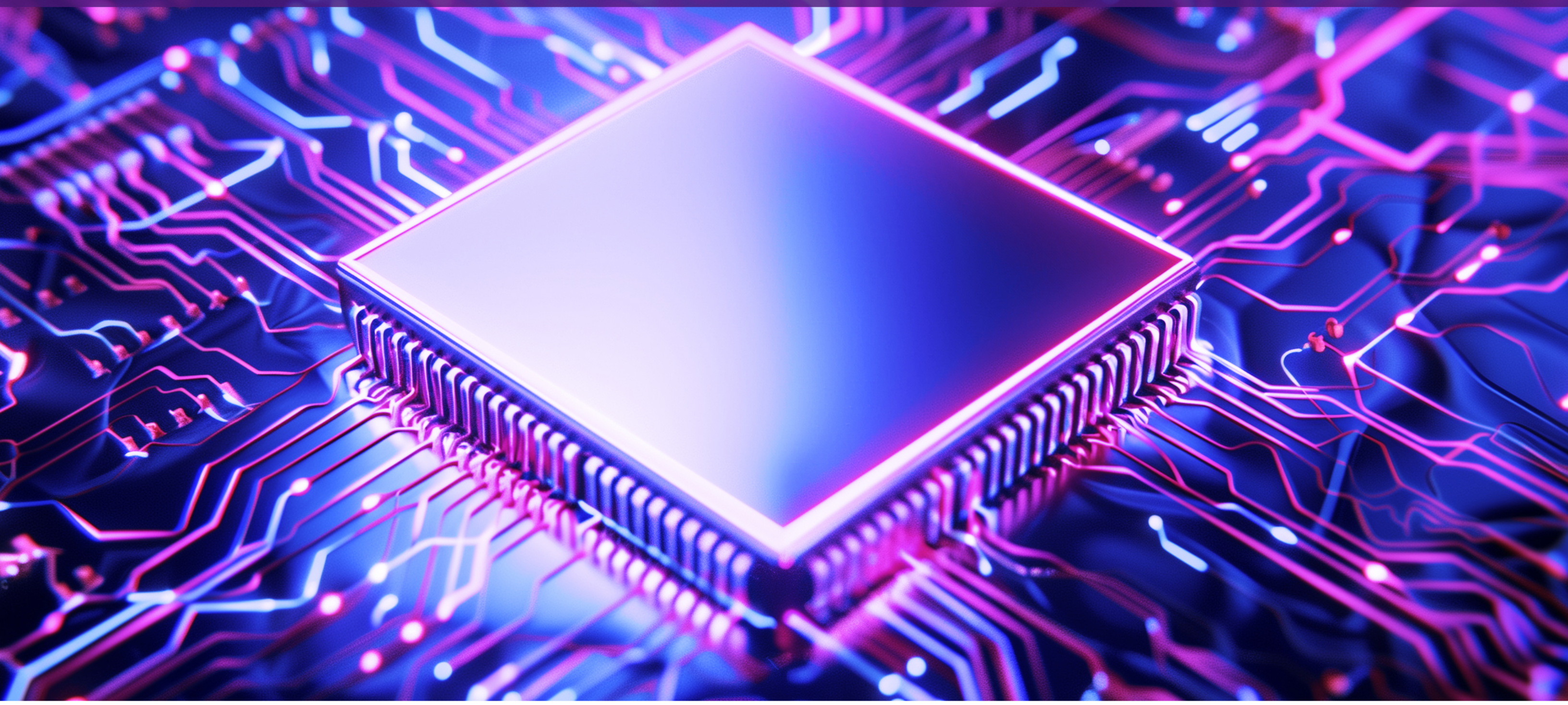
STARS

Semiconductor Technician Advanced Rapid Start



Austin Community College District

Developed in collaboration with:

ARMA — Austin Regional Manufacturers Association

Samsung Austin Semiconductor

NXP

TEL Tokyo Electron

A Note from the Participating Companies

The participating companies - Samsung Austin Semiconductor, NXP Semiconductors, Applied Materials, Infineon Technologies, and Tokyo Electron - sponsor many programs to encourage and develop promising talent. However, completion of such programs does not guarantee employment with these companies. All graduates are encouraged to apply to open positions at these companies and must go through the established hiring processes.

Contact Austin Community College

For more information on ACC's semiconductor manufacturing programs, or to connect with an ACC representative, please visit www.austincc.edu/semiconductor. The STARS Program Matrix (including an editable version) can be found at http://www.austincc.edu/stars.

