“Right Skills Now”
for manufacturing

Fast track curriculum submitted by;

South Central College – Doug Laven

Dunwoody College of Technology – E.J. Daigle

Revised 9/28/2011
Table of Contents

Rationale, Goals and Educational Pathways ................................................................. 3
Curricular Concerns ........................................................................................................ 4
Credits and Contact Hours .......................................................................................... 5
Staggered Enrollment .................................................................................................... 6
Weekly Schedule ........................................................................................................... 6
Industry Study ............................................................................................................... 7
Appendix A (Measurement, Materials & Safety Syllabus) ......................................... 8
Appendix B (Job Planning, Benchwork & Layout Syllabus) ....................................... 13
Appendix C (CNC Milling Level 1 Syllabus) .............................................................. 17
Appendix D (CNC Turning Level 1 Syllabus) .............................................................. 21
Appendix E (Internship Syllabus) ................................................................................ 26
RATIONAL

Doug Laven (South Central College) and E.J. Daigle (Dunwoody College of Technology) have spent the last 6 weeks collaborating with industry stakeholders, technical faculty from both schools, and the “Right Skills Now” committee in an effort to develop curriculum that can be replicated between the (3) campuses served by Dunwoody College and South Central College. After much deliberation, we are submitting the attached curriculum that can then be replicated across the campuses and at the same time provide educational pathways into our AAS Degree Programs. Our hope is that upon the successful pilot of this program, we can then replicate it across the nation.

Curricular Goals

1. Provide high quality training that leads to immediate entry-level jobs.
2. Provide skilled personnel (Entry Level CNC Operators) to an industry that is in desperate need.
3. Provide educational pathways that allows students a lifetime of learning and exposure to the manufacturing field.

Educational Pathways

Right Skills Now Certificate
1 semester + internship
Measurement, Materials and Safety
Job Planning, Benchwork and Layout
CNC Turning Level 1
CNC Milling Level 1
Internship

Associate of Applied Science
Machining related discipline (additional 3 Semesters)
Semester 1: Credits Articulated from Right Skills Now Certificate
Semester 2: Intermediate Machine Tool courses
Required A&S courses
Semester 3: Advanced Machine Tool courses
Required A&S courses
Semester 4: Advanced Machine Tool courses
Required A&S courses

2+2 Bachelor of Science
4 additional semesters
Semester 5: Dependent on program
Semester 6: Dependent on program
Semester 7: Dependent on program
Semester 8: Dependent on program
CURRICULAR CONCERNS

Differences in credits (yet similar in clock hours):

- Each school is required to obtain approval and accreditation by both the Minnesota Office of Higher Education and Regional Accrediting Agencies to offer financial aid eligible certificates and because of this every school has strict school guidelines they must adhere to in regards to contact hours per credit and certificate total credits.

  (A) Term lengths (quarter, semester, number of weeks) vary from school to school

  (B) Contact hours per credit varies from school to school

  (C) Cost per credit varies from school to school

- Although the model represents two different total credit loads the total contact hours were essentially the same, (SCC = 544 hours and Dunwoody = 558 hours).
  See specific campus credit and contact hour details on page 5.

Internship:

- Appendix E includes a course syllabus for an instructor-driven internship that will last approximately 8 weeks and varies from 3-4 credits depending on campus.

  Internship is credit-based and the student is charged tuition.
  Credit will be issued for completion of the internship and course competencies will be developed and assessed as collaboration between student, instructor and employer. The experience will be limited to a paid internship with a minimum of 20 hours per week but not to exceed 40 hours per week. Students will not receive their certificate until completion of the required internship competencies. Students are encouraged to take additional courses towards AAS degree requirements while participating in the internship.
## Credits and Contact Hours

<table>
<thead>
<tr>
<th>Dunwoody College of Technology</th>
<th>Lecture Credits (hrs)</th>
<th>Lab Credits (hrs)</th>
<th>Total Credits (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Materials &amp; Safety</td>
<td>1 (18)</td>
<td>1 (54)</td>
<td>2 (72)</td>
</tr>
<tr>
<td>Job Planning, Benchwork &amp; Layout</td>
<td>1 (18)</td>
<td>1 (54)</td>
<td>2 (72)</td>
</tr>
<tr>
<td>CNC Milling Level 1</td>
<td>1 (18)</td>
<td>2 (108)</td>
<td>3 (126)</td>
</tr>
<tr>
<td>CNC Turning Level 1</td>
<td>1 (18)</td>
<td>2 (108)</td>
<td>3 (126)</td>
</tr>
<tr>
<td>Internship</td>
<td></td>
<td>3 (162)</td>
<td>3 (162)</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>4 (72)</strong></td>
<td><strong>9 (486)</strong></td>
<td><strong>13 (558)</strong></td>
</tr>
</tbody>
</table>

