

Chapter 7 Solutions Thermodynamics An Engineering Approach 6th

In this textbook, the authors show that a few fundamental principles can provide students of mechanical and aeronautical engineering with a deep understanding of all modes of aircraft and spacecraft propulsion.

* Guidelines are provided on the reliability of various methods, as well as information for selecting the appropriate technique. * Unique coverage of the whole range of solubility measurements. * Very useful for investigators interested in embarking upon solubility measurements.

A growing demand for energy supply worldwide, coupled with the necessity to reduce emission of greenhouse gases, has led to a renewed interest in nuclear energy as an alternative to fossil fuels for electricity production in the last years. One of the ma
The aim of this book is to present Classical Thermodynamics in a unified way, from the most fundamental principles to non-uniform systems, thereby requiring the introduction of coarse graining methods, leading for instance to phase field methods. Solutions thermodynamics and temperature-concentration phase diagrams are covered, plus also a brief introduction to statistical thermodynamics and topological disorder. The Landau theory is included along with a general treatment of multicomponent instabilities in various types of thermodynamic applications, including phase separation and order-

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disorder transitions. Nucleation theory and spinodal decomposition are presented as extreme cases of a single approach involving the all-important role of fluctuations. In this way, it is hoped that this coverage will reconcile in a unified manner techniques generally presented separately in physics and materials texts.

This book gives the definitive mathematical answer to what thermodynamics really is: a variational calculus applied to probability distributions. Extending Gibbs's notion of ensemble, the Author imagines the ensemble of all possible probability distributions and assigns probabilities to them by selection rules that are fairly general. The calculus of the most probable distribution in the ensemble produces the entire network of mathematical relationships we recognize as thermodynamics. The first part of the book develops the theory for discrete and continuous distributions while the second part applies this thermodynamic calculus to problems in population balance theory and shows how the emergence of a giant component in aggregation, and the shattering transition in fragmentation may be treated as formal phase transitions. While the book is intended as a research monograph, the material is self-contained and the style sufficiently tutorial to be accessible for self-paced study by an advanced graduate student in such fields as physics, chemistry, and engineering.

Sample Text

Contains worked solutions to almost all end-of-chapter problems featured in the book. This title is useful as a resource for those lecturers who wish to use the extensive

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selection of problems featured in the text to support either formative or summative assessment, and want access to the solutions to these problems.

The introductory textbook provides an update on electrolyte thermodynamics with a molecular perspective. It is eminently suited as an introduction to the solution thermodynamics of ionic mixtures at the undergraduate and graduate level. It is also invaluable for the understanding and design in the engineering of natural gas treating and adsorption refrigeration with electrolytes.

For many processes and applications in science and technology a basic knowledge of liquids and solutions is a must. Gaining a better understanding of the behavior and properties of pure liquids and solutions will help to improve many processes and to advance research in many different areas. This book provides a comprehensive, self-contained and integrated survey of this topic and is a must-have for many chemists, chemical engineers and material scientists, ranging from newcomers in the field to more experienced researchers. The author offers a clear, well-structured didactic approach and provides an overview of the most important types of liquids and solutions. Special topics include chemical reactions, surfaces and phase transitions. Suitable both for introductory as well as intermediate level as more advanced parts are clearly marked. Includes also problems and solutions.

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Nuclear Systems, Volume I: Thermal Hydraulic Fundamentals, Third Edition, provides an in-depth introduction to nuclear power, focusing on thermal hydraulic design and analysis of the nuclear core and other key nuclear plant components. The authors stress the integration of fluid flow and heat transfer as applied to all power reactor types and energy source distribution. They cover nuclear reactor concepts and systems, including GEN III+, GEN IV, and SMR reactors and new power cycles. The text includes new chapter examples and problems using concept parameters, full-color text and art, computer programs, figure slides, and a solutions manual. FEATURES Rigorous coverage of nuclear power generation fundamentals Description and analysis of the latest nuclear power plant designs and technologies Extensive examples in each chapter to illustrate the analysis methods which have been presented New full-color art and text features to enhance the presentation of topics Integration of fluid flow and heat transfer as applied to single- and two-phase coolants Readers will develop the knowledge and design skills needed to improve the next generation of nuclear reactors. This book was planned and written with one central goal in mind: to demonstrate that statistical thermodynamics can be used successfully by a broad group of scientists, ranging from chemists through biochemists to biologists, who are not and do not intend to become specialists in statistical thermodynamics. The book

