MASTER SYLLABUS

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

Created by: Daniel Miller

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:

<table>
<thead>
<tr>
<th><strong>Course Student Learning Outcome [SLO]</strong></th>
<th><strong>Program Student Learning Outcome [PSLO]</strong></th>
<th><strong>GER [If Applicable]</strong></th>
<th><strong>ISLO &amp; SUBSETS</strong></th>
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<tbody>
<tr>
<td>1. Write CNC programs using G &amp; M codes for simple 2D components.</td>
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<td>5-Ind, Prof, Disc, Know Skills ISLO ISLO</td>
<td>Subsets Subsets Subsets Subsets</td>
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<td>2. Select the proper tooling used on CNC Milling Machines and Lathes.</td>
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<td>5-Ind, Prof, Disc, Know Skills ISLO ISLO</td>
<td>Subsets Subsets Subsets Subsets</td>
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<td>3. Write the proper process plan required for CNC operation.</td>
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<td>5-Ind, Prof, Disc, Know Skills ISLO ISLO</td>
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<td>4. Setup and operate 3 axis and 4 axis CNC Milling Machines (Centers) and 2 axis CNC Lathes.</td>
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<td>5-Ind, Prof, Disc, Know Skills ISLO ISLO</td>
<td>Subsets Subsets Subsets Subsets</td>
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<td>5. Enter a program into a CNC machine using the conversational programming format.</td>
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<td>5-Ind, Prof, Disc, Know Skills ISLO ISLO</td>
<td>Subsets Subsets Subsets Subsets</td>
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<td>6. Create CNC programs using CAD/CAM technology</td>
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<td>5-Ind, Prof, Disc, Know Skills ISLO ISLO</td>
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<td>ISLO #</td>
<td>Communication Skills</td>
<td>Critical Thinking</td>
<td>Foundational Skills</td>
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<td>Oral [O], Written [W]</td>
<td>Critical Analysis [CA], Inquiry &amp; Analysis [IA], Problem Solving [PS]</td>
<td>Information Management [IM], Quantitative Lit./Reasoning [QTR]</td>
</tr>
</tbody>
</table>

*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:

- ☑️ Classroom/Lab
- ☑️ Internship
- ☑️ Clinical Placement
- ☑️ Practicum
- ☑️ Service Learning
- ☑️ Community Service
- ☐ Civic Engagement
- ☐ Creative Works/Senior Project
- ☐ Research
- ☐ Entrepreneurship
  (program, class, project)

K. **TEXTS:**

HAAS CNC programming workbook for Mill and Lathe

L. **REFERENCES:**


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