* The completion of this certificate is then articulated into Dunwoody’s Machine Tool AAS Degree in the following manner;

### Right Skills Now Certificate (13 credits) = Semester 1 of Machine Tool AAS (72 Credits)

#### Semester 1 Courses (13 credits with 414 contact hours)

- MACH1110 Machine Tool Fundamentals Lab (5 cr)
- MACH1120 Machine Tool Fundamentals Theory (4 cr)
- MDES1110 Engineering Drawings (4 cr)

<table>
<thead>
<tr>
<th>South Central College</th>
<th>Lecture Credits (hrs)</th>
<th>Lab Credits (hrs)</th>
<th>Total Credits (hrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Materials &amp; Safety</td>
<td>1 (16)</td>
<td>2 (64)</td>
<td>3 (80)</td>
</tr>
<tr>
<td>Job Planning, Benchwork &amp; Layout</td>
<td>1 (16)</td>
<td>2 (64)</td>
<td>3 (80)</td>
</tr>
<tr>
<td>CNC Milling Level 1</td>
<td>2 (32)</td>
<td>3 (96)</td>
<td>5 (128)</td>
</tr>
<tr>
<td>CNC Turning Level 1</td>
<td>2 (32)</td>
<td>3 (96)</td>
<td>5 (128)</td>
</tr>
<tr>
<td>Internship</td>
<td></td>
<td>4 (128)</td>
<td></td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>6 (96)</strong></td>
<td><strong>14 (448)</strong></td>
<td><strong>20 (544)</strong></td>
</tr>
</tbody>
</table>

* The completion of this certificate is then articulated into South Central College’s Computer Integrated Machining AAS Degree in the following manner;

### Right Skills Now Certificate (16 credits) = Semester 1 of Computer Integrated Machining AAS (72 Credits)

#### Semester 1 Courses (16 credits with 416 contact hours)

- CIM1115 Measurement Materials & Safety (3 cr)
- CIM1125 Job Planning, Benchwork & Layout (3 cr)
- CIM1135 CNC Milling Level 1 (5 cr)
- CIM1135 CNC Turning Level 1 (5 cr)
- CIM1145 Internship (4 cr)
STAGGERED ENROLLMENT

Because the certificate will be offered on three separate campuses it is possible to stagger the enrollment. This is especially true for the South Central campuses due to their physical proximity of each other. As far as the Dunwoody campus goes, the starts would mirror that of the SCC-Mankato campus. This is due to the fact that they line up well with other campus starts and still offer summer time for shop maintenance. Dunwoody and SCC-Mankato are nearly 100 miles apart and do not typically compete for students and therefore can have mirrored starts.

<table>
<thead>
<tr>
<th>South Central Mankato</th>
<th>South Central Fairbault</th>
<th>Dunwoody Minneapolis</th>
</tr>
</thead>
<tbody>
<tr>
<td>January: Spring startup</td>
<td>March: Mid Spring startup</td>
<td>January: Spring startup</td>
</tr>
<tr>
<td>May: Graduation</td>
<td>July: Graduation</td>
<td>May: Graduation</td>
</tr>
<tr>
<td>June: Internship</td>
<td>August: Internship</td>
<td>June: Internship</td>
</tr>
<tr>
<td>August: Fall startup</td>
<td>October: Mid Fall startup</td>
<td>August: Fall startup</td>
</tr>
<tr>
<td>December: Graduation</td>
<td>February: Graduation</td>
<td>December: Graduation</td>
</tr>
</tbody>
</table>

WEEKLY SCHEDULE

The program requires approximately 400 classroom contact hours to be completed in 16 weeks and a minimum of 8 weeks on a paid internship.

