

## COURSE SYLLABUS

Course Number: TBD

Course Title: Introduction to Quality and Continuous Improvement

Course Pre-requisites: None

Course Credit Hours: 3 credit hours

Structure of Course: 45/0/0/0

Textbook: Tooling U-SME Online resource

Course Description: This course is designed to enable students to understand and interpret blueprints, machine shop symbols, and various drawings used in the industrial trades. The course focuses on determining dimensions and using shapes in understanding fabrication and assembly. This course will further provide students with the quality management principles, techniques, tools and skills for on-the-job applications useful in a wide range of business organizations such as the service industry and manufacturing. Students will apply basic measurement skills, system calibration skills, and measurement system analysis. Students will also study manufacturing properties of materials, the behavior of materials, and the advantages and disadvantages of types of materials in an industrial setting.

Competencies: Upon completion of this course, the student will be able to:

- A. Interpret the fundamentals of blueprint reading utilizing, multi-view drawings to visualize part shapes, identify features, and identify dimensions.
- B. Apply basic mathematical techniques to solve problems and make decisions. Interpret visual, numerical, and symbolic representations.
- C. Explain the implementation of quality assurance and quality control.
- D. Interpret methods for developing process control testing.
- E. Plan and use quality techniques in the measurement of quality.
- F. Describe the skills necessary for the management and implementation of quality assurance.
- G. Analyze and benchmark concepts for quality improvement
- H. Acquire an understanding of measurement and its relationship to process information, process control, and quality.
- I. Demonstrate basic mathematical applications and conversions
- J. Demonstrate considerable skill using measuring tools commonly used in industry.
- K. Apply good inspection procedures, particularly in the manufacturing environment.
- L. Explain the fundamentals of Geometric Dimensioning and Tolerancing standards.
- M. Acquire a basic understanding of statistics, probability and data collection strategies.
- N. Identify and correct various types of measurement errors.

## Lecture Outline:

### **BLUEPRINT READING**

1. Reading and Understanding Industrial Blueprints
  - a. Discuss the purpose of a blueprint.
  - b. Interpret a blueprint including the basic lines, symbols, views, and title block.
  - c. Communicate various methods of generating a print and the benefits of various views.
  - d. Interpret various object dimensions including object scale and tolerance.
  
2. Basic Mathematical Concepts
  - a. Demonstrate the use of addition, subtraction, multiplication, and division to solve basic problems commonly found in industry.
  - b. Explain the importance for solving mathematical problems in the correct order of operations.
  - c. Exhibit competency in accurately completing mathematical equations involving roots and powers.
  
3. Using Fraction and Decimals
  - a. Resolve mathematical equations using fractions, decimals, and percentages.
  - b. Apply the fundamental properties of fractions to resolve problems including adding, subtracting, multiplying and dividing fractions and mixed numbers.
  - c. Solve mathematical problems containing the use of decimals.
  - d. Convert between decimals, fractions, and percentages.
  
4. Unit Conversion
  - a. Describe the relationship and differences between U.S. and metric units.
  - b. Apply both U.S. and metric units in solving problems involving length, mass, volume, and area.
  - c. Convert between various units of measure.
  
5. Hole and Surface Dimensions
  - a. Determine and measure angles are specified on a blueprint.
  - b. Demonstrate the skills needed to identify and measure the features of a hole on a print.
  - c. Discuss the importance of the finish of a surface including the methods available for verifying the surface finish on an object.
  - d. Translate the finish of surface from a print.
  - e. Select the proper dimensions of threaded components utilizing the symbols and data available on a print.
  
6. Tolerance
  - a. Explain the term tolerance and specify its importance in the manufacturing of parts and materials.

- b. Compute the minimum and maximum tolerances of various components using fractions and decimals.
  - c. Specify the various means that tolerance can be indicated on a print.
7. Geometric Dimensioning and Tolerance (GD&T)
- a. Define the terms geometric dimensioning and tolerance and datum.
  - b. Discuss the advantages and disadvantages of using GD&T.
  - c. Identify the main classes of tolerances used in GD&T.

