OBJECTIVES/COMPETENCIES

Course Objectives	Competencies
Review foundational information from the previous CMM course	• Power on and home the CMM • Manually move the CMM • Fixture a part per setup documentation • Execute an existing CMM program • Edit an existing CMM program • Write basic CMM programs, given a blueprint • Interpret results on dimension report • Sort parts into conforming vs nonconforming per the blueprint
Understand common fixtures used to hold parts and explore fixture options that allow setups to be combined	• Use modular CMM Fixturing • Assemble fixtures per on screen instructions • Determine fixtures for in process inspection based on which features are completed • Determine fixtures for final inspection based on a blueprint • Use fixture standoffs to allow access to multiple sides of the part in one setup • Import and orient CAD fixtures to show future operators how to fixture the part
Perform alignments based on blueprint datum schemes and GD&T feature control frames	• Perform a manual alignment per on screen instructions • Perform an automatic alignment per on screen instructions • Write a program for an automatic alignment based on blueprint datums • Move and rotate alignments to match a GD&T feature control frame

Discuss advanced probe configuration, calibration, and selection	• Select probes based on part shape and orientation requirements • Build stylus systems using integrated probe builder software • Calibrate probes to ensure accuracy and repeatability • Perform manual and automatic stylus system changes • Build stylus systems to access multiple sides of the part in one setup
Understand CMM programming theory as applied to parts of increased complexity	• Understand how touch points are combined to create measured features, which are in turn used to output characteristics on the dimension report • Understand direct vs indirect characteristics • Use measured and constructed features to inspect tolerances that cannot be outpt directly to the dimension report • Determine number of points based on feature type and tolerance • Select the correct stylus based on feature depth and orientation • Inspect geometric dimensions and tolerances • Output graphics of geometric form variations to dimension reports
Understand how to import and manipulate CAD models to aid with setup and programming	• Discuss the difference between “teach-in” programming and CAD programming • Import and position CAD parts and fixtures • Utilize CAD feature extraction tools to aid with measuring features • Write offline CMM programs and prove them on the machine when it is available to minimize downtime

Develop proficiency writing CMM programs for parts of increased complexity	• Determine the ideal manual alignment • Program an automatic alignment using the appropriate datum schedme • Determine measurement strategy, point density, number of points, and measurement speeds per industry standards • Create travel paths that link all measured features together without collisions • Create a dimension report including all of the blueprint dimensions • Verify that all dimensions on the blueprint are accounted for in the dimension report with nothing extra • Manually verify dimension using hand gauges and the 10:1 rule for gauge precision
Gain experience to working with assemblies to understand fits and clearances and how mating parts fit together	• Run CMM programs to inspect mating parts and use the dimension report results to determine if they will actually fit • Understand typical datum schemes for mating parts • Assemble mating parts with known feature sizes to feel how much movement is allowed by clearances from .0001 to .0100
Understand a CMM's role in a modern CNC machine shop's environment	• Simulate how a CNC operator runs an existing CMM program to perform in process inspection on their parts • Use the resulting dimension report to adjust offsets on the CNC machine that manufactured the part • Perform assignable cause for what is going wrong with the manucaturing process to cause nonconforming dimensions • Witness the interaction between CNC operator and CMM programmer as they work together to bring processes into control