Course Outline

General Information

COURSE ID (CB01A AND CB01B)

DMT 80

COURSE TITLE (CB02)

Introduction to Machining and CNC Processes

COURSE CREDIT STATUS

Credit - Degree Applicable

EFFECTIVE TERM

Fall 2023

COURSE DESCRIPTION

Manufacturing lab safety. Precision measuring tools and practices. Basic manual machine operations: pedestal grinders, drill presses, saws, lathes and milling machines. Threads: types, applications and use of taps and dies. Computer Numerical Control (CNC) mills: axis moves, cutters, tooling, basic setup and controller function. Cutter speed and feed calculations.

FACULTY REQUIREMENTS

COURSE FAMILY

Not Applicable

Course Justification

Introduction to Machining and CNC Processes is an employment preparation course for our Design and Manufacturing Technologies day and evening programs. This CTE, CSU transferable course is intended to better prepare students for work in the advanced manufacturing and machining industry as an entry-level machinist and/or CNC operator as advised by our industry advisory committee. This course is also a part of the CNC/Research & Development Machinist degree and certificate in the Design and Manufacturing Technologies program.

Foothill Equivalency

DOES THE COURSE HAVE A FOOTHILL EQUIVALENT?

No

FOOTHILL COURSE ID

Formerly Statement

FORMERLY STATEMENT	(Formerly MCNC 71)

Course Development Options

BASIC SKILL STATUS (CB08)

Course is not a basic skills course.

GRADE OPTIONS

- Letter Grade
- Pass/No Pass

REPEAT LIMIT

0

Transferability & Gen. Ed. Options

Information below is subject to change. For the official listing of courses, their approval dates, and transfer credit limitations, check the De Anza catalog (by academic year), ASSIST.ORG (https://assist.org/) and C-ID.NET (https://c-id.net/).

TRANSFERABILITY

Transferable to CSU only

Units and Hours

Summary

MINIMUM CREDIT UNITS	5.0
MAXIMUM CREDIT UNITS	5.0

Weekly Student Hours

Type	In Class	Out of Class
Lecture Hours	3.0	6.0
Laboratory Hours	6.0	0.0

Course Student Hours

COURSE DURATION (WEEKS)

12.0

HOURS PER UNIT DIVISOR

36.0

Course In-Class (Contact) Hours

LECTURE

36.0

LABORATORY

72.0

TOTAL

108.0

Course Out-of-Class Hours

LECTURE

72.0

LABORATORY

0.0

NA

0.0

TOTAL

72.0

Prerequisite(s)

Corequisite(s)

Advisory(ies)

- ESL 261 and ESL 265, or ESL 461 and ESL 465, or eligibility for EWRT 1A or EWRT 1AH or ESL 5
- Pre-algebra or equivalent (or higher), or appropriate placement beyond pre-algebra

Limitation(s) on Enrollment

Entrance Skill(s)

General Course Statement(s)

Methods of Instruction

Lecture and visual aids
Discussion of assigned reading Quiz and examination review performed in class Laboratory experience which involve students in formal exercises

Assignments

A. Lab projects demonstrating mastery of skills using the machines and equipment covered in this course.
B. Take home worksheets involving feed, speed and dimensional calculations.
C. Reading from textbook and trade references.

Methods of Evaluation

A. Objective examinations consisting of material from lecture and lab demonstrations evaluated for correctness and completion.
B. In-class quizzes evaluated for applying proper speed, feed and other technical data based on lecture material and lab activities.
C. Completion and accuracy of take-home worksheets.
D. Manufacturing rubric used to evaluate and inspect laboratory projects and exercises.
E. A comprehensive, objective final exam that requires students to critically analyze and apply concepts examined throughout the course.

Essential Student Materials/Essential College Facilities

Essential Student Materials:

- Machinist's apron (recommended) - type that ties in the back with swing pocket

Essential College Facilities:

- Conventional machine tool manufacturing lab

Examples of Primary Texts and References

Author	Title	Publisher	Date/Edition	ISBN
Peter Hoffman, Eric Hopewell, Brian Janes and Kent Sharp, "Precision Machining Technology 2nd Edition" New York: Delmar, Cengage Learning, 2015.				
DMT staff: "Manufacturing and DMT 80 Syllabus," De Anza College, Cupertino, CA: 2018.				

