dion Antao	dantao@tamu.edu	College Station,TEES	Mechanical Engineering	Nano-to-macroscale heat transfer, fluid dynamics and interfacial phenomena Two-phase flow and heat transfer in energy systems (thermo-electric power generation, thermal management for electronics, motors and energy conversion systems) and for water purification Quality and durability of low surface energy materials/coatings for phase-change heat transfer enhancement in extreme environments Plasma discharges in different phases for optical	Cooling of Racks through Active control, Two-phase on-chip cooling, and thermal Emission (CRATE) for a modular EDGE data center
Dong Hee Son	dhson@chem.tamu.edu	College Station	College of Art and Science, Chemistry	Semiconductor quantum dots and related 1D and 2D nanostructure, synthesis, structural	Photonic applications and hot electron applications of semiconductor quantum dots
Emile A. Schweikert	schweikert@chem.tamu.edu	College Station	College of Arts and Sciences, Department of Chemistry	Molecular analysis at the nanoscale	Development of innovative instrumentation and methodology for accurate detection of sub-attomol quantities of molecules and their localization at the nanoscale. Nanometrology for evaluating rare defects in molecular blends and
Eric Rowell	rowell@math.tamu.edu	College Station	mathematics department	mathematical foundations of topological phases	Topological Quantum Computation

