



El Camino College  
 COURSE OUTLINE OF RECORD – Official

<b>Course Acronym:</b>	MTT
<b>Course Number:</b>	10J
<b>Descriptive Title:</b>	Numerical Control Graphics Programming
<b>Division:</b>	Industry and Technology
<b>Department:</b>	Machine Tool Technology
<b>Course Disciplines:</b>	Machine Tool Technology
<b>Catalog Description:</b>	This basic course covers Computer Aided Manufacturing (CAM), emphasizing interactive graphics programming for Computer Numerical Control (CNC) machines. Concepts studied will include interactive geometry construction, tool motion, machine functions, repetitive programming, graphic output and graphic editing. Programs will be compiled using interactive graphics computer systems.
<b>Prerequisite:</b>	
<b>Co-requisite:</b>	
<b>Recommended Preparation:</b>	Machine Tool Technology 10A and Machine Tool Technology 101 and Machine Tool Technology 40 or equivalent
<b>Enrollment Limitation:</b>	
<b>Hours Lecture (per week):</b>	2
<b>Hours Laboratory (per week):</b>	3
<b>Outside Study Hours:</b>	4
<b>Total Course Hours:</b>	90
<b>Course Units:</b>	3
<b>Grading Method:</b>	Letter Grade only
<b>Credit Status:</b>	Credit, degree applicable
<b>Transfer CSU:</b>	Yes
<b>Effective Date:</b>	03/23/1992
<b>Transfer UC:</b>	No
<b>Effective Date:</b>	
<b>General Education:</b> ECC	
<b>Term:</b>	
<b>Other:</b>	
<b>CSU GE:</b>	
<b>Term:</b>	

	<b>Other:</b>
	<b>IGETC:</b>
	<b>Term:</b>
	<b>Other:</b>
<b>Student Learning Outcomes:</b>	<p><b>SLO #1 Geometric Elements</b></p> <p>Student will create geometric elements such as points, lines, and circles.</p> <p><b>SLO #2 File Manipulation</b></p> <p>Students will be able to utilize computer operating systems to manipulate files, convert geometry from CAD databases to numerical control part geometry, and obtain listings and graphic plots.</p> <p><b>SLO #3 Tool Motion Routines</b></p> <p>Students will be able to create, manipulate and edit tool motion routines including: turning, boring, drilling, profiling, pocket roughing and turning, using interactive graphic techniques.</p>
<b>Course Objectives:</b>	<ol style="list-style-type: none"> <li>1. Utilize computer operating systems to manipulate files and obtain listings and graphic plots.</li> <li>2. Create geometric elements such as points, lines, circles and splines using interactive graphic techniques.</li> <li>3. Convert geometry from Computer Aided Drafting (CAD) databases to numerical control part geometry.</li> <li>4. Create tool motion routines including: boring, drilling, profiling and pocket roughing using interactive graphic techniques.</li> <li>5. Edit geometry, tooling statements and tool motion routines using interactive graphic techniques.</li> </ol>
<b>Major Topics:</b>	<p><b>I. COMPUTER NUMERICAL CONTROL(CNC) PROGRAMMING OVERVIEW (3 hours, lecture)</b></p> <ol style="list-style-type: none"> <li>A. Software demonstration</li> <li>B. Overview of software workspace</li> </ol> <p><b>II. CNC PROGRAMMING OVERVIEW (4 hours, lab)</b></p> <ol style="list-style-type: none"> <li>A. Sketching basic geometry</li> <li>B. Exploring software</li> <li>C. Graphics area commands</li> </ol> <p><b>III. OVERVIEW OF THE GRAPHIC PROGRAMMING PROCESS (Milling Machining Process) (3 hours, lecture)</b></p> <ol style="list-style-type: none"> <li>A. Planning operations</li> <li>B. Tooling selection</li> </ol>

