

SAULT COLLEGE OF APPLIED ARTS & TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

Course Title: COMPUTER NUMERICAL CONTROL

Code No.: MCH 248-6

Program: MACHINE SHOP

Semester: FOUR

Date: JANUARY 1988

Author: GREG WHITE

New: _____ Revision: _____

APPROVED: *R.P. Arzuffo*
Chairperson

Date _____

Course Name

Course Number

TEXT REQUIRED:

COMPUTER NUMERICAL CONTROL by J. Puztai & M. Sava -- Reston Publications.

GOALS:

Designed to acquaint the the student with the more advanced programming methods utilizing absolute and zero shift systems, feed rate per REV., radius and diameter programming using the EMCO training lathe. In order to program on an industrial control, it is imperative that the person be a capable operator. The second portion of the course is designed to acquaint the student with a typical industrial machine tool and control system.

OBJECTIVES:

Student will demonstrate proficiency in programming with G90, G91 -- absolute and incremental systems within a program.

The use of preload registers programmed offset of reference points (G26, G92).

Utilization of G94, G95 -- Feed per minute and feed per revolution within a program.

Radius programming (G24) and the implications

Theory associated with advanced industrial programming techniques.

Perform preventative maintenance and recognize parts of an industrial lathe.

Power up a control, home the machine select various C.R.T. displays and recognize their function and utilization.

Provide a set-up sheet, load and unload programs and set-up tooling to perform a pre-production row.

Utilizing graphics, single block and dry run techniques prepared for a production run.

Evaluate first run and make the necessary tooling and offset changes.

Peform a production run.

Theory associated with above topics.

COURSE CONTENT:

The course content is divided into two distinct areas. The first to satisfy the objectives as set down by the training profile of a machinist, and the second to satisfy industries' need for mechanical manufacturing technicians in the field of numerical control.

OBJECTIVES -- GROUP A

1. PERFORM PREVENTATIVE MAINTENANCE ON N.C./C.N.C. EQUIPMENT
 - check oil levels and lubricate as per maintenance schedule
 - check level of coolant and add as required
 - change/clean air/coolant filters
 - clean tape reader
 - keep N.C. machine clean and perform general housekeeping duties in work area

2. SET-UP N.C. MACHINE TOOL FOR REPEAT PARTS
 - interpret set-up and tooling info
 - interpret drawings and other instructions
 - inspect, assemble and qualify tooling
 - load tooling into machine
 - install workholding devices
 - align machine tool and/or part/fixture to specified relationship
 - load part program into control
 - input offsets
 - read and interpret part program
 - dry-run program
 - methods of loading workpiece
 - adjust tooling and offsets
 - inspect first part

3. OPERATE N.C. MACHINE TOOL
 - inspect and adjust tooling
 - replace worn or damaged tooling
 - activate machine
 - make adjustments to fluid control overrides
 - adjust offsets
 - unloading parts

4. SET-UP AND PROVE N.C. PROGRAM AND TOOLING FOR NEW PART
 - interpret set-up and tooling
 - interpret drawings and process sheets
 - inspect, assemble and qualify tooling
 - load and locate tooling in reference
 - align machine tool/part/tooling to specified relationship
 - input offsets
 - adjust dry run programs with zero offsets
 - run program single cycle
 - validate tool path
 - validate machining sequence
 - check cutting actions
 - validate tool selection
 - edit part program

NOTE: THESE ARE OBJECTIVES AS SET DOWN IN MINISTRY OF SKILLS DEVELOPMENT TRAINING MODULES U861, U862, U863.

OBJECTIVES -- GROUP B

These are designed such that the student would be qualified to begin programming at a junior entry level position. Where as Group A was designed as an operator level, this level would involve program design and implimentation.

By programming for a specific machine and control (C.N.C. lathe/6T FANUC control; C.N.C. machining center/6M FANUC control) the student will develop research and fundamental basic logic skills.

1. PROGRAM COMPOSITION
 - block, word, input format
 - program number (O)
 - sequence number (N)
 - optional block skip (/)
2. DIMENSION WORD
 - absolute, incremental
(X,Y,U,W)
(G90, G91)
 - significant digit
 - program zero point (G50, G92)
 - co-ordinate system and start point
3. FEED FUNCTION
 - rapid traverse rates and movement (G00)
 - automatic acceleration-deceleration
 - constant surface footage (s) G96, G97
 - per minute/per revolution (G94, G95)
4. PREPARATORY FUNCTIONS
 - positioning (G00)
 - linear interpolation (G01)
 - circular interpolation (G02, G03)
 - automatic reference point return (G27, G28, G29, G30)
 - inch/metric conversion (G92, G50)
 - programming absolute zero point (G92, G50)
5. MACHINING CYCLES (LATHE)
 - cutting cycle A (G90)
 - thread cutting cycle (G92)
 - cutting cycle B (G94)
 - multiple repetitive cycles
 - stock removal in turning (G71)
 - stock removal in facing (G72)
 - pattern repeating (G73)
 - finishing cycle (G70)
 - peck drilling along Z-axis (G74)
 - grooving in the X-axis (G75)
 - thread cutting (G76)

6. CONTROL COMMANDS
 - chamfer and corner rounding (K, R)
 - feedrate command switching (G98, G99)
 - constant surface speed control (G96, G97)
 - work co-ordinate system (G54 to G59)

7. MACHINING CYCLES (MACHINING CENTER)
 - highspeed peck drilling (G73)
 - reverse tapping (G74)
 - fine bore cycle (G76)
 - cancel canned cycle (G80)
 - drilling cycle (spot drilling) (G81)
 - drilling cycle (counterboring) (G82)
 - drilling cycle (peck drilling) (G83)
 - tapping cycle (G84)
 - boring cycle (G85, G86)
 - back boring cycle (G87)
 - specialized boring cycle (G88, G89)
 - initial point level and R-point levels in canned cycles

8. SPINDLE SPEED FUNCTIONS
 - S-command
 - constant R.P.M. (G97)
 - surface footage (G96)
 - setting maximum (G50)
 - spindle direction (M03, M04, M05)
 - spindle range (ie. M41)

9. TOOL FUNCTION
 - 2 digit T code
 - 4 digit T code
 - M-codes in conjunction

10. MISCELLANEOUS FUNCTION
 - M-codes
 - M00, M02, M03, M04, M05, M06, M08, M09, M98, M99

11. SUBPROGRAMS
 - preparation
 - execution
 - limiting factors