

# ENGT 015B: COMPUTER NUMERICAL CONTROLS IB

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**Originator**

dgonzalez

**Justification / Rationale**

Labor market indicators show that there are jobs available and an advisory committee recommended the course.

**Effective Term**

Fall 2019

**Credit Status**

Credit - Degree Applicable

**Subject**

ENGT - Engineering Technology

**Course Number**

015B

**Full Course Title**

Computer Numerical Controls IB

**Short Title**

CNC IB

**Discipline****Disciplines List**

Engineering Technology

**Modality**

Face-to-Face

**Catalog Description**

This course is the second of an introduction to Computer Numerical Control (CNC) programming course series. The use of M&G code programming to produce CNC programs for machined parts will be taught. Specific areas of programming including linear and circular interpolation, canned cycles, drilling, reaming, tapping, boring, face milling, end milling and the use of sub programs will be covered. Machine operation will be covered and used to proof run programs.

**Schedule Description**

This course is the second of an introduction to Computer Numerical Control (CNC) programming course series.  
Prerequisite: ENGT 015A

**Lecture Units**

1

**Lecture Semester Hours**

18

**Lab Units**

1

**Lab Semester Hours**

54

**In-class Hours**

72

**Out-of-class Hours**

36

**Total Course Units**

2

**Total Semester Hours**

108

**Prerequisite Course(s)**

ENGT 015A

**Required Text and Other Instructional Materials****Resource Type**

Book

**Author**

Valentino, James V., Goldenberg, Joseph

**Title**

Introduction to Computer Numerical Control

**Edition**

5th

**Publisher**

Pearson

**Year**

2012

**College Level**

Yes

**ISBN #**

978-0132176033

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**For Text greater than five years old, list rationale:**

This is the most recent edition of the book available.

**Class Size Maximum**

30

**Entrance Skills**

Introductory components of Computer Numerical Control systems

**Prerequisite Course Objectives**

ENGT 015A-Identify what basic components comprise Computer Numerical Control systems.

ENGT 015A-Evaluate Computer Numerical Control machine axis of motion.

ENGT 015A-Identify and describe the tooling used for such hole operations as boring, reaming, tapping, counterboring, and countersinking.

ENGT 015A-Create a program to produce a drilled part from a blank using holing operations.

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**Entrance Skills**

Identify Computer Numerical Control control and loop systems.

**Prerequisite Course Objectives**

ENGT 015A-Analyze the two types of control systems used to output tool movement.

ENGT 015A-Identify the two types of loop systems used with Computer Numerical Control controllers.

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**Entrance Skills**

Identify means to perform drill operations using Computer Numerical Control

**Prerequisite Course Objectives**

ENGT 015A-Analyze the types and applications of drills used with Computer Numerical Control equipment.

ENGT 015A-Identify and describe the tooling used for such hole operations as boring, reaming, tapping, counterboring, and countersinking.

ENGT 015A-Create a program to produce a drilled part from a blank using holing operations.

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**Course Content**

1. Introduction/review
2. Exploring Features of CNC Machining Centers
  - a. Background on machining centers
  - b. Tooling systems used with automatic tool changers
  - c. Methods of securing tools in tool holders
  - d. Methods of securing tooling systems to the CNC spindle
  - e. Automatic tool changer systems
  - f. Pallet loading systems
  - g. Features of the Machine Control Unit (MCU)
3. Review of Basic Blueprint Reading for CNC Programmers
  - a. Projection conventions used in drawings
  - b. Visualizing 3d objects from 2d orthographic views
  - c. Auxiliary views
  - d. Sectional views
  - e. Reading dimensions
  - f. Reading threads and thread notes
  - g. Reading surface finish symbols and notes
  - h. Reading material specifications
  - i. Interpreting geometric dimensioning and tolerancing
4. Mathematics for CNC Programming
  - a. Determining sides of right triangles
  - b. Useful angle concepts
  - c. Determining angles of right triangles
  - d. Oblique triangles
5. Overview of CNC Shop activities
  - a. Essential CNC shop activities
  - b. Part drawing study
  - c. Methodizing of Operations for CNC machining centers
  - d. Deciding on a CNC machine
  - e. Methods of holding the part during machining
  - f. Machining Determination
  - g. Cutting conditions
  - h. Writing a programming manuscript
    - i. Inputting programs to the MCU
    - j. Debugging and verifying the program
6. Word Address Programming
  - a. Programming language format
  - b. Programming language terminology
  - c. Arrangement of addresses in a block
  - d. Program and sequence numbers (O, N Codes)
  - e. Preparatory functions (G Codes)
  - f. Dimension words (X,Y,Z ... Codes)
  - g. Feed Rate (F Code)
  - h. Spindle speed (S Code)
    - i. Miscellaneous machine functions (M Codes)
    - j. Automatic tool changing (M6 Code)
  - k. Tool length offset and cutter radius compensation (H, D Codes)

