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Thermodynamics in Materials Science, Second Edition is a clear presentation of how thermodynamic data is used to predict the behavior of a wide range of materials, a crucial component in the decision-making process for many materials science and engineering applications. This primary textbook accentuates the integration of principles, strategies, and thermochemical data to generate accurate "maps" of equilibrium states, such as phase diagrams, predominance diagrams, and Pourbaix corrosion diagrams. It also recommends which maps are best suited for specific real-world scenarios and thermodynamic problems. The second edition yet. Each chapter presents its subject matter consistently, based on the classification of thermodynamic systems, properties, and derivations that illustrate important relationships among variables for finding the conditions for equilibrium. Each chapter also contains a summary of important concepts and relationships as well as examples and sample problems that apply appropriate strategies for solving real-world problems. The up-to-date and complete coverage of thermodynamic data, laws, definitions, strategies, and tools in Thermodynamics in Materials Science, Second Edition provides students and practicing engineers a

valuable guide for producing and applying maps of equilibrium states to everyday applications in materials sciences. The role of thermodynamics in modern physics is not just to provide an approximate treatment of large thermal systems, but, more importantly, to provide an organising set of ideas. Thermodynamics: A complete undergraduate course presents thermodynamics as a self-contained and elegant set of ideas and methods. It unfolds thermodynamics for undergraduate students of physics, chemistry or engineering, beginning at first year level. The book introduces the necessary mathematical methods, assuming almost no prior knowledge, and explains concepts such as entropy and free energy at length, with many examples. This book aims to convey the style and power of thermodynamic reasoning, along with applications such as Joule-Kelvin expansion, the gas turbine, magnetic cooling, solids at high pressure, chemical equilibrium, radiative heat exchange and global warming, to name a few. It mentions but does not pursue statistical mechanics, in order to keep the logic clear. This textbook and reference outlines the fundamental principles of thermodynamics, emphasizing applications in geochemistry. The work is distinguished by its comprehensive, balanced coverage and its rigorous presentation. The authors bring years of teaching experience to the work, and have attempted to particularly address those areas where other texts on the subject have provided inadequate coverage. A thorough review of the necessary mathematics is presented early on, both as a refresher for those with a background in university calculus, and for the benefit of those coming to the subject for the first time. The text is written for students in advanced undergraduate or graduate-level geochemistry as well as for all researchers in this field. Thermodynamics for Chemical Engineers Learn the basics of thermodynamics in this complete and practice-oriented introduction for students of chemical engineering Thermodynamics is a vital branch of physics that focuses upon the interaction of heat, work, and temperature with energy, radiation, and matter. Thermodynamics can apply to a wide range of sciences, but is particularly important in chemical engineering, where the interconnection of heat and work with chemical reactions or physical changes of state are studied according to the laws of thermodynamics. Moreover, thermodynamics in chemical engineering focuses upon pure fluid and mixture properties, phase equilibrium, and chemical reactions within the confines of the laws of thermodynamics. Given that thermodynamics is an essential course of study in chemical and petroleum engineering, Thermodynamics for Chemical Engineers provides an important introduction to the subject that comprehensively covers the topic in an easily-digestible manner. Suitable for undergraduate and graduate students, the text introduces the basic concepts of thermodynamics thoroughly and concisely while providing practice-oriented examples

