Course Acronym:	MTT
Course Number:	105
Descriptive Title:	Conventional and CNC Milling
Division:	Industry and Technology
Department:	Machine Tool Technology
Course Disciplines:	Machine Tool Technology
Catalog Description:	In this course, students will study at an advanced level the principles and operation of conventional and Computer Numerically Controlled (CNC) machine tools with an emphasis on the setup and operation of milling machines. Topics will include safety, drilling, milling, tapping, tooling, CNC programming practices, and setups as applied in industry. Note: Letter grade or pass/no pass option
Prerequisite:	Machine Tool Technology 46 or Machine Tool Technology 101 with a minimum grade of C in prerequisite or equivalent
Co-requisite:	
Recommended Preparation:	
Enrollment Limitation:	
Hours Lecture (per week):	2
Hours Laboratory (per week):	6
Outside Study Hours:	4
Total Course Hours:	144
Course Units:	4
Grading Method:	Letter Grade and Pass/No Pass
Credit Status:	Credit, degree applicable
Transfer CSU:	Yes
Effective Date:	3/19/2007
Transfer UC:	No
Effective Date:	
General Education: ECC	
Term:	
Other:	
CSU GE:	

Term:	
Other:	
IGETC:	
Term:	
Other:	
Student Learning Outcomes:	**SLO #1 Squaring the Block** Given a rough-cut aluminum block, square the block using a milling machine, cutters and measurement tools. **SLO #2 Power Machines** Using proper safety procedures and precautions, students will be able to set up and operate vertical and horizontal milling machines, rotary tables, indexing and dividing heads, and vertical milling machines to produce assigned work within the tolerances specified on engineering drawings. **SLO #3 Soft Jaws Project** Students will be able to read, de-bug and edit CNC vertical milling machine word address programs and to enter Manual Data Input (MDI) CNC word address milling machine programs to produce vise soft jaws for holding work to produce parts within the tolerances specified on engineering drawings.
Course Objectives:	1. Correctly apply machine shop safety practices with 100% accuracy. 2. Correctly use hand tools, measuring tools, power saws, engine lathes, drilling machines and grinding machines to perform supplemental machine tool operations on assigned work within the tolerances specified on engineering drawings. 3. Set up and operate vertical and horizontal milling machines to square stock, mill flat surfaces, face mill, side mill, end mill, fly cut, slit, and slot to produce assigned work within the tolerances specified on engineering drawings. 4. Set up and operate rotary tables, indexing and dividing heads to produce assigned work within the tolerances specified on engineering drawings. 5. Set up and operate CNC vertical milling machines to produce assigned work within the tolerances specified on engineering drawings." 6. Solve shop mathematics problems involving trigonometry and its application to rotary tables, indexing and dividing heads, dovetails, compound angles, speeds and feeds, blueprint interpretation and calculations relating to the milling machine.

	7. Read, de-bug and edit CNC vertical milling machine word address programs to produce assigned work within the tolerances specified on engineering drawings. 8. Enter Manual Data Input (MDI) CNC word address milling machine programs to machine vise soft jaws for holding work to produce parts within the tolerances specified on engineering drawings.
Major Topics:	**I. Safety Review (2 hours, lecture)** A. Machine tool technology analysis B. Safe shop practices in metal working C. Hand tool and bench work D. Safety test **II. Safety Review (6 hours, lab)** A. Machine tool technology analysis B. Safe shop practices in metal working C. Hand tool and bench work D. Safety test **III. Review - Basic Machining and Supplemental Processes (2 hours, lecture)** A. Measurement B. Basic lathe C. Basic milling machines D. Basic grinding E. Print reading F. Procedures **IV. Review - Basic Machining and Supplemental Processes (6 hours, lab)** A. Measurement B. Basic lathe C. Basic milling machines D. Basic grinding E. Print reading F. Procedures **V. Conventional Milling Machine Orientation, Setup and Operation (8 hours, lecture)** A. Horizontal milling machine operations B. Milling cutters **VI. Conventional Milling Machine Orientation, Setup and Operation (24 hours, lab)** A. Vertical milling machine operations

B. Milling cutters

VII. Applied Trigonometry (4 hours, lecture)

A. Rotary table calculations
B. Index and dividing head calculations
C. Dovetail calculations
D. Compound angle calculations
E. Setups
    1. Rotary tables
    2. Index and dividing heads
    3. Dovetail cutting
    4. Compound angle cutting

