MACH-211: MACHINE TECHNOLOGY 4

Effective Term
Fall 2026

CC Approval
10/03/2025

AS Approval
10/09/2025

BOT Approval
10/16/2025

SECTION A - Course Data Elements

Send Workflow to Initiator
No

CB04 Credit Status
Credit - Degree Applicable

Discipline

Minimum Qualifications	And/Or
Machine Tool Technology (Tool and die making) (Any Degree and Professional Experience)	

Subject Code
MACH - Machine Tool Technology
Course Number
211

Department
Machine Tool Technology

Division
Career Education and Workforce Development (CEWD)

Full Course Title
Machine Technology 4

Short Title
Machine Technology 4

CB03 TOP Code
0956.30 - *Machining and Machine Tools

CB08 Basic Skills Status
NBS - Not Basic Skills

CB09 SAM Code
B - Advanced Occupational

Rationale
The SLOs were revised to streamline outcomes, eliminate redundancy, and ensure alignment with current industry standards and measurable skills for student success.

SECTION B - Course Description

Catalog Course Description
An advanced course in the Machine Tool Technology degree program. This course emphasizes advanced skills in the operation and programming of CNC (computer numerical controlled) machines, utilizing skills developed in Machine Technology 1, 2, and 3. This course further develops skills in the use of precision measuring instruments, the reading of prints and engineering drawings, and

provides students with an intermediate overview of the programming and operation of CNC vertical machining centers and CNC turning centers along with hands-on operation of hand tools, grinders, engine lathes and vertical milling machines.

SECTION C - Conditions on Enrollment

Open Entry/Open Exit
No

Repeatability
Not Repeatable

Grading Options
Letter Grade or Pass/No Pass

Allow Audit
Yes

Requisites

Prerequisite(s)
Completion of MACH-210 or equivalent with a minimum grade of C.

Advisory Prerequisite(s)
Completion of TECH-107 with a minimum grade of C.

Requisite Justification

Requisite Description
Course in a Sequence

Subject
MACH
Course #
210

Level of Scrutiny
Content Review

Upon entering this course, students should be able to:
• Set up CNC machines using skills learned performing advanced work on conventional machines.
• Have a basic understanding of how CNC machine tools operate.
• Apply advanced machining concepts learned on conventional machines to CNC machines.
• Prepare blanks on conventional machines for machining operations on CNC machines.
• Measure finished parts with precision instruments.

SECTION D - Course Standards

Is this course variable unit?
No

Units
7.00

Lecture Hours
54

Lab Hours
162.00

Activity Hours
36

Outside of Class Hours
126

Total Contact Hours
252

Total Student Hours
378

Distance Education Approval

Is this course offered through Distance Education?
No

SECTION E - Course Content

Student Learning Outcomes

	Upon satisfactory completion of the course, students will be able to:
1.	Set up and operate CNC lathes and machining centers to manufacture complex parts using safe and efficient machining practices.
2.	Write and verify CNC programs using both manual G-code and computer-aided manufacturing (CAM) software such as MasterCam.
3.	Apply trigonometry and programming logic to develop multi-step machining operations, including canned cycles, tool changes, and cutter compensation.
4.	Inspect CNC-machined components using precision measurement tools to ensure compliance with blueprint tolerances and industry standards.

Course Objectives

	Upon satisfactory completion of the course, students will be able to:
1.	Work safely and accurately in a manufacturing environment.
2.	Perform calculations related to CNC programming.
3.	Measure machined parts with precision measurement instruments.
4.	Complete advanced operations on CNC machines.
5.	Program CNC machines.
6.	Use MasterCam software to program CNC machines.

Course Content

- **Safety in CNC and Automated Machining Environments**
  - Lockout/tagout procedures for CNC machines
  - E-stop function, tool breakage detection, and machine diagnostics
  - Safety protocols for automated tool changers and spindle warm-up cycles
- **Introduction to CNC Control Interfaces (HAAS, FANUC)**
  - Navigation of controller screens, offsets, and mode selections
  - Program verification and dry run procedures
  - Setting zero points (G54–G59) and tool length offsets (H codes)
- **G-Code and M-Code Programming Fundamentals**
  - Linear and circular interpolation (G00, G01, G02, G03)
  - Tool changes, spindle control, and coolant commands
  - Canned cycles (e.g., G81 drilling, G83 peck drilling)
- **Advanced CNC Programming Techniques**
  - Subprograms, macros, and conditional statements
  - Threading, tapping, and boring cycles
  - Use of cutter compensation (G41/G42)
- **CAM Programming with MasterCam or Equivalent**

