NCT 221: ADVANCED CNC PROGRAMMING AND NC TOOL OPERATION

Completed Workflow

1. AMTD Chair (acoleman10@wccnet.edu)
2. AT Dean (krue@wccnet.edu; esamulski@wccnet.edu)
3. C&A Assistant (aabooker@wccnet.edu)
4. Curricular Systems Coordinator (cacevans@wccnet.edu)
5. C&A Coordinator (sabird@wccnet.edu)
6. C&A Director (bjlinford@wccnet.edu)
7. Before Comm review (aabooker@wccnet.edu)
8. Comm Review step (sabird@wccnet.edu)
9. After Comm review (sabird@wccnet.edu,bjlinford@wccnet.edu)
10. Curriculum Committee Chair (rvanwagnen@wccnet.edu)
11. Assessment Committee Chair (jhale15@wccnet.edu)
12. Before VPI (sabird@wccnet.edu)
13. Vice President for Instruction (eloubert@wccnet.edu; brtucker@wccnet.edu)
14. Banner (cacevans@wccnet.edu)

Approval Path

1. 2026-03-03T17:19:56Z
   Allan Coleman (acoleman10): Approved for AMTD Chair
2. 2026-03-03T18:54:05Z
   Eva Samulski (esamulski): Approved for AT Dean
3. 2026-03-20T21:44:51Z
   Amber Booker (aabooker): Approved for C&A Assistant
4. 2026-03-27T15:02:08Z
   Carol Evans (cacevans): Approved for Curricular Systems Coordinator
5. 2026-07-02T17:31:52Z
   Sera Bird (sabird): Approved for C&A Coordinator
6. 2026-09-10T18:35:01Z
   Ben Linford (bjlinford): Approved for C&A Director
7. 2026-09-10T21:21:04Z
   Amber Booker (aabooker): Approved for Before Comm review
8. 2026-09-17T21:47:27Z
   Amber Booker (aabooker): Approved for Comm Review step
9. 2026-10-06T20:58:51Z
   Ben Linford (bjlinford): Approved for After Comm review
10. 2026-10-28T22:13:52Z
    Randy Van Wagnen (rvanwagnen): Approved for Curriculum Committee Chair
11. 2026-10-29T17:53:10Z
    Sera Bird (sabird): Approved for Assessment Committee Chair
12. 2026-10-29T17:53:14Z
    Sera Bird (sabird): Approved for Before VPI
13. 2026-10-29T19:13:52Z
    Brandon Tucker (brtucker): Approved for Vice President for Instruction
14. 2026-10-30T12:43:00Z
    Carol Evans (cacevans): Approved for Banner

History

1. Oct 30, 2026 by Andrew Dubuc (adubuc)

Viewing: NCT 221 : Advanced CNC Programming and NC Tool Operation

Changes proposed by: Andrew Dubuc (adubuc)

Effective Term

Summer 2027

Rationale and proposal summary

This course is the second in a sequence (NCT-121 then NCT-221) which are both undergoing syllabus updates to reflect changes in new technology and processes. The math level has been lowered as students no longer use trigonometry and advanced algebra in this course.

Course Cover

Full Course Title

Advanced CNC Programming and NC Tool Operation

Transcript Title

Adv CNC Program NC Tool

Subject Code

NCT - Numerical Control

Course Number

221

Department

Advanced Manufacturing (AMTD)

Banner Division

ATP

Division/College

Adv Tech/Public Serv Careers (AT)

Org Code

14450

Course Description

In this course, students will produce complex machined components by utilizing a variety of Computer Numerical Control (CNC) machining equipment. Topics will include advanced machine set-up procedures, strategies for programming and debugging, determination of optimal cutting speeds and feeds, and application of proper inspection techniques. Inspection of individual components and assemblies are both investigated. Parts are programmed using computer-aided design / computer-aided manufacturing (CAD/CAM) software. This is the second in a two-course study of CAD-CAM application in CNC milling and turning centers; knowledge of CAM software is required. The title of this course was previously Advanced Manual Programming and NC Tool Operation.

Planned Delivery Format

Face to Face

Has this course been approved for virtual or blended virtual?

No

Has this course been approved for online or online blended?

No

Grading method

Standard Letter, Audit, Academic Forgiveness

CIP Code

159999 - Engineering/Engineering-Related Technologies/Technicians, Other.