VIII. Applied Trigonometry (12 hours, lab)

A. Rotary table calculations
B. Index and dividing head calculations
C. Dovetail calculations
D. Compound angle calculations
E. Setups
    1. Rotary tables
    2. Index and dividing heads
    3. Dovetail cutting
    4. Compound angle cutting

IX. CNC Milling Machine Orientation, Setup and Operation (6 hours, lecture)

A. CNC performance
B. Advantages and disadantages of CNC
C. Cartesian coordinates
D. Machine tool axes
E. Absolute system
F. Storage and input media
G. Programming format
H. Program planning
I. Machine start-up
J. Fixture offset
K. Tool offset
L. Automatic operations
M. Shut down
N. Emergency stop

X. CNC Milling Machine Orientation, Setup and Operation (18 hours, lab)

A. CNC performance
B. Advantages and disadvantages of CNC
C. Cartesian coordinates
D. Machine tool axes
E. Absolute system
F. Storage and input media

G. Programming format
H. Program planning
I. Machine start-up
J. Fixture offset
K. Tool offset
L. Automatic operations
M. Shut down
N. Emergency stop

XI. Programming Commands and Codes (4 hours, lecture)

A. Methods of program proofing
B. Online editing
C. Offline editing
D. Screen plotting
E. Dry run

XII. Programming Commands and Codes (12 hours, lab)

A. Programming format
B. Program name code
C. Axis code
D. G-codes
E. M-codes
F. S-word
G. F-word

XIII. Program Proofing, Editing, Program Simulation (2 hours, lecture)

A. Methods of program proofing
B. Online editing
C. Offline editing
D. Screen plotting
E. Dry run

XIV. Program Proofing, Editing, Program Simulation (6 hours, lab)

A. Methods of program proofing
B. Online editing
C. Offline editing
D. Screen plotting
E. Dry run

XV. Tool Selection and Workpiece Holding (2 hours, lecture)

A. Cutting tools
B. Collet holders
C. CAT 40 holders
D. Vises
E. Fixtures
F. Tooling plates

G. Clamping systems

XVI. Tool Selection and Workpiece Holding (6 hours, lab)

A. Cutting tools
B. Collet holders
C. CAT 40 holders
D. Vises
E. Fixtures
F. Tooling plates
G. Clamping systems

XVII. Tool Length Offsets and Pre-set Tooling (2 hours, lecture)

A. Setting tool lengths
B. Tool setters
C. Offset page
D. H-word
E. Setting pre-set tools
F. Offsetting pre-set tools

XVIII. Tool Length Offsets and Pre-set Tooling (6 hours, lab)

A. Setting tool lengths
B. Tool setters
C. Offset page
D. H-word
E. Setting pre-set tools
F. Offsetting pre-set tools

XIX. Machine Control Units and Manual Data Input (MDI) (2 hours, lecture)

A. Haas
B. Fadal
C. Fanuc
D. Keyboard entries
E. Saving MDI program

XX. Machine Control Units and MDI (6 hours, lab)

A. Haas
B. Fadal
C. Fanuc
D. Keyboard entries
E. Saving MDI program

XXI. Data Transfer and Storage (2 hours, lecture)

A. Floppy disc
B. USB thumb drive
C. Electronic download

	D. Compact flash card **XXII. Data Transfer and Storage (6 hours, lab)** A. Floppy disc B. USB thumb drive C. Electronic download D. Compact flash card
Total Lecture Hours:	36
Total Laboratory Hours:	108
Total Hours:	144
Primary Method of Evaluation:	2) Problem solving demonstrations (computational or non-computational)
Typical Assignment Using Primary Method of Evaluation:	Using the Kennametal Insert Catalog, look up the part number for the replaceable insert needed for the tool holder provided to you. Applying industry standard specifications, prepare a purchase order for five inserts that would produce a maximum corner radius of .06". Submit the purchase order to the instructor.
Critical Thinking Assignment 1:	Calculate the angle to tilt the head on a conventional vertical mill to machine the feature shown at zone C-4 on the engineering drawing for part number MS-22. Based on the calculated angle, specify whether you would recommend cutting the feature with the side or end of the selected cutting tool on a one-page lab report. Submit lab report to the instructor.
Critical Thinking Assignment 2:	It has been determined that the rate of feed for a machining sequence in the middle of a program running on the CNC Machining Center is excessive. Determine number of the sequence, calculate the appropriate feed rate, edit the sequence at the machine control unit and run the part to confirm that the change has corrected the problem. Report the results of your corrective actions on a one-page lab report. Submit lab report to the instructor.
Other Evaluation Methods:	Performance Exams Objective Exams Other Exams Quizzes Written Homework Laboratory Reports Class Performance Homework Problems Term or other papers Multiple Choice Completion Matching Items True/False
Instructional Methods:	Demonstration Discussion Group Activities Internet Presentation/Resources

