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Metrology is a constantly evolving field, and one which has developed in many ways in the last four decades. This book presents the proceedings of the Enrico Fermi Summer School on the topic of Metrology, held in Varenna, Italy, from 26 June to 6 July 2017. This was the 6th Enrico Fermi summer school devoted to metrology, the first having been held in 1976. The 2017 program addressed two major new directions for metrology: the work done in preparation for a possible re-definition of four of the base units of the SI in 2018, and the impact of the application of metrology to issues addressing quality of life – such as global climate change and clinical and food analysis – on science, citizens and society. The lectures were grouped into three modules: metrology for quality of life; fundamentals of metrology; and physical metrology and fundamental constants, and topics covered included food supply and safety; biomarkers; monitoring climate and air quality; new SI units; measurement uncertainty; fundamental constants; electrical metrology; optical frequency standards; and photometry and light metrology. The book provides an overview of the topics and changes relevant to metrology today, and will be of interest to both academics and all those whose work involves any of the various aspects of this field.

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An in-depth description of the theory and mathematical models behind the application of the global positioning system in geodesy and geodynamics. The contributions by leading experts in the field ensure a continuous flow of ideas and developments. The mathematical models for GPS measurements are developed in the first half of the book, and these are followed by GPS solutions for geodetic applications on local, regional and global scales.

This NIST IR of Selected Publications has been updated from the 2006 version and includes Good Laboratory Practices, Good Measurement Practices, and Standard Operating Procedures for volumetric calibrations.

From combating COVID-19 and climate change to tackling corruption and tax evasion, international organisations (IOs) play a critical role in helping countries find solutions to common problems. But for IOs to deliver optimal support to countries and their populations, the international instruments they develop need to be inclusive, well understood and have a tangible impact.

Applications of optical switching in network elements and communication networks are discussed in considerable depth. Optical circuits, packet, and burst switching are all included. Composed of distinct self-contained chapters with minimum overlaps and independent references. Provides up-

to-date comprehensive coverage of optical switching, technologies, devices, systems and networks. Discusses applications of optical switching in network elements and communications networks. This handbook is a both a description of the current practice at the National Institute of Standards and Technology, and a compilation of the theory and lore of gauge block calibration. Most of the chapters are nearly self-contained so that the interested reader can, for example, get information on the cleaning and handling of gauge blocks without having to read the chapters on measurement schemes or process control, etc. This partitioning of the material has led to some unavoidable repetition of material between chapters. The basic structure of the handbook is from the theoretical to the practical. Chapter 1: basic concepts and definitions of length and units; Chapter 2: history of gauge blocks, appropriate definitions and a discussion of pertinent national and international standards; Chapter 3: physical characteristics of gauge blocks, including thermal, mechanical and optical properties; Chapter 4: a description of statistical process control (SPC) and measurement assurance (MA) concepts; and Chapters 5 and 6: details of the mechanical comparisons and interferometric techniques used for gauge block calibrations. Full discussions of the related uncertainties and corrections are included. Finally, the appendices cover in more detail some

important topics in metrology and gauge block calibration.

The goal of acceptable quality, cost, and time is a decisive challenge in every engineering development process. To be familiar with metrology requires choosing the best combination of techniques, standards, and tools to control a project from advanced simulations to final performance measurements and periodic inspections. This book contains a cluster of chapters from international academic authors who provide a meticulous way to discover the impacts of metrology in both theoretical and application fields. The approach is to discuss the key aspects of a selection of untraditional metrological topics, covering the analysis procedures and set of solutions obtained from experimental studies.

This book is a collection of overview articles showing how space-based observations, combined with hydrological modeling, have considerably improved our knowledge of the continental water cycle and its sensitivity to climate change. Two main issues are highlighted: (1) the use in combination of space observations for monitoring water storage changes in river basins worldwide, and (2) the use of space data in hydrological modeling either through data assimilation or as external constraints. The water resources aspect is also addressed, as well as the impacts of direct anthropogenic forcing on land hydrology (e.g. ground water depletion, dam building on rivers, crop irrigation, changes in land use and agricultural practices, etc.). Remote sensing observations offer important new information on this important topic as well, which is highly useful for achieving water management objectives. Over the past 15 years, remote sensing techniques have increasingly demonstrated their capability to monitor components of the water balance of large river basins on time