Examples of Supporting Texts and References

Author	Title	Publisher
Jones, Franklin and Erik Oberg, "Machinery's Handbook 30th edition" New York: Industrial Press, 2016.		

Learning Outcomes and Objectives

Course Objectives

- Demonstrate safe manufacturing lab practices.
- Interpret and record measurements made with precision measuring tools.
- Select and use hand tools properly; explain thread systems, application and thread forming procedures.
- Perform basic set-ups and operations on pedestal grinders.
- Set-up and perform basic operations on drill presses.
- Calculate and apply cutting tool speeds and feeds.
- Apply basic set-ups and operations on lathes; explain characteristics of lathe cutting tools.
- Select vertical milling machine cutting tools and perform basic machining operations.
- Explain the processes of a CAM (Computer Aided Manufacturing) system.
- Explain basic CNC system components, axis movements, and controller operations.

CSLOs

- Analyze, construct, and inspect assigned machined projects using the introductory principles of machining.
- Operate machines and equipment safely.

Outline

A. Demonstrate safe manufacturing lab practices.
    1. Hand tools.
    2. Powered machine tools.
    3. General shop.
B. Interpret and record measurements made with precision measuring tools.
    1. Gage blocks and micrometer standards.
    2. Measurement calculations.
        a. Decimal equivalents.
        b. Metric/English conversions.
    3. Dimensioning nomenclature.
        a. Basic dimensions.
        b. Tolerance.
            1. Bilateral/unilateral.
            2. High/low limits.
    4. Scaled measuring tools.

a. Steel rules.
b. Vernier calipers.
c. Plate protractors.

5. Precision measuring tools.
    a. Micrometers.
        1. Advantages and disadvantages.
        2. Calibration and care.
        3. Outside (1-12 inch).
        4. Depth.
        5. Specialty types and uses (tube and multi-anvil; blade and flange)
    b. Transfer measuring tools.
        1. Small hole gages.
        2. Telescoping gages.
    c. Vernier protractor.
    d. Fixed gages.
        1. Advantages and disadvantages.
        2. Materials and construction.
        3. Types and selection (plug, ring and snap gage, thread plug; thread plug and ring gage).
    e. Indicators.
        1. Travel (dial indicators); use, components, care and attachements.
        2. Test indicators: use, components, care and attachments; cosine error.
        3. Dial bore.

C. Select and use hand tools properly; explain thread systems, application and thread forming procedures.
1. Hammers - soft and hard face.
2. Clamps - "C" and parallel.
3. Wrenches.
    a. Adjustable.
    b. Open end and box.
    c. Allen.
4. Screwdrivers.
5. Hacksaw.
    a. Set.
    b. Pitch.
    c. Kerf.
    d. Blade materials.
    e. Use and techniques.
6. Files - types, shapes, sizes, tooth patterns.
7. Layout.
    a. Layout dye - application.
    b. Tools - scribes, combination squares, dividers, prick and center punches.
    c. Layout table and precision height gage.
8. Threads and threading.
    a. Overview of thread systems and uses.
        1. Metric.
        2. Unified, American National Standard: series; size designation.
        3. American National Acme.
        4. Square thread.
        5. British Standard Whitworth Thread.
        6. International Metric Thread (ISO).
        7. Buttress Thread.
        8. Rolled Thread: roll form taps; roll form tap drill sizes.
        9. Pipe.
    b. Thread forming with taps.
        1. Tap types - taper, plug, bottom, spiral point.
        2. Tap drill selection and hand threading.
    c. Thread forming with dies.
        1. Split adjustable.
        2. Screw plate.
        3. Rethreading.
    d. Broken tap removal.
    e. Re-threading dies.

D. Perform basic set-ups and operations on pedestal grinders.
1. Wheel replacement, ring testing and dressing.
2. Guard settings.

E. Set-up and perform basic operations on drill presses.
1. Types, components and applications.
2. Basic set-ups and operations.
3. Speed and feed selection.
4. Twist drills, center drills, reamers, counter bores, countersinks.
    a. Drill sizing system.
    b. Tool nomenclature, shank types, applications.