	Laboratory Lecture Multimedia presentations
If other:	Internet Presentation/Resources
Work Outside of Class:	Study Answer questions Required reading Problem solving activities
If Other:	
Up-To-Date Representative Textbooks:	Stephen F. Krar, Arthur R. Gill and Peter Smid. Technology of Machine Tools. 8th Edition. McGraw Hill, 2020.
Alternative Textbooks:	
Required Supplementary Readings:	
Other Required Materials:	Safety glasses or goggles Steel rule - flexible - 6" Clean shop coat/apron Lathe tool bits - 3/8" square Materials for projects Scientific calculator
Requisite:	Prerequisite
Category:	sequential
Requisite course(s): List both prerequisites and corequisites in this box.	Machine Tool Technology-46 or Machine Tool Technology-101
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	**Work in a manufacturing environment safely.** MTT 101 -Correctly apply machine shop safety practices with 100% accuracy. MTT 46 -Demonstrate manufacturing shop safety practices with 100% accuracy. **Read basic detail engineering drawings for machined parts.** MTT 101 -Interpret orthographic projection engineering drawings that incorporate geometric dimensioning and tolerancing to produce assigned work within the tolerances specified on engineering drawings.

	Identify and use metal working hand tools. MTT 101 -Select and use metal working hand tools to produce assigned work within the tolerances specified on engineering drawings. MTT 46 -Select and use metal working hand tools to produce projects within the tolerances specified by engineering requirements. **Measure and layout using semi-precision and precision measuring tools.** MTT 101 -Measure and layout utilizing semi-precision and precision measuring tools to produce assigned work within the tolerances specified on engineering drawings. MTT 46 -Measure and layout utilizing semi-precision and precision measuring tools to produce projects within the tolerances specified by engineering requirements. **Use power saws to rough shape stock.** 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. MTT 46 -Weld band saw blades and use power saws to rough finish projects within a minimum of 1/32 of an inch over the dimensions required by engineering requirements. **Perform basic machining operations using an engine lathe.** 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. MTT 46 -Set up and operate engine lathes to turn, face, center drill, thread, and cut off to produce projects within the tolerances on the engineering requirements. **Perform basic machining operations using a vertical milling machine.** 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. MTT 46 -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 projects within the tolerances specified on the engineering requirements. **Perform basic machining operations using a grinding machine.**

	MTT 101 -Set up and operate grinding machines to sharpen lathe tool bits, and surface grind to produce assigned work within the tolerances specified on the engineering drawings. MTT 46 -Set up and operate grinding machines to sharpen lathe tool bits, twist drills, and surface grind to produce projects within the tolerances specified by engineering requirements. **Ability to solve shop math calculations for speed and feeds and thread measurement.** MTT 46 -Use and read micrometers and vernier measuring tools to measure projects within the tolerances specified by engineering requirements. MTT 101 -Solve shop math problems that involve speeds and feeds, threads, engineering drawing interpretation and calculations relating to machine tools.
Requisite Skill:	or equivalent
Requisite Skill and Matching Skill(s): Bold the requisite skill(s). If applicable	If a student has taken an equivalent course at another college or has basic machining experience, the student will be qualified to enroll in this course. Students must have basic machining skills to succeed in this course.
Requisite course:	
Requisite and Matching skill(s):Bold the requisite skill. List the corresponding course objective under each skill(s).	
Requisite Skill:	
Requisite Skill and Matching skill(s): Bold the requisite skill. List the corresponding course objective under each skill(s). If applicable	
Enrollment Limitations and Category:	
Enrollment Limitations Impact:	
Course Created by:	Harold Hofmann/Eric Carlson
Date:	10/27/2015
Original Board Approval Date:	03/19/2007
Last Reviewed and/or Revised by:	Eric Carlson
Date:	03/02/2022
Last Board Approval Date:	