**Course Description**

This course is a broad introduction to semiconductor and integrated circuit manufacturing from a technician and maintenance perspective. In lecture, students will learn about what a cleanroom is, why it's important to gown up, and have a broad non-quantitative introduction to semiconductor processing. In lab students will use hand-tools to perform inspection, maintenance and repair of mechanical fasteners and fixtures associated with semiconductor equipment, and gown up to simulate working in a bunny suit.

**Strand 1. Business Operations/21st Century Skills**

Learners apply principles of economics, business management, marketing and employability in an entrepreneur, manager and employee role to the leadership, planning, developing and analyzing of business enterprises related to the career field.

**Outcome 1.1. Employability Skills:** Develop career awareness and employability skills (e.g., face-to-face, online) needed for gaining and maintaining employment in diverse business settings.

**Competencies**

1.1.1. Identify the knowledge, skills, and abilities necessary to succeed in careers.

1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience.

1.1.3. Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options.

1.1.4. Describe the role and function of professional organizations, industry associations, and organized labor and use networking techniques to develop and maintain professional relationships.

1.1.5. Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, résumé writing, interviewing skills, portfolio development).

1.1.6. Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles.

1.1.7. Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.

1.1.8. Identify the correlation between emotions, behavior, and appearance and manage those to establish and maintain professionalism.

1.1.9. Give and receive constructive feedback to improve work habits.

1.1.10. Adapt personal coping skills to adjust to taxing workplace demands.

1.1.11. Recognize different cultural beliefs and practices in the workplace and demonstrate respect for them.

1.1.12. Identify healthy lifestyles that reduce the risk of chronic disease, unsafe habits, and abusive behavior.

**Outcome 1.3. Business Ethics and Law:** Analyze how professional, ethical, and legal behavior contributes to continuous improvement in organizational performance and regulatory compliance.

**Competencies**

1.3.1. Analyze how regulatory compliance affects business operations and organizational performance.

1.3.2. Follow protocols and practices necessary to maintain a clean, safe, and healthy work environment.

1.3.3. Use ethical character traits consistent with workplace standards (e.g., honesty, personal integrity, compassion, justice).

1.3.4. Identify how federal and state consumer protection laws affect products and services.

1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], U.S. Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.

1.3.6. Identify deceptive practices (e.g., bait and switch, identity theft, unlawful door-to-door sales, deceptive service estimates, fraudulent misrepresentations) and their overall impact on organizational performance.

1.3.7. Identify the labor laws that affect employment and the consequences of noncompliance for both employee and employer (e.g., harassment, labor, employment, employment interview, testing, minor labor laws, Americans with Disabilities Act, Fair Labor Standards Acts, Equal Employment Opportunity Commission [EEOC]).

1.3.8. Verify compliance with computer, copyright, and intellectual property laws and regulations.

1.3.9. Identify potential conflicts of interest (e.g., personal gain, project bidding) between personal, organizational, and professional ethical standards.

**Outcome 1.4. Knowledge Management and Information Technology:** Demonstrate current and emerging strategies and technologies used to collect, analyze, record, and share information in business operations.

**Competencies**

1.4.1. Use office equipment to communicate (e.g., phone, radio equipment, fax machine, scanner, public address systems).

1.4.2. Select and use software applications to locate, record, analyze, and present information (e.g., word processing, electronic mail, spreadsheet, databases, presentation, Internet search engines).

1.4.3. Verify compliance with security rules, regulations, and codes (e.g., property, privacy, access, accuracy issues, client and patient record confidentiality) pertaining to technology specific to industry pathway.

1.4.4. Use system hardware to support software applications.

1.4.5. Use information technology tools to maintain, secure, and monitor business records.

1.4.6. Use electronic databases to access and create business and technical information.

1.4.7. Use personal information management and productivity applications to optimize assigned tasks (e.g., lists, calendars, address books).

1.4.8. Use electronic media to communicate and follow network etiquette guidelines.

**Outcome 1.5. Global Environment:** Evaluate how beliefs, values, attitudes, and behaviors influence organizational strategies and goals.

**Competencies**

1.5.1. Describe how cultural understanding, cultural intelligence skills, and continual awareness are interdependent.

1.5.2. Describe how cultural intelligence skills influence the overall success and survival of an organization.

1.5.3. Use cultural intelligence to interact with individuals from diverse cultural settings.

1.5.4. Recognize barriers in cross-cultural relationships and implement behavioral adjustments.

1.5.5. Recognize the ways in which bias and discrimination may influence productivity and profitability.

1.5.6. Analyze work tasks for understanding and interpretation from a different cultural perspective.

1.5.7. Use intercultural communication skills to exchange ideas and create meaning.

1.5.8. Identify how multicultural teaming and globalization can foster development of new and improved products and services and recognition of new opportunities.

**Strand 2 Electrical/Electronics**

Learners apply principles of electricity and electronics related to electronic theory, alternating and direct current, electronic components, electronic skills, digital electronics and power supplies. Knowledge and skills may be applied to fundamentals of electricity, analyzing and evaluating circuits, assembling components into electrical circuits, creating circuits to perform tasks and operations, wiring components to construct a communications system and providing power to an electrical system.