DAYTIME CLASSROOM SCHEDULE (26 CONTACT HOURS PER WEEK FOR 16 WEEKS)

<table>
<thead>
<tr>
<th>MONDAY</th>
<th>TUESDAY</th>
<th>WEDNESDAY</th>
<th>THURSDAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30AM-2:00PM</td>
<td>7:30AM-2:00PM</td>
<td>7:30AM-2:00PM</td>
<td>7:30AM-2:00PM</td>
</tr>
</tbody>
</table>

EVENING CLASSROOM SCHEDULE (26 CONTACT HOURS PER WEEK FOR 16 WEEKS)

<table>
<thead>
<tr>
<th>MONDAY</th>
<th>TUESDAY</th>
<th>WEDNESDAY</th>
<th>THURSDAY</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:30PM-10:00PM</td>
<td>3:30PM-10:00PM</td>
<td>3:30PM-10:00PM</td>
<td>3:30PM-10:00PM</td>
</tr>
</tbody>
</table>
**INDUSTRY STUDY**

Dunwoody College and South Central College conducted a survey of manufacturing companies that have hired their graduates. The study was intended to determine which skills are absolutely necessary for someone to safely and accurately operate a CNC machine tool. The survey was sent out to the following companies and the survey and results are listed below.

**Dunwoody Survey Participants**

- Top Tool
- Tom Larson Custom Training
- Boston Scientific
- Iscar
- Entegris
- Performance Tool

**South Central Participants**

- New Ulm Precision
- K & G
- SPX-OTC
- Winegar
- Dotson
- MRG
- V-Tek

(The directions sent to the companies on how to take the survey were as follows:

This survey is being conducted to determine industry needs in regard to entry level CNC operator training. Dunwoody College of Technology and South Central College are working together on an accelerated solution to meet increasing industry needs in this area. As you take the survey, please consider whether each skill is vital to the position of an entry level CNC operator. Please remember this survey is not aimed at the skills required for an entry-level machinist, but rather the skills necessary to feel comfortable hiring someone to operate your machine tools.

**Survey Findings:** Out of the 43 skills assessed on a scale of 1.0 to 3.0 (3.0 being the highest level of importance of mastery), 22 skills were found to be at or above 2.5 on our survey. These skills are aggregated in the “vital skill” category. This is not meant to discredit any of the other skills on the list. These may also require exposure during the program.

**Skills ≥ 2.5:**

<table>
<thead>
<tr>
<th>INTRO Safety, MSDS and PPE</th>
<th>CNC Tool and Work Holding (Lathe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTRO Interpreting Engineering Drawings</td>
<td>CNC Tool and Work Holding (Vert Mill)</td>
</tr>
<tr>
<td>INTRO Use of Hand Tools</td>
<td>CNC Turning</td>
</tr>
<tr>
<td>INTRO Use of Measurement Tools</td>
<td>CNC Cutter compens. and Wear offsets</td>
</tr>
<tr>
<td>INTRO Use of Shop Mathematics</td>
<td>CNC Speeds &amp; Feeds</td>
</tr>
<tr>
<td>MANUAL Lathe Operation</td>
<td>CNC Tool offsets and Work offsets</td>
</tr>
<tr>
<td>MANUAL Vertical Mill Operation</td>
<td>CNC Vertical Mill Setup/Operation</td>
</tr>
<tr>
<td>MANUAL Speeds &amp; Feeds</td>
<td>CNC Canned Cycles</td>
</tr>
<tr>
<td>MANUAL Drilling, Tapping, Threading &amp; Ream</td>
<td>CNC Milling</td>
</tr>
<tr>
<td>MANUAL Tool Holding and Work Holding</td>
<td>CNC G&amp;M Codes</td>
</tr>
<tr>
<td>INSPECT Reading Calipers and Micrometers</td>
<td></td>
</tr>
<tr>
<td>INSPECT Reading Depth and Height Gages</td>
<td></td>
</tr>
</tbody>
</table>
Measurement, Materials, and Safety
Course Outcome Summary

Course Information

Organization South Central College/Dunwoody
Developers Doug Laven, E.J. Daigle
Development Date 8/16/2011
Course Number In accordance with college policy
Potential Hours of Instruction Determined by the college
Total Credits Determined by the college

Description
This course provides an exploration of the basics in machining, raw materials, use of hand tools, safety and maintenance. Topics include an overview of measurement techniques, materials, safety, machine tool math, quality control and maintenance. Teamwork, critical thinking, and problem solving are emphasized. Hands-on experience and practical applications are included.