**IV. OVERVIEW OF THE GRAPHIC PROGRAMMING PROCESS (Milling Machining Process)  
(3 hours, lab)**

- A. Planning operations
- B. Tooling selection
- C. Post processor

**V. CREATION OF GEOMETRY, FUNDAMENTAL (3 hours, lecture)**

- A. Points
- B. Circles
- C. Lines
- D. Arcs
- E. Polygons

**VI. CREATION OF GEOMETRY, FUNDAMENTAL (5 hours, lab)**

- A. Points
- B. Circles
- C. Lines
- D. Arcs
- E. Polygons

**VII. 3D WIREFRAME (ADVANCED GEOMETRY) (2 hours, lecture)**

- A. Using Xform Translate
- B. Z origin
- C. Chamfer, Fillet

**VIII. 3D WIREFRAME (ADVANCED GEOMETRY) (4 hours, lab)**

- A. Using Xform Translate
- B. Z origin
- C. Chamfer, Fillet

**IX. MAKING CORRECTIONS AND ADDING TO GRAPHIC MODEL OF MACHINING PROCESS  
(3 hours, lecture)**

- A. Edit, modify geometry
- B. Transform toolpath

**X. MAKING CORRECTIONS AND ADDING TO GRAPHIC MODEL OF MACHINING  
PROCESS (5 hours, lab)**

- A. Edit, modify geometry
- B. Transform toolpath

**XI. ROUGHING (Milling Process) (3 hours, lecture)**

- A. Pocketing

B. Contouring

**XII. ROUGHING (Milling Process) (5 hours, lab)**

- A. Pocketing
- B. Contouring

**XIII. CONVERTING CAD DATABASES TO TOOLPATH (3 hours, lecture)**

- A. Examining part - verifying data
- B. Establishing part origin

**XIV. CONVERTING CAD DATABASES TO TOOLPATH (4 hours, lab)**

- A. Examining part - verifying data
- B. Establishing part origin

**XV. CODE REUSE (3 hours, lecture)**

- A. Repetitive programming
- B. Sub-programming

**XVI. CODE REUSE (4 hours, lab)**

- A. Repetitive programming
- B. Sub-programming

**XVII. MISCELLANEOUS TOPICS (3 hours, lecture)**

- A. Utilities
- B. Creation of splines

**XVIII. MISCELLANEOUS TOPICS (4 hours, lab)**

- A. Utilities
- B. Creation of splines

**XIX. SOLID CREATION (3 hours, lecture)**

- A. Fundamentals of 3D modeling
- B. Creating solid bodies and surfaces
- C. Modeling operations

**XX. SOLID CREATIONS (4 hours, lab)**

- A. Fundamentals of 3D modeling
- B. Creating solid bodies and surfaces
- C. Modeling operations

**XXI. CUSTOMIZATION (3 hours, lecture)**

- A. Communicating with machine tools

	<p>B. Adding toolbar states</p> <p><b>XXII. CUSTOMIZATION (4 hours, lab)</b></p> <p>A. Communicating with machine tools B. Adding toolbar states</p> <p><b>XXIII. LATHE CYCLES (2 hours, lecture)</b></p> <p>A. Rough B. Groove C. Thread</p> <p><b>XXIV. LATHE CYCLES (4 hours, lab)</b></p> <p>A. Rough B. Groove C. Thread</p> <p><b>XXV. INTRODUCTION TO CONTROLLING CODE OUTPUT (2 hours, lecture)</b></p> <p>A. Post processors B. Machining definition</p> <p><b>XXVI. INTRODUCTION TO CONTROLLING CODE OUTPUT (4 hours, lab)</b></p> <p>A. Post processors B. Machine definition</p>
<b>Total Lecture Hours:</b>	36
<b>Total Laboratory Hours:</b>	54
<b>Total Hours:</b>	90
<b>Primary Method of Evaluation:</b>	3) Skills demonstration
<b>Typical Assignment Using Primary Method of Evaluation:</b>	Create a manufacturing process model for a compressor mounting bracket to be manufactured on a CNC machining center. The process model will include a list of operations, tools, manuscript, process sheet, fixtures, drawings and tool list submitted to the instructor electronically with a minimum of 30 pages including all drawings.
<b>Critical Thinking Assignment 1:</b>	Provided with a CAD database for a mechanical part to be manufactured, convert the CAD data to CNC geometry. Submit CNC geometry on a CAD file electronically to the instructor.
<b>Critical Thinking Assignment 2:</b>	Given an engineering drawing of a mechanical part, create a Three-Dimensional (3D) CAD mechanical drawing of the part on manufacturing software. Submit CAD drawing electronically to the instructor.
<b>Other Evaluation Methods:</b>	Performance Exams Other Exams Class Performance