About the License

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INTRODUCTION

The Semiconductor Technician Advanced Rapid Start (STARS) program was developed in 2023 through a highly collaborative process blending industry voice and instructional expertise. Austin Community College District (ACC) and the Austin Regional Manufacturers Association (ARMA) convened representatives from the five major semiconductor companies in the Central Texas region with the goal of solving a common training problem: how could companies quickly upskill incumbent workers with foundational technical knowledge to prepare them for manufacturing technician roles? ACC guided conversations on the development of a training program to meet this specific need, incorporating industry input and gaining consensus on learning outcomes and objectives. The resulting STARS program is a customized blend of theoretical and hands-on training tailored to the regional need for employee upskilling.

We have implemented STARS as an earn-and-learn opportunity. Students are employed and continue to earn their salary while attending STARS full-time. In the current design, students complete the program in four weeks and two days. Our partner companies value the knowledge, skills and abilities students gain through the program. Completers are well-prepared to step into next-level positions as opportunities become available. ACC was awarded a 2023 STEM Talent Challenge grant from the U.S. Department of Commerce's Economic Development Administration (EDA) to support STARS implementation and become an onboarding method to registered apprenticeships.

The STARS curriculum, as outlined here, was developed in collaboration with, and is currently used to train employees of, Samsung Austin Semiconductor, Applied Materials, NXP Semiconductors, Infineon Technologies, and Tokyo Electron. ACC is proud to share the STARS program matrix, and we hope it will contribute to the development of strong, industry-aligned upskilling programs in other regions.

Dr. Laura Marmolejo
Dean, Advanced Manufacturing
Austin Community College District

Program Learning Outcomes

Upon completion of this Program, students will be able to:

1. Analyze various DC and AC electrical circuits and verify calculated values through measurements
2. Distinguish between common sensors found in automation and verify correct operation and limitations
3. Examine common pneumatic circuits found in automation and set up/troubleshoot various configurations
4. Design, integrate, and create working electromechanical systems, and troubleshoot and repair electromechanical system failures
5. Explain the various IC production stages, the IC manufacturing processes, and equipment used
6. Explain vacuum systems, their applications, and common problems
7. Interpret gas panel schematic diagrams and hardware interlock schematics
8. Apply RF theory to system components and discuss common problems in the context of semiconductor equipment
9. Apply the fundamentals of statistics in the manufacturing environment

Target Audience

The ideal STARS student is one with pre-existing foundational technical knowledge. STARS is designed as a rapid upskilling program; students are presented with a significant amount of content in a short amount of time and are challenged to expand upon the knowledge and skills they bring from previous experience. **STARS is not appropriate for entry-level learners**.

Program Format

Schedule

STARS is designed to be delivered in 176 total contact hours. All coursework is completed in class; there are no outside readings or take-home assignments.

To date, we have delivered STARS only in a full-time, 8am - 5pm, schedule over the course of four weeks and two days (176 total contact hours). We have mapped out options to deliver STARS on a part-time basis and believe this type of schedule could still work well, but we have not yet tried it at ACC.

Course Modality

STARS was designed for in-person delivery. Several hands-on labs and activities are included that we do not believe would translate well - or at all - to a fully online environment. That said, we do believe a hybrid delivery format could be effective, as some elements of the curriculum are more heavily dependent on lecture and class discussion. To date, we have not yet delivered STARS in a hybrid modality.

Credit Course Articulation

STARS was designed to articulate for college credit. At ACC, completion of the STARS program articulates to the following two credit courses:

- **CETT 1403 DC Circuits**: A study of the fundamentals of direct current including Ohm's law, Kirchoff's laws and circuit analysis techniques. Emphasis on circuit analysis of resistive networks and DC measurements. Includes steady state analysis of magnetism, electromagnetism, inductance, and capacitance.
- **MFGT 1404 Automated Manufacturing**: Introduction to electrical and electronic principles utilized in automated manufacturing processes.