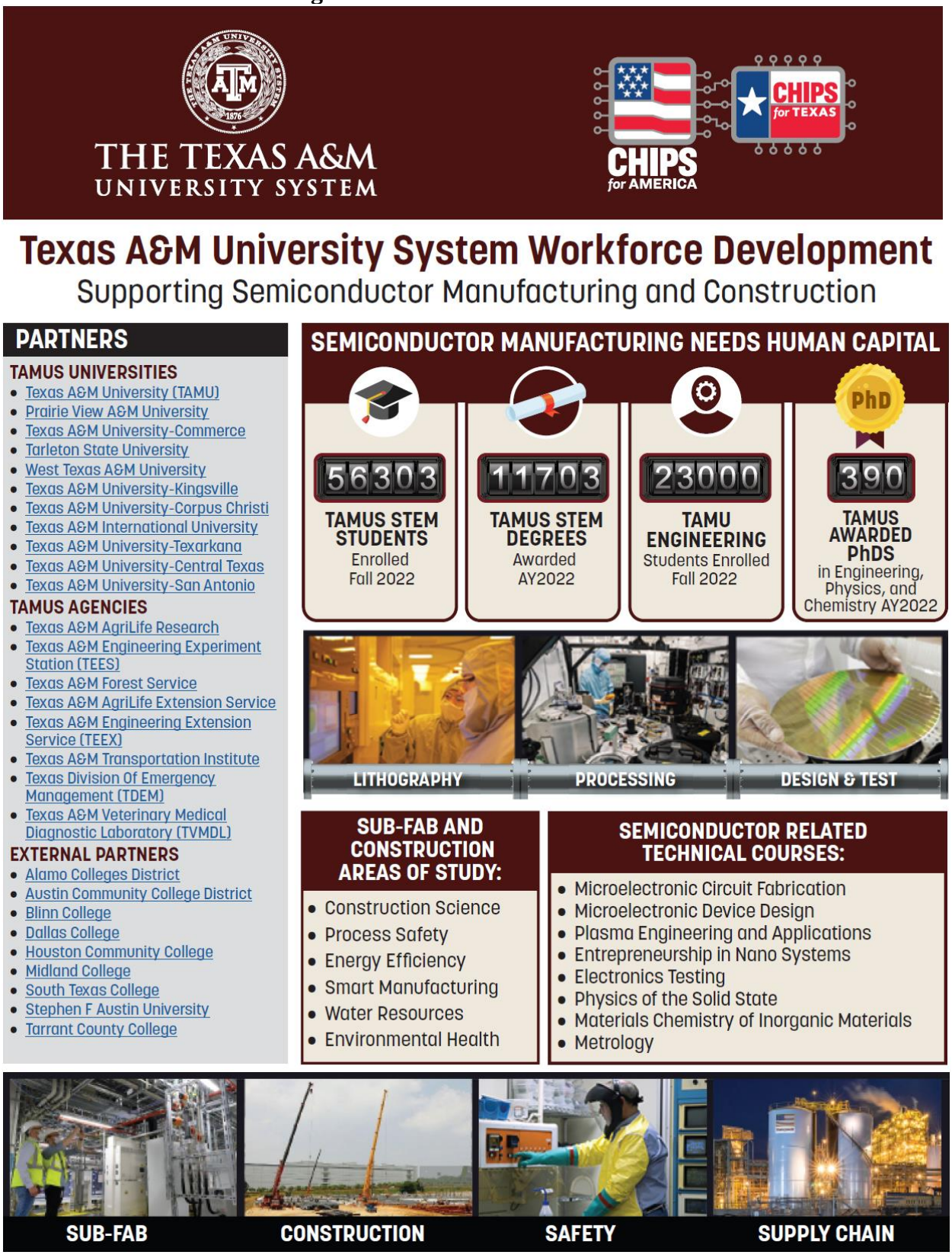
PIName	Contact	Campus	CollegeAndDepartment	Expertise	Interests_Proposals
Eun Jung Kim	ejkim@cse.tamu.edu	College Station	College of Engineering, Department of Computer Science and Engineering	Computer Architecture, Hardware Security, Heterogeneous system (with GPU/CPU/Accelerator) Design, Modular design	Secure Chip Multiprocessor Design, hardware accelerator design focusing on communication architecture, hw/sw co-design for machine
Huiyan Sang	huiyan@stat.tamu.edu	College Station	Statistics, College of Arts and Sciences	Spatial and spatio-temporal statistics, Bayesian statistics, Computational statistics, Machine learning, Extreme values, Environmental Statistics, High-dimensional data analysis,	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Iltai Isaac Kim		Corpus Christi	College of Engineering, Department of Engineering	Optical diagnostics, Nanophotonics, Near-surface imaging, Hyperbolic metamaterial, Epsilon-near-zero (ENZ) perfect absorption, Enhanced absorption with metal nanoparticles	Optical metrology, Metasurface development for enhanced sensing, Nanoscale and in-situ characterization of Interfacial phenomena (thickness, concentration, temperature, effective
Izzat Alsmadi	ialsmadi@tamusa.edu	San Antonio	College of Arts and Science, Department of Computing and	Cyber security, machine learning, Using AI for security	
James Batteas	batteas@chem.tamu.edu	College Station	College of Arts and Science, Department of Chemistry	Surface Science, Physical Chemistry, Nanotechnology, Scanning Probe Microscopy	Nanoscale Materials and Devices, Optoelectronics, Organic Electronics, 2D
Jenny Qiu	jennyqiu@tamu.edu	College Station	College of Engineering, Department of Mechanical Engineering	Nanofabrication, Advanced manufacturing, Power electronics, Mechanical metamaterials, Materials design and characterization	Design and manufacturing of semiconductors, Energy storage, Crystal structure and phase transformation during manufacturing of
Jeyavijayan (JV) Rajendran	jv.rajendran@tamu.edu	College Station	College of Engineering, Department of Electrical and Computer Engineering	Security: Supply-chain, fabrication, packaging, hardware design, Artificial intelligence/machine learning, counterfeits, piracy, vulnerability	Secure chips, Supply-chain security, Using AI for security, device-level security, chip tracking
Jingbo Liu	jingbo.liu@tamuk.edu	Kingsville	Department of Chemistry	Multi-function sensor, fuel cell - solid oxide fuel cell and PEM (proton exchange membrane) cell, water purification using cermet (ceramic and	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Jonathan Felts	jonathan.felts@tamu.edu	College Station,TEES	Mechanical Engineering	Scalable Nanomanufacturing Nanometer-Scale Thermal and Mass Transport Near Field Optics Organic Optoelectronics	Cooling of Racks through Active control, Two-phase on-chip cooling, and thermal Emission (CRATE) for a modular EDGE data center