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is addressed mainly to graduate students and research scientists interested in designing experiments the results of which may be interpreted at the molecular level, or in interpreting such experimental results. It is not addressed to those who intend to practice statistical thermodynamics per se. With this goal in mind, I have expended a great deal of effort to make the book clear, readable, and, I hope, enjoyable. This does not necessarily mean that the book as a whole is easy to read. The first four chapters are very detailed. The last four become progressively more difficult to read, for several reasons. First, presuming that the reader has already acquired familiarity with the methods and arguments presented in the first part, I felt that similar arguments could be skipped later on, leaving the details to be filled in by the reader. Second, the systems themselves become progressively more complicated as we proceed toward the last chapter. Thermodynamics deals with energy levels and the transfer of energy between states of matter, and is therefore fundamental to all branches of science. This edition provides a relatively advanced treatment of the subject, specifically tailored for the interests of the Earth sciences. The first four chapters explain all necessary concepts, using a simple graphical approach. Throughout the rest of the book the author emphasizes the use of thermodynamics to construct mathematical simulations of real systems. This helps to make the many abstract

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concepts acceptable. Many computer programs are mentioned and used throughout the text, especially SUPCRT92, a widely used source of thermodynamic data. An associated website includes links to useful information sites and computer programs and problem sets. Building on the more elementary material in the first edition, this textbook will be ideal for advanced undergraduate and graduate students in geology, geochemistry, geophysics and environmental science.

Chemical Thermodynamics: Principles and Applications presents a thorough development of the principles of thermodynamics--an old science to which the authors include the most modern applications, along with those of importance in developing the science and those of historical interest. The text is written in an informal but rigorous style, including anecdotes about some of the great thermodynamicists (with some of whom the authors have had a personal relationship), and focuses on "real" systems in the discussion and figures, in contrast to the generic examples that are often used in other textbooks. The book provides a basic review of thermodynamic principles, equations, and applications of broad interest. It covers the development of thermodynamics as one of the pre-eminent examples of an exact science. A discussion of the standard state that emphasizes its significance and usefulness is also included, as well as a more

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rigorous and indepth treatment of thermodynamics and discussions of a wider variety of applications than are found in more broadly based physical chemistry undergraduate textbooks. Combined with its companion book, Chemical Thermodynamics: Advanced Applications, the practicing scientist will have a complete reference set detailing chemical thermodynamics. Outlines the development of the principles of thermodynamics, including the most modern applications along with those of importance in developing the science and those of historical interest Provides a basic review of thermodynamic principles, equations, and applications of broad interest Treats thermodynamics as one of the preeminent examples of an exact science Provides a more rigorous and indepth treatment of thermodynamics and discussion of a wider variety of applications than are found in more broadly based physical chemistry undergraduate textbooks Includes examples in the text and exercises and problems at the end of each chapter to assist the student in learning the subject Provides a complete set of references to all sources of data and to supplementary reading sources

"an impressive text that addresses a glaring gap in the teaching of physical chemistry, being specifically focused on biologically-relevant systems along with a practical focus.... the ample problems and tutorials throughout are much

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appreciated." –Tobin R. Sosnick, Professor and Chair of Biochemistry and Molecular Biology, University of Chicago "Presents both the concepts and equations associated with statistical thermodynamics in a unique way that is at visual, intuitive, and rigorous. This approach will greatly benefit students at all levels." –Vijay S. Pande, Henry Dreyfus Professor of Chemistry, Stanford University "a masterful tour de force.... Barrick's rigor and scholarship come through in every chapter." –Rohit V. Pappu, Edwin H. Murty Professor of Engineering, Washington University in St. Louis This book provides a comprehensive, contemporary introduction to developing a quantitative understanding of how biological macromolecules behave using classical and statistical thermodynamics. The author focuses on practical skills needed to apply the underlying equations in real life examples. The text develops mechanistic models, showing how they connect to thermodynamic observables, presenting simulations of thermodynamic behavior, and analyzing experimental data. The reader is presented with plenty of exercises and problems to facilitate hands-on learning through mathematical simulation. Douglas E. Barrick is a professor in the Department of Biophysics at Johns Hopkins University. He earned his Ph.D. in biochemistry from Stanford University, and a Ph.D. in biophysics and structural biology from the University of Oregon.