Occupational Indicator

Yes

ACS Code

130

Credit hours, contact hours, repeatability

Repeatable for additional credit
No

Course credits
4

Lecture contact hours
30

Lab contact hours
60

Total Contact Hours
90
Expected Total Contact Hours
90

Prerequisites and prerequisite skill levels

College-Level Math
Other/Varies

College-Level Reading and Writing
College-level Reading and Writing

Approved Level I Prerequisite:
Academic Reading and Writing Levels of 6; Academic Math Level 3 or MTH 157, minimum grade "C"; NCT 121 and NCT 123, minimum grade "C"

Is concurrent enrollment an option for this prerequisite?
No

Course Assessment Plan
Learning Outcome

Outcome
Create programs to manufacture advanced assemblies of workpieces on CNC milling machines.

Assessment #1

Assessment Tool
Outcome-related capstone projects

Anticipated Next Assessment Year
2028

Anticipated Next Assessment Term
Winter

Assessment Cycle
Every Three Years

Anticipated assessment population
All students from all sections

How the assessment will be scored
Departmentally-developed rubric

Who does the scoring?
Departmental faculty

Standard of success
75% of the students will score 70% or higher.

Assessment #2

Learning Outcome

Outcome
Create programs to manufacture advanced assemblies of workpieces on CNC lathes or turning machines.

Assessment #1

Assessment Tool
Outcome-related capstone projects

Anticipated Next Assessment Year
2028

Anticipated Next Assessment Term
Winter

Assessment Cycle
Every Three Years

Anticipated assessment population
All students from all sections

How the assessment will be scored
Departmentally-developed rubric

Who does the scoring?
Departmental faculty

Standard of success
75% of the students will score 70% or higher.

Assessment #2

Learning Outcome

Outcome
Troubleshoot and debug advanced programs at the CNC machine controllers yielding parts to specification.

Assessment #1

Assessment Tool
Outcome-related capstone projects

Anticipated Next Assessment Year
2028

Anticipated Next Assessment Term
Winter

Assessment Cycle
Every Three Years

Anticipated assessment population
All students from all sections

How the assessment will be scored
Departmentally-developed rubric

Who does the scoring?
Departmental faculty

Standard of success
75% of the students will score 70% or higher.

Assessment #2

Course Objectives

	Objective(s)
1.	Manufacture workpieces utilizing multi-axis milling machines (4-axis and 5-axis).
2.	Design and construct customized fixtures necessary for holding workpieces within the CNC machine.
3.	Manufacture workpieces by utilizing pre-made design files supplied by an outside party.
4.	Manufacture workpieces from difficult-to-fabricate materials.
5.	Manufacture workpieces consisting of multi-axis lathes or turning machines (4-axis, live tooling).
6.	Build linking parts that adhere to industry-standard measurement data.
7.	Manufacture advanced workpieces requiring multiple types of CNC machines and operations.
8.	Apply advanced mill and lathe tooling in the creation of products.
9.	Simulate and evaluate different methods to manufacture components, fixtures, and measurement gages.
10.	Manufacture assemblies of parts by applying advanced blueprints, measurement methods, and tools.

General Education Area(s)

Area 1: Writing
No

Area 2: 2nd Writing or Communication/Speech
No

Area 3: Mathematics
No

Area 4: Natural Science
No

Area 5: Social and Behavioral Science
No

Area 6: Arts and Humanities
No

MTA General Education
No

Review

Is conditional approval requested?
No

Is this course currently conditionally approved, and you are now submitting it for full approval?
No

Reviewer Comments
Allan Coleman (acoleman10) (2026-03-03T17:19:35Z): Ref Math level. MTH 157 Technical Mathematics or Math Level 3

Sera Bird (sabird) (2026-06-23T18:47:34Z): Contacted preparer 6/23/26 for clarification of math level; minor suggestions for description, assessment plan, objective #8.

Sera Bird (sabird) (2026-07-01T15:26:32Z): Sent follow-up email 7/1/26.

Sera Bird (sabird) (2026-07-02T17:31:47Z): Based on email with preparer 7/2/26, minor updates to description/objectives, add MTH 157 as option for math prereq.

Sera Bird (sabird) (2026-10-29T17:53:06Z): Approved by Assessment Committee Chair 10/29/26 via internal tracking system.