Jorge Seminario	seminario@tamu.edu	College Station	College of Engineering, Department of Chemical Engineering (joint with Electrical and Materials	microelectronics, nanoelectronics, molecular-electronics, electrochemistry, quantum and multiscale analysis, design and simulations of	Design, Fabrication, Simulations, Energy storage, Signal processing.
Julie Harlin	j-harlin@tamu.edu	College Station	Agricultural Leadership, Education and Communivations	research focuses on mentoring and learner-centered instructional design.	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Kamran Entesari	kentesar@tamu.edu	College Station	Electrical & Computer Engineering	Radio frequency/microwave/millimeter-wave integrated circuits and systems Integrated RF photonics RF/ Microwave chemical/biochemical sensing systems Microwave filters, antennas and passive components	Co-Design of Novel Heterogeneous-Integrated Electronic-Photonic Systems for Spectrum and Energy-Efficient Millimeter-Wave Remote Antenna Units, Ultra-Wide Band Dynamically Tunable Silicon Photonics Millimeter-wave Channelizers With Automatic Calibration, ACED Fab: Co-Design of Novel Electronic-Photonic Systems for Energy-Efficient Coherent Optical Interconnects, Terabit and fJ/b Hetero-integrated Photonic Circuits for 6G MM-Wave
Karen L. Wooley	wooley@chem.tamu.edu	College Station	College of Arts & Sciences, Department of Chemistry	polymer chemistry, polymer materials, synthetic organic chemistry, nanoscience, nanotechnology	synthesis and characterization of degradable polymers derived from natural products, unique macromolecular architectures and complex polymer assemblies, and the design and development of well-defined nanostructured materials - materials in the diagnosis and treatment of disease, as superabsorbent hydrogels to address global challenges associated with excessive liquid water, as non-toxic anti-biofouling or anti-icing coatings, as safe, sustainable battery materials or materials for microelectronics device applications, and as
Karen Rambo-Hernandez	rambohernandez@tamu.edu	College Station	Education and Human Development	longitudinal data analysis, clustered data analysis, high ability studies, assessment of STEM interventions- especially in engineering	Semiconductor MAnufacturing, Research, & Testing (SMART) Scholars: Creating Pathways for Community College Students to Four-Year
