**Technical Capacity Building Program**

**at**

**SASO NMCC**

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Training List at NMCC/SASO

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| --- | --- | --- | --- | --- |
| **Code Name** | **Subject** | **Description of Training** | **Duration** | **Date** |
| 1-NMCC- Mass | Mass  Metrology | Quality | 3 weeks (15 Days) | JUNE 2020 |
| Mass Metrology |
| 2-NMCC-Force | Force  Metrology | Quality | 3 weeks (15 Days) | JUNE 2020 |
| Pressure Metrology |
| 3-NMCC-Hardness | Hardness  Metrology | Quality | 3 weeks (15 Days) | JUNE 2020 |
| Hardness Metrology |
| 4-NMCC-Dimensionmal | Dimensional  Metrology | Quality | 3 weeks (15 Days) | JUNE 2020 |
| Dimensional  Metrology |
| 5-NMCC-Thermometry | Thermometry Metrology | Quality | 3 weeks (15 Days) | JUNE 2020 |
| Thermometry Metrology |
| 6-NMCC-Voltage | Voltage  Metrology | Quality | 3 weeks (15 Days) | JUNE 2020 |
| Voltage  Metrology |
| 7-NMCC- T & F | Time and Frequency Metrology | Quality | 3 weeks (15 Days) | JUNE 2020 |
| Time and Frequency Metrology |
| 8-NMCC-RMs | Reference Materials Metrology | Quality | 3 weeks (15 Days) | JUNE 2020 |
| Reference Materials Metrology |

First: General Quality Training Courses

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| **No** | **Course Name and outlines** | **Duration (D)** |
| 1 | **General Metrology, Fundamentals of Measurement, Calibration and Validation**   * Metrology as a science of measurements. Brief history of metrology * International System of Units (SI). SI Brochure * International Metrological Infrastructure. Metre Convention. Mutual Recognition Arrangement (CIPM MRA) * General terms and concepts in metrology. International Vocabulary in Metrology (VIM) * National Quality Infrastructure. Role of National Metrology Institute in National Quality Infrastructure | 1 |
| 2 | **Introduction to Evaluation of Measurement Uncertainty**   * Basic terms and definitions used in evaluation of Measurement uncertainty * Basic method for evaluation of measurement uncertainty: GUM approach * Common sources of uncertainty in calibrations * Type A evaluation of measurement uncertainty * Type B evaluation of measurement uncertainty * Statistical distributions used in uncertainty estimation * Calculation of combined and expanded uncertainty * Reporting calibration/measurement results | 2 |
| 3 | **Introduction and Implementation of ISO/IEC 17025: 2017 Standard**   * General information about the ISO/IEC standard, history of its development * Overview of the structure of the standard * Normative references and bibliography * General and structural requirements * Resource requirements * Process requirements * Management requirements (Option A and Option B) * Metrological traceability * Risk based thinking | 2 |
| 4 | **Introduction and Implementation of ISO 17034: 2016 Standard**   * Scope of the standard * Normative references * Terms and definitions * General requirements * Structural requirements * Resource requirements * Technical and production requirements * Management system requirements (Option A and Option B) | 2 |