Required Space & Equipment

Space required: 1800-2000 sq. ft

Students supported: up to 14 at one time

	Item	Cost Per Item	Number Needed	Total
1	Power supplies	$1,000	8	$8,000
2	Function generators	$900	8	$7,200
3	O-Scopes	$800	8	$6,400
4	Pneumatic trainers	$17,000	8	$136,000
5	Universal robots	$50,000	4	$200,000
6	Hand multimeters	$100	8	$800
7	Optical sensors	$600	8	$4,800
8	Proximity sensors	$750	8	$6,000
9	Desktop meters (optional)	$1,000	8	$8,000
10	Compressors	$80	8	$640
11	AC motor trainers	$8,000	8	$64,000
12	Mechatronics trainer (8 sets)	$500,000	2	$1,000,000
Total				**$1,441,840**

Virtual Reality (VR) Labs: The VR Labs used in the STARS program are licensed from Training All People (TAP).

Course 1 Electronics

Description: This course is a study of the fundamentals of direct electrical current (DC), including Ohm's law, Kirchhoff's laws and circuit analysis techniques, as well as AC concepts such as electromagnetism, inductance, and capacitance.

Course Learning Objective: Students will be able to analyze various DC and AC electrical circuits and verify calculated values through measurements.

Estimated Time: 64 Hours

Instructional Strategy: Lecture, Demonstration, Hands-on Labs, Assessments

Topic	Learning Outcomes	Estimated Time	Activities
1. Math for Electronics	1.1 Apply basic Algebra concepts (review) 1.2 Recognize the importance of applying consistent units of measurement 1.3 Use engineering notation to express numerical values	4 HRS	Engineering Notation Activities
2. Electronics Concepts	2.1 Define electricity, resistance, voltage, and current 2.2 Distinguish between conductors, 2.3 semiconductors and insulators Describe how electrons flow in a circuit	4 HRS	Pre- and Post-test Activities
3. Electronic Equipment	3.1 Identify and describe power supplies, multimeters, and other electronics equipment 3.2 Use a multimeter to measure AC and DC voltage	4 HRS	Digital Multimeter Lab
4. Resistors: Fixed and Variable	4.1 Distinguish between fixed and variable resistors 4.2 Determine standard resistor values from color coding	4 HRS	Resistance Measurement Lab
5. Ohm’s Law and Electronic Power – Watts Law	5.1 State and apply Ohm’s Law to a variety of electrical circuits	8 HRS	Graphing Ohm’s Law Lab

	5.2 Interpret and analyze a live circuit using Ohm's Law 5.3 Represent Ohm's Law in graphical form 5.4 State and apply Watt's Law of electrical power 5.5 Explain the concept of "work" being applied in a circuit		Electrical Power Lab
6. Series Circuits, Parallel Circuits, Series-Parallel, and Bridge Circuits	6.1 Distinguish between series, parallel, series-parallel (combination), and bridge circuits 6.2 Describe how Ohm's Law applies to each type of circuit 6.3 State and apply Kirchhoff's Voltage Law (KVL) 6.4 Recognize single- and double-subscript notations for voltage levels of a network 6.5 State and apply Kirchhoff's Current Law (KCL)	12 HRS	Series Circuits Lab Kirchhoff's Voltage Law Lab Parallel Resistance Lab Series-Parallel Resistance Lab Bridge Circuit Lab
7. Switches and Control Devices (in Part 2)	7.1 Identify types of switches and their states 7.2 Describe how switches can be applied as control devices	4 HRS	Switches Application Lab
8. Semiconductors	8.1 Explain the purpose and operation of diodes and Light Emitting Diode 8.2 Explain the Operation of BJT/FET Transistor 8.3 Explain the difference between Sourcing and Sinking 8.4 Explain the difference between Open and Closed loop systems and their applications.	4 HRS	Diode Measurement Lab Light Emitting Diode (LED) Lab (Part 1) Temperature Control Lab Semi-Tool DC Power Supply Troubleshooting VR lab

9. AC Circuits	9.1 Describe the characteristics of alternating current (AC) and direct current (DC) 9.2 Use a function generator to apply an AC signal and an oscilloscope to display the signal 9.3 Explain the role of capacitors and inductors in AC Circuits	8 HRS	AC Signals and Measurement Lab Light Emitting Diode (LED) Lab (Part 2) Half Wave Rectifier Lab
10. Electromechanical Relay	10. 1 Explain the development of electromechanical relays 10. 2 Explain how relays are used to control power	5 HRS	Electromechanical Relay Lab
11. Transformers	11.1 Explain the transformers work and how they are applied 11.2 Describe and analyze the difference between single phase vs. three phase power	3 HRS	Transformer Lab
12. AC Protection Devices	12.1 Explain the difference between fuses, circuit breakers, thermal overload and GFCI protections devices	4 HRS	

Course 2 Sensors

Description: This course introduces the sensors that are commonly found in Industrial settings and reviews the advantages and disadvantages of different sensor types, solid states, and activation methods. Students practice making schematics and wire diagrams.

