

**HIGHER TECHNICAL INSTITUTE**

**MECHANICAL ENGINEERING DEPARTMENT**

**DIPLOMA PROJECT**

**DESIGN OF COMPONENTS ON A CNC LATHE**

**M / 827**

**PHILIPPOU PHILIPPOS**

**JULY 1998**

**HIGHER TECHNICAL INSTITUTE**

**MECHANICAL ENGINEERING COURSE**

**DIPLOMA PROJECT**

**"DESIGN OF COMPONENTS ON  
A CNC LATHE"**

**M/827**

**BY : PHILIPPOS PHILIPPOU**

Project Supervisor  
"DESIGN OF COMPONENTS ON A CNC LATHE"

by

Emmanuel  
Philippos Philippou

Project Report

Submitted to

the Department of Mechanical Engineering  
of the Higher Technical Institute

Nicosia , Cyprus

in partial fulfillment of the requirements  
for diploma project of

TECHNICIAN ENGINEERING

in

MECHANICAL ENGINEERING

July 1998



Project Supervisor  
"DESIGN OF COMPONENTS ON A CNC LATHE"

by

Philippos Philippou

Project Report

Submitted to

the Department of Mechanical Engineering  
of the Higher Technical Institute

Nicosia , Cyprus

in partial fulfillment of the requirements  
for diploma project of

TECHNICIAN ENGINEERING

in

MECHANICAL ENGINEERING

July 1998

HIGHER TECHNICAL INSTITUTE	PROJECT NO. 2913
----------------------------------	---------------------

Project Supervisor : Mr. L. Lazari  
Lecturer in Mechanical  
Engineering, H.T.I.

External assessor : Mr. G. Tekkis

Type of Project : Individual

June 1998

HIGHER TECHNICAL INSTITUTE	PROJECT NO. 2913
----------------------------------	---------------------

## ACKNOWLEDGEMENTS

I would like to express my  
sincere thanks to the kindness of  
my first supervisor

I would like to  
thank the  
staff of  
the part-

Finally, I  
would like  
to thank

Dedicated to my parents  
for everything they have  
done for me!



## ACKNOWLEDGEMENTS

I would like to express my great thanks to Dr. L. Lazari, who had the kindness and patience to undertake the responsibility of the first supervisor of that project.

It would be an omission if I did not express my thanks to administration of Higher Technical Institute, who kindly provided the Institute facilities and machine tool to execute the part-programs and produce the workpieces.

Finally, to all those who I might not have mentioned and who have in any way contributed to the success of the project, I am greatly thankful.

## ABSTRACT

The objectives of the  
"DESIGN OF COMPONENTS ON A CNC LATHE"

1. Study the programming characteristics of the EMCO CNC lathe.
2. Produce engineering drawings of components for programming.
3. Write part programs for the manufacture of specific components.

### Terms and conditions :

Drawings must be constructed according to ISO standards.



# CONTENTS

## ACKNOWLEDGEMENTS

## ABSTRACT

	page
<b>UNIT 1 : COMPUTER NUMERICAL CONTROL MACHINES</b>	<b>1-11</b>
1.1 History of NC/CNC Systems	1
1.2 Numerical Control	2
1.3 Computer Numerical Control	2
1.4 Use of Numerical Control in Industry	6
1.5 Growth of NC in Developing Countries	7
1.6 Advantages of NC/CNC	8
1.7 Disadvantages of NC/CNC	10
<b>UNIT 2 : COMPUTER NUMERICAL CONTROL SYSTEMS</b>	<b>11-13</b>
2.1 Open Loop Drive System	11
2.2 Closed Loop Drive System	12
<b>UNIT 3 : COMPUTER NUMERICAL CONTROL LATHES</b>	<b>13-25</b>
3.1 Main Parts of CNC Lathes	14
3.2 The Coordinate System of a CNC Lathe	17
3.2.1 Absolute Dimensioning	18
3.2.2 Incremental Dimensioning	19
3.3 CNC Lathe Tooling	21
<b>UNIT 4 : CNC LATHE PROGRAMMING</b>	<b>26-38</b>
4.1 Types of Part Programming	30
4.2 CNC Lathe Address Format	30
4.3 Address Format Example	34
4.4 Part Program Procedure	34
4.5 Part Program Feeding	35

<b>UNIT 5 : LINEAR INTERPOLATION</b>	<b>38-48</b>
5.1 Linear Interpolation Considerations	39
5.2 Longitudinal Turning	40
5.2.1 G92 Code	40
5.2.2 G00 Code	41
5.2.3 G01 Code	41
5.2.4 M03 Code	41
5.2.5 M30 Code	42
5.2.6 Example	42
5.3 Longitudinal Turning with Canned Cycle G84	43
5.3.1 Example	45
5.4 Cutting Cycle G84 with Division of Cut	46
5.4.1 Example	48
<b>UNIT 6 : FACING CYCLE G88</b>	<b>48-51</b>
6.1 Example	49
<b>UNIT 7 : TAPER TURNING</b>	<b>51-55</b>
7.1 Tooling for Taper Turning	53
7.2 Example	54
<b>UNIT 8 : CIRCULAR INTERPOLATION</b>	<b>55-69</b>
8.1 Clockwise and Counterclockwise Circular Interpolation	57
8.2 Clockwise and Counterclockwise Quadrant Circular Interpolation	59
8.3 Example	60
8.4 Clockwise and Counterclockwise Part Programming of a Part of a Quadrant	62
8.4.1 Codes I and K	63
8.5 Programming an Arc	64
8.5.1 Example	67

<b>UNIT 9 : TOOL CHANGING</b>	<b>70-76</b>
9.1 Tool Compensation	71
9.1.1 Example	72
9.2 Optical Pre-Setting Device	74
9.3 Example	75
<b>UNIT 10 : THREAD CUTTING</b>	<b>77-82</b>
10.1 Tooling	78
10.2 Part Programming with G33	79
10.3 Part Programming with G78	80
10.4 Example	80
10.5 Example	82
<b>UNIT 11 : DRILLING CYCLES</b>	<b>83-91</b>
11.1 Tooling	83
11.2 Drilling Part Programming	84
11.2.1 Drilling Cycle G81	85
11.2.2 Drilling Cycle G82	85
11.2.3 Drilling Cycle G73	86
11.2.4 Drilling Cycle G83	87
11.3 Example	88
<b>UNIT 12 : BORING</b>	<b>91-94</b>
12.1 Tooling	92
12.2 Example	94
<b>UNIT 13 : SUBROUTINE PROGRAMMING</b>	<b>95-98</b>
13.1 Programming a Subroutine	95
13.2 Subroutine Call	96
13.3 Example	97

<b>UNIT 14 : SPECIAL PARTS AND FEATURES OF INDUSTRIAL CNC LATHES</b>	<b>99-106</b>
14.1 Tool Monitoring	99
14.2 In Process Gaging	100
14.3 Safety (Crash) Zone Programming	101
14.4 Tool Path Display	102
14.5 Animation	103
14.6 Computer Numerical Control, Computer-Aided Design and Computer-Aided Manufacturing	104
<b>UNIT 15 : CNC IN THE FUTURE</b>	<b>107</b>
<b>UNIT 16 : ECONOMICS OF CNC</b>	<b>108-114</b>
16.1 Economic Justification of CNC	108
16.2 Comparison of CNC and Conventional Processes	109
16.3 The Operating Cost of a CNC Machine	110
16.4 Depreciation	111
16.5 Example	112
<b>UNIT 17 : EXAMPLES OF MANUFACTURED PARTS</b>	<b>115-134</b>