## **GEOMETRIC MEASUREMENT FUNDAMENTALS**

### 8. Introduction to Geometry

- a. Explain the term geometry.
- b. Properly name common shapes found in an industrial setting and list their key features.
- c. Identify points, rays, perpendicular and parallel lines, and types of angles.
- d. Describe the key features of a circle.

### 9. Lines and Angles

- a. Identify lines, line segments, rays, and angles.
- b. Classify angles as being acute, right, obtuse, or straight.
- c. Discuss complementary and supplementary angles and lines.
- d. Compute measures of angles and lines.

### 10. Triangles

- a. Categorize triangles by their sides and angles.
- b. Determine the measurement of sides and angles using mathematical relationships.
- c. Solve industrial problems using triangles.

### 11. Circles and Polygons

- a. Explain the terminology of a circle including radius, center, chord, area, circumference, tangent and secant.
- b. Apply methods of measuring the circumference and area of a circle.
- c. Identify and measure central and inscribed angles in a circle.
- d. Identify types of polygons.
- e. Solve problems involving circles and polygons.

### 12. Surface Measurements

- a. Explain the effects of various machining process on the finish of a surface.
- b. Differentiate between texture, flaw, lay, roughness, and waviness.
- c. Compare the importance of surface finish on mobile and immobile parts.
- d. Discuss how the finish of a surface effects its functionality and cost.
- e. Demonstrate the tools and methods commonly used to measure surface finish.

### 13. Thread and Fasteners

- a. Define and label the parts of a screw thread.
- b. List the various forms of screw thread.
- c. Identify left and right handed threads, screw head types, and classifications using ANSI and manufacturer standards.
- d. Discuss the various processes used to construct threads.
- e. Explain the key uses for the various types of threads.

## **MEASUREMENT TOOLS AND EQUIPMENT**

### 14. Basics of Precision Measurement

- a. Explain the term standardization as it pertains to measurements.
- b. Demonstrate the relationship between accuracy and precision.
- c. Discuss the importance of instrument calibration and sensitivity as it pertains to quality.
- d. Illustrate how to properly inspect materials for accuracy and precision.

### 15. Coordinating Measurement Machine (CMM)

- a. Discuss how a CMM can be used for measuring the physical characteristics of parts.
- b. Explain the primary parts and how a CMM works including its advantages and disadvantages.
- c. Describe how the Cartesian coordinate system is used for part alignment and measurement.

### 16. Optical Comparators

- a. Explain the purpose and key components of an optical comparator.
- b. Identify the different types of optical comparators and their advantages and disadvantages.
- c. Describe the properties of light waves and how mirrors affect the light path.
- d. Discuss charting in relation to the use of optical comparators.

## **INSTRUMENTATION FUNDAMENTALS**

### 17. Linear Instruments and Quality

- a. Define the term linear instrument and provide examples.
- b. Discuss the cause and effect of types of errors in measurement.
- c. Explain how stability, linearity, resolution, amplification, and hysteresis affect results.
- d. Explain the contrast between resolution, precision, and accuracy in measurement.

### 18. Instrument Calibration

- a. Explain the significance of instrument calibration.
- b. Describe measurement uncertainty and significant figures.
- c. Discuss national and internal standards.
- d. Communicate the requirements of product and standard traceability.
- e. Introduce ISO 9000 concepts.

## 19. Coordinate Measuring Machine (CMM)

- a. Explain the purpose of a coordinate measuring machine (CMM) and the key components of the device.
- b. Illustrate how to identify and use the working plane and associated coordinate axis.
- c. Identify the different types of coordinate measuring machines and their intended use.
- d. Discuss the basic software functionality and the advantages and disadvantages of the device.