	<p>Multiple Choice  Completion  Matching Items  True/False  Other (specify):</p> <p style="padding-left: 40px;">Portfolio  Part programming</p>
<b>Instructional Methods:</b>	<p>Demonstration  Laboratory  Lecture</p>
<b>If other:</b>	
<b>Work Outside of Class:</b>	<p>Study</p> <p>Required reading</p> <p>Problem solving activities</p>
<b>If Other:</b>	
<b>Up-To-Date Representative Textbooks:</b>	<p>CamInstructor. <u>Mastercam 2023 - Mill 2D Training Guide</u>. CamInstructor. 2023.</p>
<b>Alternative Textbooks:</b>	
<b>Required Supplementary Readings:</b>	
<b>Other Required Materials:</b>	<p>Removable memory media</p>
<b>Requisite:</b>	
<b>Category:</b>	
<b>Requisite course(s): List both prerequisites and corequisites in this box.</b>	
<b>Requisite and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s).</b>	
<b>Requisite Skill:</b>	
<b>Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable</b>	
<b>Requisite course:</b>	<p>Machine Tool Technology-10A AND</p> <p>Machine Tool Technology-101 AND</p>

	Machine Tool Technology-40
<p><b>Requisite and Matching skill(s):</b> Bold the requisite skill. List the corresponding course objective under each skill(s).</p>	<p><b>Ability to write word numerical control programs to perform point to point drilling and milling operations.</b></p> <p>MTT 10A - Write a word address CNC program to perform point-to-point drilling and milling operation that would produce projects or exercises within the tolerance specified on engineering drawings.</p> <p><b>Ability to calculate the speeds and feeds for basic cutting tools used in machining.</b></p> <p>MTT 101 - Solve shop math problems that involve speeds and feeds, threads, engineering drawing interpretation and calculations relating to machine tools.</p> <p><b>Ability to use trigonometric principles to solve right angle trigonometry problems.</b></p> <p>MTT 40 - Solve right triangle problems using trigonometric functions.</p> <p><b>Knowledge of the lathe and milling machine operations.</b></p> <p>MTT 101 - Set up and operate engine lathes to turn, face, center drill, thread, and cut off to produce assigned work within the tolerances specified on engineering drawings.</p> <p>MTT 101 - Set up and operate vertical and horizontal milling machines to square stock, mill flat surfaces, side mill, end mill, fly cut and slot to produce assigned work within the tolerances specified on engineering drawings.</p> <p><b>Ability of read engineering drawings.</b></p> <p>MTT 101 - Interpret orthographic projection engineering drawings that incorporate geometric dimensioning and tolerancing to produce assigned work within the tolerances specified on engineering drawings.</p> <p><b>Knowledge of cutting tools used in machining.</b></p> <p>MTT 101 - Set up and operate power saws to rough finish assigned work within a minimum of 1/32 of an inch over the dimensions required on engineering drawings.</p>
	<p><b>Requisite Skill:</b> or equivalent</p>
	<p><b>Requisite Skill and Matching skill(s):</b> Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable</p> <p>If a student has taken Machine Tool Technology 10A, 101 and 40 at another college, the student will be prepared to enroll in this course. If students have knowledge in CAD/CAM, basic machining and machine calculations, they will have the skills needed to enroll in this course. It is recommended that students have CAD/CAM, basic machining and machine calculation experience to enhance success in this course.</p>
	<p><b>Enrollment Limitations and Category:</b></p>
	<p><b>Enrollment Limitations Impact:</b></p>
	<p><b>Course Created by:</b> Ronald Way</p>
	<p><b>Date:</b> 09/01/1991</p>

<b>Original Board Approval Date:</b>	03/23/1992
<b>Last Reviewed and/or Revised by:</b>	VICTOR DE LA TORRE
<b>Date:</b>	06/05/2023
<b>Last Board Approval Date:</b>	04/15/224 effective FALL 2025