and illustrations. Thus, the book helps students bridge the gap between theoretical knowledge and basic experiments and measurement characteristics. Thermodynamics for Chemical Engineers readers will also find: Practice-oriented examples to help students connect the learned concepts to actual laboratory instruments and experiments A broad suite of illustrations throughout the text to help illuminate the information presented Authors with decades working in chemical engineering and teaching thermodynamics Thermodynamics for Chemical Engineers is the ideal resource not just for undergraduate and graduate students in chemical and petroleum engineering, but also for anyone looking for a basic guide to thermodynamics. This book presents the fundamental principles of thermodynamics for geosciences, based on the author's own courses over a number of years. Many examples help to understand how mineralogical problems can be solved by applying thermodynamic principles. At the heart of many fields - physics, chemistry, engineering - lays thermodynamics. While this science plays a critical role in determining the boundary between what is and is not possible in the natural world, it occurs to many as an indecipherable black box, thus making the subject a challenge to learn. Two obstacles contribute to this situation, the first being the disconnect between the fundamental theories and the underlying physics and the second being the confusing concepts and terminologies involved with the theories. While one needn't confront either of these two obstacles to successfully use thermodynamics to solve real problems, overcoming both provides access to a greater intuitive sense of the problems and more confidence, more strength, and more creativity in solving them. This book offers an original perspective on thermodynamic science and history based on the three approaches of a practicing engineer, academician, and historian. The book synthesises and gathers into one accessible volume a strategic range of foundational topics involving the atomic theory, energy, entropy, and the laws of thermodynamics. Written in an informal, first-person writing style that makes abstract concepts easier to understand, PRINCIPLES OF ENGINEERING THERMODYNAMICS transforms the way students learn thermodynamics. While continuing to provide strong coverage of fundamental principles and applications, the book asks students to explore how changes in a particular parameter can change a device's or process' performance. This approach helps them develop a better understanding of how to apply thermodynamics in their future careers and a stronger intuitive feel for how the different components of thermodynamics are interrelated. Throughout the book, students are encouraged to develop computer-based models of devices, processes, and cycles and to take advantage of the speed of Internet-based programs and computer apps to find thermodynamic data, just as practicing engineers do. Important

Notice: Media content referenced within the product description or the product text may not be available in the ebook version. This book covers the fundamentals of the rapidly growing field of biothermodynamics, showing how thermodynamics can best be applied to applications and processes in biochemical engineering. It describes the rigorous application of thermodynamics in biochemical engineering to rationalize bioprocess development and obviate a substantial fraction of this need for tedious experimental work. As such, this book will appeal to a diverse group of readers, ranging from students and professors in biochemical engineering, to scientists and engineers, for whom it will be a valuable reference. An account of the concepts and intellectual structure of classical thermodynamics that reveals the subject's simplicity and coherence. Students of physics, chemistry, and engineering are taught classical thermodynamics through its methods—a “problems first” approach that neglects the subject's concepts and intellectual structure. In *Thermodynamic Weirdness*, Don Lemons fills this gap, offering a nonmathematical account of the ideas of classical thermodynamics in all its non-Newtonian “weirdness.” By emphasizing the ideas and their relationship to one another, Lemons reveals the simplicity and coherence of classical thermodynamics. Lemons presents concepts in an order that is both chronological and logical, mapping the rise and fall of ideas in such a way that the ideas that were abandoned illuminate the ideas that took their place. Selections from primary sources, including writings by Daniel Fahrenheit, Antoine Lavoisier, James Joule, and others, appear at the end of most chapters. Lemons covers the invention of temperature; heat as a form of motion or as a material fluid; Carnot's analysis of heat engines; William Thomson (later Lord Kelvin) and his two definitions of absolute temperature; and energy as the mechanical equivalent of heat. He explains early versions of the first and second laws of thermodynamics; entropy and the law of entropy non-decrease; the differing views of Lord Kelvin and Rudolf Clausius on the fate of the universe; the zeroth and third laws of thermodynamics; and Einstein's assessment of classical thermodynamics as “the only physical theory of universal content which I am convinced will never be overthrown.” This 1985 textbook presents the theory of thermodynamics in a highly interesting way. The presentation of the theory of heat is logical, compact and uncluttered, with an emphasis on the underlying physical model. Unlike other texts published at this time, in this approach the student adopts at the outset the master equation which describes the rate of scattering from one quantum state into another. This makes the link between thermodynamics and kinetics more obvious. Temperature and entropy are initially introduced as statistical concepts. Unlike most other treatments, this book has early sections on the Boltzmann distribution and classical thermodynamics, which may be used as a basis for first-year courses. The book also contains extensive graded exercises. Students, academics and researchers will find this book an invaluable contribution to the understanding of thermodynamics. In this new treatment of the subject, the authors focus on the principles of thermodynamic variables and the practical simulation of