Types of Instruction

<table>
<thead>
<tr>
<th>Instruction Type</th>
<th>Contact Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Lab</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Recommended Textbooks


Exit Learning Outcomes

Core Abilities

A. Critical Thinking
B. Professionalism
C. Mechanical Aptitude: Determine the Proper Method/Equipment to Manufacture and Measure Characteristic of a Part
D. Technological Literacy
E. Recognize and Avoid Shop Hazards
Competencies

1. Explore Shop Floor Layout
   Learning Objectives
   a. Explain General Shop layout
   b. Differentiate Conventional Machinist, Programmer, CNC Machinist
   c. Apply Housekeeping Standard
   d. Demonstrate Mechanical Aptitude

2. Identify Safety
   Learning Objectives
   a. Explain Key Safety Terms
   b. Demonstrate Personal Protective Equipment (PPE)
   c. Apply Lockout/Tag-out
   d. Use Guards and Barriers
   e. Adapt Personal Protective Equipment (PPE)
   f. Acknowledge OSHA Guidelines

3. Explain Types of Machines
   Learning Objectives
   a. Demonstrate Safety Practices
   b. Explain Personal Protective Equipment (PPE)
   c. Apply Lockout/Tag-out procedure
   d. Use Guards and barriers

4. Apply Measurement Systems and Machine Tool Math
   Learning Objectives
   a. Explain the English System
   b. Explain the Metric System
   c. Apply Fractional Operations
   d. Use Basic Geometry, Trigonometry and Ratios
   e. Demonstrate Fractional/Decimal Conversions
   f. Recognize Tolerances on a Print
   g. Explain numbering they find on a print (Tenths, 150 millionths, etc)
   h. Articulate Numbering Systems found on Prints (Tenths, Millionths, etc)

5. Define Major Machine Tools
   Learning Objectives
   a. Explain Machine Differences
   b. Use Drill Press
   c. Demonstrate Sawing Machine
d. Differentiate Hand Tools  
e. Identify Lathe, Mill and various “Axes”  
f. Learn the names and to identify types of Drills, Mills, and Insert Tooling

6. **Utilize Semi-Precision Measurement Tools**  
Learning Objectives  
a. Explain Key Measurement Terms  
b. Demonstrate Calipers Use  
c. Use Adjustable Squares  
d. Apply Angular Measurements  
e. Demonstrate Fixed Gage Applications

7. **Utilize Precision Measurement Hand Tools**  
Learning Objectives  
a. Explain Precision Measurement  
b. Use Precision Fixed Gages  
c. Demonstrate Surface Plates  
d. Characterize Vernier Measuring tools  
e. Use Micrometers

8. **Learn Special Measurement Tools**  
Learning Objectives  
a. Identify Coordinate Measuring Machine  
b. Define Optical Comparator Operation  
c. Explain Toolmaker’s Microscope

9. **Apply Quality Assurance Planning**  
Learning Objectives  
a. Apply Quality Practices  
b. Compare Inspection and Preventative Processes  
c. Calculate Average, Standard Deviation, and Determine Capability Range (Average +/- 3 Standard Deviations)  
d. Develop Sampling Plan  
e. Create Inspection Plan  
f. Define Statistical Process Control (SPC)  
g. Define differences between Attributes and Variables (Surface Finish/Appearance vs. Measurable)

10. **Differentiate Raw Material Composition**  
Learning Objectives  
a. Explain Ferrous Metals  
b. Explain Nonferrous Metals
c. Define Tempering
d. Describe Heat Treatment Process
e. Characterize Hardness Scales and Test Variety of Specimens

11. **Adopt Maintenance Schedules**

   **Learning Objectives**
   a. Communicate Lubrication Needs
   b. Use Cutting Fluids
   c. Demonstrate Measuring of Cutting Fluid Techniques
   d. Explain Methods of Application

12. **Categorize Heat Treatment of Metals**

   **Learning Objectives**
   a. Distinguish Direct, Surface and Case Hardening
   b. Distinguish Tempering, Anodizing and Normalizing
   c. Analyze Hardness Scales and Testing

13. **Communicate Knowledge**

   **Learning Objectives**
   a. Take Detailed Notes
   b. Ask Questions to Industry Representatives
   c. Practice Problem-Solving and Manual Dexterity
   d. Communicate with Team members
   e. Identify and Properly name Shop Tools, Components, Supplies, and Equipment
Job Planning, Benchwork and Layout
Course Outcome Summary

Course Information
Organization: South Central College/Dunwoody
Developers: Doug Laven, E.J. Daigle
Development Date: 8/16/2011
Course Number: In accordance with college policy
Potential Hours of Instruction: Determined by the college
Total Credits: Determined by the college

Description
This course provides an exploration of the basics of hand tools, understanding drawings, manual machines and layout. Upon completion of this course the student will be able to interpret drawing information, describe basic symbols and notation and interpret basic GD&T feature control frames. Teamwork, critical thinking, and problem solving are emphasized. Hands-on experience and practical applications are included.