7. Programming Hole Operations
  - a. Fixed or canned cycles
  - b. Hole operation commands
  - c. Writing a hole operation program
8. Programming Linear profiles
  - a. Linear interpolation commands
  - b. Writing a linear profiling program
  - c. Determining cutter offsets for inclined line profiles
9. Programming Circular Profiles
  - a. Specifying the plane for circular arc interpolation
  - b. Circular interpolation commands
  - c. Circular interpolation via direct radius specification
  - d. Profiling at constant feed rate
  - e. Determining cutter offsets for line-arc profiles
10. Programming with cutter diameter compensation
  - a. Cutter diameter compensation
  - b. Advantages of using cutter diameter compensation
  - c. Some restrictions
  - d. Commands
  - e. Z-axis movement
  - f. Interruptions
11. Programming with Subprograms
  - a. Subprogram concept
  - b. Fanuc commands for calling a subprogram and returning to the main program
  - c. Additional subprogram control features
  - d. General rules for subprogramming

### Lab Content

1. Introduction/review
2. Changing Tools
3. Blueprint reading and drawing
4. Right Triangles and Oblique Triangles
5. Word Address programming
6. Programming Hole Operations
7. Programming Linear profiles
8. Programming Circular Profiles
9. Programming with cutter diameter compensation
10. Programming with Subprograms

### Course Objectives

Objectives	
Objective 1	Identify the components of vertical and horizontal machining centers.
Objective 2	Identify the four important functions of tool holders.
Objective 3	Evaluate the terms: orthographic projection, first angle projection, third angle projection, and auxiliary projection.
Objective 4	Identify the various types of dimensioning systems and practices used in CNC prints.
Objective 5	Analyze how to read material notes in drawings.
Objective 6	Evaluate the terms machine home, part origin, and tool change position.
Objective 7	Evaluate the meaning of important terminology connected with word address programming.
Objective 8	Describe the importance of G and M codes in a program.
Objective 9	Identify the meaning of a fixed or "canned" cycle.
Objective 10	Identify the different codes of information required to program a fixed cycle.
Objective 11	Write simple hole operation programs with the aid of canned cycles.
Objective 12	Write complete CNC programs for linear profiling

Objective 13 Apply cutter diameter compensation in programming milling operations.

Objective 14 Write complete programs by utilizing subprogramming.

### Student Learning Outcomes

**Upon satisfactory completion of this course, students will be able to:**

Outcome 1 Satisfactorily program a Computer Numeric Control mill to perform hole operations that may include boring, reaming, tapping, counterboring and/or countersinking.

Outcome 2 Write Computer Numerical Control programs for executing line-arc profiling operations.

### Methods of Instruction

Method	Please provide a description or examples of how each instructional method will be used in this course.
Discussion	Students will discuss the material during lecture and lab.
Laboratory	Laboratory will be used to gain a hands-on understanding of the material presented in lecture.
Lecture	Lecture will provide a theoretical introduction and explanation of the material being covered.
Participation	Students will be asked questions during lecture and lab.

### Methods of Evaluation

Method	Please provide a description or examples of how each evaluation method will be used in this course.	Type of Assignment
Computational/problem-solving evaluations	Students will be assigned homework and quizzes over Canvas. Also, labwork will utilize both Computer Aided Design and CNC machines that require computational problem solving.	In and Out of Class
Group activity participation/observation	During lab students will work in teams to perform and solve the lab report.	In and Out of Class
Laboratory projects	During Lab students will be expected to discuss with their classmates the purpose of the lab and their findings. Laboratory projects will be assigned to teach students how to operate a CNC machine.	In and Out of Class
Mid-term and final evaluations	Students will be tested through Canvas to determine their understanding of the material.	In Class Only
Student participation/contribution	Students will be evaluated by their participation in both lecture and lab.	In Class Only
Tests/Quizzes/Examinations	Quizzes and Exams will include multiple choice questions.	In Class Only
Written homework	Homework will be assigned via Canvas and some questions will require a short answer response.	Out of Class Only

### Assignments

#### Other In-class Assignments

1. Take notes
2. Participate in discussion
3. Quizzes
4. Labs
5. Lab notebooks
6. Midterm/Final Exams

#### Other Out-of-class Assignments

1. Lab write up
2. Reading assignments
3. Writing assignments

**Grade Methods**

Letter Grade Only

**MIS Course Data****CIP Code**

15.0000 - Engineering Technology, General.

**TOP Code**

092400 - Engineering Technology, General

**SAM Code**

C - Clearly Occupational

**Basic Skills Status**

Not Basic Skills

**Prior College Level**

Not applicable

**Cooperative Work Experience**

Not a Coop Course

**Course Classification Status**

Credit Course

**Approved Special Class**

Not special class

**Noncredit Category**

Not Applicable, Credit Course

**Funding Agency Category**

Not Applicable

**Program Status**

Not program-applicable

**Transfer Status**

Transferable to CSU only

**Allow Audit**

No

**Repeatability**

No

**Materials Fee**

No

**Additional Fees?**

No

**Files Uploaded**

Attach relevant documents (example: Advisory Committee or Department Minutes)

EngrTech Advisory 02-27-18 Minutes and Handouts.pdf

**Approvals**

Curriculum Committee Approval Date

11/06/2018

**Academic Senate Approval Date**

11/29/2018

**Board of Trustees Approval Date**

12/14/2018

**Chancellor's Office Approval Date**

3/20/2019

**Course Control Number**

CCC000603613

**Programs referencing this course**Engineering Technology AS Degree (<http://catalog.collegeofthedesert.eduundefined?key=209>)Robotics Certificate of Achievement (<http://catalog.collegeofthedesert.eduundefined?key=211>)