F. Calculate and apply cutting tool speeds and feeds.
1. Twist drills, center drills, reamers, counter bores, countersinks.
2. Milling cutter RPM and feed rate.
3. Lathe RPM and feed rates.

4. Coolant selection.

G. Apply basic set-ups and operations on lathes; explain characteristics of lathe cutting tools.
   1. Types and applications.
      a. Engine.
      b. CNC-controlled.
   2. Components and size designation.
   3. Definition of operations - turning, tapering, boring, facing, threading, form turning, and knurling.
   4. Spindle nose types.
   5. Tailstock tooling - centers and chucks.
   6. Spindle nose tooling, types and applications.
      a. Three and four jaw chucks.
      b. Collets and closer.
      c. Face plates.
      d. Centers.
      e. Mandrels.
   7. Lathe cutting tools.
      a. Overview of tool materials.
         1. High-speed.
         2. Carbide.
      b. Relief and rake angles for a general purpose tool.
         1. Applications for rake angles (positive and negative).
         2. Application of tool nose radius.
   8. Carbide inserts and holders.

H. Select vertical milling machine cutting tools and perform basic machining operations.
   1. Components and applications.
   2. Basic machine set-ups and machining operations.
   3. Cutting tool selection.
      a. End mills.
      b. Fly cutters.
      c. Form cutters.
   4. Shank types.
      a. End mills.
      b. Ball and corner rounding.
      c. Angle.
      d. Fly cutter.
   5. Arbor driven.
      a. Shell.
      b. Plain.
      c. Side and slitting.
      d. Angular and form.
   6. Offset boring and facing head.
   7. RPM calculation and machine speed setting.
   8. Climb and conventional milling.
   9. Boring operations.
      a. Boring applications and advantages.
         1. Size control, finish, concentricity.
         2. Boring, facing, grooving.
         3. Single point threading.
      b. Boring bars for lathe and basic cutting tool geometry.
      c. Offset boring heads and applications.
      d. Facing heads: uses.

I. Explain the processes of a CAM (Computer Aided Manufacturing) system.
   1. CAD drawing transfer to CNC program.
   2. Tool path generation and code produced by CAM program.
   3. Post processing to G&M code.
   4. Introduction to Computer Numerical Control (CNC).
      a. History.
      b. Relationship to manual machines.
      c. NC machine types and applications.
      d. CNC programmed operations.
         1. Straight and angular moves.
         2. Circular interpolation.
         3. Canned cycles.
         4. Sub routines.

J. Explain basic CNC system components, axis movements, and controller operations.
   1. CNC system components.
      a. Computer.
      b. Drive motor types.
      c. Open and close loop systems.
      d. Feed mechanism types.
         1. Re-circulating ball screws.
         2. Pneumatic and hydraulic.
      e. Data mediums.
         1. One inch tape and readers (historical reference).
         2. USB and floppy disk readers.

3. Manual data input (MDI).
4. Direct numerical control (DNC).

2. Mill axis and machine interpretation.
   a. Cartesian coordinate system.
      1. Mill axis designations (X, Y, Z, A, B, & C).
      2. Four and five axis mills.
   b. Lathe X, Z, U and W axis and machine interpretation.
   c. Incremental and absolute programmed moves.
3. Work holding.
   a. Vise and stop.
   b. Strap and toe clamps.
   c. Collet and V-blocks.
   d. Introduction to fixtures.
      1. Uses and components.
      2. Production milling methods.
   e. String, progressive and reciprocal.
4. Mill CNC controller.
   a. Download from PC.
   b. Zero - return machine.
   c. Basic controller functions.
   d. Use jog functions to accurately locate spindle.
   e. Input and operate in MDI.
   f. Call up and run programs in memory.
   g. Safely test program with single block and adjusted feed rates.
5. CNC mill set-up procedures.
   a. Workpiece/fixture alignment.
   b. Location and setting of workpiece/fixture zero.

Lab Topics

A. Shop safety
B. Precision measuring tools
C. Measuring
D. Hand Tools
E. Drill press operations
F. Lathe operations
G. Milling machine operations
H. CNC and CAM processes