Kelvin Xie	kelvin_xie@tamu.edu	College Station	College of Engineering, Department of Materials Science and Engineering	Transmission electron microscopy and atomic-level microstructural characterization	Chip design, chip microstructural characterization at the nano-scale and the atomic level, Mathematical, Molecular, and Materials
Kim Dunbar	dunbar@chem.tamu.edu	College Station	Department of Chemistry	topics in synthetic, structural and physical inorganic and bioinorganic chemistry. The use of a range of tools including spectroscopy, X-ray crystallography, magnetometry, electron microscopy, mass spectrometry and	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence, Reconfigurable Electronic Materials Inspired by nonlinear Neuron Dynamics (REMIND)
Kris Hagel	hagel@comp.tamu.edu	College Station	Texas A&M Cyclotron Institute		Low Cost, Radiation Tolerant Semiconductor Detectors for Charged Particle Spectroscopy
Laszlo Kish	laszlokish@tamu.edu	College Station	College of Engineering, Department of Electrical and Computer Engineering	Noise in semiconductors and other materials; 1/f noise; Thermal noise; Hot electron noise; Percolation; Degradation; Fluctuation-Enhanced Sensing (gas, fluid); Unconditionally secure inter-chip communications; Noise-based logic and related processors (quantum-mimic systems);	Low-noise systems; Thermally excited bit errors; Reliability; Unconditionally secure communications; Unconditionally secure processors and instruments; Quantum-mimic computing; True random number generators by semiconductors.
Lei Fang	fang@chem.tamu.edu	College Station	College of Arts and Sciences, Department of Chemistry, Department of Materials Science &	Organic and polymer electronics, Semiconducting and conducting polymers, Molecular machines and switches, Synthetic	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Linda Katehi-Tseregounis	katehi@tamu.edu	College Station	Electrical & Computer Engineering and Materials Science & Engineering	Development and characterization (theoretical and experimental) of microwave, millimeÂ-ter printed circuits Computer-aided design of VLSI interconnects Development and characterization of micro-machined circuits for microwave, millimeter-wave and sub-Â-millimeter-wave applications including MEMS switches, high-Q evanescent mode filters and MEMS devices for circuit re-configurability Development of low-loss lines for sub-millimeter-wave and terahertz frequency applications	Texas Defense Microelectronics Commons, EMERGE: Emergent-Memory Open-Research Gateway for Exploration and Innovation
Lisa Perez	perez @ tamu.edu	College Station	Texas A&M High Performance Research Computing	Computational Chemistry	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence

PIName	Contact	Campus	CollegeAndDepartment	Expertise	Interests_Proposals
Luke Nyakiti	nyakitil@tamu.edu	Galveston	Department of Marine Engineering Technology	Homo- hetero- epitaxial growth and Characterization of wide and ultra wide band gap semiconductor materials.	Epitaxial growth and structural, morphological, electrical, and optical characterization of group-III and transition metal nitrides, oxides, complex oxides, and oxide/nitride heterojunctions for high
Marcetta Darensbourg	marcetta@chem.tamu.edu	College Station	Department of Chemistry	Bio-inspired Catalysts for Hydrogen Production, New electrocatalysts for hydrogen production, When Iron Meets Nitric Oxide	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence, Reconfigurable Electronic Materials Inspired by
Matt Pharr	mpharr85@tamu.edu	College Station	College of Engineering, Department of Mechanical Engineering	Mechanics of Materials, Microelectronics, Flexible Electronics, Neuromorphic Materials, Electro-mechanics and Electro-chemo-	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence, Reconfigurable Electronic Materials Inspired by
Michael De Miranda	demiranda@tamu.edu	College Station	School of Education and Human Development, Dean	Engineering Education, electrical and computer engineering, VLSI (chip) design and microchip biosensor group, extreme ultraviolet (EUV) compact lasers technology used in microchip	
Michael Gaither	michael.gaither@tamu.edu	TEES	BCDC	Specialties: engineering, engineer, software, software development, research, research and development, production, quality analysis, failure analysis, teamwork, team builder, product manager, product management, physical product, cross-divisional leadership, executive advisement, leadership, agile, scrum, project management, solution-oriented,	EMERGE: Emergent-Memory Open-Research Gateway for Exploration and Innovation
Michael Johnson	mdjohnson@tamu.edu	College Station	Engineering Technology and Industrial Distribution	engineering education, production economics and design tools	Semiconductor MAnufacturing, Research, & Testing (SMART) Scholars: Creating Pathways for Community College Students to Four-Year
Nicholas Duffield	duffieldng@tamu.edu	College Station,TEES	Electrical & Computer Engineering	data and network science, particularly applications of probability, statistics, algorithms and machine learning to the acquisition, management and analysis of large datasets in	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Orion Ciftja	ogciftja@pvamu.edu	Prairie View A&M Univ	College of Arts and Sciences, Department of Physics	Two-dimensional semiconductor systems, Semiconductor quantum dots, Opto-electronic and spintronic applications in low-dimensional semiconductor systems, Magneto-transport studies of two-dimensional electronic systems	
Pablo Rangel	pablo.rangel@tamucc.edu	Corpus Christi	College of Engineering, Department of Engineering	Biomedical Instrumentation, autonomous systems, cyberphysical systems, circuit design and analysis, semiconductor active components applications and engineering education (BJT,	FET fabrication techniques, semiconductor fabrication/design/circuitry teaching/preparation for undergraduate/graduate students, semiconductor doping techniques, metamaterials
Pao Tai Lin	paolin@ece.tamu.edu	College Station	College of Engineering, Department of Electrical and Computer Engineering, Department of Materials Science and Engineering	Semiconductor Process, Packaging, Integrated Photonics, Optoelectronics, Thin Film Deposition	Semiconductor devices, fabrication/processes, materials, integration, packaging, Co-Design of Novel Heterogeneous-Integrated Electronic-Photonic Systems for Spectrum and Energy-Efficient Millimeter-Wave Remote Antenna Units, ACED Fab: Co-Design of Novel Electronic-Photonic Systems for Energy-Efficient Coherent Optical Interconnects, Chip-scale Biomolecular Spectral Analysis Using a Microring-Resonator Array Based
Patrick Shamberger	patrick.shamberger@tamu.edu	College Station	Materials Science & Engineering	Science and engineering of phase transitions Functional materials Thermal energy storage, transport, and conversion Nucleation and growth; hysteresis engineering; transformation kinetics Heat transfer in heterogeneous media Non-volatile resistance switching; metal-insulator phase transitions	Reconfigurable Electronic Materials Inspired by nonlinear Neuron Dynamics (REMIND), Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Paul V. Gratz	pgratz@tamu.edu	College Station	College of Engineering, Department of Electrical and Computer Engineering	Computer Architecture, 2.5D integration, hardware security, GPU and CPU microarchitecture, memory systems, non-	Secure 2.5D integrated systems, process technology driven processor and GPU/accelerator design, processor memory systems for emerging
Perla Balbuena	balbuena@tamu.edu	College Station	College of Engineering, Department of Chemical Engineering	Computational materials design, interfacial phenomena, ion and electron transfer	Degradation phenomena, smart materials, advanced manufacturing, Mathematical, Molecular, and Materials Foundations of Complementary Intelligence, Reconfigurable Electronic Materials Inspired by nonlinear Neuron
PR Kumar	prk@tamu.edu	College Station	Electrical & Computer Engineering and Industrial & Systems Engineering	Renewable energy and power systems Unmanned air vehicle transportation management system Cybersecurity Wireless networks and 5G Cyberphysical systems Autonomous transportation	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Prabhakar Pagilla	ppagilla@tamu.edu	College Station,TEES	Mechanical Engineering	Modeling and control of roll-to-roll manufacturing systems and autonomous vehicles, robotics/mechatronics, and control of	Texas Defense Microelectronics Commons
Prasad Enjeti	enjeti@tamu.edu	College Station	College of Engineering, Department of Electrical and Computer Engineering	Power semiconductor devices, Silicon Carbide (SiC) and Gallium Nitride (GaN) wide bandgap switching devices, power management, high	power management, high frequency power conversion
Qing Tu	qing.tu@tamu.edu	College Station	College of Engineering, Department of Materials Science & Engineering	Scanning Probe Microscopy, 2D materials, multiphysical coupling, piezo-/ferro-electrics, surface and interfaces, strain-engineering,	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence Terabit and fJ/b Hetero-integrated photonic
R Stanley Williams	rstanleywilliams@tamu.edu	College Station,TEES	Electrical & Computer Engineering	Nano-scale electronic, ionic and photonic devices Nonlinear dynamics and chaos Cognition	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence, Reconfigurable Electronic Materials Inspired by nonlinear Neuron Dynamics (REMIND)
Rainer Fink	fink@tamu.edu	College Station,TEES	Engineering Technology & Industrial Distribution, Electronic Systems Engineering Technology	Chip Level Cybersecurity Radiation Testing of Semiconductors Semiconductor Testing Raman Spectroscopy Medical Device Design Entrepreneurship Disability Modification of Cars Hydroponics	Semiconductor MAnufacturing, Research, & Testing (SMART) Scholars: Creating Pathways for Community College Students to Four-Year Engineering Degrees to Meet Workforce Needs, Reconfigurable Electronic Materials Inspired by nonlinear Neuron Dynamics (REMIND)