thermodynamic systems, and endeavor to show how simple thermodynamics really is. It offers a unique view of modern complex systems engineering and its ramifications. A brand-new conceptual look at dynamical thermodynamics This book merges the two universalisms of thermodynamics and dynamical systems theory in a single compendium, with the latter providing an ideal language for the former, to develop a new and unique framework for dynamical thermodynamics. In particular, the book uses system-theoretic ideas to bring coherence, clarity, and precision to an important and poorly understood classical area of science. The dynamical systems formalism captures all of the key aspects of thermodynamics, including its fundamental laws, while providing a mathematically rigorous formulation for thermodynamical systems out of equilibrium by unifying the theory of mechanics with that of classical thermodynamics. This book includes topics on nonequilibrium irreversible thermodynamics, Boltzmann thermodynamics, mass-action kinetics and chemical reactions, finite-time thermodynamics, thermodynamic critical phenomena with continuous and discontinuous phase transitions, information theory, continuum and stochastic thermodynamics, and relativistic thermodynamics. A *Dynamical Systems Theory of Thermodynamics* develops a postmodern theory of thermodynamics as part of mathematical dynamical systems theory. The book establishes a clear nexus between thermodynamic irreversibility, the second law of thermodynamics, and the arrow of time to further unify discreteness and continuity, indeterminism and determinism, and quantum mechanics and general relativity in the pursuit of understanding the most fundamental property of the universe—the entropic arrow of time. This book offers an easy to read, all-embracing history of thermodynamics. It describes the long development of thermodynamics, from the misunderstood and misinterpreted to the conceptually simple and extremely useful theory that we know today. Coverage identifies not only the famous physicists who developed the field, but also engineers and scientists from other disciplines who helped in the development and spread of thermodynamics as well. This book covers the fundamentals of thermodynamics required to understand electrical power generation systems, honing in on the application of these principles to nuclear reactor power systems. It includes all the necessary information regarding the fundamental laws to gain a complete understanding and apply them specifically to the challenges of operating nuclear plants. Beginning with definitions of thermodynamic variables such as temperature, pressure and specific volume, the book then explains the laws in detail, focusing on pivotal concepts such as enthalpy and entropy, irreversibility, availability, and Maxwell relations. Specific applications of the fundamentals to Brayton and Rankine cycles for power generation are considered in-depth, in support of the book's core goal- providing an examination of how the thermodynamic principles are applied to the design, operation and safety analysis of current and projected reactor systems. Detailed appendices cover metric and English system units and conversions, detailed steam and gas tables, heat transfer properties, and nuclear reactor system

descriptions. Using an applications perspective *Thermodynamic Models for Industrial Applications* provides a unified framework for the development of various thermodynamic models, ranging from the classical models to some of the most advanced ones. Among these are the Cubic Plus Association Equation of State (CPA EoS) and the Perturbed Chain Statistical Association Fluid Theory (PC-SAFT). These two advanced models are already in widespread use in industry and academia, especially within the oil and gas, chemical and polymer industries. Presenting both classical models such as the Cubic Equations of State and more advanced models such as the CPA, this book provides the critical starting point for choosing the most appropriate calculation method for accurate process simulations. Written by two of the developers of these models, *Thermodynamic Models for Industrial Applications* emphasizes model selection and model development and includes a useful “which model for which application” guide. It also covers industrial requirements as well as discusses the challenges of thermodynamics in the 21st Century. The title is a perfect description. Arranged alphabetically this book explains the words and phrases that crop up in thermodynamics. The author does this without resorting to pages of mathematics and algebra: the author's main aim is to explain and clarify the jargon and concepts. Thermodynamics is often difficult and confusing for students. The author knows this after 20 years of teaching and does something about it with this dictionary. Quantum Thermodynamics is a novel research field which explores the emergence of thermodynamics from quantum theory and addresses thermodynamic phenomena which appear in finite-size, non-equilibrium and finite-time contexts. Blending together elements from open quantum systems, statistical mechanics, quantum many-body physics, and quantum information theory, it pinpoints thermodynamic advantages and barriers emerging from genuinely quantum properties such as quantum coherence and correlations. Owing to recent experimental efforts, the field is moving quickly towards practical applications, such as nano-scale heat devices, or thermodynamically optimised protocols for emergent quantum technologies. Starting from the basics, the present volume reviews some of the most recent developments, as well as some of the most important open problems in quantum thermodynamics. The self-contained chapters provide concise and topical introductions to researchers who are new to the field. Experts will find them useful as a reference for the current state-of-the-art. In six sections the book covers topics such as quantum heat engines and refrigerators, fluctuation theorems, the emergence of thermodynamic equilibrium, thermodynamics of strongly coupled systems, as well as various information theoretic approaches including Landauer's principle and thermal operations. It concludes with a section dedicated to recent quantum thermodynamics experiments and experimental prospects on a variety of platforms ranging from cold atoms to photonic systems, and NV centres. A More Accessible Approach to Thermodynamics In this third edition, you'll find a modern approach to applied thermodynamics. The material is presented in sufficient detail to provide a solid understanding of the principles of thermodynamics and

