

Chicago Manufacturing Technology Bridge Curriculum

Connecting Chicago residents to manufacturing jobs with a future

Partners

Richard J. Daley College
Instituto del Progreso Latino
UIC Great Cities Institute
Illinois Institute of Technology
Chicago Manufacturing Center

Revision 2.9.99

For more information contact

Davis Jenkins, UIC Great Cities Institute ♦ (312) 996-8059 ♦ davis@uic.edu

A decorative graphic for the foreword, featuring a grey rectangular box with rounded corners and a white border. The word "Foreword" is written in a black, italicized serif font inside the box. The box has a slight shadow and a small tab-like detail on the top right corner.

Foreword

If you ask employers what they are looking for in a new hire they will no doubt say, "Someone who is trainable and has a good work ethic." For training providers, particularly curriculum authors, this is not much to go by. Yet from the employers viewpoint, in particular the Human Resource managers, these are the key issues.

Many new hires, especially young adults, don't make it through probation. Others may pass their 90-days but can't seem to advance. It is especially frustrating for shop floor supervisors in metalworking companies when new hires can't learn to use a dial caliper or when they repeatedly make mistakes filling out job forms. "It's just common sense and these kids don't have it," one press room leader said. "Common sense" is based on common experience. Nearly all of the young people filling entry-level jobs in metalworking have no manufacturing experience. What's more, their parents also lack such experience. Add to this the handicap of low communications skills and you have a prescription for failure.

The "untrainable" new hires not only fail in formal training classes, but also fail at the most important kind of training, the informal, daily on the job training that every employee must have to move on to the next task. This blocks any advance for the new hire and puts the employer in a vice between workers stuck at entry level skills and an ever-increasing need for skilled employees.

As if the current skills shortage is not enough, the rise of modern quality systems (such as QS-9000) requires employers to train their shop workers to meet the new standards. At the same time, these new standards are placing further demands on production employees such as SPC charting and participation in cross-functional teams such as corrective action teams and production pre-launch meetings. Thus, the needs for communication and teamwork skills are rising along with the need for technical skills.

The integrated curriculum presented here not only addresses the need for fundamental shop skills like math, print reading and machine operation, it also stresses work ethics, time-management, communication skills, conflict resolution and teamwork. Our goal is to lay a foundation that can develop into advanced technical and leadership skills. Students will develop self-confidence as they succeed in attaining technical competencies and basic academic skills. Building on this success, we can encourage and promote lifelong learning that will lead to advanced careers.

It is our hope that our graduates will not only find good jobs in manufacturing, but good careers.

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Bridge Project • Curriculum Competency Matrix

	Speaking & Communicating	Listening	Critical Thinking & Problem Solving	Reading in the Workplace	Writing in the Workplace	Vocabulary & Spelling	Teamwork	Workplace Safety	Time Management	Workplace Technologies	Employability Skills
Counseling & Career Development	X	X	●	●	●	●	X	X	X	●	X
Workplace Communications	X	X	●	X	X	X	X	●	X	X	X
Workplace Mathematics	●	X	X	X	●	X	X	●	X	X	X
Principles of Technology	●	X	X	X	●	X	X	X	X	X	X
Machining & Metrology	●	X	X	X	●	●	X	X	X	X	X
Industrial Computer Applications	●	X	X	X	X	X	●	●	●	X	X
Print Reading	●	X	X	X	●	X	X	●	●	X	X

KEY:

X = Primary Element

● = Secondary Element

Course Syllabus

___	16 Weeks	Instructor:	<u>TBA</u>
___	8 Weeks	Department:	<u>Manufacturing Technology / Bridge Program</u>
<u>X</u>	Other	Semester:	<u>1&2</u>
	Course Title:	<u>Counseling & Career Development</u>	
	Course Number:	<u>Counseling 111</u>	
	Contact Hours:	<u>1 Credit Hour</u>	

Course Description

This course will help the student to assess his interests, aptitudes, and abilities in order to establish appropriate career goals. Introduces career exploration activities and career development tools. Investigates workplace trends and employability skills.