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scales ranging from months to decades: satellite altimetry routinely monitors water level changes in large rivers, lakes and floodplains. When combined with satellite imagery, this technique can also measure surface water volume variations. Passive and active microwave sensors offer important information on soil moisture (e.g. the SMOS mission) as well as wetlands and snowpack. The GRACE space gravity mission offers, for the first time, the possibility of directly measuring spatio-temporal variations in the total vertically integrated terrestrial water storage. When combined with other space observations (e.g. from satellite altimetry and SMOS) or model estimates of surface waters and soil moisture, space gravity data can effectively measure groundwater storage variations. New satellite missions, planned for the coming years, will complement the constellation of satellites monitoring waters on land. This is particularly the case for the SWOT mission, which is expected to revolutionize land surface hydrology. Previously published in *Surveys in Geophysics*, Volume 37, No. 2, 2016

Optical Radiation Detectors, Eustace L. Dereniak and Devon G. Crowe Offers a comprehensive, integrated treatment of optical radiation detectors, discussing their capabilities and limitations. Background material on radiometry, noise sources, and detector physics is introduced, followed by more detailed discussions of photon detectors, thermal detectors, and charge transfer arrays of detectors.

The 18th International Conference on Electrical Engineering Electronics, Computer, Telecommunications and Information Technology (ECTI CON 2021) is the annual international conference organized by Electrical Engineering Electronics, Computer, Telecommunications and Information Technology (ECTI) Association, Thailand. The conference aims to provide an international platform to present technological advances, launch new ideas and showcase research work in the field of

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electrical engineering, electronics, computer, telecommunications and information technology

By using familiar concepts from classical measurement methods and basic statistics, this book introduces the basics of item response theory (IRT) and explains the application of IRT methods to problems in test construction, identification of potentially biased test items, test equating and computerized-adaptive testing. The book also includes a thorough discussion of alternative procedures for estimating IRT parameters and concludes with an exploration of new directions in IRT research and development.

This document describes measurement services, instrumentation, and techniques for regular spectral transmittance over the spectral range from 250 nm to 2500 nm at the National Institute of Standards and Technology. Section 2 explains the basic theory in deriving the transmittance, while a more thorough derivation is reserved for the interested reader in Appendix A. Section 3 describes the reference instrument hardware, software, validation, procedures, and uncertainties. Section 4 provides this same detailed information for the transfer instrument. Sample calibration reports and sample data are provided in Appendices B and C, respectively, and Appendix D details instructions for requesting Regular Spectral Transmittance Calibrations. The measurement services are described for the benefit of customers and potential customers, and the instruments, measurement procedures, and uncertainties are described in sufficient detail to allow comparisons with measurement methods at other laboratories.

At 170 billion barrels, Canada's Oil Sands are the third largest reserves of developable oil in the world. The Oil Sands now produce about 1.6 million barrels per day, with production expected to double by 2025

to about 3.7 million barrels per day. The Athabasca Oil Sands Region (AOSR) in northeastern Alberta is the largest of the three oil sands deposits. Bitumen in the oil sands is recovered through one of two primary methods - mining and drilling. About 20 per cent of the reserves are close to the surface and can be mined using large shovels and trucks. Of concern are the effects of the industrial development on the environment. Both human-made and natural sources emit oxides of sulphur and nitrogen, trace elements and persistent organic compounds. Of additional concern are ground level ozone and greenhouse gases. Because of the requirement on operators to comply with the air quality regulatory policies, and to address public concerns, the not-for-profit, multi-stakeholder Wood Buffalo Environmental Association (WBEA) has since 1997 been closely monitoring air quality in AOSR. In 2008, WBEA assembled a distinguished group of international scientists who have been conducting measurements and practical research on various aspects of air emissions and their potential effects on terrestrial receptors. This book is a synthesis of the concepts and results of those on-going studies. It contains 19 chapters ranging from a global perspective of energy production, measurement methodologies and behavior of various air pollutants during fossil fuel production in a boreal forest ecosystem, towards designing and deploying a multi-disciplinary,

proactive, and long-term environmental monitoring system that will also meet regulatory expectations. Covers measurement of emissions from very large industrial sources in a region with huge international media profile Validation of measurement technologies can be applied globally The new approaches to ecological monitoring described can be applied in other forested regions

A teenager discovers his voice in this contemporary love story from “one of young adult literature’s greatest living writers” (Booklist). Shy teenager Karl is desperately in love with his girlfriend, Fiorella, a literary enthusiast who’s asked him to write her a letter in which he reveals his true self. There’s just one problem . . . Karl is dyslexic. Convinced that his attempts to express himself with words will end in disaster, Karl tracks down Fiorella’s favorite novelist and begs him to take up the task. The famous writer unexpectedly agrees, but on one condition: Karl must participate in a series of interviews so the author can pen an authentic portrait of his affections. What follows is a series of misunderstandings, a startling revelation, and an unusual bond that will change all three of their lives. A moving story of love and friendship, *Dying to Know You* is the perfect novel for “that cloudy expanse between older teenager and younger adult, a novel that doesn’t pretend to advise, but merely sees its characters for who they really are” (The Guardian). “This quietly

understated performance captures the wistfulness of music in a minor key.” —Kirkus Reviews

