DE ANZA COLLEGE
APPLIED TECHNOLOGY DIVISION
COURSE OUTLINE

Degree Applicable

MANUFACTURING & CNC TECHNOLOGY 71 Effective: Fall 2004

I. Catalog Information

MCNC 71 Introduction to Machining and CNC Processes 4.5 Units

Advisory: EWRT 100A and Reading 201 (or ESL 161-163).

Nine hours lecture/lab

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 functions. Cutter speed and feed calculations.

II. Course Objectives

The student will:

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, applications 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

A. 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. Manufacturing Lab Safety
    1. Hand tools
    2. Powered machine tools
    3. General Shop
B. Measurement and Tolerance
    1. Gage blocks & 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 & disadvantages
2. Calibration & care
3. Outside (1-12 inch)
4. Depth
5. Specialty types & uses
(a) Tube and multi-anvil
(b) Blade and flange
b. Transfer measuring tools
1. Small hole gages
2. Telescoping gages
c. Vernier Protractor
d. Fixed Gages
1. Advantages & disadvantages
2. Materials & construction
3. Types and selection
(a) Plug, ring and snap gage, thread plug
(b) Thread plug and ring gage
e. Indicators
1. Travel (dial indicators)
(a) Use, components, care & attachments
2. Test indicators
(a) Use, components, care & attachments
(b) Cosine error
3. Dial bore

C. Hand Tools
1. Hammers- soft & 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 & Threading
a. Overview of thread systems and uses
1. Metric
2. Unified, American National Standard
(a) Series
(b) 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
(a). Roll form taps
(b). 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. Pedestal Grinders
1. Wheel replacement, ring testing and dressing
2. Guard settings

E. Drill Presses
1. Types, components and applications
2. Basic set-ups and operations
3. Speed & feed selection
4. Twist drills, center drills, reamers, counter bores, countersinks
a. Drill sizing system
b. Tool nomenclature, shank types, applications

F. Cutting Tool/Workpiece Speed and Feed Calculations
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. Lathes
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. 3 and 4 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 & rake angles for a general purpose tool
(1). Applications for rake angles (positive & negative)
(2). Application of tool nose radius
8. Carbide inserts and holders

H. Vertical Milling Machines
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 & 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. CAM (Computer Aided Manufacturing) system and processes overview
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. Computer Numerical Control (CNC)
1. CNC System Components
   a. Computer
   b. Drive motor types
   c. Open and close loop systems
      (1). Transducers
   d. Feed mechanism types
      (1). Recirculating ball screws
      (2). Pneumatic and hydraulic
   f. Data mediums
      (1). 1 inch tape and readers (historical reference)
      (2). Magnetic tape and floppy disk and 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
   a. String, progressive and reciprocal
4. Mill CNC Controller
   a. Down load 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. <u>Assignments</u>

A. Lab projects demonstrating mastery of skills using the machines and equipment covered in this course.
B. Take home worksheets involving calculations
C. Reading from textbooks and references

VII. 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. Completion of laboratory exercises
E. A comprehensive, objective final exam

VIII. Texts and Supporting References

A. Texts:
   1. *Kibbe, Richard, John Neely, Roland Meyer and Warren White. Machine Tool Practices, New York: Wiley & Sons, 2002.
   2. *Engle, Michael, Manufacturing & CNC Staff: Manufacturing and CNC 71 Syllabus. DeAnza College, Cupertino; 2003
B. References:
   1. Jones, Franklin and Erik Oberg: Machinery's Handbook. New York: Industrial Press, 2000.