Central Maine Community College
Auburn, Maine

Precision Machining Technology PMT 370 Multi-Axis CNC Milling

Term ***Instructor:***

2 Credits

A. Why the online format?

The hybrid format was created as part of the Advanced Machining Certificate. This model allows students to access online video lectures, demos, and course material at their own pace. Once milestones with this work have been achieved they can then contact the instructor to schedule machine time to complete projects. There is a provided schedule to finish the class in a semester but a student has the option to finish early if they choose too.

B. Purpose and Organization:

This course will provide students the opportunity to program, set-up and operate 4 and 5 axis horizontal and vertical CNC Milling Center. Students will be exposed to spindle probing and CMM operation to verify part dimensions.

C. Course Objectives: This course will provide students the opportunity to:

1. Set-up and operate 4 axis Vertical CNC Milling Center
2. Set-up and operate 5 axis Horizontal CNC Milling Center
3. Inspect first piece parts on the CMM and make necessary adjustments
4. Produce parts to print tolerances on CNC equipment

D. Student Learning Outcomes: At the conclusion of this course students will be able to:

1. Demonstrate the set-up and operation of Multi-axis CNC mills.
2. Understand programming and program editing for Multi-axis CNC mills.
3. Describe how a Coordinate Measuring Machine can inspect a multi axis part.

E. Course Topics in Sequential Order:

4 axis
- Axis of rotation
- Types of rotaries
- Axial vs Radial cuts
- Work Offsets
- Programming Changes
- Probing with a rotary
- Inspecting 4th axis parts

5 axis
- Axis of rotation
- Types of multi-axis machines
    - Table/Table
    - Head/Table
    - Head/Head
- Positioning Method
    - Indexing
    - Simultaneous motions

- Positions
    - Machine Rotary Zero
    - Program Zero
    - Dynamic Fixture Offset
- Work holding
- Lead, Lag, Tilt angles
- Programming Changes
- Probing on Multi-axis Machines

F. Textbook and Required Supplies:

Students are required to wear OSHA approved safety shoes and OSHA approved safety glasses while working in the machine shop.

Tools and work material furnished by Central Maine Community College.

G. A Note About You and This Course:

This is a hybrid class. All material needed (Lectures, Demos, Resources) will be available online. If you do not understand the information please contact the instructor via e-mail, phone, or by stopping by the lab. The material in the class will get progressively harder, if you do not understand one concept it will be harder to grasp the material later in the class.

There is a schedule provided to complete the class in a semester. Please remember to schedule machine time accordingly. Please do not wait all semester to schedule machine time to make all of your parts, remember that there are other students in the class and availability could become limited.

Because of the hybrid class format you also have the ability to finish the class ahead of the schedule that is outlined below.

H. Contact the Instructor:

Contact the instructor by email to XXXXXX. I will respond to any email inquiries within 24 hours during the school week, Mon – Fri, and 48 hours over the weekend, Sat and Sun. I will make every effort to post any project or test grades before the following weeks assignment is due.

I. Contact Classmates:

There is no grade for student post for this class. Most of you will not see each other during lab time as you will all be coming in at different times to set-up and run projects. I do encourage that you use the discussion board page to talk with each other about the issues and successes you had on the projects you will be working on.

J. Course Activities:

-Complete each assigned activity
-Watch and listen to the online lecture for each tutorial
-Watch the demo's that correspond with each project
-Complete each assigned lab project
-Complete each test before the deadline

K. Grades:

Letter Grade	Raw Score
A	95-100
A-	93-94

B+	91-92
B	87-90
B-	85-86
C+	83-84
C	79-82
C-	77-78
D+	75-76
D	70-74
F	0-69

Course Activities	**Total # of Activities**	**Pts. per Activity**	**Total Pts.**
Projects-	7	8.5 pts.	60 pts.
Homework Questions-	10	1 pts.	10 pts.
Tests-	2	15 pts.	30 pts.