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Classical Thermodynamics of Non-Electrolyte Solutions covers the historical development of classical thermodynamics that concerns the properties of vapor and liquid solutions of non-electrolytes. Classical thermodynamics is a network of equations, developed through the formal logic of mathematics from a very few fundamental postulates and leading to a great variety of useful deductions. This book is composed of seven chapters and begins with discussions on the fundamentals of thermodynamics and the thermodynamic properties of fluids. The succeeding chapter presents the equations of state for the calculation of the thermodynamic behavior of constant-composition fluids, both liquid and gaseous. These topics are followed by surveys of the mixing of pure materials to form a solution under conditions of constant temperature and pressure. The discussion then shifts to general equations for calculation of partial molal properties of homogeneous binary systems. The last chapter considers the approach to equilibrium of systems within which composition changes are brought about either by mass transfer between phases or by chemical reaction within a phase, or by both.

This solutions manual for students provides answers to approximately 25 per cent of the text's end-of-chapter physics problems, in the same format and with the same level of detail as the worked examples in the textbook.

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A well-rounded and articulate examination of polymer properties at the molecular level, Polymer Chemistry focuses on fundamental principles based on underlying chemical structures, polymer synthesis, characterization, and properties. It emphasizes the logical progression of concepts and provide mathematical tools as needed as well as fully derived problems for advanced calculations. The much-anticipated Third Edition expands and reorganizes material to better develop polymer chemistry concepts and update the remaining chapters. New examples and problems are also featured throughout. This revised edition: Integrates concepts from physics, biology, materials science, chemical engineering, and statistics as needed. Contains mathematical tools and step-by-step derivations for example problems. Incorporates new theories and experiments using the latest tools and instrumentation and topics that appear prominently in current polymer science journals. Polymer Chemistry, Third Edition offers a logical presentation of topics that can be scaled to meet the needs of introductory as well as more advanced courses in chemistry, materials science, polymer science, and chemical engineering.

The Clear, Well-Organized Introduction to Thermodynamics Theory and Calculations for All Chemical Engineering Undergraduate Students This text is designed to make thermodynamics far easier for undergraduate chemical

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engineering students to learn, and to help them perform thermodynamic calculations with confidence. Drawing on his award-winning courses at Penn State, Dr. Themis Matsoukas focuses on “why” as well as “how.” He offers extensive imagery to help students conceptualize the equations, illuminating thermodynamics with more than 100 figures, as well as 190 examples from within and beyond chemical engineering. Part I clearly introduces the laws of thermodynamics with applications to pure fluids. Part II extends thermodynamics to mixtures, emphasizing phase and chemical equilibrium. Throughout, Matsoukas focuses on topics that link tightly to other key areas of undergraduate chemical engineering, including separations, reactions, and capstone design. More than 300 end-of-chapter problems range from basic calculations to realistic environmental applications; these can be solved with any leading mathematical software. Coverage includes

- Pure fluids, PVT behavior, and basic calculations of enthalpy and entropy
- Fundamental relationships and the calculation of properties from equations of state
- Thermodynamic analysis of chemical processes
- Phase diagrams of binary and simple ternary systems
- Thermodynamics of mixtures using equations of state
- Ideal and nonideal solutions
- Partial miscibility, solubility of gases and solids, osmotic processes
- Reaction equilibrium with applications to single and multiphase reactions

