



Credit- Degree applicable
Effective Quarter: Fall 2014

I. Catalog Information

MCNC 71 Introduction to Machining and CNC Processes 4 1/2 Unit(s)

Advisory: English Writing 200 and Reading 200 (or Language Arts 200), or English as a Second Language 261, 262 and 263; Mathematics 210 or equivalent.

Nine hours lecture-laboratory (108 hours total per quarter).

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.

Course Justification: Labor market and job advertising research require a need for basic manufacturing skills offered in this CTE, CSU transferable course. These skills are desirable by our De Anza manufacturing advisory group and is an employable advantage to our new students entering the manufacturing field. This course is also a part of the CNC/Research and Development Machinist degree and certificate in the Manufacturing and CNC Technology program.

Student Learning Outcome Statements (SLO)

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

II. Course Objectives

- A. Demonstrate safe manufacturing lab practices.
- B. Read and record measurements made with precision measuring tools.
- C. Select and use hand tools properly; explain thread systems, application and thread forming procedures.
- D. Perform basic set-ups and operations on pedestal grinders.
- E. Set-up and perform basic operations on drill presses.
- F. Calculate and apply cutting tool speeds and feeds.
- G. Perform basic set-ups and operations on lathes; explain characteristics of lathe cutting tools.
- H. Select vertical milling machine cutting tools and perform basic machining operations.
- I. Explain the processes of a CAM (Computer Aided Manufacturing) system.

- J. Explain basic CNC system components, axis movements, and controller operations.

III. Essential Student Materials

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

IV. Essential College Facilities

A laboratory/classroom equipped with precision measuring tools, machines, and accessories

V. Expanded Description: Content and Form

- A. Demonstrate safe manufacturing lab practices.

1. Hand tools.
2. Powered machine tools.
3. General shop.

- B. Read 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.

- 3 of 8

5. British Standard Whitworth Thread.
6. International Metric Thread (ISO).
7. Butress 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. Perform 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. Run tool tryout 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.

VI. 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.

VII. 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

VIII. Methods of Evaluating Objectives

- A.** Two objective examinations covering lecture material and lab demonstrations.
- B.** In-class quizzes on current and past lecture and lab material.
- C.** Completion of take-home worksheets.
- D.** Evaluation and inspection of laboratory projects and exercises.
- E.** A comprehensive, objective final exam that requires students to critically analyze and apply concepts examined throughout the course.

IX. Texts and Supporting References

A. Examples of Primary Texts and References

- 1. Peter Hoffman, Eric Hopewell, Brian Janes and Kent Sharp, "Precision Machining Technology" New York: Delmar, Cengage Learning, 2012
- 2. MCNC staff: "Manufacturing and CNC 71 Syllabus," De Anza College, Cupertino, CA: 2012.

B. Examples of Supporting Texts and References

- 1. Jones, Franklin and Erik Oberg, "Machinery's Handbook 29th edition" New York: Industrial Press, 2012.