Types of Instruction

<table>
<thead>
<tr>
<th>Instruction Type</th>
<th>Contact Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Lab</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Recommended Textbooks


Exit Learning Outcomes

Core Abilities
A. Critical Thinking
B. Professionalism
C. Mechanical Aptitude: Determine the Proper Method/Equipment to Manufacture and Measure Characteristic of a Part
D. Technological Literacy
E. Recognize and Avoid Shop Hazards
Competencies

1. **Access Drawings**
   **Learning Objectives**
   a. Explain Key Terms
   b. Utilize the Components of Engineering Drawings
   c. Create Title Block
   d. Describe Line Types

2. **Identify Basic Symbols and Notation**
   **Learning Objectives**
   a. Explain Fillet
   b. Interpret Rounds and Counter-bore
   c. Identify Drawing Nomenclature
   d. Use Symbols and Notation

3. **Determine Tolerances**
   **Learning Objectives**
   a. Explain Bilateral Tolerances
   b. Explain Unilateral Tolerances
   c. Acknowledge Limit Tolerances
   d. Apply Maximum Material Condition (MMC)
   e. Apply Tolerance Specifications

4. **Explain Types of Machines**
   **Learning Objectives**
   a. Adapt safety practices with Machines
   b. Demonstrate Basic Machine Maintenance
   c. Identify Tool and Blade Materials
   d. Develop an Understanding of Tool and Blade Characteristics

5. **Apply Classes of Fit**
   **Learning Objectives**
   a. Define Classes of Fit
   b. Demonstrate Allowances between Parts
   c. Describe Classifications of Fits
   d. Use Machinery Handbook

6. **Define Geometric Dimensioning and Tolerancing (GD&T)**
   **Learning Objectives**
   a. Explain GD&T
   b. Use Drawing to Define Datum
   c. Demonstrate the Use of a Feature Control Frame
   d. Identify Flatness, Circularity and Cylindricity.
   e. Define Profile and Location Tolerances
   f. Apply Run-out Tolerances
7. **Apply Layout Fundamentals**  
   **Learning Objectives**  
   a. Explain Key Layout Terms  
   b. Use Layout Fluid  
   c. Demonstrate Dye Remover Technique

8. **Demonstrate Semi-Precision Layout**  
   **Learning Objectives**  
   a. Explain Semi-Precision Layout  
   b. Use Scribe  
   c. Demonstrate Layout with a Combination Set  
   d. Demonstrate Angle Layout with a Combination Set  
   e. Use Center Punches and Other Hand Tools

9. **Demonstrate Precision Layout**  
   **Learning Objectives**  
   a. Use Height Gage  
   b. Demonstrate the Use of the Precision Angular  
   c. Demonstrate the Use of the Vernier Bevel Protractor  
   d. Use Sine Tools

10. **Apply Proper Hand Tool Use**  
    **Learning Objectives**  
    a. Identify Shop Tools  
    b. Demonstrate Proper Tool Use  
    c. Demonstrate Safe Shop Practices

11. **Demonstrate Clamping Methods**  
    **Learning Objectives**  
    a. Explain the Different Clamping Methods  
    b. Use C-Clamp  
    c. Use Parallel Clamp  
    d. Use Hinged Clamp

12. **Exhibit Deburring Skills**  
    **Learning Objectives**  
    a. Explain File Classifications  
    b. Define the Basic Parts of a File  
    c. Select Proper File for Job  
    d. Demonstrate File Cleaning

13. **Use Abrasives**  
    **Learning Objectives**  
    a. Explain Abrasives  
    b. Choose Abrasive Material  
    c. Demonstrate Deburring
14. **Apply Knowledge to Saws and Cutoff Machines**

Learning Objectives
- a. Adapt Quality Terms
- b. Compare Inspection and Preventative Processes
- c. Calculate Speed and Feed
- d. Develop Sampling Plan
- e. Create Inspection Plan
- f. Define Statistical Process Control (SPC)