This book describes the significance of metrology for inclusive growth in India and explains its application in the areas of physical–mechanical engineering, electrical and electronics, Indian standard time measurements, electromagnetic radiation, environment, biomedical, materials and Bhartiya Nirdeshak Dravyas (BND®). Using the framework of “Aswal Model”, it connects the metrology, in association with accreditation and standards, to the areas of science and technology, government and regulatory agencies, civil society and media, and various other industries. It presents critical analyses of the contributions made by CSIR-National Physical Laboratory (CSIR-NPL), India, through its world-class science and apex measurement facilities of international equivalence in the areas of industrial growth, strategic sector growth, environmental protection, cybersecurity, sustainable energy, affordable health, international trade, policy-making, etc. The book will be useful for science and engineering students, researchers, policymakers and entrepreneurs.

Uncertainty surrounds the use of publicity as a means of controlling corporate crime. On the one hand, some agree with Justice Brandeis’s dictum that light is “the best of disinfectants...the most efficient policeman.” On the other hand, many

believe that corporations' internal affairs are effectively shrouded with a thick fog that prevents the light of public scrutiny from reaching them. The *Impact of Publicity on Corporate Offenders* is the first study to go beyond the rhetoric, through an examination of corporate experience. Fisse and Braithwaite have carried out a qualitative inquiry concerning 17 large corporations involved in publicity crises. Based mainly on interviews, the inquiry includes company employees and former employees, union officials, officers of government regulatory agencies, competitors, independent accountants, government prosecutors, public interest activists, judicial officers, stockbrokers, and other experts.

The West without Water documents the tumultuous climate of the American West over twenty millennia, with tales of past droughts and deluges and predictions about the impacts of future climate change on water resources. Looking at the region's current water crisis from the perspective of its climate history, the authors ask the central question of what is "normal" climate for the West, and whether the relatively benign climate of the past century will continue into the future. *The West without Water* merges climate and paleoclimate research from a wide variety of sources as it introduces readers to key discoveries in cracking the secrets of the region's climatic past. It demonstrates that extended

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droughts and catastrophic floods have plagued the West with regularity over the past two millennia and recounts the most disastrous flood in the history of California and the West, which occurred in 1861–62. The authors show that, while the West may have temporarily buffered itself from such harsh climatic swings by creating artificial environments and human landscapes, our modern civilization may be ill-prepared for the future climate changes that are predicted to beset the region. They warn that it is time to face the realities of the past and prepare for a future in which fresh water may be less reliable. This volume is an outgrowth of a project undertaken by the Environmental and Societal Impacts Group (ESIG) for the U.S. Environmental Protection Agency's Office of Policy Analysis to identify societal responses to extreme climate-related events in North America.

This volume contains original, refereed contributions by researchers from national metrology institutes, universities and laboratories across the world involved in metrology and testing. The volume has been produced by the International Measurement Confederation Technical Committee 21, Mathematical Tools for Measurements and is the twelfth in the series. The papers cover topics in numerical analysis and computational tools, statistical inference, regression, calibration and metrological traceability, computer science and data provenance, and describe applications in a wide range of application domains. This volume is

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useful to all researchers, engineers and practitioners who need to characterize the capabilities of measurement systems and evaluate measurement data. It will also be of interest to scientists and engineers concerned with the reliability, trustworthiness and reproducibility of data and data analytics in data-driven systems in engineering, environmental and life sciences. Edited by two very well-known and respected scientists in the field, this excellent practical guide is the first to cover the fundamentals and a wide range of applications, as well as showing readers how to efficiently use this increasingly important technique. From the contents: *

- The Isotopic Composition of the Elements
- * Single-Collector ICP-MS
- * Multi-Collector ICP-MS
- * Advances in Laser Ablation - Multi-Collector ICP-MS
- * Correction for Instrumental Mass Discrimination in Isotope Ratio Determination with Multi-Collector ICP-MS
- * Reference Materials in Isotopic Analysis
- * Quality Control in Isotope Ratio Applications
- * Determination of Trace Elements and Elemental Species Using Isotope Dilution ICP-MS
- * Geochronological Dating
- * Application of Multi-Collector ICP-MS to Isotopic Analysis in Cosmochemistry
- * Establishing the Basis for Using Stable Isotope Ratios of Metals as Paleoredox Proxies
- * Isotopes as Tracers of Elements Across the Geosphere-Biosphere Interface
- * Archaeometric Applications
- * Forensics Applications
- * Nuclear Applications
- * The Use of Stable Isotope Techniques for Studying Mineral and Trace Element Metabolism in Humans
- * Isotopic Analysis via Multi-Collector ICP-MS in Elemental Speciation

A must-have for newcomers as well as established scientists seeking

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an overview of isotopic analysis via ICP-MS.

