QUALITY CONTROL (QC) TECHNICIAN Certificate (recommended)

TOP CODE: 0956.80

QC Technician

(suggested classes)

SEMESTER 1	Units	Laney equivalent
Blueprint reading	3	MACH 205
Math (basic through elem Algebra)	1.5	MATH 220A-C
Introduction to Machining	5	MACH 210
QC: Introduction to QA	3	New
	12.5	

SEMESTER 2	Units	Laney equivalent
Math (through right angle Trigonometry)	2.5	MATH 220D-G
QC: Dimensional Metrology	3	New
GD&T using CMM	2	MACH 75
	7.5	

(ask industry how important this is to have in entry-level program)

Total units 20

Dimensional Metrology Class

Units	*3 units*	*1.5 lecture / 1.5 lab*	
Class Time	*6 hours / week over semester (17.5 weeks)*	*1.5 hours lecture / 4.5 hours lab per week = 105 total hours over semester*	
Book	*Fundamentals of Dimensional Metrology, 6th Edition*	*Connie Dotson*	*Cengage Learning*
Supplemental Materials	*None*		
Prerequisites	*Basic machining class (or work experience working with measurement)*		

Class # (3 hrs per class)	**Classroom Topic (Lecture)** (estimate about 30 hours total lecture)	**Classroom Topic (Lab)** (estimate about 75 hours total lab)	***Reading*** *(due that class period)*	***Homework*** ***(due that class period)***
1	Introduction Overview of common gages and measurements Examples of QC and dimensional metrology	Walk through lab and show and explain different equipment - Give examples of parts that might need to be measured		
2	Review of Measurement Systems Numeric Conversions	Begin simple measures of parts using calipers. Convert to metric. Have unique parts and discuss how to measure.	Ch. 1 - Measurement & Metrology Ch. 2 - Systems of Measurement	Measure the length of your forearm. Measure the length of your fingers. Convert to metric. Have a list of 10-20 different measurements (0.005", 0.001", 0.4 mm, etc.) and have them convert between English & Metric
3	* Flexible, steel graduated rules & rigid rules mounted in square or protractor heads; tape measures. * Linear Vernier scales (on calipers, height gages, slide type depth gages & Pi-tapes. Give detailed description of how vernier scales work with multiple examples.	Practice techniques for measuring parts & part features. Practice using Vernier calipers / height gages on available parts. Errors to avoid.	Chapter Five - Graduated scales Chapter Six - Reading vernier scales.	Answer questions at chapter's end. Take-home exercise with illustrations (or photo) showing scale in different position: Write down numerical value represented by each.
4	Variable gages: Calipers (V-DI-Digital) Multifunctional measuring tool: Outside, inside & 2 ways for depth. Proper techniques. Critical guidelines for ensuring accurate function.	Routine performance checks (Examining gib tension & jaw parallelism and condition of 'inside' tips & 'outside' tips - quick checks to standards). Practice outside, inside & depth measurements. Flip back & forth between inch & metric with electronic calipers.	Review Ch. 6	Take-home exercise with illustrations (or photo) of vernier calipers showing scales in different position: Write down numerical value represented by each.
5	Variable gages: Outside micrometers - reg. analogue mics (with vernier scales) and electronic, digital mics. How they work; how to read; proper technique. How to read mic vernier scales for measuring to four places. Examine multiple examples.	Routine performance checks ("Zero" check & gage block check). Practice technique on multiple parts examples. Compare readings resulting from force based on friction thimble, ratchet & by feel.	Ch. 7	Take-home exercise with illustrations (or photo) showing different scale positions: Write down numerical value represented by each.
6	***QUIZ I, Written and lab***	> > >	> > >	> > >
7	Review Quiz. Variable Gages - Other mics: Inside mics & depth mics (Note: scale reversal); Thread pitch mics, blade mics, disc mics, etc. Hole-test mics & Bore gages.	Practice measuring techniques for pitch diameter (PD) with PD micrometer - compare to the 3-wire method.	Threads: Review p. 174-5 in ch.7	Review charts for common inch and metric threads. Study handout from Starrett catalog showing series 575 P.D. mic. With explanation.

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8	Attribute gages: Identify and use of - plug, thread plug, progressive ring, flush pin gages. Radius profile & thread profile gauges, etc.	Practice Go/no-go gages on multiple holes & threaded part examples. Go over topics of force and feel; note allowable turns of no-go portion of plug thread gage.	pp. 213 - 217 in ch.8, Dotson	Study handout of pages from Starrett catalog illustrating ser.#229 telescoping gages, #831 small-hole gages, 474 fixed pitch gage, 167 fixed rad. Gage. Meyers cat. Plug P.D. gages.
9	Transfer gages: Identification & use of - Small hole & telescoping gages, spring calipers (inside & outside).	Practice on multiple parts examples. Spring-caliper results checked against micrometers. Develop skills for proper alignment of calipers for optimum measurements. Practice w/ profile gages against threaded or corner-radiused parts.	Ch. 5 - tools illustrated pp. 104 - 114	Answer end-of-chapter questions
10	Surface plate equipment: Select and use height gages, V-blocks, right-angle plates, indicators, etc., to measure various types of features.	Practice measurement with height gages (with rigid tips & with mounted test indicators). Measurement from hole-to-hole ... V-blocks	Ch. 11 Handout from Curtis/Farago: pp. 292-3, 299 & 163-5	Answer end-of-chapter questions
11	Angle measurement instruments Identify and use protractors - Vernier protractors with minutes & seconds (digital with decimal fractions). Sine bars & sine plates (Pythagorean & trig. calculations) / cylindrical squares / angle plates, angle blocks, etc.	Practice w/ protractors. Calculate stack heights for sine-bar/plate for given angles.	Ch. 12	Answer end-of-chapter questions
12	Measurement by Comparison	Use Master Height Gage (ex., Starrett #258) set up on surface plate. Using height gage with 10th-reading test indicator, practice transfer measurements.	Ch. 10 (Preview Ch. 8 on gage blocks)	Answer end-of-chapter questions
13	Gage selection Select gages according to the feature or characteristic to be measured, the applicable tolerance / accuracy, and the resolution and capability of the test instrument. Determining whether the type of measurement should be direct, differential, or transfer.	Provide blueprints with dimensions having a variety of tolerances (loose, intermediate & tight): Write down the appropriate measuring tools.	Handouts: 10-to-1 (Schuetz article in MMS) Levels of precision Field Guide - from Quality Magazine, June 2nd 2010	
14	Gage handling, preservation, and storage Identify and apply various methods of cleaning, handling, and storing gages.	Demonstrate proper storage, cleaning, protective coating, handling during use.		

