

INTRODUCTION/INTERMEDIATE MANUFACTURING TECHNOLOGY

Activity/Course Code: 6045

COURSE DESCRIPTION: Introduction/Intermediate Manufacturing Technology is an entry-level to mid-level course that provides students an introduction/intermediate path to manufacturing industries and may be used as a prerequisite for any of the manufacturing career majors: Electronics Technology, Machine Technology, Mechatronics Integrated Technologies, Metal Fabrication, and Welding. All standards come from the [Manufacturing Skill Standards Council's \(MSSC\)](#) "worker" standards four critical work functions of production:

1. Safety
2. Quality Practices and Measurement
3. Manufacturing Processes and Production
4. Maintenance Awareness

Completion of Worker standards 1 and 2 provides the student with the basic knowledge and skills required by an entry level production technician to perform the work.

Completion of Worker standards 1-4 provides the student with the basic knowledge and skills required by an mid- level production technician to perform the work

OBJECTIVE: Given the necessary equipment, materials, and instruction, the student, on completion of the prescribed course of study, will be able to successfully accomplish the following standards.

RECOMMENDED GRADE LEVEL: 9 - 12

COMPUTER ACCESSS REQUIRED: 1:1

PREREQUISITE: N/A

RECOMMENDED MAXIMUM ENROLLMENT: 24

RESOURCES: [Instructional Materials](#)

CREDIT: 1 unit (120-180 hours)

A. SAFETY

Proficient professionals know the academic subject matter, including safety as required for proficiency within their area. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in any program of study.

1. Review school safety policies and procedures.
2. Review classroom safety rules and procedures.
3. Review safety procedures for using equipment in the classroom.
4. Identify major causes of work-related accidents in office environments.
5. Demonstrate safety skills in an office/work environment.

B. STUDENT ORGANIZATIONS

Proficient professionals know the academic subject matter, including professional development, required for proficiency within their area. They will use this knowledge as needed in their role. The following accountability criteria are considered essential for students in any program of study.

1. Identify the purpose and goals of a Career and Technology Student Organization (CTSO).
2. Explain how CTSOs are integral parts of specific clusters, majors, and/or courses.
3. Explain the benefits and responsibilities of being a member of a CTSO.
4. List leadership opportunities that are available to students through participation in CTSO conferences, competitions, community service, philanthropy, and other activities.
5. Explain how participation in CTSOs can promote lifelong benefits in other professional and civic organizations.

C. TECHNOLOGY KNOWLEDGE

Proficient professionals know the academic subject matter, including the ethical use of technology as needed in their role. The following accountability criteria are considered essential for students in any program of study.

1. Demonstrate proficiency and skills associated with the use of technologies that are common to a specific occupation.
2. Identify proper netiquette when using e-mail, social media, and other technologies for communication purposes.
3. Identify potential abuse and unethical uses of laptops, tablets, computers, and/or networks.
4. Explain the consequences of social, illegal, and unethical uses of technology (e.g., piracy; illegal downloading; cyberbullying; licensing infringement; inappropriate uses of software, hardware, and mobile devices in the work environment).
5. Discuss legal issues and the terms of use related to copyright laws, fair use laws, and ethics pertaining to downloading of images, Creative Commons, photographs, documents, video, sounds, music, trademarks, and other elements for personal use.
6. Describe ethical and legal practices of safeguarding the confidentiality of business-related information.
7. Describe possible threats to a laptop, tablet, computer, and/or network and methods of avoiding attacks.

D. PERSONAL QUALITIES AND EMPLOYABILITY SKILLS

Proficient professionals know the academic subject matter, including positive work practices and interpersonal skills, as needed in their role. The following accountability criteria are considered essential for students in any program of study.

1. Demonstrate creativity and innovation.
2. Demonstrate critical thinking and problem-solving skills.
3. Demonstrate initiative and self-direction.
4. Demonstrate integrity.
5. Demonstrate work ethic.
6. Demonstrate conflict resolution skills.
7. Demonstrate listening and speaking skills.
8. Demonstrate respect for diversity.
9. Demonstrate customer service orientation.
10. Demonstrate teamwork.

E. PROFESSIONAL KNOWLEDGE

Proficient professionals know the academic subject matter, including positive work practices and interpersonal skills, as needed in their role. The following accountability criteria are considered essential for students in any program of study.