Key: 7674

Washtenaw Community College Comprehensive Report

NCT 221 Advanced Manual Programming and NC Tool Operation
Effective Term: Fall 2022

Course Cover

College: Advanced Technologies and Public Service Careers
Division: Advanced Technologies and Public Service Careers
Department: Advanced Manufacturing
Discipline: Numerical Control
Course Number: 221
Org Number: 14450
Full Course Title: Advanced Manual Programming and NC Tool Operation
Transcript Title: Adv Manual Program/NC Tool Op
Is Consultation with other department(s) required: No
Publish in the Following: College Catalog , Time Schedule , Web Page
Reason for Submission: Three Year Review / Assessment Report
Change Information:
Consultation with all departments affected by this course is required.
Pre-requisite, co-requisite, or enrollment restrictions
Rationale: Students entering this class need to have knowledge in CAD/CAM programming. NCT 123 is the class that teaches this skill set for students to apply all tools in the final class in the certificate they must have taken NCT 123. We have been fortunate that student in the last couple of years have had the skill set needed to do CAD/CAM programming in NCT 221.
Proposed Start Semester: Winter 2022
Course Description: In this course, students will learn complex cutter path generation, cutter compensation, repetitive programming, multi-quadrant circular interpolation, three axis interpolation, threading macros, and other advanced programming techniques are practiced. Geometry creation using computer-aided design/computer-aided manufacturing (CAD/CAM) software will be presented and used in this class. The class format is similar to that of NCT 121. Students with experience equivalent to NCT 121 may contact the instructor for permission to waive the prerequisite. This is the second of a two-course study of manual programming and computer numerical control (CNC) Machine Tool Operation.

Course Credit Hours

Variable hours: No
Credits: 4
Lecture Hours: Instructor: 30 **Student:** 30
Lab: Instructor: 60 **Student:** 60
Clinical: Instructor: 0 **Student:** 0

Total Contact Hours: Instructor: 90 **Student:** 90
Repeatable for Credit: NO
Grading Methods: Letter Grades
Audit
Are lectures, labs, or clinicals offered as separate sections?: NO (same sections)

College-Level Reading and Writing

College-level Reading & Writing

College-Level Math

Level 4

Requisites

Prerequisite
NCT 121 minimum grade "C"
and
Prerequisite
NCT 123 minimum grade "C"

General Education

General Education Area 7 - Computer and Information Literacy
Assoc in Arts - Comp Lit
Assoc in Applied Sci - Comp Lit
Assoc in Science - Comp Lit

Request Course Transfer

Proposed For:

Student Learning Outcomes

1. Create machine tool paths at CNC milling and turning centers using advanced machine tool codes.
   Assessment 1
   Assessment Tool: Outcome-related capstone projects
   Assessment Date: Winter 2024
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All
   Number students to be assessed: All
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 75% of the students will score a minimum of 70% or higher.
   Who will score and analyze the data: Departmental faculty

2. Analyze machine tool paths to optimize machining processes.
   Assessment 1
   Assessment Tool: Outcome-related capstone projects
   Assessment Date: Winter 2024
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All
   Number students to be assessed: All
   How the assessment will be scored: Departmentally-developed rubric
   Standard of success to be used for this assessment: 75% of the students will score a minimum of 70% or higher.
   Who will score and analyze the data: Departmental faculty

3. Interpret part drawings and develop manuscripts for part programming and part setup at CNC machine tool centers.
   Assessment 1
   Assessment Tool: Outcome-related capstone projects
   Assessment Date: Winter 2024
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All
   Number students to be assessed: All
   How the assessment will be scored: Departmentally-developed rubric

Standard of success to be used for this assessment: 75% of the students will score a minimum of 70% or higher.
Who will score and analyze the data: Departmental faculty

Course Objectives

1. Apply code including; string statements, loops, subroutines and or macros to produce patterns of holes.
2. Apply G & M codes to produce single and multiple lead threads of various forms at the mills and lathes.
3. Construct local subroutines as well as general subprograms within main program.
4. Apply X-Z & Y-Z linear and circular interpolation within part programs to produce 3-dimensional features.
5. Apply both static and dynamic 4th axis machine tool motion to parts at the mills.
6. Apply single angle, single angle to radius, double angle, and double angle to radius cutter locations using rules with geometry, algebra, and trigonometry. These cutter locations will be used to identify cutter to part transitional locations.
7. Integrate variables, mathematical expressions, counters and conditional statements allowing an operator to produce an array of part features within the structure of a program (families of parts).
8. Design, program and document parts at computer numerically controlled machine tools.
9. Debug and cut parts at computer numerically controlled machine tools.

New Resources for Course

Course Textbooks/Resources

Textbooks
Manuals
Periodicals
Software

Equipment/Facilities

Level III classroom

Reviewer	Action	Date
Faculty Preparer:		
Thomas Penird	*Faculty Preparer*	*Aug 16, 2021*
Department Chair/Area Director:		
Thomas Penird	*Recommend Approval*	*Aug 16, 2021*
Dean:		
Jimmie Baber	*Recommend Approval*	*Aug 19, 2021*
Curriculum Committee Chair:		
Randy Van Wagnen	*Recommend Approval*	*Feb 17, 2022*
Assessment Committee Chair:		
Shawn Deron	*Recommend Approval*	*Feb 23, 2022*
Vice President for Instruction:		
Kimberly Hurns	*Approve*	*Feb 23, 2022*