Instructional Methods

X Lecture X Discussion ___ Laboratory X Other(Seminar)

Course Objectives in Measurable Terms

Students will formulate a career plan, learn key competencies for success in the work world, prepare a resume and portfolio for industry, participate in a mock job interview, and receive individual career counseling. Students will concentrate on improving self-management, problem-solving, and communication.

Required and/or Recommended Reading List

1. The Mindful Worker: Learning and Working into the 21st Century
Curtis Miles, H&H Publishing Company

Additional Instructional Aids

1. TABE exam
2. Meyers- Briggs Career Inventory
3. Counselor Prepared Handouts and Worksheets
4. Notebook and Career Technical Assessment Portfolio
5. Job/Career Ladder Profiles
6. Current Labor Market Analysis
7. Evaluation Reports for Individual Case Studies
8. SCANS competencies

Grade Determination Factors

1. Pre/post tests
2. Seminar participation
3. Attendance and punctuality
4. Career Technical Assessment Portfolio
5. Homework and notebook review
6. Final exit interview

Course Outline

Instructor:	<u>TBA</u>
Course:	<u>Counseling and Career Development</u>
Semester	<u>1 & 2</u>

Principal Topics Covered and Approximate Timeline

- TABE Testing and Program Orientation
- Meyers-Briggs Career Inventory; Individual Conferences with Counseling Team
- Positive Personal Traits: Flexibility, Responsibility, Honesty, Dependability
- Career Exploration and Assessment; Formulating a Career Plan
- Time Management, Study Skills, and Motivation
- Problem-Solving Strategies
- Pre-Employment Screening and Testing
- Starting a New Job: Listening to Directions
- Upgrading and Changing Jobs: Promoting Continuous Job Skills Enhancement
- Evaluating Individual Performance: Setting Goals and Objectives for Life-long Learning

Grade Determination Factors

1. Tests and quizzes on competencies
2. Class participation and “shop talks”
3. Attendance and punctuality
4. Career Technical Assessment Portfolio
5. Homework and class log
6. Class projects

Course Outline

Instructor:	<u>TBA</u>
Course:	<u>Industrial Computer Applications</u>
Semester	<u>1 & 2</u>

Principal Topics Covered and Approximate Timeline

Week 1 Basic Concepts

- A. Information systems
 - information, data
 - analog, digital
 - computer
 - input, output
 - network
 - user, user interface
- B. Computers
 - hardware/software
 - CPU
 - peripheral device
 - program
 - memory

Personal Computers (PCs): What's Inside (Hands-On Lab)

- A. Main unit
 - microprocessor (CPU)
 - RAM, ROM
 - hard disk
 - keyboard, keypad
 - monitors, touchscreens
 - mouse, trackball, trackpad
 - floppy disk drive, CD-ROM drive
 - network interface
- B. Peripheral Devices
 - printers
 - modems, faxmodems
 - scanners
 - card readers

Week 2 Organizing and Moving Information (Hands-On Lab)

- A. Organization of Information in the Computer
 - document, file
 - directory, folder
 - volume, drive
- B. Sharing Information Among Computers
 - floppy disks, CD-ROMs, cartridges
 - local area networks (LAN), file servers
 - wide area networks (WAN), intranets, host computers
 - the Internet: backbone, nodes, Internet service provider (ISP)
- C. Long-Term Storage and Archiving of Information
 - local backup storage
 - network file server backups
 - archiving

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Software Basics

- A. Types of software and their inter-relationships
 - data
 - operating systems
 - applications
 - plug-ins, extensions
 - viruses
- B. Applications and their purposes
 - word processors
 - spreadsheets
 - browsers
 - communications, fax, e-mail
 - drafting, graphic design
 - audio-visual
 - proprietary and custom programs
 - security, virus protection
 - general utilities, screen savers
 - games, entertainment

Week 3 Using Computers I (Lab Exercises)

