SAULT COLLEGE OF APPLIED ARTS AND TECHNOLOGY

SAULT STE. MARIE, ONTARIO

COURSE OUTLINE

COURSE TITLE:	METROLOGY AND QUALITY CONTROL		
CODE NO. :	MCH241	**SEMESTER:**	FIVE
PROGRAM:	MECHANICAL ENGINEERING TECHNOLOGY		
AUTHOR:	TOM KATAGIS		
INSTRUCTOR:	RAYMOND BONE		
DATE:	September 2013	**PREVIOUS OUTLINE DATED:**	September 2011

APPROVED:

"Corey Meunier"

CHAIR **DATE**

TOTAL CREDITS:	THREE
PREREQUISITE(S):	MCH138 – PRECISION MEASURING EQUIPMENT
HOURS/WEEK:	THREE

For additional information, please contact Corey Meunier, Chair
School of Technology & Skilled Trades
(705) 759-2554, Ext. 2610

I. COURSE DESCRIPTION:

A course dedicated to quality systems and an understanding of the theory behind basic meteorology. A theoretical understanding of calibration techniques, calibration standards, statistical process control, methods of measurement will be covered.

II. LEARNING OUTCOMES AND ELEMENTS OF THE PERFORMANCE:

Upon successful completion of this course, the student will demonstrate the ability to:

1. QUALITY SYSTEMS: History and Philosophy of Metrology and Calibration/The Basics of Quality Systems/Quality Standards and Their Evolution/Quality Documentation/Calibration Procedures and Equipment Manuals/Calibration Records/Calibration Certificates/Quality Manuals/ Traceability/ Calibration Intervals/ Calibration Standards/Audit Requirements/ Training/Environmental Controls

Potential Elements of the Performance:

- Describe the evolution of quality standards and metrology
- Describe key points and timelines for the evolution of the quality system as we know it today
- Define what a quality system is and why it is utilized
- Identify and provide the uses for various quality tools such as checksheets, pareto charts, flowchart, cause and effect diagrams, histogram, scatter diagram and control charts
- Give examples of situation that quality tools such as the ones listed above would be used and illustrate the tools in those applications
- Identify and explain several process improvement techniques
- Define what a quality standard is and why it is important
- Identify reasons why voluntary quality standards are imposed
- Explain and describe what ISO is and the role that ISO plays
- Identify and describe key historical events in the evolution of quality standards in the 20^{th} century
- Understand the ISO 9000 series and the importance it plays
- Explain the term Quality documentation and how the role that it plays within the quality system
- Explain the purpose of having written instructions such as SOP's, calibration procedures, protocols, work instructions etc…

- Identify and explain 4 requirements for the calibration of measurement equipment
- Identify and explain 7 areas that calibration procedures must contain
- Interpret, develop and utilize a calibration procedure for a measuring device
- Explain and communicate the importance of maintaining calibration records
- Identify and Explain 10 requirements of a calibration record
- Define Calibration certificates and the role that they play in the quality system
- The ability to identify a calibration certificate
- Define what a quality manual is and why it is important
- Define traceability and identify the six essential elements that traceability is characterized by
- Illustrate a traceability pyramid and explain
- Understand reverse traceability
- Identify influences that determine calibration intervals
- Explain three different types of calibration laboratory policies regarding calibration intervals
- Explain what is the importance of the SI system to calibration standards
- Identify the 7 base units and the 2 supplementary units of the SI system
- Identify the 19 derived SI units and produce the formula using the base and supplementary units to calculate them
- Explain the four stages for which a practical national and international measurement system is achieved
- Identify the realization techniques used for the base units of SI
- Define audit and explain why it is essential for a quality system to complete audits
- Identify and explain different types of audits
- Explain the importance of training as part of the quality system
- Explain the importance of environmental controls as part of a laboratory environment
- Identify and explain key points of maintaining environmental control in a laboratory setting
- Define, understand and interpret industry specific requirements

2. METROLOGY CONCEPTS – A General Understanding of Metrology/Measurement Methods, Systems, Capabilities and Data/Specifications/ Proficiency Testing, Measurement, Assurance Programs, and Laboratory Inter-comparisons.