its classical applications. Also included are the applications of chemical engineering thermodynamics to issues such as the distribution of chemicals in the environment, safety, polymers, and solid-state-processing. To make thermodynamics more accessible, several helpful features are included. Important concepts are emphasized in marginal notes throughout each chapter. Illustrations have also been added to demonstrate the use of these concepts and to provide a better understanding of the material. Boxes are used to highlight equations so that students can easily identify the end results of analyses. You can also visit the text's web site to download additional problem sets, computer programs to solve thermodynamic and phase behavior problems, and Mathcad(r) worksheets used for problem solving. This book is a beginners introduction to chemical thermodynamics for engineers. In the textbook efforts have been made to visualize as clearly as possible the main concepts of thermodynamic quantities such as enthalpy and entropy, thus making them more perceivable. Furthermore, intricate formulae in thermodynamics have been discussed as functionally unified sets of formulae to understand their meaning rather than to mathematically derive them in detail. In this textbook, the affinity of irreversible processes, defined by the second law of thermodynamics, has been treated as the main subject, rather than the equilibrium of chemical reactions. The concept of affinity is applicable in general not only to the processes of chemical reactions but also to all kinds of irreversible processes. This textbook also includes electrochemical thermodynamics in which, instead of the classical phenomenological approach, molecular science provides an advanced understanding of the reactions of charged particles such as ions and electrons at the electrodes. Recently, engineering thermodynamics has introduced a new thermodynamic potential called exergy, which essentially is related to the concept of the affinity of irreversible processes. This textbook discusses the relation between exergy and affinity and explains the exergy balance diagram and exergy vector diagram applicable to exergy analyses in chemical manufacturing processes. This textbook is written in the hope that the readers understand in a broad way the fundamental concepts of energy and exergy from chemical thermodynamics in practical applications. Finishing this book, the readers may easily step forward further into an advanced text of their specified line. - Visualizes the main concepts of thermodynamics to show the meaning of the quantities and formulae. - Focuses mainly on the affinity of irreversible processes and the related concept of exergy. - Provides an advanced understanding of electrochemical thermodynamics. This textbook covers chemical thermodynamics in materials science from basic to advanced level, especially for iron and steel making processes. To improve a process by applying knowledge of thermodynamics or to assess the calculation results of thermodynamic software, an accurate and systematic understanding of thermodynamics is required. For that purpose, books from which one can learn thermodynamics from the basic to the advanced level are needed, but such books are rarely published. This book bridges the gap between the basics, which are treated in general thermodynamic books, and their application, which