Course Learning Objective: Students will be able to distinguish between common sensors found in automation and verify correct operation and limitations.

Estimated Time: 8 Hours

Instructional Strategy: Lecture, Demonstration, Hands-on Labs, Activities

Topic	Learning Outcomes	Estimated Time	Activities
1. Multimeter	1.1 Describe types of sensors found in manufacturing 1.2 Identify multimeter settings needed when working with sensors	1 HR	Light and Audio Level Lab
2. Mechanical Switches	2.1 Identify various mechanically operated switching devices 2.2 Describe the difference between Normally Open push button and Normally Closed push button 2.3 Explain the operation of a magnetic reed switch and its applications	1HR	Reed Switch Lab
3. Transistor Theory	3.1 Explain the difference between PNP and NPN 3.2 Describe the difference between sourcing and sinking	1.5 HRS	
4. Solid State Sensors - Photoelectric Sensors	4.1 Identify wire color codes used in both US and in Europe 4.2 Differentiate between light-operated (LO) and dark-operated (DO) mode 4.3 Differentiate between the various types of photo sensors 4.4 Use a multimeter to troubleshoot sensor operation	2.5 HRS	Diffuse Sensor Lab Retro-Reflective Sensor Lab Through Beam Sensor Lab Challenge Lab – Fiber Optic Sensor

5. Solid State Sensors - Proximity Sensors	5.1 Explain the purpose of an inductive proximity sensor 5.2 Differentiate between shielded and unshielded inductive proximity sensors 5.3 Explain the purpose of a capacitive proximity sensor 5.4 Differentiate between guarded and unguarded capacitive proximity sensors	1 HR	Inductive Proximity Sensor (unshielded) Lab Inductive Proximity Sensor (shielded) Lab Capacitive Proximity Sensor (unguarded) Lab Capacitive Proximity Sensor (guarded) Lab
6. Schematics in Industrial Settings	6.1 Identify your power source wires in a schematic 6.2 Identify schematic symbols for the sensors	1 HR	Schematic Drawing Activities

Course 3 Pneumatics

Description: This course is designed to teach the fundamentals of pneumatics and its application to semiconductor manufacturing. The course introduces fundamental theory which is then practiced and verified through the use on hands-on labs.

Course Learning Objective: Students will be able to examine common pneumatic circuits found in automation and set up/troubleshoot various configurations.

Estimated Time: 16 Hours

Instructional Strategy: Lecture, Demonstration, Hands-on Labs, Activities

Topic	Learning Outcomes	Estimated Time	Activities
1. Safety, Basic Physical Laws, Basic Schematic Symbols	1.1 Describe how pneumatics is used in manufacturing 1.2 Identify safety considerations when working with pneumatic systems 1.3 Describe the basic physical laws and explain what each means 1.4 Identify pneumatic symbols in a schematic	2 HRS	Pneumatic Cylinder Problems Single- and Double-acting Cylinder Drawing Exercises
2. Understanding Control Valves Cylinders Pilot Control	2.1 Describe the purpose of control valves in a pneumatic system 2.2 Identify directional control valves in a schematic 2.3 Describe the types of cylinders used in manufacturing and the recommended valves used with each 2.4 Describe the types of pilot actuated valves used in manufacturing	2.5 HRS	Single Acting Cylinder Lab Dual Acting Cylinder Lab Single Pilot Actuated Lab Double Pilot Actuated Lab
3. Electrical Schematics	3.1 Describe the purpose of electrical diagrams used in pneumatic systems 3.2 Identify electrical schematic symbols	1 HR	Electrical Schematic Lab
4. Solenoid Valve Operation	4.1 Describe the purpose and characteristics of a solenoid valve 4.2 Differentiate between directly-actuated valves and indirectly-actuated valves	2 HR	Solenoid Valves Lab

