

**STATE UNIVERSITY OF NEW YORK
COLLEGE OF TECHNOLOGY
CANTON, NEW YORK**



MASTER SYLLABUS

**COURSE NUMBER – COURSE NAME
MECH 223 – Introduction to Computer Numerical Control**

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Updated by:

Canino School of Engineering Technology

Department: Mechanical & Energy Technologies

Semester/Year: Fall 2018

- A. **TITLE:** Introduction to Computer Numerical Control
- B. **COURSE NUMBER:** MECH 223
- C. **CREDIT HOURS:** (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)

Credit Hours: 3
Lecture Hours: 2 per week
Lab Hours: (1) three-hour lab per week
Other: per week

Course Length: 15 Weeks

- D. **WRITING INTENSIVE COURSE:** Yes No
- E. **GER CATEGORY:** None: Yes: GER
If course satisfies more than one: GER
- F. **SEMESTER(S) OFFERED:** Fall Spring Fall & Spring

G. **COURSE DESCRIPTION:**

A course designed to introduce students to the capabilities of CNC machine tools used in industry, to teach students the fundamentals in programming CNC lathes and milling machines, to provide students the opportunity to setup and operate CNC equipment and to experience the use of CAD/CAM technology.

- H. **PRE-REQUISITES:** None Yes If yes, list below:

MECH 121

CO-REQUISITES: None Yes If yes, list below:

I. STUDENT LEARNING OUTCOMES: (see key below)

By the end of this course, the student will be able to:

<u>Course Student Learning Outcome</u> <u>[SLO]</u>	<u>Program Student Learning Outcome</u> <u>[PSLO]</u>	<u>GER</u> <i>[If Applicable]</i>	<u>ISLO & SUBSETS</u>	
1. Write CNC programs using G & M codes for simple 2D components.			5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
2. Select the proper tooling used on CNC Milling Machines and Lathes.			5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
3. Write the proper process plan required for CNC operation.			5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
4. Setup and operate 3 axis and 4 axis CNC Milling Machines (Centers) and 2 axis CNC Lathes.			5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
5. Enter a program into a CNC machine using the conversational programming format.			5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets
6. Create CNC programs using CAD/CAM technology			5-Ind, Prof, Disc, Know Skills ISLO ISLO	Subsets Subsets Subsets Subsets

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KEY	<u>Institutional Student Learning Outcomes [ISLO 1 – 5]</u>
ISLO #	ISLO & Subsets
1	Communication Skills Oral [O], Written [W]
2	Critical Thinking <i>Critical Analysis [CA] , Inquiry & Analysis [IA] , Problem Solving [PS]</i>
3	Foundational Skills <i>Information Management [IM], Quantitative Lit./Reasoning [QTR]</i>
4	Social Responsibility <i>Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]</i>
5	Industry, Professional, Discipline Specific Knowledge and Skills

*Include program objectives if applicable. Please consult with Program Coordinator

J. **APPLIED LEARNING COMPONENT:** Yes No

If YES, select one or more of the following categories:

- | | |
|---|--|
| <input checked="" type="checkbox"/> Classroom/Lab | <input type="checkbox"/> Civic Engagement |
| <input type="checkbox"/> Internship | <input type="checkbox"/> Creative Works/Senior Project |
| <input type="checkbox"/> Clinical Placement | <input type="checkbox"/> Research |
| <input type="checkbox"/> Practicum | <input type="checkbox"/> Entrepreneurship |
| <input type="checkbox"/> Service Learning | (program, class, project) |
| <input type="checkbox"/> Community Service | |

K. **TEXTS:**

HAAS CNC programming workbook for Mill and Lathe

L. **REFERENCES:**

Machinery's Handbook, 26th edition, Industrial Press

M. **EQUIPMENT:** None Needed: NS106 - Machine Tools Lab

N. **GRADING METHOD:** A-F

O. **SUGGESTED MEASUREMENT CRITERIA/METHODS:**

Exams, Homework, Laboratory

P. **DETAILED COURSE OUTLINE:**

I. Introduction to Machine Tool Controls

A. Components

1. Machine Tools
2. Machine Control Unit (MCU)

B. Type of Control Systems

1. Point to Point
2. Continuous Path

C. Loop Systems

1. Open Loop vs. Closed Loop

D. Positioning Systems

1. Absolute vs. Incremental

II. Tooling for CNC

A. General Tooling Considerations for CNC

B. Types of Tooling Used

C. Special Tools

D. Cutting Speeds and Feed Rates

E. Tool Changing

III. CNC Machining Center Features

IV. Programming Coordinates

- A. Hole Operations**
- B. Milling Operations (Linear & Circular Profiling)**
- C. Mixing Absolute and Incremental Coordinates**
- D. Metric Coordinates**

V. Three Axis Programming (Milling)

- A. Word Address Format**
 - 1. Address codes**
 - 2. Preparatory codes (G – codes)**
 - 3. Miscellaneous codes (M – codes)**
 - 4. Math for CNC Programming**
- B. Modal Programs**
 - 1. Drilling**
 - 2. Milling**

VI. Two Axis Programming (Lathe)

- A. Word Address Format**
 - 1. How lathe codes differ from milling**
 - 2. New codes**
- B. Modal Programs**
 - 1. Turning**
 - 2. Radius cutting**
 - 3. Threading**
- C. Setting up and operation of HAAS Turning Center**

VII. Do Loops and Subroutines

- A. Do Loops**
- B. Subroutines**
- C. Nested Loops**
- D. Modal Programs**

VIII. Advanced CNC Features

- A. Cutter Diameter Compensation (CDC)**
- B. Fixture Offsets**
- C. Tool Offsets (TLO)**
 - 1. Measuring**
 - 2. Calculating**
 - 3. Input at MCU**

X. CAD/CAM

- A. Part Definition**
- B. Toolpath Generation**
- C. Post Processing for various controllers**

Q. LABORATORY OUTLINE: None Yes

I. CNC Vertical Mill

- A. Program Entry**
- B. Tool Setting**
- C. Work Offset Setting**
- D. Verifying Program**
- E. Editing Program**
- F. 4th Axis Indexing**

II. CNC Lathe

- A. Program Entry**
- B. Tool Setting**
- C. Work Offset Setting**
- D. Verifying Program**
- E. Editing Program**
- F. Setting up a Turret**
- G. Using Parts Catcher**

III. CAD/CAM

- A. Geometry Design 2D/3D**
- B. Tool path creation**
- C. Post Processing**
- D. Program verification**