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

The Certified QUALITY TECHNICIAN

HANDBOOK

Second Edition

H. Fred Walker
Donald W. Benbow
and Ahmad K. Elshennawy

Introduction to Quality Assurance Class

Units	*3 units*	*2 lecture / 1 lab*
Class Time	*5 hours / week over semester (17.5 weeks)*	*2 hours lecture / 3 hours lab per week = 88 total hours over semester*
Book	*"The Certified Quality Technician Handbook" 2nd edition*	*Walker / Benbow / Elshennawy (ASQ Press)*
Supplemental Materials	*None*	
Prerequisites	*None*	

Class # (2.5 hrs per class)	**Classroom Topic**	**Objectives** (topics to define and explore)	***Reading*** *(due that class period)*	***Homework*** *(due that class period)*	Instructor Materials needed	Supplements suggested to make	ASQ Related Section	Lab / Lecture
1	Cost of Quality Introduction	Safety Define "risk" (end user, customer, parts, integrity, employees, etc) 4 costs of quality with examples Cannot Inspect in Quality, can only detect Quality Creep goal of manufacturing, (Ship good parts)	p193-194 TCQT: ch1A		chart for cost of Quality ($oQ)	chart for $oQ	4c	lecture
2	Safety, environment, what companies look like	PPE different PPE companies/industries in the bay how to be safe in different environments how to identify others safety A Tech's role in safety	p193-194 TCQT: ch1C	10 questions about situations and what PPE is required.	PPE standard		4g	lecture
3	gage basics. Tolerances, metric, importance of digits	gages (define & types of) calibrated vs reference zeroing before use standards (fig 3.31 ASQ TCQT) gage controlled environment	TCQT: ch3 a-a5	connect 10 gages with correct type dimensions (on print)	measurement demo thermal expansion		2f	lecture
4	gage selection / importance of measurements	standards of calibration traceability/serialization out of calibration containment	TCQT: ch3 a (remaining)	finish lab	hand gages, dials, digital, ESD reader		2f	lab
5	MSA. The gut check of what you're missing	bias stability accuracy linearity R&R	TCQT: ch3 b&c	arrange standards (figure 3.31) in correct order	shadow casting method, functional gages,		2g	lecture
6	Sampling plans	Random sampling Lot/batches/runs AQL charts acceptance % sampling plans	TCQT: ch1B,4d	questions about what sampling used for certain characteristics on certain processes (e.g. hardness from a furnace etc)	examples of several "populations" & "samples" from different types of process with measurements. AQL chart (purchase)		3b	lecture
7	Introduction to big picture	inspection stages pre-production errors - man, machine, method traceability (gage serials, parts to gages used, inspector stamps) severity levels (design FMEA) Poka Yoke (introduce) Good Gages Measure the Same	TCQT: ch4 abc	questions about different kind of measurements (5 where in process 4.b, 5 type4.C)	"real life" examples for each of the stages in objectives related to a manufacturing setting	need sample "company map" of inspection points through Product Realization	3c	lecture
8	Gage selection, resolution, speed, bias, R&G	select correct gages preform R&R with multiple operators then take an AQL based on prescribed data with the samples being a representative amount	(internet) - information about gage R&R/ examples of / rules about	finish lab	different types of hand gages, sample pieces to measure, spreadsheet/program to input measurement data for R&R	(see materials)	2g 3b	lab

Introduction to Quality Assurance Class

Units	*3 units*	*2 lecture / 1 lab*
Class Time	*5 hours / week over semester (17.5 weeks)*	*2 hours lecture / 3 hours lab per week = 88 total hours over semester*
Book	*"The Certified Quality Technician Handbook" 2nd edition*	*Walker / Benbow / Elshennawy (ASQ Press)*
Supplemental Materials	*None*	
Prerequisites	*None*	