5. Memory Control Emergency Stops Controlling Speed	5.1 Differentiate between memory and momentary control operations 5.2 Identify the various emergency stop responses in pneumatic systems 5.3 Explain how cylinder speed can be controlled in pneumatic systems 5.4 Explain how a one-way flow control valve works	2 HR	Memory Control Circuit Lab Emergency Stop Lab Speed Control Lab
6. Quick Exhaust Valve Pressure Regulation	6.1 Explain the principles of quick exhaust valves and their application 6.2 Analyze the differences between relieving and non-relieving pressure regulators 6.3 Determine the appropriate type of pressure regulator for regulating specific gasses	2 HR	Quick Exhaust Valve Lab Pressure Regulation Lab
7. Control System Basics Troubleshooting	7.1 Describe the basics of a control system 7.2 Analyze failure modes of various pneumatic components and apply established troubleshooting methods 7.3 Explain the principles of pressure sensors and their application	2 HR	Troubleshooting Lab SDE-1 Pressure Sensor Activities
8. OR and AND Logic Automatic Return Timers	8.1 Describe OR circuits using both "T" connectors and shuttle valves 8.2 Describe AND circuits using both series-connected directional control valves and AND gates 8.3 Explain how limit switches automate sequential movements in pneumatic systems 8.4 Describe pneumatic timer circuits and their function	2.5 HR	OR Logic Lab AND Logic Lab Automatic Return and AND Extend Lab Pneumatic Lab Timer

Course 4 Mechatronics

Description: This course is a study of electromechanical systems found in typical manufacturing environments. Pneumatics, electric motors, valves, sensors, cylinders, PLCs, and other industrial devices are all reviewed.

Course Learning Objective: Students will be able to design, integrate, and create working electromechanical systems, and troubleshoot and repair electromechanical system failures.

Estimated Time: 48 Hours

Instructional Strategy: Lecture, Demonstration, Hands-on Labs, Activities

Topic	Learning Outcomes	Estimated Time	Activities
1. Safety Requirements Definition of an Electromechanical System Electromechanical Subsystems	1.1 Identify potential hazards associated with electromechanical systems and describe appropriate safety measures 1.2 Describe the concept of electromechanical systems 1.3 Identify key subsystems and explain their function in automation 1.4 Identify examples of electromechanical systems, from simple applications to those used in the semiconductor industry	8 HR	Safety checklist, SOP and Operation Labs on: Jogging an Actuator Overriding an Electro-Pneumatic Valve Adjusting Pneumatic Actuator Stroke and Speed Overriding a Motor
2. Logic Circuits Industrial Control Systems	2.1 Identify elements of an industrial control system 2.2 Describe how industrial control systems monitor and control electromechanical processes 2.3 Analyze basic logic gates (AND, OR, NOT) 2.4 Demonstrate how logic circuits are used in mechatronics applications	16 HR	Component Adjustment, Alignment, and/or Troubleshooting Labs on: Adjusting a Limit Switch Adjusting a Sensor

			Adjusting a Vacuum Gripper and Switch
3. Mechatronics System Troubleshooting	3.1 Identify elements needed for a mechatronics system to meet specified performance criteria 3.2 Apply systematic troubleshooting methodologies, to identify and rectify malfunctions in mechatronics systems	24 HR	Review Various PLC Ladder Logic Diagrams During Operation

Course 5 Basic IC Manufacturing

Description: This course introduces students to the semiconductor manufacturing process by reviewing the steps required to create a planar MOSFET device, including technical details on major unit process steps used in a semiconductor fabrication facility. Topics include the equipment used to support each process step.

Course Learning Objective: Students will be able to explain the various IC production stages, the IC manufacturing processes, and equipment used.

Estimated Time: 8 Hours

Instructional Strategy: Lecture

Topic	Learning Outcomes	Estimated Time	Activities
1. Basic IC Technologies Device Operation	1.1 Distinguish the different segments of an integrated circuit (IC) and review the operational process steps. 1.2 Explain the MOSFET semiconductor devices and its operation.	1 HR	
2. Semiconductor Materials IC Process Flow	1.1 Identify the chemicals used in IC fabrication 1.2 Explain each process step used to fabricate an integrated circuit.	3 HR	
3. Process Steps and Equipment Tool in Fabrication	1.1 Describe each unit process used in IC fabrication	4 HR	

Course 6 Vacuum Systems & Principles

Description: This course reviews the basics of vacuum technology as it applies to semiconductor manufacturing equipment, including the details of vacuum measurement devices and basic troubleshooting techniques.

Course Learning Objective: Students will be able to explain vacuum systems, their applications, and common problems.