- A. Terminal interfaces (less frequently used)
 - navigation: special keys, cursor, highlight
 - visual format: individual alphanumeric and graphic characters, contrived graphics
 - control: typed commands, function keys
 - manipulation: delete, overwrite
 - data entry fields
- B. Graphical interfaces (commonly used)
 - navigation: terminal plus mouse, trackball, trackpad
 - visual format: desktop, icons, windows (opening, closing, resizing, scrolling), detailed graphics
 - control: menus, buttons, checkboxes, slide controls, arrays and maps
 - manipulation: selection, cut/copy/paste, "drag-and-drop"
- C. Browser interfaces
 - pages, panes
 - text fields
 - static/animated graphic fields
 - hypertext links

Week 4 Using Computers II (Lab Exercises)

- D. Common practices and procedures
 - system startup/restart
 - system security and virus check operations
 - launching/opening applications
 - opening documents
 - entering and saving data
 - exiting/quitting applications
 - connecting to networks and Internet
 - uploading, downloading
 - backing up, archiving
- E. Common problems and pitfalls: symptoms, avoidance, and recovery
 - system freeze
 - unreadable file/document
 - damaged disk
 - network down
 - virus infection

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Week 5 Using Applications I (Lab Exercises)

- A. Working with Microsoft® WORD-97
- create, print, and save
 - text removal/replacement/relocation
 - changes in font, point size, style, margins, line spacing, headers/footers
 - spell check, pagination
 - column/table entries
 - project: Resume

Week 6 Using Applications II (Lab Exercises)

- B. Working with Microsoft® EXCEL spreadsheet
- creating, printing, saving documents
 - cell data entry
 - cell relocation, cell formatting
 - formulas
 - sorting
 - project: Payroll Spreadsheet

Week 7 Using E-Mail and the Internet (Lab Exercises)

- C. Working with e-mail
- creating and sending messages
 - retrieving and printing messages
 - storing and filing messages
 - e-mail directories
 - e-mail privacy and security
 - responsible use of e-mail
- D. Using the Internet
- Internet organization: domains, universal resource locators (URL)
 - the World Wide Web (WWW)
 - organization of websites: homepages, internal links, external links
 - using and organizing bookmarks
 - connecting to the Internet
 - privacy and security
 - responsible use of the Internet

Week 8 Special Project

Career Technical Assessment Portfolio
Skills developed during this course are applied to the development of an attractive portfolio. The portfolio will include information and work product developed in this and other courses within the curriculum, as well as information and graphics obtained via the Internet. The format will include text, information tables and/or graphs, and graphic elements.

Course Syllabus

<u>X</u>	16 Weeks	Instructor:	<u>TBA</u>
___	8 Weeks	Department:	<u>Manufacturing Technology / Bridge Program</u>
___	Other	Semester:	<u>Ongoing</u>

Course Title: Machining and Metrology
 Course Number: Manufacturing Technology 111; Manufacturing Technology 112
 (See NOTE)
 Contact Hours: 88 Contact Hours /5 Credit Hours

Course Description

This course combination introduces the basic tools, safety, and technical information required for work in the machine tool and related industries. Students will learn basic machining operations with lathes, drill presses, pedestal grinders, and milling machines. Safety procedures, shop practices, and proper use of micrometers and calipers are also covered.

The courses cover reading and interpreting blueprints, setting up machines to meet the quality requirements of the blueprints, and machining parts or stock to standard tolerances within two thousandths of an inch. Basic operations such as grinding, facing, turning, boring, knurling, chamfering, center drilling, tapping, grooving, cutting tapers, and adjusting feeds and speeds are covered. The student will be taught to mill flat, square surfaces and to cut slots. The use of layout tools, measuring tools, and hand tools will be emphasized.

NOTE: Courses #111 and #112 will be taught concurrently. Course #111 is an introductory course which emphasizes safety procedures and prepares the student for basic machining. Course #112 introduces the student to actual hands-on work with lathes, drill presses, milling machines, and pedestal grinders. Both courses are taught on the same day, in succession.