Class # (2.5 hrs per class)	**Classroom Topic**	**Objectives** (topics to define and explore)	***Reading*** *(due that class period)*	***Homework*** *(due that class period)*	Instructor Materials needed	Supplements suggested to make	ASQ Related Section	Lab / Lecture
9	Problem identification	NONC (really explore... out of spec vs customer satisfaction) intermittent, one-off, consistent defects lot by lot changes proper handling what is disposition and who can do it, introduce containment & MRB, scrap/rework/use as is/return (& design authority)	TCQT: ch4 e + internet	5 questions of determining conformance/non-conformance. Per print, handling etc.	good examples of nonc, good and close to nonc parts (good to have real samples with prints/specifications) mock up MRB results on one of the samples		3c	lecture
10	Introduce TQM. Products & processes	expand on 8 steps of TQM (see link)	http://asq.org/learn-about-quality/total-quality-management/overview/overview.html	questions about TQM			4c	lecture
11	Problem solving intro	problem solving tools (pro and con of common ones) common solutions 5why, 8d DMAIC, PDCA, PDSA, Lean, six sigma	Supplier Quality ; John Deer, https://www.flextronics.com/supplier-information/supplier-quality (8d); http://www.ti.com/lit/ml/szza063/szza063.pdf	5 why based on industrial supplier quality manual (Jdeere etc)	examples based on supplier quality manual		4f	lecture
12	How does a shop work? Travelers, plans, cp, engineering process	from vantage of different manufactured/purchased components start to conceptualize the world/environments Techs spend day-to-day explain what a role of a tech is(can be) and where they bring value, speak to quota TAC time (specifically inspection) of mfg persons and tech	TCQT: ch5 ab	questions about audit sheets, label parts, fill in parts etc	layout of a manufacturing building and the "product realization" cycle (ISO9001 chapter 7)	map of the process(s)	4d	lecture
13	Stats intro	Mean,median,mode, rand, std dev,variance, % ratio, trends, trend analysis graphing concepts introduction	TCQT: chapter 2 A&B	interact with 5 graphs (identify in spec, out of spec, min max, label the chart with limits, etc) 5 questions about sampling 4d	use material from day 6		4a	lecture
14	SPC intro	spec limit control limit one sided limit stat charting vs stat control machine capability (Cpk, Ppk) variable, attribute	TCQT: chapter 2 C	definitions of the objectives (short answer)	take material from day 4		4b	lecture
15	Stats more	distributions and how to read common examples what does several processes look like (not bell curve) show common distributions (left leaning, center missing, missing data) what processes/after processes create which distributions	TCQT: chapter 1B(p22-29)	graph 3 sets of data, show distributions (bell curve) and answer questions about sample vs population (ref day 6)	use material from day 5 and 8	Stats Recap?	4a	lecture
16	spc using stats	western electric rules (p68) other "standard" rules (can we find Tesla's?)	Purchase Western Electric Rules	control chart examples with western electric rules (5-10 questions)	data populations for SPC rule applications	SPC - Tesla rules? https://en.wikipedia.org/wiki/Western_Electric_rules	4b	lecture
17	SPC Stats Lab - computer lab	using samples take readings and react in line with SPC rules	(internet) - company with a SPC success story	finish lab	sample set. Business Partner.	sample set, dimensions, multiple?	4a 4b	lab
18	Full work center layout, create Control Plan & Inspection Standard	lay out work center complete with NONC bin. Bonus for PokaYoke have techs identify different aspects of inspection and controls	(internet) - reading about Poka Yoke	finish lab	need a mfg work center without any gages/inspections/NonC containment	(see materials)	3c	lab

Introduction to Quality Assurance Class

Units	*3 units*	*2 lecture / 1 lab*
Class Time	*5 hours / week over semester (17.5 weeks)*	*2 hours lecture / 3 hours lab per week = 88 total hours over semester*
Book	*"The Certified Quality Technician Handbook" 2nd edition*	*Walker / Benbow / Elshennawy (ASQ Press)*
Supplemental Materials	*None*	
Prerequisites	*None*	

