**CHAMP Course Map**

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| **Course Name:** MAC 205– Introduction to CNC Milling Operations | |
| **Instructor Name:** | **Date:** |
| **Course Competencies:**  I. Provide a transitional base that derives from conventional machining operations to operations consisting of numerical control technology  II. Provide fundamentals to CNC machining operations and applications  III. Identify NC controls and functions on a CNC machine  IV. Demonstrate the basic concepts of CNC programming  V. List the factors that influence the selection of a NC machine  VI. Identify the correct process plan and tooling selection  VII. Develop a manual program to run a NC machine  VIII. Demonstrate competency to run a fixtured part using a NC program | |

**Course Materials (Text, Edition and any other publisher items)**

**Textbooks and/or Resources:**

1. **Precision Machining Technology 2nd Edition**

Peter J. Hoffman, Eric S. Hopewell, Brian James

ISBN -10:1-2854-4454-X

1. **Precision Machining Technology Workbook and Projects Manual 2nd Edition**

David Lenzi, James Hillwig

ISBN – 10: 1-2854-4455-8

**NIMS Certification Alignment**

1. NIMS Measurement, Materials & Safety
2. NIMS CNC Milling: Programming Setup & Operations
3. NIMS CNC Milling: Operations

| **Module # and Title** | **CCNS Competencies** | **Content, Activities or Challenges**  **(Learner Interaction**  **& Engagement)** | **Assessments, Rubrics (Feedback)** |
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| **Module 1:**  CNC Fundamentals | I.  II.  V. | * View pictures of different milling machines. * View lecture 1 – CNC mill coordinates presentation * View CNC milling coordinate system handout * Discuss the different components of a Mill machine   + CNC Mill components presentation * View Lecture 2 – G-Codes & M-Codes.pptx * Read G90 and G91 Hole Pattern Handout * Read Letter Address Descriptions for CNC Mill Handout * Complete Absolute and Incremental Positioning exercise. * Discussion questions * Start HAAS simulator training | * Absolute and Incremental Positioning exercise. * Discussion questions * HAAS simulator training |
| **Module 2:**  CNC Mill Program Structure | II.  III.  IV. | * Discussion questions * View Lecture 1 – CNC Mill Coordinates.pptx * Read Multiple Coords Example Handout * Lecture 3 – Speeds and Feed.pptx * Continue with HAAS simulator training | * Discussion questions * HAAS simulator training |
| **Module 3:**  Tools and Toolholders | IV.  VI. | * Begin CNC Milling Tools descriptions and uses. * Discuss various tool holders and their applications. * Discuss G43 Tool length compensation. * View Lecture 4 – Cutting Tool Holders.pptx * Continue training on CNC milling machining and HAAS simulator. | * Discussion questions * HAAS simulator training |
| **Module 4:**  Linear Interpolation | IV. | * Discussion questions * Complete Linear Interpolation exercise part 1. * View Lecture 5 – Linear Interpolation.pptx * View CNC Trigonometry.pptx * Continue training on CNC milling machining and HAAS simulator | * Discussion questions * HAAS simulator training * Linear Interpolation exercise part 1. |
| **Module 5:**  Compensation Concepts | VI. | * Discuss tool radius compensation and wear compensation and why learning these concepts are important to the job. * Study the concept of compensation direction - G41 to left, G42 to right and G40 cancellation. * Apply compensation to previous Linear Interpolation Exercise Part 1. * View the cutter compensation training example. * View CNC Milling Trigonometry.pptx * Continue training on CNC milling machining and HAAS simulator | * Linear Interpolation exercise part 1 – Compensation * Discussion questions * Training on CNC milling machining and HAAS simulator |
| **Module 6:**  Trigonometry | VI. | * Complete Linear Interpolation Exercise Part 2. * Complete Linear Interpolation Trigonometry Training Handout. * Complete Trigonometry Exercise 1. * Complete Trigonometry Exercise 2. * Complete Trigonometry Exercise 3. * View CNC Trigonometry.pptx * Complete Circular Interpolation Training Part 1. * Complete circular Interpolation Exercise. * View CNC Milling Circular Interpolation.pptx * Continue training on CNC milling machining and HAAS simulator | * Linear Interpolation exercise with trigonometry part 2 * Trigonometry exercise 1 * Trigonometry exercise 2 * Trigonometry exercise 3 * Circular Interpolation exercise * Circular Interpolation Training Part 1 * Training on CNC milling machining and HAAS simulator |
| **Module 7:**  Circular Interpolation |  | * Discuss the concept of Circular Interpolation, why these skills are need on the job, and how it will be used on the job. * View CNC Milling Circular Interpolation.pptx * Discuss Plane Selection commands. G17, G18 and G19. * Complete Quiz 1. * View Tool Length Offset Visual Example Handout.pptx * Continue training on CNC milling machining and HAAS simulator | * Discussion questions. * Quiz 1. * Training on CNC milling machining and HAAS simulator |
| **Module 8:**  CNC Mill Bolt Circle Part | VII.  VIII. | * View Lecture 7 - CNC Mill Operator Bolt Circle Part Program.pptx * Develop a part program for CNC Mill Bolt Circle Part. * View CNC Trigonometry.pptx | * Develop part program for CNC Mill Bolt Circle Part. |
| **Module 9:**  Circular Interpolation and Bolt Circle Part | VII.  VIII. | * Complete quiz 2 * Continue training on CNC milling machining and HAAS simulator | * Quiz 2 * Training on CNC milling machining and HAAS simulator |
| **Module 10:**  Circular Pocket Milling | VII.  VIII. | * Complete Circular Pocket Training Single Pass * Complete Circular Pocket Training Multi-Passes * View Lecture 8 - CNC Milling Circular Pocket Exercises.pptx * Complete Circular Pocket Milling Student Exercise * Complete General Pocket Milling Training Exercise * View Lecture 9 - CNC Milling General Pocket Milling with Sub Programming.pptx * Continue training on CNC milling machining and HAAS simulator | * Circular Pocket Training Single Pass * Circular Pocket Training Multi-Passes * Circular Pocket Milling Student Exercise * General Pocket Milling Training Exercise * Training on CNC milling machining and HAAS simulator |
| **Module 11:**  Profiling, Bolt Circle Drilling and General Pocket Milling | VII.  VIII. | * Complete Quiz 3 * Continue training on CNC milling machining and HAAS simulator | * Quiz 3 * Training on CNC milling machining and HAAS simulator |
| **Module 12:**  Process Planning | VI.  VII.  VIII. | * Discuss the use of Process Planning, why it’s important and how it fits into Quality Improvement Plans. * Discuss how to use the Fishbone Diagram as part of Process Planning. * View Lecture 11 - Fishbone-Root Cause Analysis.pptx * Create program for Process Planning and Drilling Cycles with Return Planes * View Lecture 12 - CNC Canned Drill Cycles and Process Planning.pptx | * Discussion Questions * Process Planning and Drilling Cycles with Return Planes exercise |
| **Module 13:**  Lab Project |  | * Complete your final project-Vise Stop | * Vise Stop Project |
| **Module 14:**  Process Planning Assessment and Final Exam | VI. | * Complete Final Test. * Complete NIMS Criteria Sheet | * Final Test * Criteria Sheet. |