Instructional Methods

X Lecture X Discussion X Laboratory ___ Other

Course Objectives in Measurable Terms

1. Upon completion of these courses, given a part blueprint, the student will be able to complete in two to four hours a workpiece requiring from six to ten separate machining operations, achieving dimensional tolerances on specified features of the workpiece to 0.015 inch or better. Machining operations will include four or more of the following: grinding, turning, facing, plain surface milling, drilling, tapping, thread cutting. The student will demonstrate knowledge and practice of appropriate safety procedures and shop practices.
2. Upon completion of these courses the student will be proficient in the following Illinois Occupational Skill Standards:
 - Skill Objective 1: Job Process Planning*
Develop a process plan for a part requiring milling, drilling, turning, or grinding operations. Develop an operation sheet detailing the process plan and required speeds and feeds.
 - Skill Objective 2: Manual Operations Bench Work*
Tap holes and use files, scrapers and coated abrasives to debur parts. Use arbor presses to perform press fitting. Use bench vises and hand tools appropriately.
 - Skill Objective 3: Manual Operations: Layout*
Lay out the location of hole centers and surfaces within an accuracy of +/-0.015 inch.
 - Skill Objective 5: Turning Operations: Chucking*
Perform setup and chucking operations for turning using 3- and 4-jaw chucks and collets.
 - Skill Objective 10: Drill Press Operation*
Set up and operate drill press and perform routine drilling operations.
 - Skill Objective 11: Power Saw Operation*
Set up and operate power saw for cut-off operation.
 - Skill Objective 16: General House Keeping and Maintenance:*
Keep duty station clean and safe for work; keep tools, work benches, and manual equipment clean, maintained and safe for work.
 - Skill Objective 17: Preventive Maintenance, Machine Tools*
Perform routine preventive maintenance, including common adjustments.
 - Skill Objective 18: Tooling Maintenance*
Inspect and assess the condition of tooling. Refurbish tooling where appropriate; refer tooling for repair or grind where appropriate.
 - Skill Objective 19: Machine Operations and Material handling*
Adhere to safe practices in accordance with Occupational Safety and Health Administration (OSHA) requirements and guidelines. Document safety and activities as required.
 - Skill Objective 20: Hazardous Materials, Storage & Handling*
Store hazardous materials as assigned while adhering to safe practices per OSHA and EPA.

Required and/or Recommended Reading List

1. Machining Fundamentals
John R. Walker, Goodheart-Willcox Company, Inc.

Additional Instructional Aids

1. Instructional handouts
2. Working drawings and instruction sheets
3. OSHA approved safety glasses
4. Tool box including mike, scale, dial caliper, & protractor
5. Calculator

Grade Determination Factors

1. Written exams involving measurement, terminology, and processes.
2. Quizzes on competencies
3. Class participation and “shop talks”
4. Steps and procedures regarding hammer project for Career Technical Assessment Portfolio
5. Homework and class log
6. Lab projects

Course Outline

Instructor:	<u>TBA</u>
Course:	<u>Machining and Metrology</u>
Semester:	<u>Ongoing</u>

Principal Topics Covered and Approximate Timeline

- Week 1 Orientation to facility and instructional program and demonstration of equipment Introduction to machining processes, occupations, and shop safety
- Week 2 Introduction to technical drawings: geometric dimensioning and tolerancing
- Week 3 Measurement: using rulers, micrometers, vernier calipers, gages, and dial indicators
- Week 4 Introduction to layout work
- Week 5 Hand tools, fasteners, and drilling
- Week 6 Offhand grinding and sawing
- Week 7 Analysis of the lathe
- Week 8 Review and Midterm Exam
- Week 9 Lathe operations
- Week 10 Hammer Project (Hammer Head): Steps and Procedures for CTAP Portfolio
- Week 11 Hammer Project (Hammer Handle): Steps and Procedures for CTAP Portfolio
- Week 12 Hammer Project (Hammer Shaft): Steps and Procedures for CTAP Portfolio
- Week 13 Analysis of the milling machine
- Week 14 Milling machine operations
- Week 15 Introduction to Computer Numerical Control technology and quality control techniques
- Week 16 Review and Final Exam