Potential Elements of the Performance:

- Define Metrology and explain the importance of the basic concept
- Identify frequently used constants and explain their uncertainty
- Identify common measurement parameters, their units and instruments used to measure these parameters
- Identify and define measurement parameters and the physical world factors that comprise their makeup
- Define the terms measurement, measurand and method of measurement, measurement system, measuring instrument, measurement signal, measuring chain, results of measurement and indication as per VIM
- Identify and explain the seven measurement methods and provide examples of each
- Identify and interpret the 10 stage sequence in defining measurement requirements
- Define measuring capability
- Explain the term bias, linear scale, repeatability, reproducibility, stability and drift as per VIM and provide causes of each
- Utilize SPC charts, both x-bar and r-bar, to determine that a process is out of control
- Utilize the gage R&R study to determine % Equipment Variation, % Appraiser Variation, % Repeatability and Reproducibility, and % Part Variation
- Explain the importance of 5 key measurement data considerations
- Identify and explain the most common calibration methods and techniques
- Define the terms tolerance and specifications and distinguish the two terms
- Interpret and explain one way and two way specification limits
- Calculate and explain the baseline, modifier and qualifier specifications by utilizing specification tables
- Determine instruments suitability by comparing the uncertainty of both instruments
- Define the terms proficiency testing and interlaboratory comparisons

3. Mathematics and Statistics: Their Use in Measurement and Managing Uncertainty

Potential Elements of the Performance:

- Calculate and explain significant digits
- Explain how the number of significant digits is determined through the operations of addition, subtraction, multiplication and division
- Utilize standard notation, scientific notation and SI prefix notation
- Explain the ISO Preferred Numbers
- Utilize and explain five number rounding methods
- Interpret and utilize the understanding that all SI units are based on the 7 base and 2 derived units
- Explain why all SI units are considered coherent
- Identify and define all SI units derived from base, derived units with specialized names and symbols and other derived units
- Identify and define all recognized SI prefixes
- Understand which units cannot be used in the SI system
- Utilize conversion factors to move from customary units and SI
- Review of logarithmic functions and their properties and how that relates to decibel measures
- Explain the term degrees of freedom and how it impacts statistics in metrology
- Explain what is meant by residuals
- Understand and calculate mean, median, mode, bimodal distribution, root mean square, sum square, root sum square, variance, standard deviation, sample variance, sample standard deviation and standard error of mean
- Interpret distributions which indicate kurtosis and skew and calculate those values based on a set of data
- Determine Pearson's coefficient and explain how the data analyzed is related based on this constant
- For linear systems demonstrate the use of two point slope intercept relationships and linear regression
- Identify the various linear and non-linear interpolation methods and demonstrate the ability to utilize these methods
- Identify and explain various types of distribution
- Demonstrate a broad understanding of uncertainty in measurement

III. TOPICS:

1. Quality Systems
2. Metrology Concepts
3. Mathematics and Statistics; Their use in measurement

IV. REQUIRED RESOURCES/TEXTS/MATERIALS:

Bucher, Jay L, The Metrology Handbook, ASQ Quality Press., ISBN 0-87389-0620-3

V. EVALUATION PROCESS/GRADING SYSTEM:

Type of Grading	Duration	Mark Breakdown	Topics
Class Participation		**20%**	
Tests and Mid Term	**1.0 hr/each**	**30%**	**Sections 1, 2 and 3**
Final Exam	**2.0 hours**	**30%**	**All course material.**
Assignments and Labs		**20%**	**4 Labs**
Bonus			

The following semester grades will be assigned to students:

Grade	Definition	*Grade Point Equivalent*
A+	90 – 100%	4.00
A	80 – 89%	
B	70 - 79%	3.00
C	60 - 69%	2.00
D	50 – 59%	1.00
F (Fail)	49% and below	0.00

CR (Credit)	Credit for diploma requirements has been awarded.
S	Satisfactory achievement in field /clinical placement or non-graded subject area.
U	Unsatisfactory achievement in field/clinical placement or non-graded subject area.
X	A temporary grade limited to situations with extenuating circumstances giving a student additional time to complete the requirements for a course.
NR	Grade not reported to Registrar's office.
W	Student has withdrawn from the course without academic penalty.

VI. SPECIAL NOTES:

Attendance:
Sault College is committed to student success. There is a direct correlation between academic performance and class attendance; therefore, for the benefit of all its constituents, all students are encouraged to attend all of their scheduled learning and evaluation sessions. This implies arriving on time and remaining for the duration of the scheduled session.

VII. COURSE OUTLINE ADDENDUM:

The provisions contained in the addendum located on the portal form part of this course outline.

MECHANICAL ENGINEERING TECHNOLOGY - 4043

Metrology and Quality Control – MCH241

DISTRIBUTION OF HOURS

Sequence/Type	Topics	# of Hours
Lecture	Quality Systems	18
Lecture	Metrology Concepts	10
Lecture	Mathematics and Statistics:	12
Testing	Tests and Final Exam	8
	Sub-Totals:	
	Lectures	40
	Testing	8
	TOTAL HOURS	**48**