COURSE PREFIX/NO: **QAT 202**
COURSE TITLE: **Metrology and Calibration**
LEC HRS/WK: **2.0**
LAB HRS/WK: **3.0**
CREDIT HRS/SEMESTER: **3.0**

Distance Learning Attendance/VA Statement
Textbook Information

COURSE DESCRIPTION
This course covers the measuring instruments used in a typical industrial metrology laboratory. Techniques of making measurements, accuracy and precision, and calibration control systems are stressed.

COURSE COMPETENCIES
Upon successful completion of this course, the student should be able to take measurements of manufactured objects using various hand gages, a coordinate measuring machine, or a laser scanner. Student should be able to judge the validity of such measurements based on concepts of accuracy, precision, and proper calibration. Student should be able to select the proper measurement instrument for a given situation and judge whether a proper calibration system is in place for that instrument.

MODULE 1: Fundamentals of measurement systems
- Contrast dimensions versus tolerances
- Discuss accuracy, precision, and reliability
- Describe sources of error in measurements
- Recognize the role of calibration in measurement
- Give examples of standards used in measurement systems

MODULE 2: Hand Gages
- Demonstrate the proper use and selection of hand gages that may consist of any or all of the following types:
  - Steel rules, protractors, squares
  - Calipers
  - Micrometers
  - Height gages
  - Gage blocks and pins
  - Dial indicators
  - Profilometers
  - Radius, telescoping, taper gages
- Discuss the role of applied force in proper gage use
- Compare vernier, dial, and digital readouts
- Compare relative measurements to absolute measurements

MODULE 3: Coordinate Measuring Machines (CMMs)

- Complete the pre-measurement setup of the CMM and probe
- Describe the use of CMM controls and results of improper use
- Utilize the CMM to manually take required measurements
- Program the CMM to take an automated series of required measurements
- Discuss methods for establishing references for measurements
- List maintenance, storage, and calibration issues of CMM components

MODULE 4: Laser Scanning

- Define laser scanning in the context of measurements
- Evaluate the proper application of laser scanning to a given situation
- Compare the outputs possible from a laser scan and their uses
- Identify the post processing required of the data from a laser scan
- Demonstrate proper setup and use of the laser scanner to take required measurements

MODULE 5: Selection and comparison of instruments

- Analyze required measurements and select the appropriate instrument
- Identify critical measurements
- Utilize different methods in measuring the same critical dimension and discuss any differences

MODULE 6: Calibration

- Define the role of calibration in a quality management system
- Describe the role of record keeping, calibration certificates, and calibration labels
- Explain traceability as it relates to calibration
- Discuss calibration intervals and scheduling
- Discuss the role of audits in a quality management system
- Determine calibration status
- Perform calibrations to specified calibration procedures
- Analyze calibration results and take appropriate action
- Prepare required documentation of calibration and audit activities

MINIMAL STANDARDS/PERFORMANCE OBJECTIVES

Given a hand gage and a part (manufactured, rapid prototyped, or raw material), the student shall measure the part and correctly determine the required dimensions within the resolution of the gage.

Given an assortment of hand gages, the student shall select the appropriate gage for the particular type of dimension or tolerance to be measured.

Given a CMM, a probe, and a part, the student shall install and calibrate the probe, setup the part on the CMM table, correctly establish needed references, and determine the required measurements within the resolution of the CMM.

Given a CMM, a part, and a list of dimensions or characteristics, the student shall program the CMM to take the required measurements and then run that program and output the data.

Given a laser scanning head, a CMM, and a part, the student shall install and calibrate the laser scanner, setup the part, and perform a laser scan and capture the required data in the desired format.

Given the digital output of a laser scan, the student shall post-process that data for a specified subsequent use, such as to verify conformance to a CAD model or for use in other processes.

Given an assortment of measurement equipment (hand gages, CMM, laser scanner, etc.), a part, and the engineering drawing of the part, the student shall select the appropriate tool for the given dimension or tolerance, and determine whether the part meets the requirements of the drawing.

Given a part and multiple methods of measurement, the student shall measure critical dimensions using multiple independent methods and compare the results and formulate conclusions on the relative appropriateness and usefulness of the methods.

Given a specific measurement instrument or device and the calibration records, the student shall determine the calibration status of the instrument or device and decide if calibration is required.

Given a specific measurement instrument or device, a calibration procedure, and acceptance criteria, the student shall perform the calibration and determine if the instrument or device is acceptable for use.

Given the data generated during a calibration, the student shall document the results in the proper format and update any applicable record keeping systems.

Given an outline of the quality management system in place, the student will conduct an audit of specified portions of that system, evaluate the results, document the findings, and take appropriate follow up action.

Student must complete all modules and achieve a 60% average on tests, projects, reports, and any other required assignments.

COURSE REQUIREMENTS

ATTENDANCE

Students will be bound by the policies stated in the York Technical College Student Handbook. Students must attend 90% of the hours assigned the class for a semester to receive credit for the course. In case a student does miss a class, the student is responsible for obtaining the material that was covered during the absence.

If a student is aware that a class will be missed, then the student should notify the instructor at the earliest possible date. If a student misses a test because of illness or urgent emergency, it is the responsibility of the student to notify the instructor prior to the class period, or at the earliest possible date.

Students with absences during tests will be allowed to take a makeup test only at the discretion of the instructor. The student has the burden to be sure that some arrangement was made with the instructor for a missed test or the student will automatically receive a zero for that test.

PARTICIPATION IN CLASS
It is expected that students will participate in class discussions and will read the text and take notes during lectures. It is expected that students will arrive on time for class and will turn off cell phones and similar devices before entering the classroom and leave them off for the duration of the class.

ACADEMIC HONESTY
York Technical College adheres to the Student Code For The South Carolina Technical College System, as approved by the State Board for Technical and Comprehensive Education. A copy of this code is available in the Library or from Student Services, and says, in part, "All forms of academic misconduct including, but not limited to, cheating on tests, plagiarism, collusion, and falsification of information will call for discipline."

EVALUATION STRATEGIES/GRADING
The class grade will be determined from the student performance in all modules. The grading scale is as follows:

Grade Points

A	90 - 100
B	80 - 89
C	70 - 79
D	60 - 69
F	0 - 59

The class grade will be determined as follows:

Tests	40%
Labs/Assignments	50%
Conduct/Participation	10%
	100%

ENTRY LEVEL SKILLS
The entering student should have knowledge and understanding of basic drafting and dimensioning guidelines and practices. The student should be able to read and interpret engineering multi-view orthographic drawings, including tolerances. Student should be proficient in the CAD system currently in use by the College.

PREREQUISITES: EGT 210

CO-REQUISITES: None

Disabilities Statement: Any student who feels s/he may need an accommodation based on the impact of a disability should contact the Special Resources Offices (SR) at 803-327-8007 in the 300 area of Student Services. The SRO coordinates reasonable accommodations for students with documented disabilities.