Course Syllabus

<u> </u>	16 Weeks	Instructor:	<u> TBA </u>
<u> X </u>	8 Weeks	Department:	<u> Manufacturing Technology / Bridge Program </u>
<u> </u>	Other	Semester	<u> 1&2 </u>

Course Title:	<u> Print Reading </u>
Course Number:	<u> Manufacturing Technology 102 </u>
Contact Hours:	<u> 32 contact hours </u>

Course Description

Through sketching and other techniques, students will learn to visualize three-dimensional objects from two dimensional prints to demonstrate understanding of different types of lines and views, the projection of various shapes and surfaces, the depiction of dimensioning, tolerances, surface texture, threads, fasteners, and gears.

Instructional Methods

 X Lecture X Discussion Laboratory Other

Course Objectives in Measurable Terms

Given a basic print, the student will have a basic understanding of lines and views, geometric dimensioning and tolerancing practices, and essential blueprint reading skills and freehand technical sketching techniques used in analyzing industrial drawings.

Required and/or Recommended Reading List

1. Basic Blueprint Reading and Sketching
Dr. C. Thomas Olivo and Thomas P. Olivo, Delmar Publishers, Inc.

Additional Instructional Aids

1. Basic Principle Series Transparencies
2. Industrial Drawings Supplement
3. Instructional Handouts
4. Drafting Essentials
5. Calculator

Grade Determination Factors

1. Tests and quizzes
2. Class participation and "shop talks"
3. Attendance and punctuality
4. Career Technical Assessment Portfolio Drawings
5. Homework and notebook organization

Course Outline

Instructor:	<u>TBA</u>
Course:	<u>Print Reading</u>
Semester	<u>1 & 2</u>

Principal Topics Covered and Approximate Timeline

- Week 1 Orientation: Organization and Time Management, Equipment and Materials, Work Ethic Standards and Common Elements in Drafting
- Week 2 Analysis of Basic Lines: object lines, hidden and center lines, extension and dimension lines, projection lines, and other lines used in combination
- Week 3 Ability to Understand Various Spatial Views
- Week 4 Dimensions, Tolerances, and Notes
- Week 5 The SI Metric System
- Week 6 Drawing Sections
- Week 7 Technical Sketching and Basic Forms
- Week 8 Pictorial Drawings and Introduction to CAD

Course Outline

Instructor:	TBA
Course:	Principles of Technology
Semester	1 & 2

Principal Topics Covered and Approximate Timeline

- Week 1 Course Overview; Lab Orientation; Concept of Force
- Week 2 Mechanical Force: Units, Balanced/Unbalanced Forces, Stress/Strain, Springs, , Linear/Rotational Motion, Torque, Measurement, Control; Math Skills: Scalars/Vectors, Using Related Formulas
- Week 3 Fluid Force: Units, Liquid/Gas Systems, Absolute/Gage Pressure, Flow, Density, Specific Gravity, Measurement, Control; Math Skills: Using Related Formulas
- Week 4 Electrical Force: Units, Voltage, Sources, AC/DC Voltage, Current, Series/Parallel Circuits, Measurement, Control; Math Skills: Graphs, Using Related Formulas
- Thermal Force: Units, Temperature, Heat & Molecular Motion, Farenheit/Celsius, Thermocouples, Measurement, Control; Concept of Work; Math Skills: Using Related Formulas
- Week 5 Mechanical Work: Units, Relation to Force, Rotational Systems, Pulleys & Winches, Efficiency, Effects & Applications; Math Skills: Radian Angles, Using Related Formulas
- Week 6 Fluid Work: Units, Relation to Pressure, Open/Closed Systems, Efficiency, Effects & Applications; Math Skills: Using Related Formulas
- Week 7 Electrical Work: Units, Relation to Voltage, Electrical Charge, Solenoids, Motors, Efficiency, Effects & Applications; Concept of Rates; Math Skills: Reading Multimeters, Using Related Formulas
- Week 8 Mechanical Rates: Units, Speed/Velocity, Acceleration, Linear/Rotational Systems, Measurement, Control, Applications; Math Skills: Using Related Formulas
- Week 9 Fluid Rates: Units, Volume/Mass Flow, Liquid/Gas Systems, Measurement , Control, Applications; Math Skills: Scientific Notation, Using Related Formulas
- Week 10 Electrical Rates: Units, AC/DC Current, Frequency/Period, Measurement, Control, Applications; Math Skills: Oscilloscope Measurements, Using Related Formulas
- Thermal Rates: Units, Heat Flow, Heat Capacity/Specific Heat, Latent/Sensible Heat, Measurement, Control, Applications; Math Skills: SI Unit Prefixes, Using Related Formulas
- Week 11 Concept of Resistance; Mechanical Resistance: Units, Static/Kinetic Friction, Controlling Friction, Measurement, Control, Applications; Math Skills: Using Related Formulas
- Week 12 Fluid Resistance: Units, Drag, Laminar/Turbulent Flow, Pipe Flow, Pressure Drop, Controlling Resistance, Measurement, Applications; Math Skills: Using Related Formulas
- Week 13 Electrical Resistance: Units, Ohm's Law, Conductivity/Resistivity, Series/Parallel Circuits, Circuit Diagrams, Resistors, Measurement, Control, Applications; Math Skills: Using Related Formulas
- Week 14 Thermal Resistance: Units, Conductivity, Insulation R-Factor, Controlling Resistance, Measurement, Applications; Summary of Resistance; Math Skills: Using Related Formulas

