

# NIST Sponsored Subject Specific Metrology Course Series – 2016

## NIST & SIM

### Overview

On behalf of the National Institute of Standards and Technology, the International and Academic Affairs Office is happy to announce its 2016 metrology course series. These courses are being offered to SIM member National Metrology Institutes (NMIs) seeking opportunities for their staff to enhance the quality and complexity of the important measurement services they provide to their academic, governmental and private sector stakeholders.

These courses will provide NMI staff with hands-on, practical laboratory experience. Students will have the opportunity to work closely with NIST's world renowned metrologists and form strong professional connections. The small course sizes will allow students to engage their trainers and fellow participants in substantive discussions regarding their specific needs. NIST hopes that this opportunities will lead to improvements in the measurement services provided by the NMIs throughout the hemisphere.

*The National Institute of Standards and Technology values its important relationship with Sistema Interamericano de Metrologia (SIM). It is this mutually beneficial relationship NIST shares with each of SIM's 34 member states that helps to enhance the quality of the global metrology system. Through SIM, member states can realize their goal of attaining international measurement recognition – a cornerstone to facilitating international trade and improving health and human welfare.*

*In order for SIM to meet its goal of promoting and supporting an integrated measurement infrastructure in the Americas, all SIM members must seek to work together to improve the calibration and measurement capabilities of the region's National Metrology Institutes.*



**FUNDAMENTALS OF METROLOGY**  
**NIST, OFFICE OF WEIGHTS AND MEASURES**

**TRAINER(S): DR. GEORGIA HARRIS**  
**DATES OF TRAINING: 4 – 8 APRIL 2016**  
**NUMBER OF SEATS AVAILABLE: 12**

**COURSE DESCRIPTION:**

The Fundamentals of Metrology workshop will introduce participants to the concepts of measurement systems, units, measurement uncertainty, measurement assurance, traceability, basic statistics and how they fit into the laboratory Quality Management System. Additional topics covered will include overall Laboratory Management and Laboratory Quality Management Systems as well as specific discussions of the requirements for proficiency testing, calibration report generation, software verification and validation and management reviews. Topics will be covered using a variety of measurement disciplines and case studies so that the participants will be able to apply the concepts to any measurement discipline upon completion. Topics will be covered in a mixture of training styles including lecture, hands-on exercises, case studies and discussion.

Learning Objectives: Identify and use reference materials to ensure good quality, accurate, traceable measurement results; explain highlights and key concepts of each topic (noted on the Table of Contents and the detailed learning objectives) to each other and to your managers and show how these topics fit in to a management system using ISO/IEC 17025 as the basis. Have and know how to implement several simple tools, job aids, and references to use and improve your laboratory operations.

Technology Requirement(s): You will need to bring a 10-digit scientific calculator to use during this workshop. Participants MUST be familiar with the use of the hand-held scientific calculator. Additionally, use of a laptop or tablet PC is required to succeed in the workshop. Participants must have access to Microsoft Word and Excel (versions 2003, 2007 or 2010 are acceptable) and be able to open and use template Excel workbooks that will be provided on either CD-ROM or USB media. You must also be able to save/store files to USB media devices or CD-RW to facilitate printing.

**ITS-90 REALIZATION, INDUSTRIAL PLATINUM RESISTANCE THERMOMETERS AND UNCERTAINTY**  
**ANALYSIS TRAINING**  
**NIST, SENSOR SCIENCE DIVISION AND STATISTICAL ENGINEERING DIVISION**

**TRAINER(S): DR. MICHAL CHOJNACKY, DR. DAWN CROSS AND DR. ANTONIO POSSOLO**  
**DATES OF TRAINING:**  
**NUMBER OF SEATS AVAILABLE: 18 – 22 APRIL 2016**

The ITS-90 Fixed-Point Cell workshop is designed to provide intensive "hands-on" laboratory training in the realization of ITS-90 fixed-point cells. Using standard platinum resistance thermometers (SPRTs), participants will measure the freezing, melting and immersion curves of the ITS-90 fixed-point cells over the range from the mercury triple point to the zinc freezing point. Additionally, part of the course will focus on the development of uncertainty statements for the fixed-point cells and subsequently SPRT calibrations. Time will be split between laboratory (90%) and lecture (10%) sessions.

**[COURSE DESCRIPTION CONTINUES ON THE FOLLOWING PAGE]**

Who Should Attend: The workshop is intended for calibration laboratory personnel who are familiar with using ITS-90 fixed-point cells and SPRTs.