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Because classical thermodynamics evolved into many branches of science and engineering, most undergraduate courses on the subject are taught from the perspective of each area of specialization. General Thermodynamics combines elements from mechanical and chemical engineering, chemistry (including electrochemistry), materials science, and biology to present a unique and thorough treatment of thermodynamics that is broader in scope than other fundamental texts. This book contains classroom-tested materials designed to meet the academic requirements for students from a variety of scientific and engineering backgrounds in a single course. The first half focuses on classical concepts of thermodynamics, whereas the latter half explores field-specific applications, including a unique chapter on biothermodynamics. The book's methodology is unified, concise, and multidisciplinary, allowing students to understand how the principles of thermodynamics apply to all technical fields that touch upon this most fundamental of scientific theories. It also offers a rigorous approach to the quantitative aspects of thermodynamics, accompanied by clear explanations to help students transition smoothly from the physical concepts to their mathematical representations. Each chapter contains numerous worked examples taken from different engineering applications, illustrations, and an extensive set of exercises to support the material. A complete solutions manual is

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available to professors with qualifying course adoptions.

This is the second edition of the book “Thermodynamics of Fluids under Flow,” which was published in 2000 and has now been corrected, expanded and updated. This is a companion book to our other title Extended irreversible thermodynamics (D. Jou, J. Casas-Vázquez and G. Lebon, Springer, 4th edition 2010), and of the textbook Understanding non-equilibrium thermodynamics (G. Lebon, D. Jou and J. Casas-Vázquez, Springer, 2008). The present book is more specialized than its counterpart, as it focuses its attention on the non-equilibrium thermodynamics of flowing fluids, incorporating non-trivial thermodynamic contributions of the flow, going beyond local equilibrium theories, i.e., including the effects of internal variables and of external forcing due to the flow. Whereas the book's first edition was much more focused on polymer solutions, with brief glimpses into ideal and real gases, the present edition covers a much wider variety of systems, such as: diluted and concentrated polymer solutions, polymer blends, laminar and turbulent superfluids, phonon hydrodynamics and heat transport in nanosystems, nuclear collisions, far-from-equilibrium ideal gases, and molecular solutions. It also deals with a variety of situations, emphasizing the non-equilibrium flow contribution: temperature and entropy in flowing ideal gases, shear-induced effects on phase transitions in real gases and on polymer

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solutions, stress-induced migration and its application to flow chromatography, Taylor dispersion, anomalous diffusion in flowing systems, the influence of the flow on chemical reactions, and polymer degradation. The new edition is not only broader in scope, but more educational in character, and with more emphasis on applications, in keeping with our times. It provides many examples of how a deeper theoretical understanding may bring new and more efficient applications, forging links between theoretical progress and practical aims. This updated version expands on the trusted content of its predecessor, making it more interesting and useful for a larger audience.

This book is intended to serve as a text for an introductory course in geochemistry for undergraduate/graduate students with at least an elementary level background in earth sciences, chemistry, and mathematics. The text, containing 83 tables and 181 figures, covers a wide variety of topics ranging from atomic structure to chemical and isotopic equilibria to modern biogeochemical cycles which are divided into four interrelated parts: Crystal Chemistry; Chemical Reactions (and biochemical reactions involving bacteria); Isotope Geochemistry (radiogenic and stable isotopes); and The Earth Supersystem, which includes discussions pertinent to the evolution of the solid Earth, the atmosphere, and the hydrosphere. In keeping with the modern trend in

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the field of geochemistry, the book emphasizes computational techniques by developing appropriate mathematical relations, solving a variety of problems to illustrate application of the mathematical relations, and leaving a set of questions at the end of each chapter to be solved by students. However, so as not to interrupt the flow of the text, involved chemical concepts and mathematical derivations are separated in the form of boxes. Supplementary materials are packaged into ten appendixes that include a standard state (298.15 K, 1 bar) thermodynamic data table and a listing of answers to selected chapter end questions. Additional resources for this book can be found at:

www.wiley.com/go/misra/geochemistry.