Course Outline

Instructor:	<u>TBA</u>
Course:	<u>Workplace Communications</u>
Semester	<u>1 & 2</u>

Principal Topics Covered and Approximate Timeline

- Week 1 Ethical Decisionmaking and Leadership: The Power of Insight
- Week 2 Positive Personal Traits: Flexibility, Responsibility, Honesty, Dependability
- Week 3 Studying and Test-Taking Techniques
- Week 4 Reading, Listening, and Critical Thinking Skills
- Week 5 Workplace Writing: Preparing Resumes, Memos, Forms, Letters
- Week 6 Editing: Grammar, Mechanics, Spelling, Vocabulary
- Week 7 Speaking Skills and Strategies for Job Interviews
- Week 8 Graphic Interpretation in the Manufacturing Environment
- Week 9 Preparation of the Career Technical Assessment Portfolio for Industry
- Week 10 Communicating in the Workplace; Working in Teams
- Week 11 Conflict/ Resolution
- Week 12 The Work Ethic: Productivity
- Week 13 Communications in Problem-Solving
- Week 14 Employer Expectations: Review of SCANS Competencies

Course Syllabus

<u>X</u>	16 Weeks	Instructor:	<u>TBA</u>
___	8 Weeks	Department:	<u>Manufacturing Technology / Bridge Program</u>
___	Other	Semester	<u>1&2</u>

Course Title:	<u>Workplace Mathematics</u>
Course Number:	_____
Contact Hours:	<u>56 contact hours</u>

Course Description

This course will review arithmetic operations with whole numbers, common fractions and decimals to four places. It will cover in depth squares and square roots, basic plane geometry, operations with signed numbers, and an introduction to analytical geometry and trigonometry as they apply to CNC machining. It will also introduce statistical methods in preparation for future SPC (Statistical Process Control) training

Instructional Methods

X Lecture X Discussion X Laboratory ___ Other

Course Objectives in Measurable Terms

Students completing this course will:

1. Be proficient in arithmetic with decimals to four places and unintimidated by five and six place decimals (micro inches).
2. Be proficient in arithmetic with common fractions (halves, fourths, eighths, 16ths, 32nds and 64ths) and able to convert them to decimal numbers.
3. Be proficient with scientific calculators including calculations with fractions, basic statistical functions, and trig. functions.
4. Be able to perform the math calculations necessary for interpreting piece-part blueprints including tolerance calculations, geometric (especially angular) relationships, metric to inch conversions, and (sheet metal) bend allowances.
5. Be able to perform the math calculations necessary for reading a 0-1" micrometer, 6" dial calipers, 6" scale (4R or 16R gradations), metal protractor and a vernier height gage.
6. Develop problem solving abilities that, combined with computational skills, will enable students to solve shop problems regarding coil progression, tap drill size and depth, feeds and speeds, and material handling.
7. Be able to apply the Pythagorean theorem and the basic trig functions (sine, cosine, tangent) to solve at least one advanced shop problem (e.g. bolt-hole circles, CNC coordinates for angled cuts, blend radius tangent points).
8. Demonstrate an understanding of averaging and centering in statistical process control and be able to calculate n-1 standard deviations with a scientific calculator.
9. Be able to create charts from collected data and offer interpretations. Students will be able to complete an X-bar and R chart for SPC.

Required and/or Recommended Reading List

1. Workforce Mathematics I
Center for Occupational Research and Development; CORD
2. Workforce Mathematics II
Center for Occupational Research and Development; CORD

Additional Instructional Aids

1. Scientific calculator (e.g. Texas Instrument TI-30)
2. Instructional handouts
3. Notebook
4. Measuring tools: 0-1" micrometer, 6" dial calipers, 6" scale (4R), 24" scale (16R)
5. Sargent Welch Workforce Mathematics Laboratory Equipment.

Grade Determination Factors

1. Attendance and punctuality
2. Notebook
3. Graphs for Career Technical Assessment Portfolio
4. Exams and quizzes
5. Homework

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6. Group lab project

Course Outline

Instructor:	<u>TBA</u>
Course:	<u>Workplace Mathematics</u>
Semester	<u>1 & 2</u>

Principal Topics Covered and Approximate Timeline

- Week 1 Introduction: Math in metalworking. Review arithmetic of whole numbers. Introduce scientific calculator, memory functions.
- Week 2 Rules for decimal addition and subtraction. Caliper math worksheet. Repetitive calculations with scientific calculator. Rules for decimal multiplication and division. Micrometer math worksheet. Material handling problems with band saw and shear: calculating blank sizes before fabricating.
- Week 3 Fractions. What is a fraction? Rules for fraction multiplication and division. Rulers and the ruler fractions. Common Denominators, Lowest Common Denominator. Addition and subtraction with fractions. Ruler worksheet (64ths), caliper math worksheet for fractions. The fraction keys on the scientific calculator.
- Week 4 Shortcuts for machinists (LCD is easy). Abolishing fractions in the workplace: Converting fractions to decimals with calculators and with decimal equivalent charts. ANSI standards and industry practice re: fractions. Converting any decimal to the closest ruler fraction. Applications: sizing drills with charts.
- Week 5 Tolerances: bilateral, unilateral and basic. Decimal and Fraction problem solving with live problems taken from prints of partnering companies and industry contacts. Converting millimeters to inches. More reading charts: Rockwell hardness conversions.
- Week 6 Squares and Square Roots. The Pythagorean theorem. Using formulas. Application: finding minimum size of bar stock for a milling project. Charting: make a table of squares and square roots.
- Week 7 Review, Midterm Exam
- Week 8 Triangles and right triangles: 45 degree right triangle, 3-4-5 triangle, 30-60-90 triangle. Application: chamfer problems.
- Week 9 Introducing trigonometry: sine, cosine, tangent and "SOHCAHTOA." Using formulas: rearranging. Solve triangles.
- Week 10 Problem solving with trig: find the triangles first, then solve them. Applications: center drilling, more chamfer problems, taper problems.
- Week 11 Introduction to analytical geometry. Signed numbers. Rules for negative numbers. Charting pairs of numbers, CNC coordinate systems. Application: bolt-hole circles, and for advanced students, the blend radius problem.
- Week 12 Introduction to statistics: mean and median and standard deviation. Finding the center of the data points vs. measuring how dispersed they are. Calculate mean by hand. Calculate mean and standard deviation with calculator.
- Week 13 What is SPC? Filling out an "X-bar and R" chart. Finding trends in SPC chart. Make graphs with data from real measurements.
- Week 14 Finish portfolio of graphs. Review, Final Exam.