Estimated Time: 8 Hours

Instructional Strategy: Lecture, Demonstration, Hands-on Labs, Activities

Topic	Learning Outcomes	Estimated Time	Activities
1. Vacuum System Principles	1.1 Explain the fundamental principles of vacuum systems, including the concept of pressure, gas behavior at low pressures 1.2 Explain the significance of vacuum levels	2 HR	View videos illustrating the flow paths in a vacuum system (laminal, turbulent)
2. Vacuum Components & Pumps	2.1 Recognize different components and types of pumps used in vacuum systems 2.2 Describe the functions and operational principles of various types of pumps used in vacuum	3 HR	View pictorial and video examples of various vacuum components
3. Vacuum Measurement	3.1 Recognize appropriate vacuum instruments used to assess vacuum levels in different systems 3.2 Detect and diagnose leaks in vacuum systems and apply troubleshooting strategies	3 HR	Leak Detection & Troubleshooting VR lab

Course 7 Gas Delivery Systems

Description: This course reviews the components found in a gas delivery system, with a focus on gas panels used in the semiconductor industry. Students will discuss common problems and learn to interpret schematics.

Course Learning Objective: Students will be able to interpret gas panel schematic diagrams and hardware interlock schematics.

Estimated Time: 8 Hours

Instructional Strategy: Lecture, Demonstration, Activities

Topic	Learning Outcomes	Estimated Time	Activities
1. Gas System Overview	1.1 Describe the purpose and function of key components in gas delivery systems 1.2 Explain the flow of gasses from sources to end-users 1.3 Identify safety measures associated with gas handling	2 HR	
2. Gas Delivery Components	2.1 Recognize different components used in gas delivery systems 2.2 Explain the roles, functions, and interconnections of these components	2 HR	View videos on different components used in gas delivery systems
3. Gas Panel Configurations	3.1 Analyze and interpret gas panel configurations commonly used in semiconductor manufacturing	2 HR	
4. Gas System Analysis and Troubleshooting	4.1 Apply systematic approaches to analyze gas system performance 4.2 Identify potential faults and techniques for troubleshooting	2 HR	Troubleshooting Activity

Course 8 RF/Plasma Systems

Description: This course reviews RF and plasma systems and their applications in semiconductor manufacturing. Common problems with RF and plasma systems are discussed.

Course Learning Objective: Students will be able to apply RF theory to system components and discuss common problems in the context of semiconductor equipment.

Estimated Time: 8 Hours

Instructional Strategy: Lecture, Demonstration, Activities

Topic	Learning Outcomes	Estimated Time	Activities
1. RF System Hardware and Plasma Process Overview	1.1 Describe basic RF systems and their operation	2 HR	Trace the signal path through an RF generator schematic
2. RF Systems Transmission Line and Grounding	2.1 Analyze the characteristics of transmission lines and grounding system in RF applications	2 HR	
3. Matching Networks	3.1 Describe different types of matching networks and their function 3.2 Explain how matching networks compensate impedance matching between RF sources, transmission lines, and plasma loads	2 HR	
4. RF Plasma Processes and System Troubleshooting	4.1 Examine the physical behavior of RF-induced plasmas. 4.2 Apply systematic troubleshooting methods to diagnose and rectify problems in RF systems.	2 HR	

Course 9 Statistics

Description: This course introduces students to basic statistical analysis concepts, quality improvement tools, and their applications to manufacturing.

Course Learning Objective: Students will be able to apply the fundamentals of statistics in the manufacturing environment.

Estimated Time: 8 Hours

Instructional Strategy: Lecture, Demonstration, Hands-on Labs

Topic	Learning Outcomes	Estimated Time	Activities
1. Statistics in Manufacturing	1.1 Explain how statistics is used in manufacturing and other common applications 1.2 Define the cost of poor quality and its impact on manufacturing 1.3 Explain data types and data collection guidelines 1.4 Describe data distributions and their applications	3 HR	Measures of Central Tendency Exercise Data Distribution Exercise Flow Chart Exercise Cause and Effect Exercise
2. Understanding Control Charts	2.1 Explain how control charts are used to monitor manufacturing processes 2.2 Define common control charts used in manufacturing 2.3 Interpret key patterns that signals process changes 2.4 Explain process capability	3 HR	Process Measurement Exercise Control Chart Pattern-recognition Exercise Process Capability Exercises
3. Intro to Six Sigma	3.1 Describe the principles of Lean and Six Sigma 3.2 Define the 5 main stages of the DMAIC process 3.3 Explain other quality improvement tools used in manufacturing	2 HR	