1. Demonstrate global or “big picture” thinking.
2. Demonstrate career and life management skills and goal-making.
3. Demonstrate continuous learning and adaptability skills to changing job requirements.
4. Demonstrate time and resource management skills.
5. Demonstrates information literacy skills.
6. Demonstrates information security skills.
7. Demonstrates information technology skills.
8. Demonstrates knowledge and use of job-specific tools and technologies.
9. Demonstrate job-specific mathematics skills.
10. Demonstrates professionalism in the workplace.
11. Demonstrates reading and writing skills.
12. Demonstrates workplace safety.

BASIC TECHNICAL KNOWLEDGE AND SKILLS SAFETY

F. CAREERS IN MANUFACTURING

Proficient manufacturing technicians demonstrate appropriate job seeking skills required for career success. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Describe job opportunities in the area of manufacturing.

2. Describe careers in other areas that support the manufacturing process.
3. Identify manufacturing industries in the local area and job opportunities in these industries.
4. Complete a job application form for a manufacturing position.

G. SAFE AND PRODUCTIVE WORKPLACE

Proficient manufacturing technicians demonstrate basic knowledge of manufacturing as required as by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Discuss ways in which manufacturing affects the national economy and standard of living.
2. Describe knowledge of ways in which the global economy affects manufacturers.
3. Discuss common safety practices and systems.
4. Discuss responsibilities of a frontline production worker in a high-performance, safety-conscious work organization.

H. SAFETY PROCEDURES

Proficient manufacturing technicians demonstrate basic safety knowledge and skills as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Locate and use Material Safety Data Sheets (MSDS).
2. Demonstrate knowledge of first aid or first response procedures.
3. Demonstrate knowledge of material handling techniques required to move materials safely.
4. Discuss how to be proactive in responding to a safety concern and how to document occurrences.
5. Discuss emergency exits.
6. Discuss various emergency alarms and procedures.
7. Use clean-up procedures for spills.
8. Describe Lock Out/Tag Out requirements.
9. Inspect work area and report possible safety risks.
10. Demonstrate knowledge of machinery and equipment safety functions to determine whether or not all safeguards are operational.
11. Describe safety procedures to follow in cases of smoke/chemical inhalation.
12. Describe procedures for handling hazardous material.
13. Develop safety checklists.
14. Demonstrate knowledge of equipment shutdown procedures.

I. PERSONAL SAFETY PRACTICES

Proficient manufacturing technicians demonstrate basic personal safety knowledge and skills as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Identify and report unsafe conditions.
2. Select and use personal protective equipment.
3. Demonstrate knowledge of ergonomic impact of work techniques.
4. Demonstrate knowledge of proper and improper techniques for lifting loads.
5. Demonstrate knowledge of safety requirements for platforms, man lifts, and ladders.
6. Demonstrate knowledge of safety requirements for material handling equipment such as forklifts, cranes, rigging, and pry trucks.
7. Demonstrate knowledge of safety requirements for manual, electrical-powered, and pneumatic tools.
8. Demonstrate knowledge of safety requirements for operation of automated machines/automated processes.

J. SAFETY POLICIES AND REGULATIONS

Proficient manufacturing technicians demonstrate knowledge of safety policies and regulations as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Demonstrate knowledge of Occupational Safety and Health Administration (OSHA) and other health and safety requirements as applied to the workplace.
2. Demonstrate knowledge of government policies, procedures, and regulations governing the safe use of equipment.
3. Demonstrate knowledge of Hazardous Materials (HAZMAT) procedures information.
4. Demonstrate knowledge of Material Safety Data Sheets (MSDS).
5. Demonstrate knowledge of applicable safety standards.
6. Demonstrate knowledge of which tools and equipment require safety certification.
7. Demonstrate knowledge of what the law requires companies to post or publish in order to keep employees abreast of OSHA and other government regulations.
8. Demonstrate knowledge of Environmental Protection Agency (EPA)-required documentation for (a) disposal of hazardous waste generated during maintenance or (b) transportation of contaminated items.
9. Demonstrate knowledge of accident documentation procedures.

K. SAFETY TRAINING

Proficient manufacturing technicians have knowledge of basic safety training as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Demonstrate knowledge of certifications needed for regulatory compliance, (e.g., Cardio

Pulmonary Resuscitation [CPR], fire extinguisher, blood-borne pathogens).