PIName	Contact	Campus	CollegeAndDepartment	Expertise	Interests_Proposals
Raymundo Arroyave	rarroyave@tamu.edu	College Station,TEES	Materials Science & Engineering	computational thermodynamics and kinetics of materials; integration of atomic-scale materials simulations and phenomenological thermodynamic and kinetic models; prediction of thermo-mechanical properties of materials through atomic-scale methods; development of phase field methods to describe the time	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Samuel Palermo	spalermo@tamu.edu	College Station,TEES	department of Electrical & Computer Engineering	Analog and Mixed-Signal Circuits High-Speed Electrical and Optical Interconnect Circuits and Design Methodologies Design and Modeling of Clock Generation and Recovery Circuits (PLL/DLL/CDRs) Overcoming Increasing Variability in Analog Circuits with Digital Assistance	Co-Design of Novel Heterogeneous-Integrated Electronic-Photonic Systems for Spectrum and Energy-Efficient Millimeter-Wave Remote Antenna Units, ACED Fab: Co-Design of Novel Electronic-Photonic Systems for Energy-Efficient Coherent Optical Interconnects, Terabit and fJ/b Hetero-integrated Photonic Circuits for 6G MM-
Sarbajit Banerjee	banerjee@chem.tamu.edu	College Station	Chemistry, Materials Science and Engineering	Solid-state inorganic materials exhibiting unusual chemical bonding motifs and electronic instabilities Spectroscopy and chemical imaging of the electronic structure of 2D materials, nanomaterials, and interfaces Developing metalâ€"organic syntheses for the rational growth of metal oxide and	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence , EMERGE: Emergent-Memory Open-Research Gateway for Exploration and Innovation, Reconfigurable Electronic Materials Inspired by nonlinear Neuron Dynamics (REMIND)
Sarhan Musa	smmusa@tamu.edu	Prairie View A&M Univ	College of Engineering, Department of Electrical and Computer Engineering	Computational methods, Deep learning for semiconductor devices, Control and Signal Systems, Photonic, power and energy systems	Computational methods, power and energy systems, Deep learning for semiconductor devices, Control and Signal Systems, Photonic
Sayantan Das	sdas@tamusa.edu	San Antonio	College of Arts and Sciences, M.P.E.S.	Surface Engineering via Nano-particle self assembly for industrial application. Electronic(Analog and Digital) Sensor Development	Utilizing bottom up processes to create hierarchical structures on surfaces for sensor development(humidity sensor , conductive thin films) , anti reflective surfaces and fundamental study of meniscus driven self assembly of particles
Serap Savari	savari@tamu.edu	College Station	College of Engineering, Department of Electrical and Computer	Manufacturing Data Analytics	Semiconductor Metrology
Seung Won Yoon	swyoon@tamu.edu	College Station	School of Education and Human Development. Department of Educational Administration & Human Resource Development	Social Network Analysis, Human Resources (HR)/People Analytics, Program Evaluation, e-Learning, Instructional Design, Learning Theories, Accreditation	Improving individual/team/organizational performance by connecting leadership, learning/knowledge sharing and data analytics; Career and leadership development in STEM;
Shawna Fletcher	fletcher.234@tamu.edu	College Station,TEES	College of Engineering	Women in Engineering	Collaborative Research: Development of an Engineering Elective Course â€œIntroduction of Semiconductor Manufacturing Processes"
Sherry Yennello	yennello@chem.tamu.edu	College Station	Department of Chemistry	Cyclotron, Radiation hardened semiconductors and electronics	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Simon Foucart	foucart@tamu.edu	College Station	Department of Mathematics	Mathematical Data Science, Approximation-Theory Flavored	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Srinivas Shakkottai	sshakkot@tamu.edu	College Station	College of Engineering, Department of Electrical and Computer Engineering, Department of Computer Science and Engineering	Multi-agent learning and game theory, wireless networks, information systems, reinforcement learning, data collection and analytics	Optimization, decision and control, Networks and networked systems, 5G and beyond, high performance compute