## 20. Using Optical Comparators

- a. Investigate in great detail optical comparator instruments and factors that affect the quality of measurement.
- b. Illustrate how to use an optical comparator including parts illumination, screen rotation, and chart motion.
- c. Describe the steps necessary to accurately and precisely complete measurements.
- d. Communicate the proper maintenance and calibration factors necessary to ensure correct operation of the device.

## **QUALITY PROCESSES**

### 21. Quality Overview

- a. Establish what the term “quality” means and its relationship to customer service.
- b. Discuss the long- and short-term effects of quality on both the business and the customer.
- c. Define “customer” both internal and external to the company.
- d. Present the links between the hierarchy of a company and quality.

### 22. ISO 9000

- a. Introduce ISO 9000 and its benefits to businesses.
- b. Discuss the key principles of ISO 9000.
- c. Discuss the role and expectations of all employees in maintaining a quality management system and complying with ISO 9000.
- d. Outline what a quality management system (QMS) is and critical components of the system.
- e. Describe how ISO 9000 and QMS can be implemented to improve the quality at all stages of operations.

### 23. Six Sigma

- a. Introduce six sigma methodology and how it applies to day-to-day operations.
- b. Present tools and techniques used to improve upon product defects.
- c. Describe factors that contribute to defects and methods to detect and correct various causes.
- d. Discuss the role of employees in promoting and using six sigma.

#### 24. Lean Manufacturing

- a. Introduce the history and concepts of lean manufacturing.
- b. Recognize the eight primary types of waste within a facility.
- c. Differentiate between lean manufacturing and mass production.
- d. Discuss the primary lean principles and their benefits.
- e. Demonstrate how the use of lean principle relations to six sigma and defect minimization.

#### 25. Total Quality Management

- a. Define Total Quality Management (TQM).
- b. Identify keys to total quality success.
- c. Outline approach to total quality implementation.
- d. Discuss the relationship between quality and business competitiveness.
- e. Explain common roadblock to achieving total quality.

### **QUALITY PROCESSES AND APPLICATIONS**

#### 26. Concepts of "5S"

- a. Introduce "5S".
- b. Describe the purpose and benefits of "5S".
- c. Discuss the five phases of its process and the key objectives, tools, and methods used to achieve each phase.

#### 27. Quality Control of Holes

- a. Discuss the importance of quality control as related to product holes.
- b. Demonstrate examples of good and poor quality in relation to the roundness of holes.
- c. Introduce various instruments and their use in ensuring quality compliance for holes.

#### 28. Threads

- a. Introduce types of threads.
- b. Compare and contrast thread characteristics.
- c. Examine various tools and techniques used to measure and inspect threads.
- d. Familiarize students with various thread gages and measurement techniques.

#### 29. Hardness Testing

- a. Define material hardness.
- b. Explain the operation of common industrial hardness testing including Brinell, Vickers, and Rockwell.
- c. Discuss the benefits and challenges of hardness testing.

#### 30. Geometric Dimensioning and Tolerancing (GD&T) Continued

- a. Review the eight key terms associated with GD&T.

- b. Define datum and dimensioning.
- c. Introduce GD&T Rules 1 and 2 with respect to individual tolerance, datum reference, or both.
- d. Explain the “Rule 321” as it pertains to GD&T.

## **STATISTICAL PROCESS CONTROL (SPC)**

### 31. Statistical Analysis

- a. Define statistics and common uses in industry.
- b. Identify data ranges, mean, median and mode.
- c. Demonstrate how to determine standard deviation.
- d. Develop and interpret quality charts including histograms, line graphs, and bell curves.

## **QUALITY CHARTING AND INTERPRETATION**

### 32. Statistical Process Control

- a. Describe the concept of statistical process control (SPC).
- b. Determine how customer requirements relate to the establishment of control limits.
- c. Discuss the concept of process variation and how it can be described statistically through the use of control charts.
- d. Illustrate in-control and out-of-control process and its effect on quality.