15. **Develop Workholding Skills**

Learning Objectives
- a. Explain Ferrous Metals
- b. Explain Nonferrous Metals
- c. Define Tempering
- d. Describe Heat Treatment Process
- e. Characterize Hardness Scales and Testing

16. **Use Drill Press**

Learning Objectives
- a. Demonstrate Drilling Operations
- b. Apply Countersinking, Spot-facing, and Counterboring Practices
- c. Identify Various Tap Types and Tap Drill Selection
- d. Demonstrate Tap Removal Techniques

17. **Maintain Speeds and Feeds**

Learning Objectives
- a. Perform Speed and Feed Operations
- b. Demonstrate Lubrication
- c. Use Cutting Fluids
- d. Demonstrate Measuring of Cutting Fluid Techniques
- e. Explain Methods of Application
CNC Milling Level 1
Course Outcome Summary

Course Information
Organization South Central College/Dunwoody
Developers Doug Laven, E.J. Daigle
Development Date 9/1/2011
Course Number In accordance with college policy
Potential Hours of Instruction Determined by the college
Total Credits Determined by the college

Description
This course provides the student an introduction to basic milling operations. Upon completion of this course the student will have an understanding of manual and CNC milling practices as well gain knowledge in tooling, machining practices and applied mathematics. Teamwork, critical thinking, and problem solving are emphasized. Hands-on experience and practical applications are included.

Types of Instruction
<table>
<thead>
<tr>
<th>Instruction Type</th>
<th>Contact Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Lab</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Recommended Textbooks


Exit Learning Outcomes
Core Abilities
A. Critical Thinking
B. Professionalism
C. Mechanical Aptitude: Determine the Proper Method/Equipment to Manufacture and Measure Characteristic of a Part
D. Technological Literacy
E. Recognize and Avoid Shop Hazards
Competencies

1. **Demonstrate Shop Safety**
   **Learning Objectives**
   a. Explain Key Terms
   b. Demonstrate Proper Mill Power UP and Power Down Procedures
   c. Demonstrate Proper Lockout/Tag-out Procedures

2. **Identify CNC Milling Machine Types**
   **Learning Objectives**
   a. Identify and Explain Vertical and Horizontal Spindle Machines
   b. Describe the Machine Axes Used for Milling
   c. Explain Manufacturing Cell

3. **Identify Basic Components of a CNC Milling Machine**
   **Learning Objectives**
   b. Identify Work Envelope
   c. Identify Control Panel

4. **Use Work Holding Solutions**
   **Learning Objectives**
   a. Explain Workholding Techniques
   b. Demonstrate Various Workholding Applications
   c. Demonstrate Workpiece Clamping
   d. Use Machine Vices
   e. Apply Workholding Solutions with Chucks, Collet Closers and Indexing Fixtures

5. **Use Tool Holding Solutions**
   **Learning Objectives**
   a. Acknowledge Cutting Tool
   b. Identify Spindle Types
   c. Demonstrate Tool Attachment to Various Tool Holders

6. **Demonstrate Milling Machine Canned Operations**
   **Learning Objectives**
   a. Explain Canned Cycles
   b. Apply Holemaking Operations
   c. Demonstrate Peck Drilling Cycles
   d. Demonstrate Single-Pass Drilling

7. **Explore Indexing and Rotary Table Operations**
# Learning Objectives

## 8. Demonstrate CNC Machining Basics

### Learning Objectives

- Demonstrate Face Milling
- Demonstrate Squaring a Block
- Demonstrate Slot Milling
- Perform Keyseat Milling Operation

## 9. Describe the two major types of ATCs

### Learning Objectives

- Define Automatic Tool Changers
- Identify Swing-Arm Type Tool Changer
- Explain Carousel-Type Tool Changer

## 10. Utilize Coordinate Geometry

### Learning Objectives

- Explain the X, Y and Z Axes
- Align Coordinate Positioning
- Demonstrate Workpiece X, Y and Z Offsets
- Calculate Tolerances

## 11. Identify Control System

### Learning Objectives

- Identify Types of CNC Control Panels
- Demonstrate Soft Key Use
- Analyze Control Panel Screen Function Labels
- Explain MDI and Auto Modes

## 12. Explain Program Planning

### Learning Objectives

- Explain Part Overview
- Identify Part Material Composition
- Define Type of Motion for Milling Part
- Calculate Tool-Change