**Outcome 2.1 Electrical and Electronic Theory:** Explain electrical and electronic principles and theory.

**Competencies**

2.1.1 Describe the structure of atoms and their relationship to electricity.

**Outcome 2.10 Semiconductors**

**Competencies**

2.10.1 Describe a semiconductor product, such as a silicon wafer, and its relevance to other products/technologies.

2.10.2 Explain the history of integrated circuit technology with a focus on function, size, power usage, and application.

2.10.3 Describe cleanroom requirements, purpose and maintenance.

2.10.4 Describe semiconductor processing, tools and chemistry.

2.10.5 Describe how a wafer is made.

2.10.6 Describe the processes performed at a semiconductor fabrication facility used in the manufacturing of integrated circuits (IC).

2.10.7 Describe the thin film sputtering process.

2.10.8 Describe photolithography processing and purpose of the “photoresist.”

2.10.9 Describe basic processes and toolsinvolved in semiconductor manufacturing wet etching.

2.10.10 Describe basic processes and tools involved in semiconductor manufacturing dry etching.

2.10.11 Describe basic processes and toolsinvolved in semiconductor manufacturing diffusion.

2.10.12 Describe basic processes and tools involved in semiconductor manufacturing thin film disposition (PVD, CVD).

2.10.13 Describe how cleaning, thin film deposition, etching, and photolithography are used to create multiple layers that constitute the fabrication of an integrated circuit (IC).

2.10.14. Describe basic processes and tools in Chemical Mechanical Planarization (CMP).

2.10.15 Describe the final steps in a wafer IC production process.

**Strand 6 Precision and Advanced Machining**

Learners apply principles of precision machining to measuring work pieces, drawing interpretation, inspection, bench work and layout, power saws, drilling machines, lathes and turning machines, milling machines and grinding machines.

**Outcome 6.11 Quality:** Apply quality processes.

**Competencies**

6.11.1 Describe quality control systems and their benefits (e.g., Statistical Process Control (SPC), Six Sigma, Total Quality Management (TQM), Lean Management, “Plan‐Do‐Check‐Act” and International Organization of Standardization standards, especially ISO 9001 for manufacturers).

6.11.6 Explain the basic principles and purpose of Quality Control and Quality Systems

6.11.7 Describe the seven basic tools of quality control.

6.11.8 Describe data set characteristics.

6.11.9 Describe types of variation and control charts.

6.11.10 Interpret a variety of charts and diagrams used in Statistical Process Control (SPC).

6.11.11 Assess the stability of a process using statistical methods.

6.11.12 Interpret SPC charts to identify assignable causes and corrective actions.

**Strand 7 Precision and Advanced Machining**

Learners apply principles of protection, prevention and mitigation to create and maintain safe working conditions at manufacturing sites. Knowledge and skills may be applied in all aspects of personal and site safety, including handling materials, using tools and equipment, working with and around electricity and using personal protective equipment.

**Outcome 7.1 Site Safety:** Handle materials, prevent accidents and mitigate hazards.

**Competencies**

7.1.7 Identify and eliminate worksite clutter in accordance with standards for cleanliness and safety.

7.1.8 Identify procedures for the handling, storage and disposal of hazardous materials.

7.1.14 Describe the interactions of incompatible substances when measuring and mixing chemicals.

**Outcome 7.2 Personal Safety:** Practice personal safety.

**Competencies**

7.2.3 Select, use, store, maintain and dispose of personal protective equipment (PPE) appropriate to job tasks, conditions and materials.

7.2.5 Identify, inspect and use safety equipment appropriate for a task.

**Outcome 7.3 Industrial Maintenance Safety:** Plan, develop and ensure industrial maintenance safety.

**Competencies**

7.3.1 Safely operate machinery and equipment.

7.3.6 Identify tools and equipment requiring safety certification.

7.3.8 Monitor equipment for unsafe conditions.

7.3.10 Deliver set‐up and operational procedures.

7.3.11 Demonstrate cleanroom gowning (Lab) using Standard Operating Procedures (SOP).

**Outcome 7.4 Industrial Maintenance Installation and Repair:** Inspect, maintain and repair industrial equipment.

**Competencies**

7.4.1 Identify installation techniques using manuals, checklists, and regulations.

**Strand 9 Fundamentals of Applied Physics**

**Outcome 9.1 Physics of Engineering:** Learn the fundamentals of physics as it relates to engineering.

**Competencies**

9.1.1 Display and interpret numbers in scientific notation and logarithmic scales

9.1.2 Describe and convert SI and US system units of measurement.

9.1.3 Identify and use both metric and inch rules.

9.1.4 Express physical quantities with appropriate number of significant digits, units and dimensions.

9.1.5 Perform operations on whole numbers, fractions and mixed numbers.

9.1.6 Analyze measurements and perform technical calculations.

9.1.11 Describe and justify the importance of dimensional measurement.

9.1.12 Identify/differentiate engineering drawings.

9.1.13 Interpret basic schematics or diagrams, including a parts list.

9.1.14 Use facility drawings to locate equipment.