Second: Specialized Technical Training Courses

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| **Area** | **Course outlines** | **Duration (D)** | |
| Mass | * Secondary level mass measurements, dissemination of unit of mass, determination of mass value and conventional mass value and uncertainty calculations * Performance tests of mass comparators to be used for mass determination * Volume/Density determination of mass standards by hydrostatic weighing method * Verification of weights / weight sets * Verification of non-automatic weighing instruments * Verification of automatic weighing instruments * Calibration of non-automatic weighing instruments * Calibration of automatic weighing instruments | 10 | |
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| Force |   Basic concepts of force    Necessity of force Measurement    Types of force proving instruments and application    Force standard machines    calibrate of force proving instruments    Calculations the calibration of force proving instruments    Calculation of measurement uncertainty    Classification of force proving instruments    Calibration certificate    practical training | | 5 |
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| Hardness | * General information about application fields of hardness instruments * Calibration of Rockwell, * Calibration of Brinell, * Calibration of Vickers, * Hardness Reference Blocks and Uncertainty Calculations * Calculation of measurement uncertainty * Calibration of Force Application Systems, * Calibration of Indentation Measurement Systems, * Calibration of Indirect Calibration by Hardness Reference * Blocks of Hardness Testing Machines (Rockwell, Brinell, Vickers) * Calculation of measurement uncertainty | | 5 |
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| Dimensional | **Special Training program for Basic Dimensional Devices (Micrometers, Dial Gauges, Height Gauges, Vernier Calipers)**   * Use of basic dimensional devices, * Calibration methods, * Uncertainty parameters and calculations   **Short Gauge Blocks And Their Calibration**   * Short gauge blocks calibration and uncertainty calculation, gauge blocks definitions, technical specifications, materials, production and classifications   **Short Gauge Block Comparators And Their Calibration**   * Training of short gauge block comparators calibration (Acc.to EURAMET/cg-02/v.02)   **Special Training program for measurement tapes and scales**   * General terms and definitions * Calibration of tapes and scales * Uncertainty parameters and calculations * Parallel Thread Ring-Plug Gauges Calibration and Uncertainty Calculation   **Form Measurements and Uncertainty Calculations**   * Form measurements and uncertainty calculations, form deviations and method of determination of form deviations, calibration of form measurement device | | 10 |
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| Thermometry | **Primary Level Contact Temperature Metrology**  **Calibration of Standard platinum Resistance Thermometers**    Theoretical background for temperature measurements. International Temperature Scale (ITS-90)  and terms and definitions related to temperature    Basic elements of Primary Level Temperature Calibration (Fixed Points, SPRTS, Bridges)    Practical work – Measurements with ITS-90 fixed point cells, Inducing freezing plateau, Evaluation of the plateau    Applying hydrostatic head and self-heating corrections    Calculation of W value and  Uncertainty Evaluation  **Secondary Level Contact Temperature Metrology**  **Calibration of Industrial Thermometers**    Theoretical background for temperature measurements with industrial PRTs,  Digital Thermometers, Thermistors, Interpolation Equations    Laboratory Practice : Calibration of Industrial PRT and Digital Thermometer by comparison method    Uncertainty Evaluation  **Calibration of Temperature-controlled Enclosures and Dry-Block Calibrators**    Definition of the thermometers used for temperature measurements for temperature-controlled volumes, The related standards EURAMET/cg.20 guide, EURAMET/cg.13 guide TS EN 600068-3-5, in accordance with TS EN 600068-3-11,    Laboratory practice with characterization of temperature-controlled volume and dry-block calibrator    Uncertainty evaluation  **Calibration of  Radiation Thermometers by Comparison Method**    Definitions and equations related with Radiation thermometry in ITS-90 Temperature Scale & Planck’s Radiation Law, Industrial Radiation Thermometers and Blackbody Sources and Emissivity    Laboratory Practice : Calibration of  IR calibrator and radiation thermometer by comparison method    Uncertainty evaluation  **Calibration of Thermo-Hygrometers**    Definitions and equations related with relative humidity, working principles of various hygrometers, humidity generators, humidity measuring techniques, Theoretical background of Two-pressure humidity generator in terms of Relative Humidity    Laboratory Practice : Hygrometer relative humidity calibration in the Two-pressure humidity generator    Uncertainty Evaluation    Laboratory Practice : Dew-point meter calibration in the Two-pressure humidity generator    Uncertainty Evaluation | | 10 |
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| Voltage | **DC Current Measurements**   * Calibration of the DC Current source by using Reference Shunt * Uncertainty calculations   **AC-DC Transfer Measurements**   * Basic Concepts of AC-DC transfer * Thermal Converters * Calibration of the thermal converters by comparison   **High Precision (8.5 Digit) Multimeter Calibration**   * Calibration of the multimeter by Reference Calibrator   Uncertainty calculations | | 10 |
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| Time and Frequency | * Calibration of function generator * Calibration of universal frequency counter * Calibration of Tacometer * Calibration of Stopwatch * Uncertainty calculation | | 10 |
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| Reference Materials | * Weighing of gas cylinder by automatic balance * Calibration of GC-TCD by standard gas concentrations * Measurement of HCl concentration by Coulometry * Measurement of Buffer pH by primary Harned Cell * Extraction of catchup from tomato paste * Preparation of calibration solution of Na benzoate CRM * Calibration of HPLC-UV using Na benzoate CRM * Calculation of the expanded uncertainty of measurement * Calibration of Spectrophotometer using Na benzoate CRM * Calculation of uncertainty of measurement | | 8 |