Washtenaw Community College Comprehensive Report

NCT 221 Advanced Manual Programming and NC Tool Operation
Effective Term: Fall 2014

Course Cover

Division: Advanced Technologies and Public Service Careers
Department: Industrial Technology
Discipline: Numerical Control
Course Number: 221
Org Number: 14450
Full Course Title: Advanced Manual Programming and NC Tool Operation
Transcript Title: Adv Manual Program/NC Tool Op
Is Consultation with other department(s) required: No
Publish in the Following: College Catalog , Time Schedule , Web Page
Reason for Submission: Three Year Review / Assessment Report
Change Information:
Consultation with all departments affected by this course is required.
Course description
Pre-requisite, co-requisite, or enrollment restrictions
Outcomes/Assessment
Objectives/Evaluation
Rationale: Regular 3-year review. Conditionally approved - seeking full approval.
Proposed Start Semester: Winter 2014
Course Description: This is the second of a two-course study of manual programming and CNC Machine Tool Operation. Complex cutter path generation, cutter compensation, repetitive programming, multi-quadrant circular interpolation, three axis interpolation, threading macros, and other advanced programming techniques are practiced. Geometry creation using CAD/CAM software will be presented and used in this class. The class format is similar to that of NCT 121. Students with experience equivalent to NCT 121 may contact the instructor for permission to waive the prerequisite.

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Are lectures, labs, or clinicals offered as separate sections?: NO (same sections)

College-Level Reading and Writing

College-level Reading & Writing

College-Level Math

Level 4

Requisites

Prerequisite
NCT 121 minimum grade "C"

General Education

General Education Area 7 - Computer and Information Literacy
Assoc in Arts - Comp Lit
Assoc in Applied Sci - Comp Lit
Assoc in Science - Comp Lit

Request Course Transfer

Proposed For:

Student Learning Outcomes

1. Use advanced machine tool codes for creating machine tool paths at CNC milling and turning centers.
   Assessment 1
   Assessment Tool: Capstone Projects
   Assessment Date: Fall 2014
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All
   Number students to be assessed: All
   How the assessment will be scored: departmentally-developed rubric.
   Standard of success to be used for this assessment: 75% of the students will score a minimum of 70% or higher.
   Who will score and analyze the data: Department Faculty

2. Examine machine tool paths and make needed changes for optimizing machining processes.
   Assessment 1
   Assessment Tool: Capstone Projects
   Assessment Date: Fall 2014
   Assessment Cycle: Every Three Years
   Course section(s)/other population: All
   Number students to be assessed: All
   How the assessment will be scored: departmentally-developed rubric.
   Standard of success to be used for this assessment: 75% of the students will score a minimum of 70% or higher.
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3. Interpret part drawings and develop manuscripts for part programming and part setup at CNC machine tool centers.
   Assessment 1
   Assessment Tool: Capstone Projects
   Assessment Date: Fall 2014
   Assessment Cycle: Every Three Years
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Course Objectives

1. Apply code including; string statements, loops, subroutines and or macros to produce patterns of holes.
   Matched Outcomes

2. Apply G & M codes to produce single and multiple lead threads of various forms at the mills and lathes.
   Matched Outcomes
3. Construct local subroutines as well as general subprograms within main program.
   Matched Outcomes
4. Apply X-Z & Y-Z linear and circular interpolation within part programs to produce 3-dimensional features.
   Matched Outcomes
5. Apply both static and dynamic 4th axis machine tool motion to parts at the mills.
   Matched Outcomes
6. Apply single angle, single angle to radius, double angle, and double angle to radius cutter locations using rules with geometry, algebra, and trigonometry. These cutter locations will be used to identify cutter to part transitional locations.
   Matched Outcomes
7. Integrate variables, mathematical expressions, counters and conditional statements allowing an operator to produce an array of part features within the structure of a program (families of parts).
   Matched Outcomes
8. Design, program, document, debug and cut parts at computer numerically controlled machine tools.
   Matched Outcomes

New Resources for Course

Course Textbooks/Resources

Textbooks
Manuals
Periodicals
Software

Equipment/Facilities

Level III classroom

Reviewer	Action	Date
Faculty Preparer:		
Thomas Penird	*Faculty Preparer*	*Dec 19, 2013*
Department Chair/Area Director:		
Thomas Penird	*Recommend Approval*	*Dec 19, 2013*
Dean:		
Marilyn Donham	*Recommend Approval*	*Jan 10, 2014*
Vice President for Instruction:		
Bill Abernethy	*Approve*	*Feb 10, 2014*