are only partially dealt with in most specialized books on a specific field. This textbook can be used to teach the basics of chemical thermodynamics and its applications to beginners. The basic part of the book is written to help learners acquire robust applied skills in an easy-to-understand manner, with in-depth explanations and schematic diagrams included. The same book can be used by advanced learners as well. Those higher-level readers such as post-graduate students and researchers may refer to the basic part of the book to get down to the basic concepts of chemical thermodynamics or to confirm the basic concepts. Abundant pages are also devoted to applications designed to present more advanced applied skills grounded in a deep understanding of the basics. The book contains some 50 examples and their solutions so that readers can learn through self-study. Based on courses for students of science, engineering, and systems science at the Zurich University of Applied Sciences at Winterthur, this text approaches the fundamentals of thermodynamics from the point of view of continuum physics. By describing physical processes in terms of the flow and balance of physical quantities, the author achieves a unified approach to hydraulics, electricity, mechanics and thermodynamics. In this way, it becomes clear that entropy is the fundamental property that is transported in thermal processes (i.e., heat), and that temperature is the corresponding potential. The resulting theory of the creation, flow, and balance of entropy provides the foundation of a dynamical theory of heat. This extensively revised and updated second edition includes new material on dynamical chemical processes, thermoelectricity, and explicit dynamical modeling of thermal and chemical processes. To make the book more useful for courses on thermodynamics and physical chemistry at different levels, coverage of topics is divided into introductory and more advanced and formal treatments. Previous knowledge of thermodynamics is not required, but the reader should be familiar with basic electricity, mechanics, and chemistry and should have some knowledge of elementary calculus. The special feature of the first edition -- the integration of thermodynamics, heat transfer, and chemical processes -- has been maintained and strengthened. Key Features: · First revised edition of a successful text/reference in fourteen years · More than 25 percent new material · Provides a unified approach to thermodynamics and heat transport in fundamental physical and chemical processes · Includes worked examples, questions, and problem sets for use as a teaching text or to test the reader's understanding · Includes many system dynamics models of laboratory experiments Designed for pharmacy students Now updated for its Second Edition, Thermodynamics of Pharmaceutical Systems provides pharmacy students with a much-needed introduction to the mathematical intricacies of thermodynamics in relation to practical laboratory applications. Designed to meet the needs of the contemporary curriculum in pharmacy schools, the text makes these connections clear, emphasizing specific applications to pharmaceutical systems including dosage forms and newer drug delivery systems. Students and practitioners involved in drug discovery, drug delivery, and drug

action will benefit from Connors' and Mecozzi's authoritative treatment of the fundamentals of thermodynamics as well as their attention to drug molecules and experimental considerations. They will appreciate, as well, the significant revisions to the Second Edition. Expanding the book's scope and usefulness, the new edition: Explores in greater depth topics most relevant to the pharmacist such as drug discovery and drug delivery, supramolecular chemistry, molecular recognition, and nanotechnologies Moves the popular review of mathematics, formerly an appendix, to the front of the book Adds new textual material and figures in several places, most notably in the chapter treating noncovalent chemical interactions Two new appendices provide ancillary material that expands on certain matters bordering the subject of classical thermodynamics Thermodynamics need not be a mystery nor confined to the realm of mathematical theory. Thermodynamics of Pharmaceutical Systems, Second Edition demystifies for students the profound thermodynamic applications in the laboratory while also serving as a handy resource for practicing researchers. Based on a university course, this book provides an exposition of a large spectrum of geological, geochemical and geophysical problems that are amenable to thermodynamic analysis. It also includes selected problems in planetary sciences, relationships between thermodynamics and microscopic properties, particle size effects, methods of approximation of thermodynamic properties of minerals, and some kinetic ramifications of entropy production. The textbook will enable graduate students and researchers alike to develop an appreciation of the fundamental principles of thermodynamics, and their wide ranging applications to natural processes and systems. The laws of thermodynamics the science that deals with energy and its transformation have wide applicability in several branches of engineering and science. The revised edition of this introductory text for undergraduate engineering courses covers the physical concepts of thermodynamics and demonstrates the underlying principles through practical situations. The traditional classical (macroscopic) approach is used in this text. Numerous solved examples and more than 550 unsolved problems (included as chapter-end exercises) will help the reader gain confidence for applying the principles of thermodynamics in real-life problems. Sufficient data needed for solving problems have been included in the appendices. Definitions; Pressure and temperature; Work and heat; The first law of thermodynamics; Applications of the first law to physical changes; Thermochemistry; Partial molar properties; The second law of thermodynamics; Applications of the second law; Work content and free energy; The third law of thermodynamics; Criteria of equilibrium and stability; Open systems. "Blurb & Contents" "A superb reference." Physics Today "Will become a classic text in climate research. " Physics World "Valuable to anyone who studies, models, or uses the climate of the earth." Walter Robinson, Bulletin of the American Meteorological Society "Informative and authoritative on a remarkably wide range of topics." Nature Are we entering a period of global warming? Is weather predictable? Physics of Climate offers you an in-depth description of atmospheric circulation and how environmental

