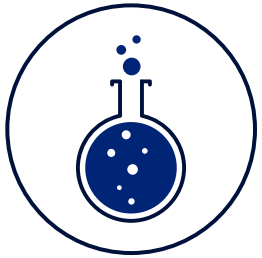
5 priority roles for phase 1 to strengthen Michigan's Semiconductor competitive advantage

Electrical Engineers

- ✓ Bachelor's degree in engineering (e.g., electrical)

Computer Engineers

- ✓ Bachelor's degree in engineering (e.g., computer, software)



Process Engineers

- ✓ Bachelor's degree in engineering or science (e.g., industrial, chemical, mechanical, material science)

Semis Processing Technicians

- ✓ Associates degree OR
- ✓ HS diploma / GED and certificate / apprenticeship

Maintenance and Repair

- ✓ Associates degree OR
- ✓ HS diploma / GED and certificate / apprenticeship

TAT Semis priority roles align to SOC codes, with more detailed descriptions in skills profiles (see following pages)

TAT Semis Priority Role	SOC Code(s)
Electrical Engineer	• Electrical Engineer (17-2071) • Electronics Engineer (17-2072)
Computer Engineers	• Computer Engineer (17-2061)
Process Engineers	• Industrial Engineer (17-2112) • Chemical Engineer (17-2041) • Material Scientist (19-2032)
Semiconductor Process Technician	• Semiconductor Processing Technician (51-9141)
Maintenance and Repair Workers	• Maintenance and Repair Workers (49-9071)

Industrial / process engineer | Skills profile and learning modules

Industrial / process engineer

Foundational Skills

Standard Knowledge

Process Engineer Foundations

STEM (Intermediate)

- Algebra, Calculus, Analytic Geometry & Trigonometry
- Calculus-Based & Electromagnetic Physics

Chemical Engineering (Basic)

- Safe chemical handling
- Organic chemistry
- Thermodynamics
- Transport processes
- Chemical kinetics

Material Science (Basic)

- Materials characterization
- Diffusion, kinetic and phase transformation
- Fundamentals of electrical, optical and magnetic materials
- Kinetics and phase transformations
- Nanomaterials
- Structure and mechanical properties

Core Competencies

Semiconductor-Focused Knowledge

Business Processes

- Manufacturing Processes (e.g. lean/agile)
- Six Sigma, Red X Principles, Value stream analysis

Soft Skills

- Communication Skills
- Teamwork / Collaboration
- Problem Solving
- Self-Motivation

Devices & Manufacturing

- Microelectronics Fabrication & Manufacturing
- Nanoscale Transistors
- Device Simulation
- RF Design, Passive & Active

Chemical Engineering

- Vacuum operation
- Chemistry of coating reactions
- Surface chemistry
- Process modeling
- ALD/CVD process chemistry

Material Scence

- Electron microscopy
- Thin film characterization and compositional analysis
- Experience with highly air and/or moisture sensitive materials

Industrial Engineering

- Value stream analysis
- Systems analysis
- Automation

Use Cases

Illustrative Use Cases

- Update design rules that will ensure manufacturability
- Improve productivity and yield through data analysis and variability reduction projects
- Maintain tool history and update operating procedures
- Perform failure analysis on defective products and equipment (e.g., wafers) and implement corrective actions
- Demonstrate process technology to customers and optimize processes for specific applications
- Support supplier quality and purchasing in collaboration with cross-functional teams

Source: Lightcast, company job postings, company interviews, 4-year university and graduate university course materials, MEDC analysis

Electrical Engineer | Skills profile and learning modules

Electrical Engineer

Foundational Skills
Standard Knowledge

Electrical Engineer Foundations

Electrical Engineering (Intermediate understanding)
- Electrical Circuits
- Electromagnetics
- Analog & Digital Comm. Systems
- Automatic Control Systems
- Schematic Diagrams
- Root Cause Analysis
- Signal and Power Integrity
- Electro-optics

STEM (Intermediate)
- Algebra, Calculus, Analytic Geometry & Trigonometry
- Calculus-Based & Electromagnetic Physics