This book is intended for scientists, researchers, and graduate students interested in solutions in general, and solutions of metals in particular. Readers are assumed to have a good background in thermodynamics, presented in such books as those cited at the end of Chapter 1, "Thermodynamic Background." The contents of the book are limited to the solutions of metals + metals, and metals + metalloids, but the results are also applicable to numerous other types of solutions encountered by metallurgists, materials scientists, geologists, ceramists, and chemists. Attempts have been made to cover each topic in depth with numerical examples whenever necessary. Chapter 2 presents phase

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equilibria and phase diagrams as related to the thermodynamics of solutions. The emphasis is on the binary diagrams since the ternary diagrams can be understood in terms of the binary diagrams coupled with the phase rule, and the Gibbs energies of mixing. The calculation of thermodynamic properties from the phase diagrams is not emphasized because such a procedure generally yields mediocre results. Nevertheless, the reader can readily obtain thermodynamic data from phase diagrams by reversing the detailed process of calculation of phase diagrams from thermodynamic data. Empirical rules on phase stability are given in this chapter for a brief and clear understanding of the physical and atomistic factors underlying the alloy phase formation.

Mechanics and Thermodynamics of Propulsion Pearson Education

Technical progress has for a very long time been directly dependent on progress in metallurgy, which is itself connected with improvements in the technology of alloys. Metals are most frequently used in the form of alloys for several reasons: the quantity of pure metal in its native state in the earth's crust is very limited; pure metals must be extracted from ores which are themselves impure. Finally, the methods of treatment used lead more easily to alloys than to pure metals. The most typical case is that of iron, where a pure ore may be found, but which is the starting point for cast iron or steel, alloys of iron and carbon. In addition, the

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properties of alloys are in general superior to those of pure metals and modern metallurgy consists of controlling these properties so as to make them conform to the requirements of the design office. Whilst the engineer was formerly compelled to adapt his designs and constructions to the materials available, such as wood, stone, bronze, iron, cast iron and ordinary steels, he can now expect, due to metallurgical research, the creation of special alloys meeting specific requirements. These requirements must of course be reasonable, but VIII INTRODUCTION must be sufficiently imperative for them to become the motive for progress.

Like so many of its kind, this textbook originated from the requirements of teaching. While lecturing on macromolecular science as a required subject for chemists and materials scientists on the undergraduate, graduate, and postgraduate levels at Swiss Federal Institute of Technology at Zurich (1960-1971), I needed a one-volume textbook which treated the whole field of macromolecular science, from its chemistry and physics to its applications, in a not too elementary manner. This textbook thus intends to bridge the gap between the often oversimplified introductory books and the highly specialized texts and monographs that cover only parts of macromolecular science. This first English edition is based on the third German edition (1975), which is about 40% different

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from the first German edition (1971), a result of rapid progress in macromolecular science and the less rapid education of the writer. This text intends to survey the whole field of macromolecular science. Its organization results from the following considerations. The chemical structure of macromolecular compounds should be independent of the method of synthesis, at least in the ideal case. Part I is thus concerned with the chemical and physical structure of macro molecules.

Properties depend on structure. Solution properties are thus discussed in Part II, solid state properties in Part III. There are other reasons for discussing properties before syntheses: For example, it is difficult to understand equilibrium polymerization without knowledge of solution thermody of the glass temperature, etc.

Rather than simply describing the processes and reactions involved in metal extraction, this book concentrates on fundamental principles to give readers an understanding of the possibilities for future developments in this field. It includes a review of the basics of thermodynamics, kinetics and engineering principles that have special importance for extractive metallurgy, to ensure that readers have the background necessary for maximum achievement. The various metallurgical unit processes (such as roasting, reduction, smelting and electrolysis) are illustrated by existing techniques for the extraction of the most

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common metals. Each chapter includes a bibliography of recommended reading, to aid in further study. The appendices include tables and graphs of thermodynamic qualities for most substances of metallurgical importance; these are ideal for calculating heat (enthalpy) balances and chemical equilibrium constants. SI Units are used consistently throughout the text.

Practical Chemical Thermodynamics for Geoscientists covers classical chemical thermodynamics and focuses on applications to practical problems in the geosciences, environmental sciences, and planetary sciences. This book will provide a strong theoretical foundation for students, while also proving beneficial for earth and planetary scientists seeking a review of thermodynamic principles and their application to a specific problem. Strong theoretical foundation and emphasis on applications Numerous worked examples in each chapter Brief historical summaries and biographies of key thermodynamicists-including their fundamental research and discoveries Extensive references to relevant literature "3 full-length online practice tests"--Cover.