Handbook for the Quality Assurance of Metrological Measurements
The Gauge Block Handbook
Createspace Independent Publishing Platform

If you're looking for an up-to-date, easy-to-understand treatment of the GPS (Global Positioning System), this one-of-a-kind resource offers you the knowledge you need for your work, without bogging you down with advanced mathematics. It addresses all aspects of the GPS, emphasizes GPS applications, examines the GPS signal structure, and covers the key types of measurement being utilized in the field today.

It is now becoming recognized in the measurement community that it is as important to communicate the uncertainty related to a specific measurement as it is to report the measurement itself. Without knowing the uncertainty, it is impossible for the users of the result to know what confidence can be placed in it; it is also impossible to assess the comparability of different measurements of the same parameter. This volume collects 20 outstanding papers on the topic, mostly published from 1999-2002 in the journal "Accreditation and Quality Assurance." They provide the rationale for why it is important to evaluate and report the uncertainty of a result in a consistent manner. They also describe the concept of uncertainty, the methodology for evaluating uncertainty, and the advantages of using suitable reference materials. Finally, the benefits to both the analytical laboratory and the user of the results are considered.

This Dictionary of Weighing Terms is a comprehensive

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practical guide to the terminology of weighing for all users of weighing instruments in industry and science. It explains more than 1000 terms of weighing technology and related areas; numerous illustrations assist understanding. The Dictionary of Weighing Terms is a joint work of the German Federal Institute of Physics and Metrology (PTB) and METTLER TOLEDO, the weighing instruments manufacturer. Special thanks go to Peter Brandes, Michael Denzel, and Dr. Oliver Mack of PTB, and to Richard Davis of BIPM, who with their technical knowledge have contributed to the success of this work. The Dictionary contains terms from the following fields: fundamentals of weighing, application and use of weighing instruments, international standards, legal requirements for weighing instruments, weighing accuracy. An index facilitates rapid location of the required term. The authors welcome suggestions and corrections at www.mt.com/weighing-terms.

Braunschweig (DE) and Greifensee (CH), The Authors
Summer 2009 Foreword Since its founding in 1875, the International Bureau of Weights and Measures (BIPM) has had a unique role in mass metrology. The definition of the kilogram depends on an artefact conserved and used within our laboratories. The mass embodied in this artefact defines the kilogram, and this information is disseminated throughout the world to promote uniformity of measurements. Although the definition of the kilogram may change in the relatively near future, reflecting the success of new technologies and new requirements, the task of ensuring world-wide uniformity of mass measurements will remain.

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Experimental Thermodynamics, Volume II: Experimental Thermodynamics of Non-reacting Fluids focuses on experimental methods and procedures in the study of thermophysical properties of fluids. The selection first offers information on methods used in measuring thermodynamic properties and tests, including physical quantities and symbols for physical quantities, thermodynamic definitions, and definition of activities and related quantities. The text also describes reference materials for thermometric fixed points, temperature measurement under pressures, and pressure measurements. The publication takes a look at absolute measurement of volume and equation of state of gases at high temperatures and low or moderate temperatures. Discussions focus on volumes of cubes of fused silica, density of water, and methods of measuring pressure. The text also examines the compression of liquids and thermodynamic properties and velocity of sound, including thermodynamics of volume changes, weight methods, and adiabatic compression. The selection is a dependable reference for readers interested in the thermophysical properties of fluids.

This book is a comprehensive collection of the best scholarship available on the transition between the Paleocene and Eocene epochs -- when the earth experienced the warmest climatic episode of the Cenozoic era. These 21 contributions detail the major turnover among marine and terrestrial organisms that resulted from sudden global warming.

Market: Applied acousticians and microphone users such as engineers, scientists, and technicians. The first single-volume reference to offer complete, up-to-date coverage of the wide-ranging topics related to condenser microphone calibration. Featuring contributions by prominent acousticians, this book provides easy-to-follow calibration methods and step-by-step

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procedures for operating the various measuring instruments and acoustic devices discussed. It also includes a history of the development of condenser microphones, material never before published.

This accessible reference presents the evolution of concepts of time and methods of time keeping, for historians, scientists, engineers, and educators. The second edition has been updated throughout to describe twentieth- and twenty-first-century advances, progress in devices, time and cosmology, the redefinition of SI units, and the future of UTC.

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