L. COMMUNICATION SKILLS THAT ENHANCE SAFETY

Proficient manufacturing technicians demonstrate effective communications skills that enhance safety as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Demonstrate knowledge of ways to improve reading, listening, and writing skills.
2. Demonstrate knowledge of techniques for making effective presentations to internal and external customers, including safety orientations.
3. Demonstrate skill in using different forms of communication, such as e-mail, fax, and phone.
4. Demonstrate skill in providing effective feedback and in making decisions.
5. Demonstrate skill in communicating customer needs effectively to others including shift-to-shift, coworkers, and managers, including needs that impact safety.

M. TEAMWORK SKILLS THAT ENHANCE SAFETY

Proficient manufacturing technicians demonstrate teamwork skills that enhance safety as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Demonstrate knowledge of the characteristics of a high-performance team.
2. Demonstrate knowledge of roles and responsibilities of production team members.
3. Demonstrate skill in using teamwork to deal with customer requests.
4. Demonstrate knowledge of ways to align team goals to customer and business production needs.
5. Demonstrate skill in ensuring that team goals are specific, documented, measurable, and achievable.
6. Demonstrate skill in communicating production information to team members.
7. Demonstrate skill in using team problem solving and conflict resolution processes.

BASIC TECHNICAL KNOWLEDGE AND SKILLS QUALITY PRACTICES AND MEASUREMENT

N. OVERALL QUALITY PROCESS

Proficient manufacturing technicians demonstrate knowledge of the overall quality process as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Demonstrate knowledge of quality standards and how they apply to products in order to make effective decisions about quality problems.
2. Demonstrate knowledge of quality procedures and product specifications to identify

- nonconformance.
3. Demonstrate skill in identifying product defects and defect patterns.
 4. Demonstrate knowledge of how to check and test good products and nonconforming products.
 5. Demonstrate knowledge of quality terminology.
 6. Demonstrate knowledge of quality assurance procedures.

O. QUALITY SYSTEMS AND INSPECTION TOOLS

Proficient manufacturing technicians demonstrate knowledge of overall quality systems and tools as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Demonstrate knowledge of quality systems such as Statistical Process Control (SPC), Six Sigma, Total Quality Management (TQM), Lean Management, “Plan-Do-Check-Act,” and International Standards Organization standards, especially ISO 9001:2000 for manufacturers.
2. Demonstrate skill in determining accuracy and precision when using measuring equipment.
3. Demonstrate knowledge of how to use inspection tools, equipment, and procedures.
4. Demonstrate knowledge of inspection equipment calibration standards and requirements.
5. Demonstrate skill in verifying calibration of inspection equipment.
6. Demonstrate knowledge of appropriate automated inspection system.
7. Demonstrate skill in using hand-held inspection devices to examine materials.
8. Demonstrating skill in maintaining and storing inspection tools.

P. QUALITY DOCUMENTATION

Proficient manufacturing technicians demonstrate knowledge of documentation needed in the quality process as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Complete proper forms to document problems and corrective action.
2. Use computer systems to document and track substandard and scrapped parts, materials, and assemblies as required by quality processes.
3. Demonstrate knowledge of documentation process and requirements to ensure verifiable evidence of product quality.
4. Demonstrate knowledge of quality system protocol for performing an audit.
5. Demonstrate knowledge of the procedure for reviewing quality problems with operators to provide feedback.
6. Demonstrate knowledge of correct and incorrect approval procedures to document inspection results.
7. Demonstrate knowledge of procedures for recording and storing product history and maintaining records.
8. Demonstrate knowledge of how to use route sheets and statistical method charts to

document process.

9. Demonstrate knowledge of follow-up and reporting documentation procedures to ensure proper communications.

Q. BLUEPRINT READING FUNDAMENTALS

Proficient manufacturing technicians demonstrate appropriate blueprint reading skills as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Visualize objects from a multi-view drawing.
2. Identify product features from a multi-view drawing.
3. Identify dimensions and tolerances of an object from a multi-view drawing.
4. Interpret geometric dimensioning and assembly tolerances on a drawing.
5. Interpret title blocks.
6. Demonstrate skill in interpreting assembly drawings.