## 13. Demonstrate Programming G and M Codes

### Learning Objectives
a. Explain G and M Codes  
b. Define Screen Display and Keyboard  
c. Demonstrate Linear Interpolation for CNC Milling  
d. Demonstrate Circular Interpolation for CNC Milling  
e. Demonstrate Two-Dimensional CNC Milling

14. **Explain Offsets**  
**Learning Objectives**  
a. Interpret Work Offsets  
b. Explain Machine Origin and Workpiece Origin  
c. Define Workshift  
d. Calculate X, Y and Z Offset Settings

15. **Activate Homing Procedure**  
**Learning Objectives**  
a. Demonstrate Machine Power-Up  
b. Demonstrate Homing Procedure  
c. Demonstrate Jog Operation  
d. Activate Zero Return Operation

16. **Describe Coordinate Systems**  
**Learning Objectives**  
a. Acknowledge Machine Coordinate Move Operations on Control Panel  
b. Explain Work Coordinate System  
c. Identify Cartesian Coordinate System

17. **Utilize Different Methods for Loading Programs**  
**Learning Objectives**  
a. Explain Program Entry  
b. Demonstrate Manual Typing of Program into the Control Panel  
c. Demonstrate Uploading Program to the Mill from a PC  
d. Demonstrate Downloading Program from a PC to the Mill
CNC Turning Level 1
Course Outcome Summary

Course Information

Organization South Central College/Dunwoody
Developers Doug Laven, E.J. Daigle
Development Date 8/28/2011
Course Number In accordance with college policy
Potential Hours of Instruction Determined by the college
Total Credits Determined by the college

Description
This course provides the student an introduction to basic lathe operations. Upon completion of this course the student will have an understanding of manual and CNC lathe turning practices as well gain knowledge in tooling, machining practices and applied mathematics. Teamwork, critical thinking, and problem solving are emphasized. Hands-on experience and practical applications are included.

Types of Instruction

<table>
<thead>
<tr>
<th>Instruction Type</th>
<th>Contact Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>TBD</td>
<td>TBD</td>
</tr>
<tr>
<td>Lab</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

Recommended Textbooks


Exit Learning Outcomes

Core Abilities
A. Critical Thinking
B. Professionalism
C. Mechanical Aptitude: Determine the Proper Method/Equipment to Manufacture and Measure Characteristic of a Part
D. Technological Literacy
E. Recognize and Avoid Shop Hazards

Competencies

1. **Apply Shop Safety**
   **Learning Objectives**
   a. Explain Key Terms
   b. Adapt Basic OSHA Requirements
   c. Demonstrate Proper Chip Handling
   d. Demonstrate Proper Lockout/Tag-out Procedures
   e. Clean Workstation

2. **Identify Basic Components of a CNC Lathe**
   **Learning Objectives**
   a. Identify and Explain the Carriage
   b. Identify and Explain the Spindle
   c. Identify and Explain the Headstock and Tailstock
   d. Identify and Explain the Bed and Ways
   e. Use Control Panel

3. **Describe CNC Machine Modes**
   **Learning Objectives**
   a. Analyze Manual Data Input (MDI)
   b. Identify the Jog Feature
   c. Acknowledge Feed Rate Override and Rapid Override Feature
   d. Demonstrate Machine Home Position Sequence

4. **Use Workholding Solutions**
   **Learning Objectives**
   a. Explain the Difference between Universal and Independent-type Chucks
   b. Demonstrate Various Chuck Applications
   c. Demonstrate Various Collet Applications
   d. Demonstrate Faceplates, Centers and Mandrels Applications
   e. Apply Workholding Solutions with Turning Operation

5. **Explain Depth of Cut, Speed & Feed and Time Calculation**
   **Learning Objectives**
   a. Explain Cutting Rates
   b. Identify Material
   c. Calculate Spindle RPM for Various Cutting Operations
   d. Calculate Machining Time
6. Demonstrate Facing and Turning Operations
Learning Objectives
a. Apply Facing Operation
b. Apply Turning Operation
c. Describe Basic Tool Geometry
d. Use Filing and Polishing Methods

7. Demonstrate Center Drilling
Learning Objectives
a. Explain Reasons for Center Drilling
b. Perform Center Drilling
c. Use Spotting Drill
d. Create a Hole using the Lathe
e. Apply Reaming, Boring, Counter-boring and Countersinking Methods