Stanislav Verkhoturov	verkhoturov@tamu.edu	College Station	College of Arts and Sciences, Department of Chemistry	Nanoparticle Interaction with 2D and 3D materials. Metrology.	Secondary Ion Mass-Spectrometry with single large projectiles impacts. The research is focused on methodology and instrumentation for surface analysis of materials used in the semiconductor
Stavros Kalafatis	skalafatis-tamu@tamu.edu	College Station	ECE	Computer architecture, high performance computing, Agriculture engineering, AI, Robotics, AR/VR	Computer Architecture, HPC, Smart Interconnect through AI, memory systems, non-volatile memory, Secure Chip Multiprocessor Design, AR/VR, Secure chips for Robotic applications
Suin Yi	yisuin@tamu.edu	College Station,TEES	Electrical & Computer Engineering	Brain-like computing algorithms and computer architectures Memristor-based ASIC for NP-hard combinatorial optimizations Neuromorphic devices compact modeling	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence , EMERGE: Emergent-Memory Open-Research Gateway for Exploration and Innovation
Ulisses Braga Neto	ulisses@tamu.edu	College Station,TEES	Electrical & Computer Engineering	Statistical Signal Processing Pattern Recognition and Machine Learning Collaborative Applications in Bioinformatics and Materials Informatics	Mathematical, Molecular, and Materials Foundations of Complementary Intelligence
Wei Gao	wei.gao@tamu.edu	College Station,TEES	Mechanical Engineering	Mechanics of materials Multiscale materials modeling Surface and Interface Mechanochemistry and mechanobiology AI and Machine learning 2D materials, metallic materials, soft	Atomistic Investigation of Phase Transition in Nanostructured Silicon--Towards Convergent Understanding with Mechanics-Informed Machine Learning Potential
Weiping Shi	wshi@tamu.edu	College Station	College of Engineering, Department of Electrical and Computer Engineering	Test of ICs, EDA, including layout synthesis and circuit simulation, and semiconductor manufacturing, including ADC (automatic defect classification), APS (automatic production	Test of ICs, EDA, including layout synthesis and circuit simulation, and semiconductor manufacturing, including ADC (automatic defect classification), APS (automatic production system),
Xiaofeng Qian	feng@tamu.edu	College Station	College of Engineering, Department of Materials Science and Engineering	Theory and Simulation of Quantum/Topological Materials, Neuromorphic Materials, Semiconductors, Semimetals, Ferroelectric/Ferromagnetic/Multiferroics, Nonlinear Optics	Nanoelectronics, Neuromorphics, Optoelectronics, 2D/1D Semiconductors and Contacts, Mathematical, Molecular, and Materials Foundations of Complementary Intelligence, Reconfigurable Electronic Materials Inspired by
Yuxuan Cosmi Lin	yxclin@tamu.edu	College Station	College of Engineering, Department of Materials Science and Engineering	Semiconductor electronic and optoelectronic devices, semiconductor nanofabrication and manufacturing, heterogeneous integration of Si CMOS and emerging non-silicon technologies, materials and devices for neuromorphic computing and near-sensor/in-sensor	advanced metrology, heterogeneous integration
Zi Jing Wong	zijing@tamu.edu	College Station	College of Engineering, Department of Aerospace Engineering	Integrated optics, optoelectronics, nanophotonics, metamaterials, 2D materials,	Integrated optics, optoelectronics, nanophotonics, metamaterials, 2D materials, nanofabrication,
ZJ Pei	zjpei@tamu.edu	College Station,TEES	Industrial & Systems Engineering	Additive manufacturing Subtractive manufacturing processes	Collaborative Research: Development of an Engineering Elective Course â€œIntroduction of Semiconductor Manufacturing Processes"