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15	Optical: Optical comparators, measuring microscopes, laser scanning machines and digital vision machines. Optical flats for very fine measure.	Demonstrate: Optical Comparator - set-ups. Their use as profile projector and use as front-lit optical measuring machine. Measure simple lengths, hole-to-hole, etc.	Ch. 17, pp. 519-534	(Find You Tube videos on optical comparators)
16	Review			
17	***Midterm***	> > >	> > >	> > >
18	Special gages & applications: Electronic, oscilloscopes, multimeters, pyrometers, etc.		Ch. 14	Answer end-of-chapter questions
19	Automated Gaging Components: Machine vision, ultrasonic, x-ray, laser …		View You Tube videos - for example Zeiss Automated Inspection, Hexagon Metrology, Perception Metrology, etc.	
20	Pneumatic gaging: Air columns, probes & rings		Ch. 15	Answer end-of-chapter questions
21	Measuring mass: Describe and apply weights, balances, and weighing scales. Tripple beam, analytical balances, etc.		Wikipedia articles on "Weight" ("Measuring Weight"), weighing scales, balance scales & analytical balances.	
22	Measuring finish: Describe and apply profilometers & the different roughness systems, fingernail comparators, etc.	Check a variety of surfaces: Estimate by eye and fingernail test using visual profilometer standards Retest same surfaces with electronic profilometer, using the Ra system.	Ch. 13	Answer end-of-chapter questions
23	***QUIZ II, Written and lab***	> > >	> > >	> > >
24	Analyzing Measurement Data Statistics - Population, sampling, mean, median, mode, standard deviations, etc.. Processing data for Quality Control: SPC, X-bar Charts, R-charts	Do measuring series and analyze collected data - calculate for bar chart and R-chart	"Precision Machine Technology" pp. 150-155 Review chapter 4 in Dotson (Look for alternate textbook coverage)	
25	Calibration systems Calibration environments Equipment Traceability		Ch. 9	Answer end-of-chapter questions

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26	Calibration standards Gage Blocks	Demonstrate proper gage block storage, cleaning, protective coating, handling with cotton gloves during use.	Ch. 8 (thorough) Handout from Starrett: "Instructions & Suggestions for the use & care of Precision Gage Blocks.	Answer end-of-chapter questions
27	Measuring shape and profile: Describe and apply mechanical comparators, roundness testers, precision spindles, profile tracers, etc.	Note: Without specialized profile measuring machines, measurement can still be done on CMMs - see CMMs	Ch. 9: pp. 242, 225-227	
28	Effects of out-of-calibration on product acceptability. 5-whys and similar programs … corrective actions			
29	First Article Inspection Reports: Drawing is "bubbled" where all dimensions and specifications are numbered, inspected & recorded on inspection sheet - It is noted "Pass" or "Fail" for each and what method (tool) was used.	Provide a drawing and a FAI sheet: "Bubble" the drawing and begin measuring and filling out FAI sheet.		
30	Geometric Dimensioning & Tolerancing review. Measuring per GD&T requirements: The need for machines with computational capacity (computers) like coordinate measuring machines (CMMs)	Converting "X" and "Y" caliper measurements into a value that is compatible with interpreting compliance to a cylindrical (GD&T) tolerance zone.	Ch. 3 Tolerances - GD&T	Answer end-of-chapter questions
31	Coordinate Measuring Machines (CMM's). Structure, how they move & computational software that enable GD&T results.	Coordinate Measuring Machines (CMM's). Demonstrate measurement of form, true position, orientation, runout, etc.	Ch. 18 CMMs	Answer end-of-chapter questions
32	Coordinate Measuring Machines (CMM's). Continued	Coordinate Measuring Machines (CMM's). Practicing datum set-up and GD&T measurement.		
33	Review	Hand out measurement project for Lab Final: Blueprint with blank FAI sheet and part. For measurements, also note selection choice of measuring tools for each case and give reasons for choice. "Performance check" sheet filled out for each tool used.		
34	***Written Final***	**> > >**	**> > >**	**> > >**
35	***Lab Final Hand in measurement project***			

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NOTES

Lead for developing Curriculum	*David Baruch (June 2016)*
Homework / reading time	*1.5 lecture hours per week = 3 hours should be spent on activities outside of class. 17.5 weeks in semester = 52 hours over semester in outside work.*
Student equipment / tools needed	*None. We considered asking them to purchase their own calipers, in order to help teach them the importance of maintaining tools. However, since some will not be able to afford, decision was made not to.*

SIXTH EDITION

FUNDAMENTALS OF DIMENSIONAL METROLOGY

CONNIE L. DOTSON