Fundamentals of Engineering Thermodynamics, 9th Edition sets the standard for teaching students how to be effective problem solvers. Real-world applications emphasize the relevance of thermodynamics principles to some of the most critical problems and issues of today, including topics related to energy and the environment,

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biomedical/bioengineering, and emerging technologies.

Through the ages, water has been the inspiration of poets, painters, composers and philosophers. Today however, water is perceived as a commodity, with little thought for its role in influencing chemical reactions and shaping our terrestrial environment to make it fit for life. *Water 2nd Edition* is an update and extension of the RSC paperback first published in 1983. This book discusses current scientific knowledge of water: its remarkable properties, its influence on dissolved substances and its usually neglected but controlling role in the life sciences and ecology. With emphasis on developments over the last two decades, attention is drawn to important issues such as water quality, usage, economics and politics.

Describes the use of concept of the energetic unity of fundamental laws of thermodynamics. Refers only to experimentally measurable properties of materials such as internal energy, free energy, and entropy.

Hydrothermal Properties of Materials: Experimental Data on Aqueous Phase Equilibria and Solution Properties at Elevated Temperatures and Pressures is designed for any scientists and engineer who deals with hydrothermal investigations and technologies. The book is organized into eight chapters, each dealing with a key physical property of behavior of solutions, so that a reader can obtain information on: hydrothermal experimental methods; available experimental data and the main features of properties behavior in a wide range of temperatures and pressures; and possible ways of

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experimental data processing for obtaining the derivative properties.

Modern Thermodynamics: From Heat Engines to Dissipative Structures, Second Edition presents a comprehensive introduction to 20th century thermodynamics that can be applied to both equilibrium and non-equilibrium systems, unifying what was traditionally divided into 'thermodynamics' and 'kinetics' into one theory of irreversible processes. This comprehensive text, suitable for introductory as well as advanced courses on thermodynamics, has been widely used by chemists, physicists, engineers and geologists. Fully revised and expanded, this new edition includes the following updates and features: Includes a completely new chapter on Principles of Statistical Thermodynamics. Presents new material on solar and wind energy flows and energy flows of interest to engineering. Covers new material on self-organization in non-equilibrium systems and the thermodynamics of small systems. Highlights a wide range of applications relevant to students across physical sciences and engineering courses. Introduces students to computational methods using updated Mathematica codes. Includes problem sets to help the reader understand and apply the principles introduced throughout the text. Solutions to exercises and supplementary lecture material provided online at <http://sites.google.com/site/modernthermodynamics/>. Modern Thermodynamics: From Heat Engines to Dissipative Structures, Second Edition is an essential resource for undergraduate and graduate students taking a course in thermodynamics.

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30% discount for members of The Mineralogical Society of Britain and Ireland This volume addresses the fundamental factors that underlie our understanding of mineral behaviour and crystal chemistry - a timely topic given current advances in research into the complex behaviour of solids and superconducting.

Volume 14 of Reviews in Mineralogy covers a short course about the relations among the microscopic structure of minerals and their macroscopic thermodynamic properties. Understanding the micro-to-macro relations provides a rigorous theoretical foundation for formulation of energy relations. With such a foundation, measured parameters can be understood, and extrapolation and prediction of thermodynamic properties beyond the range of measurement can be done with more confidence than if only empirical relations are used. The purpose of this course is to consider the microscopic factors that influence the free energy of minerals: atomic environments, bonding, and crystal structure. These factors influence the structural energy and the detailed nature of the lattice vibrations which are an important source of entropy and enthalpy at temperatures greater than 0 K. The same factors determine the relative energy of different phases, and thereby; the relative stability of different minerals. Configurational entropy terms arising from disorder also contribute to the energy and entropy. In transition metal compounds there are additional energy and entropy terms arising from the electronic configurations, leading to additional stabilizations, magnetic ordering, and, incidentally, color. Organized by Sue Kieffer and Alex Navrotsky, the course was

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presented by the ten authors of this book on the campus of Washington College in Chestertown, Maryland. This was the second of MSA's short courses to be given in conjunction with meetings of the American Geophysical Union.

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