Appendix B: Entities partnering with A&M System on semiconductor manufacturing initiative

C: The Texas A&M University System Workforce Development - Supporting Semiconductor Manufacturing and Construction



SEMICONDUCTOR SCIENCE AND ENGINEERING COURSES

CHEM 468	Materials Chemistry of Inorganic Materials
CHEM 623	Surface Chemistry
CHEM 641	Structural Inorganic Chemistry
ECEN472	Microelectronic Circuit Fabrication
ECEN 473	Microelectronic Device Design
ECEN 440	Thin Film Technology and Device Application
ESET 351	Electronics Testing
ESET 352	Intro to Mixed-Signal Test and Measurement
ESET 452	Advanced Semiconductor Test and Measurement
ESET 453	Validation and Verification
MEEN 417, NUEN 417	Plasma Engineering and Applications
MEEN 490	Entrepreneurship in Nano Systems
MMET 414	Micro/Nano Manufacturing
PHYS 617	Physics of the Solid State
PHYS 631	Quantum Theory of Solids
PHYS 649	Physics of Optoelectronic Devices

Bridge to Test

FOUNDATIONAL AND SUPPORTING COURSES:

CHEM 433	Advanced Inorganic Chemistry Laboratory
CHEM 434	Analytical Instrumentation Laboratory
CHEM 635	Introduction to X-ray Diffraction Methods
CHEM 661	Radiochemistry
CHEM 673	Symmetry and Group Theory in Chemistry
ECEN 214	Electric Circut Theory
ECEN 350	Computer Architecture and Design
ECEN 370	Electronic Properties of Materials
ECEN 416	Hardware Design Verification
ECEN 420	Laser Principles and Applications
MSEN 410	Material Processing
MSEN 430	Nanomaterials Science
MATH 661	Mathematical Theory of Finite Element Methods
MATH 676	Finite Element Methods in Scientific Computing
PHYS 309	Modern Physics
PHYS 606	Introduction to Quantum Mechanics
PHYS 632	Condensed Matter Theory
STAT 436	Multivariate Analysis And Statistical Learning
STAT 615	Stochastic Processes

CONSTRUCTION:

COSC 325/326:	Mechanical, Electrical and Plumbing Systems in Construction I/II
COSC 450	Facility Management Principles and Practices
COSC 459	Industrial Construction
COSC 475	Construction Project Planning
COSC 253	Construction Materials and Methods I
CVEN 342	Materials of Construction

SMART MANUFACTURING:

MMET 410	Manufacturing Automation and Robotics

Cybersecurity
Electromechanical Automation
Smart Automation
TEES Institute for Manufacturing Systems

PROCESS SAFETY PROGRAMS & MS SAFETY ENGINEERING

SENG 310	Industrial Hygiene Engineering
SENG 312	Systems Safety Engineering
SENG 321	Industrial Safety Engineering
NUEN/SENG 309	Radiological Safety
SENG 313	Product Safety Engineering
SENG 422	Fire Protection Engineering
SENG 424	System Safety Analysis and Design
SENG 439	Ergonomics Design
CHEN/SENG 455	Process Safety Engineering
BAEN/MEEN/SENG 477	Air Pollution Engineering
SENG 430	Engineering Risk Analysis
SENG 460/660	Quantitative Risk Analysis

Mary Kay O'Connor Process Safety Center (MKOPSC)

Safety Engineering Certificate

SENG 655	Process Safety Engineering
SENG 670	Industrial Safety Engineering
SENG 660	Quantitative Risk Analysis
SENG 677	Fire Protection Engineering

Process Safety Certificate Program For Incumbent Plant Workers
Process Safety Practice Certificate For Industry Professionals

WATER AND ENERGY EFFICIENCY:

Continuous Commissioning Program®

AGEC 606	Water Resource Economics
CVEN 339/EVEN 339	Water Resources Engineering
CVEN 458/EVEN 458	Hydraulic Engineering of Water Distribution Systems
CVEN 664	Water Resources Engineering, Planning Management
MEEN 437	Principles of Building Energy Analysis
MEEN 436	Principles of Heating, Ventilating and Air Conditioning
MEEN 406	Energy Management in Industry
RENR 662	Environmental Law and Policy
WMHS 602	Contemporary Issues in Water Resources

TEEX COURSES / PROGRAMS

Advanced Manufacturing Skills Training
Cybersecurity
Environmental Health and Safety
Hazardous Materials
Information Technology
Heavy Equipment
Water and Wastewater
Utilities
OSHA Training Institute Education Center
Lineworker Academy

Texas A&M Engineering TEEX Extension Service

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