Tests:

Tests will be a cognitive written test. This will test your knowledge of the material that has been covered in Lecture assignments. They will be administered through CMConnect and will be timed. Tests will be open for the week but once the test is started the time will begin. Tests will close on the last day of the week. Students who have not taken the test before it closes will receive a 0 for the assignment.

Homework:

Homework questions will be over the Lecture assignments. These questions will be uploaded to the CmConnect webpage and can be printed off and filled out or filled out electronically. Either way I will need to receive the completed questions the week they are due. Questions not completed that week will receive a 0 for the assignment.

Projects:

There will be a total of 7 projects that will need to be made for this class. The projects are designed to evaluate your application of lectures and demos in the lab setting. They will also evaluate your ability to set-up and operate the machine tool. See attached rubric for project grade breakdown. There will be not late grade for projects not passed in on time.

- 4^{th} Axis
  - Project 1
  - Project 2
  - Project 3
- 5 Axis
  - Project 4
  - Project 5
  - Project 6
- Probing
  - Project 7

L. Navigational Aids:

When you log onto CMconnect you will find a "My Courses" button on the left side of the main page screen, midway down the page. When you open up "My Courses", you will see a link to the PMT 370 course. Click on the PMT 370 link to enter this course site. Most of the course content is located on pages that you can access from the buttons on the upper left side of the main page**. DO NOT USE THE BACK BUTTON** when navigating from one page to the next; you will be kicked out of the CMconnect program. On the main page you will find some introductory information that will help you get started in this course.

M. Getting to Class:

Students will need to access CMconnect to view the weekly assignments. All of the class lectures, demos, and related work will be done through this site. Lectures (Both video and Audio PowerPoint) will be available here.

Machine time will be scheduled when students are ready to try a project. When a student schedules machine time it is expected that they have completed all lectures, watched all online machine demos, and have questions ready when they come into the lab.

Please refer to the calendar on CMconnect to find out and schedule machine availability.

N. Related National Web Sites:

O. Schedule:

Date	Topic	Assignment/reading/activity	Approximate time on task
Week 1	4th Axis	☐ Study 4th Axis Lecture 1	2 hrs
		☐ Complete 4th Axis Lecture 1 Questions	1 hr
		☐ Study 4th Axis Lecture 2	2 hrs
		☐ Complete 4th Axis Lecture 2 Questions	1 hr
Week 2	4th Axis	☐ Study 4th Axis Lecture 3	2 hrs
		☐ Complete 4th Axis Lecture 3 Questions	1 hr
		☐ Project 1	7 hrs
Week 3	4th Axis	☐ Study 4th Axis Lecture 4	2 hrs
		☐ Complete 4th Axis Lecture 4 Questions	1 hr
		☐ Project 2	7 hrs
Week 4	4th Axis	☐ Project 3	7 hrs
		☐ Test 1	2 hrs

Week 5	5 axis	☐ Study 5 Axis Lecture 1 ☐ Complete 5 Axis Lecture 1 Questions ☐ Study 5 Axis Lecture 2 ☐ Complete 5 Axis Lecture 2 Questions	2 hrs 1 hr 2 hrs 1 hr
Week 6	5 axis	☐ Study 5 Axis Lecture 3 ☐ Complete 5 Axis Lecture 3 Questions ☐ Project 4	2 hrs 1 hr 7 hrs
Week 7	5 axis	☐ Study 5 Axis Lecture 4 ☐ Complete 5 Axis Lecture 4 Questions ☐ Project 5	2 hrs 1 hr 8 hrs
Week 8	5 axis	☐ Project 6	8 hrs
Week 9	Probing	☐ Probing Lecture 1 ☐ Complete Probing Lecture 1 Questions	2 hrs 1 hrs
Week 10	Probing	☐ Probing Lecture 2 ☐ Complete Probing Lecture 2 Questions	2 hrs 1 hrs
Week 11	Probing	☐ Project 7	8 hrs
Week 12		☐ Test 2	2 hrs