Western Technical College

10420120 Manufacturing Processes/Machining CAM (Computer Aided Manufacturing)

Course Outcome Summary

Course Information

Description	This course examines primary and secondary manufacturing processes. You will use the tools of traditional material removal processes by "making a part." You will also study forming, casting, and other manufacturing techniques and their applications. Final assembly and finishing are examined. You will be required to visit manufacturing facilities to observe the day-to-day operations of modern manufacturing. The student will learn a computer aided manufacturing (CAM) software. They will model a part and then take the part into the CAM software and machine the part using the CNC machine.
Career Cluster	Manufacturing
Instructional Level	Associate Degree Courses
Total Credits	3
Total Hours	90

Pre/Corequisites

Pre/Corequisite	10420119 Manufacturing and Engineering Materials
Pre/Corequisite	10606115 Parametric Design 1

Textbooks

Manufacturing Processes. 3rd Edition. Copyright 2012. Duvall, J. Barry. Publisher: Goodheart-Wilcox Co. **ISBN-13**: 978-1-60525-569-9. Required.

Mastercam 2022 Mill Essentials – with Access. Copyright 2022. Lendel, Mariana. Publisher: In House Solutions, Inc. **ISBN-13:** 978-1-77146-943-2. Required.

Learner Supplies

Safety glasses with side eye protection that meet Z87 OSHA guidelines. **Vendor:** Campus Shop. Required.

Scientific calculator (recommend T1-36x Solar). **Vendor:** Campus Shop. Required.

Success Abilities

1. Cultivate Passion: Expand a Growth-Mindset
2. Cultivate Passion: Increase Self-Awareness
3. Live Responsibly: Develop Resilience
4. Live Responsibly: Embrace Sustainability
5. Live Responsibly: Foster Accountability
6. Refine Professionalism: Act Ethically
7. Refine Professionalism: Improve Critical Thinking
8. Refine Professionalism: Participate Collaboratively

Program Outcomes

1. Analyze mechanic engineering problems
2. Produce and revise supporting engineering documentation
3. Evaluate manufacturing processes and materials for product development
4. Demonstrate awareness of product liability and industry standards
5. Meet design and production deadlines
6. Interpret and communicate technical concepts, designs, and documentation

Course Competencies

1. Document the significant events in the history of manufacturing.

Assessment Strategies

1.1. in the completion of all learning activities
1.2. in a course portfolio

Criteria

You will know you are successful when

1.1. documentation contains a historical time line of manufacturing
1.2. documentation explains the historical significance of events
1.3. documentation describes how products were made before and after the Industrial Revolution
1.4. documentation lists and characterizes changes to machine tools
1.5. portfolio contains all class notes
1.6. portfolio contains correctly completed learning activities

Learning Objectives

1.a. Describe the history of modern manufacturing.
1.b. Explain the three most significant manufacturing developments of the Industrial Revolution that

characterize the production of products today.
1.c. Differentiate the production of goods before and after the Industrial Revolution.
1.d. Summarize the changes and innovations in machine tool design since the Industrial Revolution.

2. Classify contemporary manufacturing systems.

Assessment Strategies

2.1. in the completion of all learning activities
2.2. in a course portfolio
2.3. in a site visit to a manufacturing facility

Criteria

You will know you are successful when

2.1. classification contains the SIC/NAICS code system for manufacturing establishments
2.2. different products are classified as discreet or process manufactured
2.3. classification includes a description of different types of manufacturing organizations
2.4. portfolio contains all class notes
2.5. portfolio contains correctly completed learning activities
2.6. summary of a site visit describes the type of manufacturing system observed

Learning Objectives

2.a. Describe the SIC/NAICS code system for manufacturing.
2.b. Differentiate process and discreet manufacturing.
2.c. Describe the benefits of applying group technology principles to design and manufacturing.
2.d. Identify the components of a Flexible Manufacturing System.
2.e. Describe the characteristics of a just-in-time system.
2.f. Discuss the working of a Kanban or Pull System of production.

3. Determine the traditional material removal machine tools and operations necessary to generate specific geometric shapes.

Assessment Strategies

3.1. completion of all learning activities
3.2. in a course portfolio
3.3. on a written exam
3.4. making a part in the machine shop
3.5. in a summary of a site visit to a machine shop

Criteria

Criteria - Performance will be satisfactory when:

3.1. determination identifies the correct machine tool for the specific geometry
3.2. determination names the correct operation
3.3. determination includes correct tooling
3.4. summary of a site visit describes the products and material removal process observed
3.5. learner uses traditional material removal processes in the machine shop to make a part
3.6. portfolio contains correctly completed written learning activities
3.7. portfolio contains class notes
3.8. learner earns 70% on a written exam

Learning Objectives

3.a. Describe the principles of machining and material removal (chip making).
3.b. Identify material removal processes necessary to generate specific shapes.
3.c. Distinguish how material is removed in terms of the relative motion of the tool and the workpiece.
3.d. Identify basic machine tools and their component parts.
3.e. Describe workholding devices used for different machine tools.
3.f. Examine some typical tooling used for material removal.
3.g. List the advantages and limitations of each material removal process identified.
3.h. Determine expected tolerance, surface finish, and relative cost for traditional material removal processes.
3.i. Use the band saw, lathe, milling machines, and drill press to perform material removal processes.
3.j. Derive a CNC cutting program from a CAD solid model.

