Degree Applicable

Glendale Community College
April 2012

COURSE OUTLINE

MACHINE TECHNOLOGY 110
Principles of Numerical Control

I. Catalog Statement

Machine Technology 110 is an advanced course in machine technology presenting principles of numerical control, preparation of machining programs and development of control tapes. Design and construction of tools and fixtures, selection and modification of tooling are studied.

Units- 5.0
Lecture Hours- 3.0
Total Laboratory Hours- 6.0
Prerequisite: Machine Technology 102

II. Course Entry Expectations

Skill level ranges: Reading 3; Writing 3; Listening/Speaking 3; Math 4.

III. Course Exit Standards

Upon successful completion of required coursework the student will be able to:

1. Demonstrate an understanding of numerical control programming by completing a series of individual part programs;
2. Demonstrate a knowledge of basic machine operation by performing a series of individual operation on the numerical controlled milling machine;
3. Complete a simple individually designed part following established requirements;
4. Demonstrate critical thinking skills by attaining satisfactory scores on a written quizzes and examinations.

IV. Course Content

Total Contact Hours:

A. General Introduction — 6 **hours**
   1. Scope of curriculum
   2. Course requirements
   3. Grading standards
   4. Methods of work preparation

B. Familiarization — 6 **hours**
   1. Physical machine
   2. Capabilities of control
   3. Limitations of machine functions
   4. Limitations of number of control operations
   5.

C. History of Numerical Control 3 **hours**
1. Vacuum Tube, original method of control
2. Transistor advanced to reduce size
3. Solid-State replacement card simplified repair and updating
4. Advantage in comparison to standard machines
5. Disadvantages-single part production more expensive in some cases

D. Applications 4 **hours**
1. Industries using system for total automation of plants
2. Applications of controls to various machine functions

E. Systems of Measurement 10 **hours**
1. Point-to-Point systems, straight line or single angle
2. Continuous path, capable of all functions including arcs
3. Servo mechanisms which power drive is best
4. Open loop systems - reasons for reduced cost
5. Closed loope systems - reasons for accuracy control

F. Dimensioning 6 **hours**
1. Cartesian coordinate system
2. Datum reference system - single point of reference
3. Delta dimensioning chair-link measurement

G. Machine Positioning 13 **hours**
1. Absolute positioning uses on point-to-point
2. Incremental positioning, uses on contouring system
3. Linear interpolation on straight line system work
4. Circular interpolation used on arcs or circles
5. Pocketing procedure for rough and finish cuts
6. Practice problems

H. Tape and Command Programming l5 **hours**
1. Tape standards for machines
2. Coding of basic commands for tapes
3. Tape types, paper, paper mylar, mylar, aluminum mylar, and magnetic
4. Reader or tape interpret
5. Operational sequence
6. Set-up sheet for operations
7. Coordinate points for reference
8. Tape preparation of key punch
9. Tape proofing on trial run
10. Tape correction as required

I. Tooling Selection and Set-up 12 **hours**
1. .Center cutting drills and end mills
2. Edge cutting shell mills and end mills
3. Point cutting center drills and drills
4. Tool height in relationship to work
5. Tool offsets for cutting
6. Set-up practice

J. Calculation 12 **hours**

1. Develop a boss using mill cutters
2. Develop a pocket using end mills
3. Arc developed using three commands
4. Circle inside and outside
5. Contour inside and outside
6. Radius to radius connecting cut

K. Machine Speeds and Feeds 12 **hours**

1. Economics of various combinations
2. Estimating machining time
3. Cycle time for complete parts
4. Turning on the lathe
5. Milling time for various materials and cutters
6. Rapid feed for positioning
7. Slow feed for exact positioning
8. Practice problems in positioning and cutting

L. Machine Set-Up 16 **hours**

1. When is a fixture needed
2. Clamps-Where to place them
3. Vise, standard jaw and special jaw
4. Tooling plate advantages
5. Where to place the zero point
6. Tool height settings
7. Tool loading for speed
8. Feed setting to reduce cycle time
9. Machine practice

M. Project 20 **hours**

1. Design project
2. Operation sheet for machining
3. Tool preparation
4. Machine set-up for project
5. Test run to check the tape
6. Program correction if required
7. Actual run of project part

N. Inspection of Project 6 **hours**

1. Program log sheet
2. Tooling check for signs of problems
3. Inspection of part for accuracy

V. Methods of Presentation

The following instructional methodologies may be used in the course:

1. lecture/discussion;
2. demonstrations;
3. films;
4. peer learning.

VI. Assignments and Methods of Evaluation

1. Midterm examinations.
2. Project evaluations.
3. Reading assignments.
4. Final examination.

VII. Textbooks

Programming for Numerical Control Machines, Roberts & Prentice, McGraw-Hill Publishing Company, New York City, New York, 1968

Numerical Control Part Programming, James J. Child, Industrial Press, Inc., l973

VIII. Student Learning Outcomes

1. Student will understand the historical and modern applications for machines with counting programs or numerical controls.
2. Student will demonstrate advanced knowledge in machining through individual projects completed during lab hours.
3. Student will design, execute, and analyze in-class project from an educated perspective.
4. Student will improve machining skills with numerical accuracy though course material and laboratory practice.