phenomena worldwide interact in a single, unified system. This integrated approach unites all the key features of the climate system--oceans, atmosphere, and cryosphere--to explain the structure and behavior of climate over time. Ideal for students and professionals in meteorology, oceanography, geophysics, and physics. Contents: Nature of the Problem. Basic Equations for the Atmosphere and Oceans. Various Decompositions of the Circulation. The Data. Radiation Balance. Observed Mean State of the Atmosphere. Observed Mean State of the Oceans. Observed Mean State of the Cryosphere. Exchange Processes between the Earth's Surface and the Atmosphere. Angular Momentum Cycle. Water Cycle. Energetics. The Ocean-Atmosphere Heat Engine. Entropy in the Climate System. Interannual and Interdecadal Variability in the Climate System. Mathematical Simulation of Climate. Acknowledgments. Appendices. References. An introductory textbook presenting the key concepts and applications of thermodynamics, including numerous worked examples and exercises. This book describes several approaches to biological phenomena based on thermodynamics and illustrates the descriptive and predictive power of the laws that govern molecular recognition in biological systems. The current structural emphasis in the study of biological macromolecules provides the motivation for a deeper understanding of the driving forces that determine biological interactions. Because molecular explanations of biological phenomena as inferred from structural information must be informed by and consistent with the laws and principles of thermodynamics, a thorough understanding of biological function requires approaches well balanced between structure and energetics. Topics covered in this book are protein and nucleic acid folding and stability, enzyme-substrate interactions, prediction of the affinity of complexes, electrostatics, and non-equilibrium aspects of protein function. The breadth of the topics covered illustrates the growing importance of thermodynamic approaches in the study of biological phenomena. As more information continues to emerge from structural studies, and faster and more accurate computational methods are developed, we will look at biological thermodynamics with renewed interest as a fundamental tool to decipher the rules for specificity and function in proteins and nucleic acids. Aimed at providing undergraduate and postgraduate students with an understanding of this subject, the book brings out the thermodynamic interrelationships by explaining its essential elements. It begins with the fundamentals and progresses to advanced concepts to enable students to appreciate the application of thermodynamics in different areas of chemistry. Chemical Thermodynamics is written in a simple and lucid language, the discussion and explanations being interspersed with appropriate worked-out examples. Every chapter is accompanied by adequate end-of-chapter exercises. Take some heat off the complexity of thermodynamics Does the mere thought of thermodynamics make you sweat? It doesn't have to! This hands-on guide helps you score your highest in a thermodynamics course by offering easily understood, plain-English explanations of how energy is used in things like automobiles, airplanes, air conditioners, and electric power plants.

Thermodynamics 101 — take a look at some examples of both natural and man-made thermodynamic systems and get a handle on how energy can be used to perform work Turn up the heat — discover how to use the first and second laws of thermodynamics to determine (and improve upon) the efficiency of machines Oh, behave — get the 411 on how gases behave and relate to one another in different situations, from ideal-gas laws to real gases Burn with desire — find out everything you need to know about conserving mass and energy in combustion processes Open the book and find: The laws of thermodynamics Important properties and their relationships The lowdown on solids, liquids, and gases How work and heat go hand in hand The cycles that power thermodynamic processes Chemical mixtures and reactions Ten pioneers in thermodynamics Real-world applications of thermodynamic laws and concepts Learn to: Master the concepts and principles of thermodynamics Develop the problem-solving skills used by professional engineers Ace your thermodynamics course Given that thermodynamics books are not a rarity on the market, why would an additional one be useful? The answer is simple: at any level, thermodynamics is usually taught as a somewhat abstruse discipline where many students get lost in a maze of difficult concepts. However, thermodynamics is not as intricate a subject as most people feel. This book fills a niche between elementary textbooks and mathematically oriented treatises, and provides readers with a distinct approach to the subject. As indicated by the title, this book explains thermodynamic phenomena and concepts in physical terms before proceeding to focus on the requisite mathematical aspects. It focuses on the effects of pressure, temperature and chemical composition on thermodynamic properties and places emphasis on rapidly evolving fields such as amorphous materials, metastable phases, numerical simulations of microsystems and high-pressure thermodynamics. Topics like redox reactions are dealt with in less depth, due to the fact that there is already much literature available. Without requiring a background in quantum mechanics, this book also illustrates the main practical applications of statistical thermodynamics and gives a microscopic interpretation of temperature, pressure and entropy. This book is perfect for undergraduate and graduate students who already have a basic knowledge of thermodynamics and who wish to truly understand the subject and put it in a broader physical perspective. The book is aimed not at theoretical physicists, but rather at practitioners with a variety of backgrounds from physics to biochemistry for whom thermodynamics is a tool which would be better used if better understood. In this book the author systemizes mathematical tools of thermodynamics, and concurrently emphasizes questions that are often a source of error in thermodynamic calculations. He deals with thermodynamic characteristic functions, the differential equations for a one-phase region and more. Aspiring engineers have long needed a text that prepares them to use thermodynamics in professional practice. Thermodynamics instructors need a concise textbook written for a one-semester undergraduate course—a text that foregoes clutter and unnecessary details but furnishes the essential facts and methods. Thermodynamics for

