**ESSEX COUNTY COLLEGE**

**Engineering Technologies and Computer Sciences Division**

**MET 225 – Computer Numerical Control**

**Course Outline**

**Course Number & Name:**  MET 225 Computer Numerical Control

**Credit Hours:**  4.0 **Contact Hours:**  6.0 **Lecture:** 2.0 **Lab:**  4.0 **Other:**  N/A

**Prerequisites**:  Grade of “C” or better in ENR 103 or placement

**Co-requisites:** ENR 105 **Concurrent Courses:** None

**Course Outline Revision Date:**  Fall 2010

**Course Description**: This course introduces computer numerical control (CNC) programming in an applied fashion using lathe, milling, and other machines in the laboratory. The course emphasizes mastery of G and M codes and focuses on the integration of computer aided design (CAD), computer aided manufacturing (CAM), and CNC. The latest release of CAM software packages and modern CNC machines are available and used by the students to complete several hands-on projects.

**Course Goals:** Upon successful completion of this course, students should be able to do the following:

1. complete design projects using AutoCAD, Inventor, and MasterCAM;

2. develop Computer Numerical Control (CNC) programs using the Preparatory Code (G) and Miscellaneous Code (M); and

3. operate the CNC machines.

**Measurable Course Performance Objectives (MPOs)**: Upon successful completion of this course, students should specifically be able to do the following:

1. Complete design projects using AutoCAD, Inventor, and MasterCAM:

* 1. *develop a 3D model using Inventor;*
	2. *generate the 2D multiviews from the 3D design;*
	3. *prepare the 2D design using AutoCAD;*
	4. *import the 2D AutoCAD design into MasterCAM;*
	5. *generate the contour and tool path for design;* and
	6. *post process to generate the CNC program for the design*

**Measurable Course Performance Objectives (MPOs)** (continued):

1. Develop Computer Numerical Control (CNC) programs using the Preparatory Code (G) and Miscellaneous Code (M):
	1. *develop a SpectraLight lathe program;*
	2. *develop a SpectraLight mill program;*
	3. *write a CNC ProLIGHT turning program;*
	4. *write a CNC ProLIGHT mill program;* and

2.5 *verify the CNC programs*

3. Operate the CNC machines:

1. *program* *the robot with necessary positions to integrate with the CNC machine;*
2. *write the robotic program using Scorbase software to configure the robot with the CNC machine;*
3. *verify and simulate the Robot/CNC machine configuration;*
4. *initialize the CNC machine by setting the position of the tool at the origin,* $(0,0,0)$*;*
5. *select the tool to be used;*
6. *select the stock size;*
7. *move the vise (mill) to the loading position for the robot’s easy access;*
8. *start the CNC machine, staying close to the emergency switch for quick stopping action if necessary;* and
9. *operate the CNC machine to complete the part*

**Methods of Instruction**: Instruction will consist of laboratory demonstrations and the completion of supervised projects in the lab.

**Outcomes Assessment:** Selected homework, quiz, and test questions are blueprinted to course objectives. Rubrics are used to evaluate the projects and the oral presentations for the presence and mastery of course objectives. Data is collected and analyzed to determine the level of student performance on these assessment instruments in regards to meeting course objectives. The results of this data analysis are used to guide necessary pedagogical and/or curricular revisions.

**Course Requirements:** All students are required to:

1. Maintain regular attendance and participate in classroom discussions.

2. Complete homework assignments and projects on time.

3. Sit for all quizzes and tests that are scheduled and participate in all lab exercises.

4. Read all assigned textbook pages.

**Methods of Evaluation:** Final course grades will be computed as follows:

 **% of**

**Grading Components final course grade**

* **Quizzes and Class Participation**  **5 – 10%**

A perusal of quizzes and analysis of class discussions will indicate the extent to which students master course objectives.

* **Homework**  **10 – 15%**

A perusal of homework problems will indicate the extent to which students master course objectives.

* **2 or more Tests** (dates specified by the instructor) **20 – 30%**

Tests will show evidence of the extent to which students meet course objectives, including but not limited to identifying and applying concepts, analyzing and solving problems, estimating and interpreting results and stating appropriate conclusions using correct terminology.

**• Class Projects 15 – 25%**

Class projects will show evidence of applying various components of program courses to produce objects of all shapes. Synthesis of course content should be evident.

**• Team Work 10 – 20%**

Collaboration between colleagues, an essential component of engineering practice in industry, will be practiced as students do their class and term projects.

**• Term Project/Oral Presentations 30 – 40%**

The term project will show evidence of applying course concepts to real world problems, designing a solution, and composing a technical report, which includes an oral presentation component.

Note: The instructor will provide specific weights, which lie in the above-given ranges, for each of the grading components at the beginning of the semester.

**Academic Integrity:** Dishonesty disrupts the search for truth that is inherent in the learning process and so devalues the purpose and the mission of the College. Academic dishonesty includes, but is not limited to, the following:

* plagiarism – the failure to acknowledge another writer’s words or ideas or to give proper credit to sources of information;
* cheating – knowingly obtaining or giving unauthorized information on any test/exam or any other academic assignment;
* interference – any interruption of the academic process that prevents others from the proper engagement in learning or teaching; and
* fraud – any act or instance of willful deceit or trickery.

Violations of academic integrity will be dealt with by imposing appropriate sanctions. Sanctions for acts of academic dishonesty could include the resubmission of an assignment, failure of the test/exam, failure in the course, probation, suspension from the College, and even expulsion from the College.

**Student Code of Conduct:** All students are expected to conduct themselves as responsible and considerate adults who respect the rights of others. Disruptive behavior will not be tolerated. All students are also expected to attend and be on time for all class meetings. No cell phones or similar electronic devices are permitted in class. Please refer to the Essex County College student handbook, *Lifeline*, for more specific information about the College’s Code of Conduct and attendance requirements.

**Course Content Outline:** based on the reference text **Computer Numerical Control,** 4thedition, by Seames Warren; published by Delmar, 2002

**Week**

**(2 meetings**

**@ 160 minutes) Topic**

1 Introduction to CNC

2 Coordinate System/Part Program

3 G and M codes

4 Linear and Circular Interpolations

5 Review, **Test #1**

6 Automatic Tool Change

7 Term Project Proposals review

8 Subroutines and Canned Routines

9 CAM Software to Generate CNC Codes

10 CAD/CAM/CNC

11 Review, **Test #2**

12 – 14 Term Project work

15 **Term Projects due**

 **Oral Presentations**