- Part modeling, 2D/3D toolpath generation
- Simulation and collision checking
- Post-processing for different machine platforms

- **Tool Selection and Setup Sheets**
  - Defining tool libraries and cutting parameters
  - Speeds and feeds for carbide vs. HSS tooling
  - Tool life tracking and replacement planning
- **CNC Lathe Operations**
  - Setup and programming of turning operations (facing, roughing, threading)
  - Use of live tooling and tailstock
  - Bar feeder and chucking systems
- **CNC Milling Operations**
  - 2.5D and 3D contouring
  - Pocketing, slotting, and engraving operations
  - Fixture design and repeatable workholding
- **Advanced Inspection and Quality Control**
  - First Article Inspection (FAI) and SPC basics
  - Use of digital calipers, height gauges, and bore micrometers
  - Surface finish, roundness, and tolerance reporting

Methods of Instruction

Methods of Instruction

Types	Examples of learning activities
Lab	Students test CNC programs in a virtual environment (e.g., MasterCam Verify) before applying them to real machines, reinforcing safe and accurate setups.
Lecture	Lectures covering CNC concepts, trigonometry in programming, canned cycles, and machine code structure. Group discussions on real-world machining problems, optimization of tool paths, and production strategies.
Activity	Students create, verify, and run CNC programs on both lathe and milling machines to produce precision parts. Students practice troubleshooting and correcting CNC program errors.

Methods of Evaluation

Methods of Evaluation

Types	Examples of classroom assessments
Projects	Graded machining projects (e.g., multi-operation parts) where students must plan, program, set up, and inspect CNC-produced components for tolerances and finish.
Lab Activities	Students submit G-code programs or CAM-generated tool paths that are evaluated for accuracy, efficiency, and correct use of machining strategies.
Exams/Tests	Written exams with CNC programming problems, trigonometry-based calculations, and identification of CNC codes and cycles.
Other	Continuous evaluation of adherence to CNC safety protocols, proper machine setup, and tool handling.

Assignments

Reading Assignments

1. Students will be required to read their notes from lab lectures in order to perform their lab assignments.

Example: notes from lecture on cutter diameter compensation, *C&C Programming Handbook*, Krar, textbook.

2. Students will be required to read weekly assignments from the textbooks in preparation for lectures and for lab assignments.

Example: lecture on canned cycles, *C&C Programming Handbook*, Krar, textbook.

Writing Assignments
1. Students will be required to read the assigned portions of the textbook to determine the correct procedure for machining a part.
Example: notes from the lecture on canned cycles, *C&C Programming Handbook*, Krar, textbook.
2. Students will be required to take notes on the procedures for completion of lab assignments.
Example: notes from lecture on procedures for machining a pump packing gland flange.
3. Students will analyze the drawings given to them and formulate a strategy for machining the assigned part.
Example: lab assignment #3, machining of a packing gland flange.

SECTION F - Textbooks and Instructional Materials

Material Type
Textbook

Author
Oberg, Jones, Horton, & Ryffel

Title
Machinery's Handbook

Edition/Version
30th

Publisher
Industrial Press

Year
2020

Material Type
Manual

Author
Haas Automation, Inc

Title
Mill Series Programming Workbook

Publisher
Haas Automation, Inc.

Year
2015

Material Type
Manual

Author
Haas Automation, Inc.

Title
Lathe Series Programming Workbook

Publisher
Haas Automation, Inc.

Year
2015

SECTION G - Diversity, Equity and Inclusivity

How does your course and/or course outline of record reflect strategies for accommodating and engaging diverse student populations, advancing equitable outcomes, and fostering inclusion for all students?

This course ensures equitable learning by pairing traditional CNC programming with user-friendly CAM software, providing multiple pathways for students to master skills. Students receive one-on-one coaching, collaborative problem-solving sessions, and access to modern CNC simulations to accommodate various learning preferences.

Course Codes (Admin Only)

CB00 State ID

CCC000115733

CB10 Cooperative Work Experience Status

N - Is Not Part of a Cooperative Work Experience Education Program

CB11 Course Classification Status

Y - Credit Course

CB13 Special Class Status

N - The Course is Not an Approved Special Class

CB23 Funding Agency Category

Y - Not Applicable (Funding Not Used)

CB24 Program Course Status

Program Applicable

Allow Pass/No Pass

Yes

Only Pass/No Pass

No