R. BASIC MEASUREMENT

Proficient manufacturing technicians demonstrate appropriate measurement skills as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Convert measurements in U.S. measurement and standard international metrics systems.
2. Demonstrate measuring parts using a machinist's rule.
3. Demonstrate measuring parts using a tape measure.
4. Demonstrate measuring parts using dial and digital calipers.
5. Demonstrate measuring parts using a micrometer.
6. Demonstrate measuring parts using a dial indicator.
7. Demonstrate collecting measurement data from a digital gauge using a computer.

S. MANUFACTURING PROCESSES & PRODUCTION

Proficient manufacturing technicians demonstrate appropriate knowledge of the production process as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Analyze the components of the production process.
 - a. Identify customer needs.
 - b. Determine resources available for the production process.
 - c. Set up and verify equipment for the production process.
 - d. Set team production goals.
 - e. Make job assignments.
 - f. Coordinate work flow with team members and other work groups.
 - g. Communicate production and material requirements and product specifications.
 - h. Perform, monitor and document the process to make the product.

- i. Document product and process compliance with customer requirements.
 - j. Prepare final product for shipping or distribution.
2. Analyze workflow planning and control procedures.
- a. Describe principles of Lean Manufacturing and High Performance Work Organizations.
 - b. Make job assignments and coordinate workflow.
 - c. Ensure appropriate resources are available to meet customer specifications.
 - d. Ensure setup and operation procedures are available and up-to date.
 - e. Read and interpret a production schedule and manufacturing work order.
 - f. Explain production process, including flow and bottlenecks.
 - g. Describe lead time required for a production plan.
 - h. Read and interpret bills of materials and routing sheets.
 - i. Explain methods of productivity measurement and improvement.
 - j. Define principles and practice of Just in time (JIT) inventory control.
 - k. Perform a physical inventory.
3. Analyze production equipment operations.
- a. Start and operate production machines.
 - b. Perform emergency shutdown of production machines.
 - c. Recognize and address machine malfunctions.
 - d. Describe common types of mechanisms used in machines.
 - e. Describe ways in which force and torque are used in machine operations.
 - f. Explain impact of friction on machine operation and methods.
 - g. Explain use of cams.
 - h. Define ways in which machines use pulley and gear drives.
 - i. Describe which manufacturing processes are used to make and finish parts.
 - j. Use basic types of manual machine tools, such as drill press and cutoff saw.
 - k. Define basic machine tooling.
 - l. Describe basic casting, molding and stamping processes.
 - m. Describe basic direct digital and additive manufacturing.
 - n. Define and use injury prevention safety devices on machines.
4. Analyze various materials, tools, and equipment to complete the process.
- a. Describe various materials used in production.
 - b. Explain machinery operation, set up and testing.
 - c. Read and interpret gauges (i.e., analog, digital and Vernier).
 - d. Determine whether additional tools need to be purchased.
 - e. Describe lubricants and coolants to make the proper selection.
 - f. Set up, program and operate computerized control process.
 - g. Describe equipment capabilities to maximize productivity.
 - h. Make machine adjustments.
 - i. Order tools and materials.
5. Analyze written orders and prepare appropriate documentation.
- a. Interpret work orders to meet customer needs.
 - b. Review order sheets to determine if on site adjustments are needed.
 - c. Use diagrams and technical drawings.

- d. Interpret route sheets and operation sheets to set up and operate machine.
 - e. Complete compliance tag to indicate that the sub assembly meets the customer requirements.
 - f. Determine packing requirements based upon customer specifications.
 - g. Determine packing requirements based upon available packing materials.
 - h. Determine the safest method of shipping the product based upon available packing materials.
6. Analyze various advanced technologies used in manufacturing processes.
- a. Describe advanced technologies that are now in common use, such as Computer Numerically Controlled machines (CNC), Industrial Robotics, Programmable Logic Controllers (PLC), Lean Processes, Sensors and Lasers, Mobile Internet, and the Internet of Things.
 - b. Describe emerging technologies that could become commonly used in the next one to four years, such as Additive Manufacturing (3D Printing), Augmented Reality, Mechatronics, Nanotechnology and Next Generation Robotics.