Class # (2.5 hrs per class)	**Classroom Topic**	**Objectives** (topics to define and explore)	***Reading*** *(due that class period)*	***Homework*** *(due that class period)*	Instructor Materials needed	Supplements suggested to make	ASQ Related Section	Lab / Lecture
19	Responsibilities of a QE Tech	pre production / new product introduction design validation production, supply chain management, dock audits Emphasize: product quality, process quality, input quality escapes to customer	TCQT: ch5 cd (1 week to read)	questions about objective evidence. Ethics questions about audit interviews	layout of a manufacturing building (same as day 16 with more details) fill out physical locations/times of inspections	mfg map	4c	lecture
20	Delegated Responsibilities to Manufacturing, Escalation Paths	empowerment vs passing the buck, taking direction from management / engineering, giving support to production/engineering, hierarchy (speak to different culture types) expectations, role. … Emphasize that companies have different philosophies, there is no absolute right.	TCQT: ch5 cd (1 week to read)	5-10 questions about ethics in manufacturing	layout of a manufacturing building (same as day 19 with more details) showing physical locations/times of inspections. Examples of inspections & escalation	chart of manufacturing	4c	lecture
21	Audit to the Control Plan, Inspection Standard. Corrective Actions	Types of audits, audit process, audit tools Corrective/Preventative Actions Continuous Improvement	TCQT ch 6 A&B	questions about table 6.1 and containment	audit forms (book & external sources)		4d	lecture
22	Software	"dinosaurs" - that advance gaging is founded on basic gaging. Need to know the basics otherwise can apply the advanced in house gage comparison, customer/supplier gage comparison. Describe 3d space & "home"	assign reading/company profile of a local Bay Area metrology company	questions to answer about the local company (per reading)	resources showing modern gaging/3d printing	needs chart for CMM,	3e	lecture
23	Understanding your neighborhood Quality Engineer	What a QE does, how do QE'techs interact in different roles What do quality engineers depend on Techs for?	none		job descriptions of QE/QE Techs pulled near to class time. Speak to what is out there and set real expectations		4e	lecture
24	Testing methods	Nondestructive vs destructive functional and end of life testing hardness, surface, visual inspections examples of when to use what	assign reading/company profile of a local Bay Area advanced testing company	questions to answer about the local company (per reading)	resources showing modern testing methods / testing needs (how are batteries tested, how are circuit boards and ESD tested)	needs sponsor emails/ something cutting edge	3d	lecture
25	LEAN, PFMEA, PCDA. Have plan will execute (planning)	(2 day) day 1 intro. Introduce a problem for the class Build the solution and brainstorm in groups come up with a plan to execute on lab day	http://asq.org/learn-about-quality/project-planning-tools/overview/pdca-cycle.html	assignment to help group participation/prepare for lab	several problems for different groups. Group assignment structure		4f	lecture
26	LEAN, PFMEA, PCDA. Have plan will execute (in motion)	(2 day) day 2 lab. Have each of the groups implement their plans and show gains. 3-5 minute presentations with questions (similar to a kaizan event)	none	finish lab	lab		4f	lab
27	Understanding and helping your friendly Quality/MFG managements	roles of MFG eng, Software Eng, Process Eng, Design. What is management (different departments)? What do these people need from me? What is a Career Path, how do I plan one?	none		job descriptions of Engineers /QE Techs /managers pulled near to class time. Speak to what is out there and set real expectations		4e	lecture
28	Externals. Society's, FAIRs, PE/CE! (food, medicine)	exposure to as many external audits as possible (OSHA,AS9100,FDA…) Corrective/preventative actions going into and out of audits what to do with minor and major findings	list of "as many external audits as possible (OSHA,AS9100,FDA…)" websites	extra credit: scavenger hunt of info from websites (from reading)	examples of rigorous testing methods required (space X, Toyota heat treat, special audits etc)	chart/resource that shows all 3rd party audits	4d	lecture

Introduction to Quality Assurance Class

Units	*3 units*	*2 lecture / 1 lab*
Class Time	*5 hours / week over semester (17.5 weeks)*	*2 hours lecture / 3 hours lab per week = 88 total hours over semester*
Book	*"The Certified Quality Technician Handbook" 2nd edition*	*Walker / Benbow / Elshennawy (ASQ Press)*
Supplemental Materials	*None*	
Prerequisites	*None*	

Class # (2.5 hrs per class)	**Classroom Topic**	**Objectives** (topics to define and explore)	***Reading*** *(due that class period)*	***Homework*** *(due that class period)*	Instructor Materials needed	Supplements suggested to make	ASQ Related Section	Lab / Lecture
29	Product Launch	all the preproduction activities what can a Qetech do and what is more specialized (functional testing, lifecycle testing, highly specialized)	none	finish lab	examples of product launches based on industries or technologies. (casting in an auto, wire harness in aerospace, injection molding in agro…etc)	domestic launch of 5 parts.	comprehensive	lab
30	Conflict Resolution	ethics, team roles forming, storming, norming, performing conflict management solutions	news/publication of modern day (or historical) ethics example	5-10 questions about ethics in business culture (geared to working with office staff)	some examples for discussion. Some "gray" examples where there is no right or wrong but just two different points of view		5b	lecture
31	Quality Excursion	major containment of a defect that crosses multiple processes, inspection points and Risk areas		finish lab	couple examples for demonstration. Lab is complex containment across multiple work centers/inventory locations	scenario.	comprehensive	lab
32	Raw material to customer	establish sampling plan(s) for: raw, components, sub, in process, dock audit		finish lab	use map from day 20		3b	lab
33	Resources. Connecting the pieces, finding your place.	where to find information to further education private vs government jobs projects and resources international law &standards, RHOS, Conflict minerals etc	publications. Websites? OSHA?		list of external resources. Access to information		4g	lecture
34	Audit exercise	use ability of auditing and overall knowledge to assess if the student feels comfortable in the quality world	none	complete audit	audit form	audit checklist	4d	audit class or audit off-site
35	***Written Final***	> > >	> >	> >	> >	> >	>	

NOTES

Lead for developing Curriculum	*Aaron Haynes (June 2016)*
Homework / reading time	*2 lecture hours per week = 6 hours should be spent on activities outside of class per week. 17.5 weeks in semester = 105 hours over semester in outside work.*
Student equipment / tools needed	*None*

SIXTH EDITION

FUNDAMENTALS OF DIMENSIONAL METROLOGY

CONNIE L. DOTSON

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.

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)***
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.		

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)***
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

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)***
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***			

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)***

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.*