8. Learn Grooving, Cutoff and Knurling Operations
Learning Objectives
a. Create Internal Shoulder
b. Demonstrate Form Cutting
c. Produce Parts using Grooving and Cutoff Methods
d. Perform Knurling Operation

9. Demonstrate Lathe Threading
Learning Objectives
a. Define Thread Terminology
b. Perform Calculations required for Thread Cutting
c. Demonstrate Proper Setup for Cutting Threads
d. Verify Thread Measurement and Classes of Fit

10. Demonstrate Taper Turning
Learning Objectives
a. Define a Taper
b. Perform Taper Calculations
c. Recognize Taper Per Inch (TPI) and Taper Per Foot (TPF)
d. Demonstrate Setup Procedures for Taper Turning

11. Identify CNC Lathe Components
Learning Objectives
a. Identify Types of CNC Lathes
b. Define Axes
c. Analyze Programming Approach
d. Explain Lathe Features and Specifications

12. **Utilize Coordinate Geometry**
   **Learning Objectives**
   a. Explain Real Number System
   b. Explain Rectangular Coordinates
   c. Explain Point of Origin
   d. Explain Quadrants
   e. Define Axes and Planes

13. **Identify Control System**
   **Learning Objectives**
   a. Explain General Description of Operation Panel
   b. Define Screen Display and Keyboard
   c. Select Parameter Settings
   d. Explain System Memory and Defaults

14. **Acknowledge Part Drawing**
   **Learning Objectives**
   a. Interpret Part Drawing
   b. Review Title Block
   c. Explain Dimensioning
   d. Calculate Tolerances

15. **Explain Program Planning**
   **Learning Objectives**
   a. Define Part Complexity
   b. Choose Steps in Program Planning
   c. Demonstrate Programming

16. **Identify M & G Codes**
   **Learning Objectives**
   a. Analyze Coordinate Positioning
   b. Acknowledge Types of Motion
   c. Identify Various Interpolation
   d. Adapt Offset Commands
   e. Administer M-Codes

17. **Demonstrate Coordinate Positioning for CNC Turning**
   **Learning Objectives**
   a. Demonstrate Radial and Diametral Programming
   b. Demonstrate Linear and Circular Interpolation for CNC Turning
c. Demonstrate Non-Axis Motion Commands

d. Demonstrate Tool Nose Radius Compensation (TNRC) for CNC Turning

18. **Describe Canned Cycles for CNC Turning Applications**

**Learning Objectives**

a. Demonstrate Holemaking Canned Cycles

b. Apply Tapping Canned Cycles

c. Demonstrate Rough and Finish Turning Canned Cycles
**Internship**

**Course Outcome Summary**

**Course Information**

<table>
<thead>
<tr>
<th>Organization</th>
<th>South Central College/Dunwoody</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developers</td>
<td>Doug Laven, E.J. Daigle</td>
</tr>
<tr>
<td>Development Date</td>
<td>9/19/2011</td>
</tr>
<tr>
<td>Course Number</td>
<td>In accordance with college policy</td>
</tr>
<tr>
<td>Potential Hours of Instruction</td>
<td>A minimum of 8 weeks</td>
</tr>
<tr>
<td>Total Credits</td>
<td>Determined by the college</td>
</tr>
</tbody>
</table>

**Description**

This course is an eight week paid internship designed to facilitate learning in the manufacturing environment. Course competencies are developed and approved as a cooperative learning contract between employer, student and course instructor. Students are required to perform bi-weekly reports and a final presentation to present their individual learning competencies to the rest of their class. Instructors make at least two site visits during the eight week internship to assess progress.

<table>
<thead>
<tr>
<th>Instruction Type</th>
<th>Contact Hours</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practicum/Internship</td>
<td>TBD</td>
<td>TBD</td>
</tr>
</tbody>
</table>

**Textbooks**

Internship Handbook – Developed by the college and Includes Learning Contract that must be approved prior to starting internship.

**Exit Learning Outcomes**

**Core Abilities**

A. Critical Thinking
B. Professionalism
C. Mechanical Aptitude: Determine the Proper Method/Equipment to Manufacture and Measure Characteristic of a Part
D. Technological Literacy
E. Recognize and Avoid Shop Hazards

**Competencies**

1. Demonstrate applicable shop safety standards
2. Operate CNC equipment to produce real-world product
3. Inspect parts for quality
4. Other competencies as laid out in learning contract