Computer Science (Basic)
- Object-Oriented Programming Languages (e.g., C and C++)
- Processing Models
- Stacks and Stacks Applications
- Embedded Systems
- Software Design and Implementation

Core Competencies
Semiconductor-Focused Knowledge

Business Processes
- Manufacturing Processes (e.g., lean/agile)
- Operations Analysis

Soft Skills
- Problem Solving for EE
- Teamwork & Leadership (org. behavior concepts)
- Oral & Written Communication

Programming Languages
- MATLAB
- C/C++

Semiconductor EE
- IC package/design layout
- Semiconductor Device Fundamentals
- Energy Storage & High-Voltage Systems
- Memory/storage devices

Specializations[1] (Choose One)

Manufacturing
- Microelectronics Fabrication & Manufacturing
- Nanoscale Transistors
- Device Simulation
- RF Design, Passive & Active

Circuits
- Power Electronics in Power Systems (e.g., analysis, design, simulation, & modeling)
- RF System Design
- Analog & Digital Integrated Circuits
- Quantum Processes
- VLSI Design

Signals & Systems
- Digital Signal Processing
- Analog & Discrete Signals and Systems
- System-on-chip Design
- Signal fundamentals for IC/package/board design
- Linear Systems

Use Cases

Illustrative Use Cases
- Support design of electronic systems (e.g., schematic capture, simulation, layout review)
- Conduct debugging, updates, and develop diagnostics for equipment and applications (e.g., printed circuit boards, power electronics)
- Maintain electrical data and testing plans to validate performance (e.g., hands-on testing, spec validation, troubleshooting)
- Work with cross-function teams (e.g., software, mechanical, packaging, production) to define specifications for electrical / electronic systems

1. Specializations in benchmarked EE majors or curricula electives;
Source: Lightcast, company job postings, company interviews, 4-year university and graduate university course materials, MEDC analysis

Computer Engineer | Skills profile and learning modules

Computer Engineer

Foundational Skills

Standard Knowledge

Computer Engineer Foundations

Computer Engineering (Intermediate understanding)

- Data Structures
- Computer Systems
- Random Signal Theory
- CPU/GPU/FGPA Memory Controllers
- Digital System Design
- Server Architecture (e.g., processor, memory interfaces)

STEM Skills (Intermediate)

- Algebra, Calculus, Analytic Geometry & Trigonometry
- Calculus-Based & Electromagnetic Physics

Computer Science (Intermediate)

- Object-Oriented Programming Languages (e.g., C and C++)
- AI and Machine Learning
- Processing Models
- Stacks and Stacks Applications
- Computer Networks
- Software Design and Implementation

Core Competencies

Semiconductor-Focused Knowledge

Business / Manufacturing Processes

- Manufacturing Processes (e.g. lean/agile)
- Six Sigma, Red X Principles
- Functional safety

Soft Skills

- Communication Skills
- Teamwork / Collaboration
- Problem Solving
- Self-Motivation

Software and Programming

- Oracle (Agile, X86)
- C++
- Python
- AutoCAD (2D, 3D)
- Solaris
- Tensorflow
- Spark/Hadoop
- Solidworks
- Cadence/Allegro
- Linux
- Bash

Electrical Engineering

- Electromagnetics
- Signals and Systems
- Signal and Power Integrity
- Power Systems
- Linear Systems & Signals
- Power Electronics in Power Systems (e.g., analysis, design, simulation, & modeling)
- RF System Design
- Analog & Digital Integrated Circuits

Additional Computer Engineering

- Computer Networks
- Microprocessors, Microprogramming
- Computer Architecture
- System-on-Chip Embedded Systems
- Sequential Logic Design
- Software Design and Implementation
- Data Science and Information Processing

Use Cases

Illustrative Use Cases

- Build, test and modify prototypes and derivative platforms
- Test parts and troubleshoot and support and part or system failures
- Support research and development to apply machine learning into data analysis and parts
- Work with computer suppliers to handle parts failures and coordinate replacements

Source: Lightcast, company job postings, company interviews, 4-year degree course materials, MEDC analysis