## **QUALITY ASSURANCE AND MEASUREMENT**

### 33. Product Sampling and Measurement

- a. Introduce the importance of product sampling and sample size.
- b. Define common terminology used in sampling.
- c. Depict how to use sample tables to determine sample size.
- d. Discuss the effects of sample size on product and process quality.
- e. Establish methods of measuring sample size.

### 34. Basic Algebra

- a. Evaluate variable expressions.
- b. Perform operations following the proper order of operations.
- c. Explain how to solve linear equations and applications of varying forms and formulas.
- d. Simplify variable expressions using addition, multiplication and distributive properties.

### 35. Basic Trigonometry

- a. Explain the types and angles of a triangle.
- b. Introduce the use of the Pythagorean Theorem to find the lengths and angles of right triangles.
- c. Illustrate how to solve problems using sine, cosine, and tangent ratios for right triangles.

36. Kaizen

- a. Define Kaizen and its applications.
- b. Relate lean principles and Kaizen as a means to achieve lean production.
- c. Study the Kaizen methodology including the steps and tools necessary to implement.
- d. Perform a mock Kaizen event for product improvement.

**ANGLES IN INDUSTRIAL APPLICATIONS**

37. Pythagorean Theorem

- a. Review the Pythagorean Theorem.
- b. Practice using the Pythagorean Theorem to solve right triangles embedded in other shapes.
- c. Demonstrate how the Pythagorean Theorem can be used to solve problems involving arcs.
- d. Explain how to use the scientific calculator to solve problems involving powers, roots, and mathematic functions associated with the Pythagorean Theorem.

38. Sine, Cosine, and Tangent

- a. Review the phrase SOHCAHTOA.
- b. Practice solving for missing angles using trigonometry functions.
- c. Introduce the concepts of cosecant, secant, and cotangent.
- d. Contextualize various industrial uses for the trigonometry functions.

39. Sine Bar

- a. Define the term sine bar and its application to industry.
- b. Demonstrate how to set up and calculate a sine bar angle between plates and cylinders.
- c. Practice using sine bar to determine angles.

**AUDITING**

40. Internal Audits

- a. Build an understanding of the role of internal audits on the continuous improvement process.
- b. Preview the role and responsibilities associated with internal audits.
- c. Outline the major steps involved in the internal audit process.
- d. Discuss the importance of recording observations and documenting the findings in a report.
- e. Explain the importance of audit finding and corrective action.

**TROUBLESHOOTING FUNDAMENTALS**

41. Basics of Troubleshooting

- a. Explain the importance of systematic troubleshooting.
- b. Distinguish between normal variation and a true quality problem.
- c. Discuss the importance of historical data and documentation.



- d. Relate troubleshooting to preventative, predictive, and reactive maintenance.

#### 42. Cause and Effect of Problems

- a. Discuss the cause and effect relationship of problems and problem troubleshooting.
- b. Explain the basic troubleshoot strategy steps.
- c. Illustrate the importance of asking key questions and brainstorming in process troubleshooting.
- d. Discuss tools and techniques for quickly resolving process problems.

#### 43. Corrective Actions

- a. Discuss the advantages and disadvantages of using teams to troubleshoot production problems.
- b. Explain means to prioritize problems and corrective actions.
- c. Differentiate between permanent and temporary solutions.
- d. Communicate challenges and solutions for troubleshooting complex processes.

### **QUALITY CONTROL AND DOCUMENTATION**

#### 44. Six Sigma Goals and Tools

- a. Overview DMAIC and its relationship to lean six sigma.
- b. Discuss the five phases of the DMAIC process and the key objectives, tools, and methods use to achieve each phase.
- c. Explain the benefit and challenges of the DMAIC process.

#### 45. Measuring System Analysis

- a. Define the term Measurement System Analysis (MSA).
- b. Differentiate between MSA and SPC.
- c. Discuss the five parameters of in MSA: bias, linearity, stability, repeatability, and reproducibility.
- d. Introduce types of variation.
- e. Introduce the terminology and concept of gage repeatability and reproducibility.