MECH 491/596 Syllabus
Computer-Aided Manufacturing / CAD CAM Principles and Practice

3 Credits / [2-2*-0]

Overview

MECH 491/596 focuses on the introduction of modern computer-aided manufacturing technologies as well as the related computer-aided geometric modeling methods. Students will develop practical knowledge and understanding of the applications, underlying mathematical principles, and limitations of these technologies through lectures and laboratory tutorials/projects.

Prerequisite

MECH 392

Main Topic Areas

1. CNC Machine Tool Basics and Milling Operations
2. NC Part Programming
3. Parametric Representation of Curves and Surfaces
4. Machining: Three-Axis and Five-Axis

People and Places

Instructor	Serban Cojocaru
Email	serban.cojocaru@mech.ubc.ca
Office	No office
Office hours	No set hours – email or after class
Lab Assistant	Bernhard Nimmervoll
Email	bnimmer@mech.ubc.ca
Office	KAISER 1150 / KAISER 1190
Office hours	To be specified
Lectures	Wednesdays, 5:00-7:00 pm, Frank Forward 303
Labs	Fridays, 5:00-7:00 pm, RH 123

Textbooks (Reference)

1. Zeid, I., *Mastering CAD/CAM*, McGraw-Hill, 2005
2. Lee, K., *Principles of CAD/CAM/CAE Systems*, Addison-Wesley, 1999
3. Hoffman, E., *Fundamentals of Tool Design*, Society of Manufacturing Engineers, 1984
4. *Dimensioning and Tolerancing ASME Y14.5-2009*, ASME, 2009

Learning Objectives

Upon successful completion of the course, students should be able to:

- **Describe** the fundamental components and limitations of a modern computer numerical control (CNC) machine tool
- **Select** suitable cutting tools and process parameters for a given milling operation
- **Read** and **troubleshoot** NC programs written in standard G-code format
- **Formulate** free-form curves and surfaces mathematically using a parametric expression
- **Describe** the basic principles of Hermite curve, Bezier curve, B-spline curve and NURBS curve representations
- **Use** NX computer-aided manufacturing (CAM) software to generate both roughing and finishing milling tool paths for three-axis surface machining
- **Describe** the relative advantages and disadvantages between three-axis and five-axis machining in practical applications

Lecture and Laboratory Schedule

<table>
<tr><th>Week</th><th>Lecture</th><th>Date</th><th>Topic</th><th>Assignment</th><th>Lab</th><th>Date</th><th>Lab</th></tr>
<tr><td>1</td><td>1
2</td><td>Jan. 8</td><td>Course overview and introduction to CAM/NC/CNC</td><td rowspan="2">Assignment #1
(Due: Jan. 29)</td><td>1</td><td>Jan. 10</td><td rowspan="2">L1 - Sketching
(Due: Jan. 24)</td></tr>
<tr><td>2</td><td>3
4</td><td>Jan. 15</td><td>Machine tool basics and milling operations</td><td>2</td><td>Jan. 17</td></tr>
<tr><td>3</td><td>5
6</td><td>Jan. 22</td><td>NC part programming</td><td rowspan="2">Assignment #2
(Due: Feb. 12)</td><td>3</td><td>Jan. 24</td><td>L2 - Feature Modeling
(Due: Jan. 31)</td></tr>
<tr><td>4</td><td>7
8</td><td>Jan. 29</td><td>Fixture concepts, design and milling operation setup</td><td>4</td><td>Jan. 31</td><td>L3 - Manufacturing Basics
(Due: Feb. 7)</td></tr>
<tr><td>5</td><td>9
10</td><td>Feb. 5</td><td>CAD/CAM part programming</td><td rowspan="2">Assignment #3
(Due: Mar. 4)</td><td>5</td><td>Feb. 7</td><td>L4 - Prismatic Machining
(Due: Feb. 14)</td></tr>
<tr><td>6</td><td>11
12</td><td>Feb. 12</td><td>Tool path generation</td><td>6</td><td>Feb. 14</td><td>L5 - Mold and Die Machining
(Due: Feb. 28)</td></tr>
<tr><td colspan="5">Midterm Break: February 17 – 21</td><td rowspan="2">L6 - Simulating CNC Machine Motion
(Due: Mar. 6)</td></tr>
<tr><td>8</td><td colspan="4">Midterm Quiz: February 26</td><td>7</td><td>Feb. 28</td></tr>
<tr><td>9</td><td>16
17</td><td>Mar. 4</td><td>GD&T</td><td>Assignment #4
(Due: Mar. 18)</td><td>8</td><td>Mar. 6</td><td>L7 - Constructing a Kinematic Model
(Due: Mar. 13)</td></tr>
<tr><td>10</td><td>18
19</td><td>Mar. 11</td><td>Parametric curves</td><td rowspan="3">Assignment #5
(Due: Apr. 1)</td><td>9</td><td>Mar. 13</td><td rowspan="2">L8 - Complex Machining
(Due: Mar. 27)</td></tr>
<tr><td>11</td><td>20
21</td><td>Mar. 18</td><td>Parametric curves</td><td>10</td><td>Mar. 20</td></tr>
<tr><td>12</td><td>22
23</td><td>Mar. 25</td><td>Term Review - all topics</td><td>11</td><td>Mar. 27</td><td>L9 - Splines
(Due: Apr. 3)</td></tr>
<tr><td>13</td><td colspan="4">Seminar Presentations: April 1</td><td>12</td><td>Apr. 3</td><td>L10 - Swept and Fill Surface
(Due: Apr. 3)</td></tr>
</table>

This is the approximate schedule for lectures and laboratory sessions. Please note that this is a rough guide, subject to adjustments and changes as needed.

Evaluation for MECH 491

The course grade will be determined according to the following:

Assignments (5 in total)	10%
Laboratory Tutorials	10%
Project #1 – Individual	10%
Project #2 – Group (2 people / group)	10%
Midterm Quiz (closed book)	10%
Final Examination (closed book)	50%

Evaluation for MECH 596

The course grade will be determined according to the following:

Assignments (5 in total)	5%
Laboratory Tutorials	5%
CAD/CAM Seminar Presentation	10%
Project #1 – Individual	10%
Project #2 – Group (2 people / group)	10%
Midterm Quiz (closed book)	10%
Final Examination (closed book)	50%

Requirements to Pass

To pass the course, you must both:

- achieve an overall course grade of at least 50%; and
- achieve an average grade of at least 50% on the combined midterm quiz and final exam grade (each weighted as shown above).
- Note: For any Masters students taking this course passing grade is 60%, and for Doctoral students the passing grade is 68%.

Professional Standards

All students in this course and in engineering at UBC are expected to conduct themselves in accordance with the high standards demanded of the profession of engineering. This includes, but is not limited to, acting in accordance with University policies on academic conduct. The UBC Calendar articulates what acceptable academic conduct is, and it is the responsibility of each student to inform themselves of the standards.

See: http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,54,111,959

If you have any doubt about what is acceptable practice, please see the course instructor for guidance.