Semiconductor technician | Skills profile and learning modules

Semiconductor Processing Technician

Foundational Skills
Standard Knowledge

Semiconductor Processing Technician Foundations

Electrical Knowledge (Intermediate understanding)
- Digital Electronics
- Electromechanical Devices and Systems
- Electrical distribution systems (AC, DC, RF)
- Series and Parallel Circuits
- Schematic Diagrams

STEM Basics (Basic)
- Precalculus
- Calculus
- General Physics
- General Chemistry
- Statistics

Professional Skills (Basic)
- Microsoft Systems (e.g., Office, PowerPoint)
- Technical and Professional Writing
- Professional Communication

Core Competencies
Semiconductor-Focused Knowledge

Manufacturing Knowledge
- Shop floor control systems
- Lean manufacturing, 5S and Six Sigma Processes
- Shutdown planning
- Quality Assurance & Control
- Machine Maintenance Strategy
- Root Cause Analysis
- Statistical Process Control (SPC)
- Hand and Power Tools

Business Processes
- Inventory Control
- Project Management
- Inventory Management
- Lean, Agile, Six Sigma Processes

Soft Skills
- Teamwork
- Critical thinking
- Oral & Written Communication

Software
- Microsoft Systems (e.g., Excel)
- Computer Aided Drafting
- Query Management Apps

Workplace Knowledge
- Production Safety (e.g., PPE, industrial ergonomics)
- Dexterity with Tools
- Cleanroom Standards

Semiconductor Manufacturing Knowledge
- Semiconductor Materials
- Nanofabrication Processes (e.g., Electroplating, Wet Etch Process, Photolithography)
- Vacuum and Power RF
- MEMS Packaging
- Sensors, Power Amps and Motors
- Sputter Deposition
- Metrology and Process Control

Use Cases

Illustrative Use Cases
- Perform assembly of parts in a safe manner, including of sub-assemblies and electro-mechanical parts
- Ensure quality parts are assembled by conducting inspection and following quality assurance standards
- Conduct troubleshooting
- Communicate appropriately to avoid unplanned downtime, inform other shifts of problems, trends, etc.
- Support cross functional groups on continuous improvement

Source: Lightcast, company job postings, company interviews, two-year college course materials, MEDC analysis

Maintenance & Repair | Skills profile and learning modules

Maintenance & Repair

Foundational Skills
Standard Knowledge

Maintenance & Repair Foundations

Electrical Knowledge (Intermediate understanding)
- Knowledge of instrumentation
- Control systems
- Electrical distribution systems (AC, DC, RF)
- Digital electronics
- Schematic Diagrams

STEM Basics (Basic)
- Precalculus
- General Physics
- General Chemistry
- Statistics

Professional Skills (Basic)
- Microsoft Systems (e.g., Office, PowerPoint)
- Technical and Professional Writing
- Professional Communication
- Business and manufacturing processes (e.g., agile/lean)

Core Competencies
Semiconductor-Focused Knowledge

Manufacturing Knowledge
- Manufacturing processes and logistics
- Shop floor control systems
- Lean manufacturing and 5S organizational practice
- Shutdown planning
- Quality Assurance & Control
- Machine Maintenance Strategy

Repair Processes
- Root Cause Analysis
- Query Management Applications
- Statistical Process Control
- Hand and Power Tools

Soft Skills
- Teamwork
- Critical thinking
- Oral & Written Communication

Software
- PERL Scripting Language
- UNIX
- Programming and Logic skills (e.g., C/C++)

Physical Skills
- Production Safety (e.g., PPE, industrial ergonomics)

Semiconductor Knowledge
- Micro and Nano Processing
- Semiconductor Processing
- PC Hardware
- Electromechanical Devices and Systems
- Assembly of Mechanical Systems
- Sensors, Power Amps and Motors
- Vacuum Technology

Use Cases

Illustrative Use Cases
- Maintain fabrication mechanical system and conduct trouble shooting
- Verify effectiveness of preventative maintenance and adjust long-term planning
- Develop production report of online machine status and issue to shift manager, lead, or engineer
- Provide clear status reporting to facilitate next steps in repair and recovery

Source: Lightcast, company job postings, company interviews, two-year college course materials, MEDC analysis