4. Analyze feeds and speeds for traditional material removal processes.

Assessment Strategies

4.1. in completion of all learning activities
4.2. in a course portfolio
4.3. on a written exam

Criteria

Criteria - Performance will be satisfactory when:

4.1. learner correctly calculates feeds and speeds to match the process
4.2. learner correctly uses standardized tables to analyze feeds and speeds
4.3. portfolio contains correctly completed learning activities
4.4. portfolio contains speed and feed tables
4.5. portfolio contains class notes
4.6. learner earns 70% on a written exam

Learning Objectives

4.a. List the dependent and independent variables that affect machinability.
4.b. Define the following terms: feed, cutting speed, depth of cut, material removal rate, machinability.
4.c. Describe how "chips" are made.
4.d. Use standard tables to select appropriate speeds for a specific part material/cutting process combination.
4.e. Compare costs of machining specific geometry using different processes.
4.f. Calculate machine tool settings, material removal rates, and horsepower requirements.
4.g. List the machining factors that have the greatest impact on surface finish, tool life, and material removal rate.

5. Evaluate the applications of joining techniques.

Assessment Strategies

5.1. in a written exam
5.2. in a course portfolio
5.3. in the completion of all learning activities

Criteria

Criteria - Performance will be satisfactory when:

5.1. learner visits a welding shop and observes welding processes
5.2. learner earns 70% on a written exam
5.3. portfolio contains correctly completed written learning activities
5.4. portfolio contains class notes

Learning Objectives

5.a. Identify common methods of joining materials.
5.b. Categorize joining by the different methods used, material to be joined, and strength of the joint.
5.c. Discuss the advantages and disadvantages of different joining techniques.
5.d. Identify different techniques for joining metals and nonmetals.
5.e. Differentiate the different fusion welding process according to type of electrode, power supply, shielding gas, welding positions, metals, advantages, and limitations
5.f. Use the American Welding Society classification system for joining of metals.
5.g. Explain the differences between fusion, resistance, and solid state welding.
5.h. Differentiate welding, brazing, and soldering.
5.i. Describe applications, advantages, and limitations of brazing and soldering.
5.j. Discuss the use of adhesives as a bonding mechanism.
5.k. Identify and explain mechanical fastening applications.

6. Create geometry using CAM software.

Assessment Strategies

6.1. In the classroom, lab, or shop setting
6.2. Using computer software
6.3. In applied assignments
6.4. Individually

6.5. On tests and quizzes
6.6. Given prints, files, tutorials, and course reference materials

Criteria

Performance will be satisfactory when:

6.1. learner correctly selects the geometry tool required for specific applications
6.2. learner completes the lines creation tutorial
6.3. learner completes the circle creation tutorial
6.4. learner completes the arc creation tutorial
6.5. learner completes the fillet creation tutorial
6.6. learner completes the dimensions creation tutorial
6.7. learner accurately reproduces geometry from prints
6.8. prints are drawn completely and accurately
6.9. prints are completely and accurately dimensioned
6.10. learner are drawn completely and accurately
6.11. learner scores a minimum of 70% on rubric criteria for each assignment
6.12. learner completes all activities by the due date
6.13. learner scores a minimum of 70% on tests and quizzes

Learning Objectives

6.a. Utilize geometry toolbar fly-out menus
6.b. Create lines using CAM software
6.c. Create circles using CAM software
6.d. Create fillets using CAM software
6.e. Create arcs using CAM software
6.f. Create dimensions using CAM software
6.g. Trim and extend geometry using CAM software
6.h. Utilize the snap mode toolbar
6.i. Reproduce prints using CAM geometry tools

7. Modify geometry using CAM software.

Assessment Strategies

7.1. In the classroom, lab, or shop setting
7.2. Using computer software
7.3. In applied assignments
7.4. Individually
7.5. On tests and quizzes
7.6. Given prints, tutorials, files, and course reference materials

Criteria

Performance will be satisfactory when:

7.1. learner identifies and describes the function of the transform tool
7.2. learner correctly selects the geometry or curve to be transformed
7.3. learner completes the part rotation tutorial
7.4. learner completes the part scaling tutorial
7.5. learner completes the part mirroring tutorial
7.6. learner completes the part creation tutorial
7.7. learner correctly transforms geometry per print specifications
7.8. learner correctly transforms curves per print specifications
7.9. learner demonstrates the use of the transform tool in applied assignments
7.10. learner scores a minimum of 70% on rubric criteria for each assignment
7.11. learner completes all activities by the due date
7.12. learner scores a minimum of 70% on tests and quizzes