T. MAINTENANCE AWARENESS

Proficient manufacturing technicians understand the importance in regular, scheduled maintenance as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

- 1. Perform preventive maintenance and routine repair.
- 2. Monitor indicators to ensure correct operations.
- 3. Perform all housekeeping to maintain production schedule.
- 4. Recognize potential maintenance issues with basic production systems, including knowledge of when to inform maintenance personnel about problems with:
 - a. Electrical systems
 - b. Pneumatic systems
 - c. Hydraulic systems
 - d. Machine automation systems
 - e. Lubrication processes
 - f. Bearings and couplings
 - g. Belts and chain drives
 - h. High vacuum systems
 - i. Laser systems

U. OVERALL MAINTENANCE PROCESS

Proficient manufacturing technicians identify and repair equipment as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

- 1. Explain principles of Total Productive Maintenance (TPM).
- 2. Describe what equipment is to be maintained and monitored.

3. Troubleshoot to identify a problem with equipment.
4. Follow preventive maintenance schedules.
5. Define job specific guidelines or collective bargaining agreement that affect maintenance.
6. Recognize significant wear and tear on equipment components.
7. Follow procedures for logging repairs and work order requests.
8. Explain the most common causes of failure of equipment to diagnose problem quickly.
9. Explain what equipment alarms mean.
10. Make on-process adjustments during production.

V. MAINTENANCE OF TOOLS AND EQUIPMENT

Proficient manufacturing technicians use appropriate technology to maintain equipment and tools as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Describe materials management to know what is recyclable and what is not.
2. Use appropriate maintenance tools to maintain machines.
3. Use monitoring or diagnostic devices to find out when equipment is operating correctly.

W. DOCUMENTATION OF MAINTENANCE

Proficient manufacturing technicians use appropriate documentation procedures for equipment and tool maintenance as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Ensure that equipment is producing a quality product using statistical methods charts.
2. Explain which forms and procedures to use for correctly documenting needs.
3. Repair equipment using diagrams, schematics, manuals and specifications.
4. Document repairs, replacement parts, problems and corrective actions to maintain log to determine patterns of operation.
5. Review maintenance log/checklist to ensure that recommended preventative procedures are followed.

X. MAINTENANCE-RELATED SAFETY

Proficient manufacturing technicians use appropriate safety procedures for equipment and tool maintenance as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Verify machine safety through proper set-up.
2. Explain safety procedures to prevent accidents.
3. Know the certification/license requirements to operate specific equipment.
4. Use and store hazardous materials and chemicals (e.g., compliance with SDS, EPA and DOT regulations).
5. Describe Lock out/Tag out policies and procedures.
6. Visually inspect equipment to ensure safety compliance before operating.
7. Identify and report unsafe work conditions.

8. Define materials management to know what is recyclable and what is not.

Y. POTENTIAL MAINTENANCE ISSUES WITH BASIC PRODUCTION SYSTEMS

Proficient manufacturing technicians understand reliability issues that may arise from various systems usage as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Define electrical systems reliability issues, including knowledge of when to inform maintenance personnel.
2. Define pneumatic systems reliability issues, including knowledge of when to inform maintenance personnel.
3. Define hydraulic systems reliability issues, including knowledge of when to inform maintenance personnel.
4. Define machine automation systems reliability issues, including knowledge of when to inform maintenance personnel.

Z. PROPER LUBRICATION PROCEDURES

Proficient manufacturing technicians use proper lubrication procedures as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Take and analyze oil samples.
2. Use correct lubricants for various types of equipment.
3. Operate grease guns correctly for various types of lubrication.
4. Store and dispose of lubricants safely.
5. Monitor machine for coolant level and correct mixture.

AA. BEARINGS AND COUPLING RELIABILITY

Proficient manufacturing technicians ensure bearings and coupling reliability as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Explain proper functioning of mechanical power transmission equipment, including knowledge of when to inform maintenance personnel.
2. Describe proper functioning of bearings and shafts, including knowledge of when to inform maintenance personnel.
3. Explain proper functioning of couplings, including knowledge of when to inform maintenance personnel.

AB. BELT AND CHAIN DRIVE RELIABILITY

Proficient manufacturing technicians ensure belt and chain reliability as required by a mid-level production technician. The following accountability criteria are considered essential for students in the manufacturing program of study.

1. Describe proper functioning of belt drive systems, including knowledge of when to inform maintenance personnel.
2. Explain proper functioning of roller chain drive systems, including knowledge of when to inform maintenance personnel.
3. Explain proper adjustment of chain sag, including knowledge of when to inform maintenance personnel.