**Agenda:** Overview of ITS-90 Fixed-Point Cells

I. Realization Techniques

II. Use of Measurement Equipment

Calibrating an SPRT using ITS-90 Fixed-Point Cells – Hands-on in the laboratory

- Mercury Triple-Point Cell
- Water Triple-Point Cell
- Gallium Melting-Point Cell
- Tin Freezing-Point Cell
- Zinc Freezing-Point Cell
- Fixed-point cell and SPRT calibration uncertainties
- Bridge Validation Techniques – Hands-on in the laboratory

The Industrial Platinum Resistance Thermometer section is designed to provide intensive "hands-on" laboratory training in selecting and using Industrial Platinum Resistance Digital Thermometers over the temperature range from –196 °C to 500 °C. The participants will learn how to transition from a mercury thermometer to a digital thermometer for their measurement application. Application-based selection-criteria of a digital thermometer will be addressed with respect to the participants measurement needs. Measurements will focus on understanding the difference between a mercury thermometer and digital thermometer measurement result, proper measurement techniques for digital thermometers, how to use the ice melting point and steam point to validate a digital thermometer, and the development of uncertainty statements. Time will be split between laboratory (85%) and lecture (15%) sessions.

Lecture Topics: Overview of alternative thermometers

- Application-based selection
- Measurement equipment
- Measurement differences between analog and digital thermometers
- ITS-90 vs E1137 equations

Using an industrial platinum resistance digital thermometer – Hands-on in the laboratory

- Measurement differences between analog and digital thermometers
- Use and care of a digital thermometer
- Validation techniques
- Ice melting point
- Steam point
- Field-use of a digital thermometer
- Calibrating a digital thermometer by comparison
- Determining device under test uncertainty
- Digital thermometer uncertainty budget determination
- –196 °C to 500 °C

**[COURSE LISTING CONTINUES ON NEXT PAGE]**

## DIMENSIONAL METROLOGY

NIST, ENGINEERING PHYSICS DIVISION

**TRAINER(S): DR. DAN SAWYER**

**DATES OF TRAINING: 10 – 12 MAY 2016**

**NUMBER OF SEATS AVAILABLE: 12**

The basic principles of dimensional metrology are the same for nearly every calibration made in typical labs. This seminar teaches these principles for the case of the most typical dimensional measurement instrument, the Universal Length Measuring Machine. This is a 3 day hands on workshop based on characterizing the most common measuring machine in dimensional calibration labs, the Universal Length Measuring Machine. The class size is limited to 12 metrologists who will work in 3 groups or 4. Each group will do all of the studies: make the measurements, enter the data into analysis spread sheets, and evaluate the data.

The workshop is intended for calibration laboratory personnel at all levels. There will be technical staff there to teach how to use the measuring machine and explain each experiment.

The workshop will consist of a number of experiments and short presentations on the techniques and analysis methods. The studies planned are:

- Thermal studies of the machine and its environment throughout the 3 days
- Geometry of the contacts using optical flats, balls, cylinders and blocks
- Scale calibration using gage blocks, cylinders and rings
- Measurements of sub-pitch interpolation errors in the encoder system
- Calibration of contact forces
- Elastic Deformation
- Thermal Soaking times
- Gage Geometry Effects
- Uncertainty budgets
- R&R on end standards
- R&R on cylinders
- R&R on ring gages

There will also be short tours of our labs and time to discuss your laboratory uncertainty with NIST staff. Bring pictures of your lab and your uncertainty budgets if you would like an in-depth discussion.

**[COURSE LISTING CONTINUES ON NEXT PAGE]**

## TIME AND FREQUENCY

NIST, TIME AND FREQUENCY DIVISION

**TRAINER(S): DR. TOM O'BRIAN AND DR. MICHAEL LOMBARDI**

**DATES OF TRAINING: 7 – 11 JUNE 2016**

**NUMBER OF SEATS AVAILABLE: 5**

Accepted students will be invited to participate in the 4-day Annual Time and Frequency Metrology Seminar offered June 7-10, 2016. The Seminar includes lectures, hands-on laboratory experience, and informal discussion covering a full range of time and frequency measurement topics, led by NIST experts and external experts from industry and national labs. The SIM scientists will be selected from among the 23 SIM laboratories participating in the SIM Time Network.

A special extra session – only for the SIM participants – will be included focusing on time and frequency issues for NMIs, such as the details of participating in international UTC realization, and focus areas where NMIs can have the greatest impact on their national economy and technology. The SIM scientists will benefit through learning about a broad range of time and frequency metrology and research, and through the special SIM session tailored to their specific needs and interests. This improved knowledge will enable them to strengthen and expand their time and frequency metrology and research programs. NIST will benefit by having even stronger SIM Time Network partners (more knowledgeable about time and frequency metrology), and the potential of new research and metrology partnerships with strengthened SIM labs.

### Background on the Annual Time and Frequency Metrology Seminar

The 2016 Seminar will be the 41<sup>st</sup> annual presentation of a full range of time and frequency metrology and research topics, covered through lectures by world experts, hands-on laboratory experience, and informal discussion. Extensive electronic course materials are also provided. Teachers/lecturers/discussion leaders represent world experts from NIST and from industry and national labs. About 50 to 60 people typically participate, from industry, metrology labs, national labs, academia, and NMIs. The Seminar evolves every year based on feedback from the participants, and on the rapidly evolving nature of time and frequency metrology.