Learning Objectives

7.a. Utilize the transform function in CAM program
7.b. Translate geometry using CAM software
7.c. Rotate geometry using CAM software
7.d. Scale geometry using CAM software
7.e. Reflect geometry using CAM software

8. Chain boundary curves using CAM software.

Assessment Strategies

8.1. In the classroom, lab, or shop setting
8.2. Using computer software
8.3. In applied assignments
8.4. Individually
8.5. On tests and quizzes
8.6. Given prints, tutorials, files, and course reference materials

Criteria

Performance will be satisfactory when:

8.1. learner correctly describes the type of geometry that requires a boundary chaining process
8.2. learner identifies and describes the function of the boundary curve tools
8.3. learner correctly selects the geometry to be chained into a boundary
8.4. learner completes the curve chaining tutorial
8.5. learner completes the text creation tutorial
8.6. learner correctly chains open boundaries
8.7. learner correctly chains closed boundaries
8.8. learner correctly chains complex curves using the pick pieces curve tool
8.9. learner correctly chains part geometry per print specifications
8.10. learner correctly changes the names of curves
8.11. learner correctly names new curves
8.12. learner selects the correct curve from the part view menu to create features
8.13. learner demonstrates the use of the curve tool in applied assignments
8.14. learner scores a minimum of 70% on rubric criteria for each assignment
8.15. learner completes all activities by the due date
8.16. learner scores a minimum of 70% on tests and quizzes

Learning Objectives

8.a. Define the term curve as it relates to a machining boundary
8.b. Describe the types of geometry that require boundaries for machining
8.c. Chain closed boundaries
8.d. Chain open boundaries
8.e. Create curves using the curve wizard
8.f. Chain boundaries that cross other boundaries
8.g. Name boundary curves
8.h. Locate curves in the step toolbox
8.i. Locate curves in the part view toolbox

9. Select appropriate post processor and generate NC code.

Assessment Strategies

9.1. In the classroom, lab, or shop setting
9.2. Using computer software
9.3. In applied assignments
9.4. Individually
9.5. On tests and quizzes
9.6. Given prints, tutorials, files, and course reference materials

Criteria

Performance will be satisfactory when:

9.1. learner locates and opens post processor options
9.2. learner browses computer to find correct post processor
9.3. learner selects the correct post processor for a specific CNC machine tool
9.4. learner demonstrates the process to generate NC code
9.5. learner saves NC code with the correct name and in the correct locations
9.6. learner uses the correct application to open NC code text files
9.7. learner edits NC code text files as required for specific CNC machine tools
9.8. learner sends all NC code text files to instructor per directions

9.9. learner scores a minimum of 70% on rubric criteria for each assignment
9.10. learner completes all activities by the due date
9.11. learner scores a minimum of 70% on tests and quizzes

Learning Objectives

9.a. Locate post processor options
9.b. Select the required post processor
9.c. Generate NC code
9.d. Save NC code
9.e. Open and view NC code
9.f. Edit NC code text file

10. Prove-out CAM programs in CNC machine tools.

Assessment Strategies

10.1. In the classroom, lab, or shop setting
10.2. Using computer software and actual CNC machine tools
10.3. In applied assignments
10.4. Individually and in groups
10.5. On tests and quizzes
10.6. Given prints, stock, process sheets, diagrams, materials, and all available shop equipment and supplies

Criteria

Performance will be satisfactory when:

10.1. learner selects correct stock for CNC project
10.2. learner correctly sets up stock in CNC machine tool
10.3. learner selects correct tools for CNC program
10.4. learner sets up tools in correct locations in CNC machine tool turret, carousel, or magazine
10.5. learner correctly sets all tool and work coordinate offsets
10.6. learner uses dry run or single block to prove programs prior to cutting stock
10.7. learner selects correct speeds and feeds for material and operations
10.8. learner runs program to cut part programs
10.9. learner produces a minimum of one turned project
10.10. learner produces a minimum of one milled project
10.11. learner verifies part dimensions prior to removing machined part from CNC machining center
10.12. learner accurately completes process plans for each CNC project
10.13. learner accurately completes set up sheets for each CNC project
10.14. learner accurately completes quality inspection sheets for each CNC project
10.15. learner scores a minimum of 70% on rubric criteria for each assignment
10.16. learner completes all activities by the due date
10.17. learner scores a minimum of 70% on tests and quizzes

Learning Objectives

10.a. Adhere to machine shop safety procedures
10.b. Adhere to CNC machine tool safe operating procedures
10.c. Prove-out CAM milling programs in CNC machining centers
10.d. Prove-out CAM turning programs in CNC turning centers
10.e. Complete CNC/CAM process sheets