Engineers fills both those needs. Paying special attention to the learning process, the author has developed a unique, practical guide to classical thermodynamics. His approach is remarkably cohesive. For example, he develops the same example through his presentation of the first law and both forms of the second law- entropy and exergy. He also unifies his treatments of the conservation of energy, the creation of entropy, and the destruction of availability by using a balance equation for each, thus emphasizing the commonality between the laws and allowing easier comprehension and use. Accessible, practical, and cohesive, Thermodynamics for Engineers builds a solid foundation for advanced engineering studies and practice. It exposes students to the "big picture" of thermodynamics, and its streamlined presentation allows glimpses into important concepts and methods rarely offered by texts at this level. Thermodynamics is an ever evolving subject. This book aims to introduce to advanced undergraduate students and graduate students the fundamental ideas and notions of the first and second laws of thermodynamics in a manner unavailable in the usual textbooks on the subject of thermodynamics. For example, it treats the notions of unavailable work, compensated and uncompensated heats, and dissipation, which make it possible to formulate the thermodynamic laws in more broadened forms than those in the conventional treatment of equilibrium thermodynamics. It thus strives to prepare students for more advanced subjects of irreversible processes, which are encountered in our everyday scientific activities. In addition, it also aims to provide them with functional and practical knowledge of equilibrium chemical thermodynamics of reversible processes in real fluids. It discusses temperature, work and heat, thermodynamic laws, equilibrium conditions and thermodynamic stability, thermodynamics of reversible processes in gases and liquids, in surfaces, chemical equilibria, reversible processes in electrolyte solutions and dielectrics in static electric and magnetic fields. A couple of examples for irreversible processes associated with fluid flows and chemical pattern formation and wave propagations are discussed as examples for applications of broader treatments of the thermodynamic laws in the realm of irreversible phenomena. Now in its seventh edition, Fundamentals of Thermodynamics continues to offer a comprehensive and rigorous treatment of classical thermodynamics, while retaining an engineering perspective. With concise, applications-oriented discussion of topics and self-test problems the text encourages students to monitor their own comprehension. The seventh edition is updated with additional examples, homework problems, and illustrations to increase student understanding. The text lays the groundwork for subsequent studies in fields such as fluid mechanics, heat transfer and statistical thermodynamics, and prepares students to effectively apply thermodynamics in the practice of engineering. Thermodynamics is not the oldest of sciences. Mechanics can make that claim. Thermodynamics is a product of some of the greatest scientists of the 19th and 20th centuries. But it is sufficiently established that most authors of new textbooks in thermodynamics find it necessary to justify their writing of yet another textbook. Is this an unnecessary

exercise because of the centrality of thermodynamics as a science in physics, chemistry, biology, and medicine. I do acknowledge, however, that instruction in thermodynamics often leaves the student in a confused state. My attempt in this book is to present thermodynamics in as simple and as unified a form as possible. As teachers we identify the failures of our own teachers and attempt to correct them. Although I personally acknowledge with a deep gratitude the appreciation for thermodynamics that I found as an undergraduate, I also realize that my teachers did not convey to me the sweeping grandeur of thermodynamics. Specifically the simplicity and the power that James Clerk Maxwell found in the methods of Gibbs were not part of my undergraduate experience. Unfortunately some modern authors also seem to miss this central theme, choosing instead to introduce the thermodynamic potentials as only useful functions at various points in the development.

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