

Emission Absorption And Transfer Of Radiation In Heated Atmospheres

Thermal Radiation Heat Transfer: Radiation transfer with absorbing, emitting, and scattering media Robert Siegel 1971

Compr. Engineering Heat Transfer Mahesh M. Rathore 2000

Global Atmospheric Chemical Change C.N. Hewitt 2013-11-11 Air pollution has historically been viewed as a local or regional scale problem with attention focused on acute episodes such as the sulphur dioxide and smoke smogs of London in the 1950s and 1960s and the photochemical smogs of southern California first recognized by Haagen Smit in the early 1950s. In recent years, however, it has become apparent that human activity has, and still is, changing the chemical composition of the atmosphere on a global scale. The composition of the atmosphere has seen enormous changes due to natural processes since the formation of the planet. Data obtained from air bubbles trapped in polar ice are beginning to reveal information about these changes over the last tens of thousands of years and geochemical models of the evolution of the Earth give us insights into the changes over much longer periods of time. Perhaps the crucial differences between these natural changes and those now being induced by man are their relative rates of change. The magnitude of present day fluxes of some compounds released as air pollutants is in some cases much larger than those arising naturally. In other cases, for example carbon dioxide, the anthropogenic emission rates are small compared with that of the natural cycle, but the kinetics of the system are such that the steady state concentrations of the compounds in the atmosphere are now being perturbed.

Air Force Research Resumés

Radiative Heat Transfer During Atmosphere Entry at Parabolic Velocity

Kenneth K. Yoshikawa 1961 Stagnation point radiative heating rates for manned vehicles entering the earth's atmosphere at parabolic velocity are presented and compared with corresponding laminar convective

heating rates. The calculations were made for both nonlifting and lifting entry trajectories for vehicles of varying nose radius, weight-to-area ratio, and drag. It is concluded from the results presented that radiative heating will be important for the entry conditions considered.

Radiative Transfer in the Atmosphere and Ocean Knut Stamnes 2017-07-13 This new and completely updated edition gives a detailed description of radiative transfer processes at a level accessible to advanced students. The volume gives the reader a basic understanding of global warming and enhanced levels of harmful ultraviolet radiation caused by ozone depletion. It teaches the basic physics of absorption, scattering and emission processes in turbid media, such as the atmosphere and ocean, using simple semi-classical models. The radiative transfer equation, including multiple scattering, is formulated and solved for several prototype problems, using both simple approximate and accurate numerical methods. In addition, the reader has access to a powerful, state-of-the-art computational code for simulating radiative transfer processes in coupled atmosphere-water systems including snow and ice. This computational code can be regarded as a powerful educational aid, but also as a research tool that can be applied to solve a variety of research problems in environmental sciences.

Thermal Radiation Heat Transfer Robert Siegel 2002-01-01

Radiative Heat Exchange in the Atmosphere Kirill I. Kovlevich Kondrat'ev 1965

Thermal Radiation Heat Transfer John R. Howell 2015-09-18 Explore the Radiative Exchange between Surfaces Further expanding on the changes made to the fifth edition, *Thermal Radiation Heat Transfer*, 6th Edition continues to highlight the relevance of thermal radiative transfer and focus on concepts that develop the radiative transfer equation (RTE). The book explains the fundamentals of radiative transfer, introduces the energy and radiative transfer equations, covers a variety of approaches

used to gauge radiative heat exchange between different surfaces and structures, and provides solution techniques for solving the RTE. What's New in the Sixth Edition This revised version updates information on properties of surfaces and of absorbing/emitting/scattering materials, radiative transfer among surfaces, and radiative transfer in participating media. It also enhances the chapter on near-field effects, addresses new applications that include enhanced solar cell performance and self-regulating surfaces for thermal control, and updates references.

Comprised of 17 chapters, this text: Discusses the fundamental RTE and its simplified forms for different medium properties Presents an intuitive relationship between the RTE formulations and the configuration factor analyses Explores the historical development and the radiative behavior of a blackbody Defines the radiative properties of solid opaque surfaces Provides a detailed analysis and solution procedure for radiation exchange analysis Contains methods for determining the radiative flux divergence (the radiative source term in the energy equation) Thermal Radiation Heat Transfer, 6th Edition explores methods for solving the RTE to determine the local spectral intensity, radiative flux, and flux gradient. This book enables you to assess and calculate the exchange of energy between objects that determine radiative transfer at different energy levels.

Non-LTE Radiative Transfer in the Atmosphere Manuel López-Puertas 2001 During the last three decades, it has become increasingly clear that atmospheric modelling and remote sounding of the atmosphere from space, to name just two important application areas, are affected by non-equilibrium processes which have not been incorporated into traditional radiative transfer calculations. These processes, dubbed "non-LTE", are therefore the subject of growing interest among scholars and researchers dealing with the upper atmosphere. This important book provides the first comprehensive and "global" description of non-LTE infrared emissions in the atmosphere of the Earth and other planets, starting with the theoretical foundations and progressing to the most important applications. Besides giving an introduction to this complex subject, it is a guide to the state-of-the-art in incorporating non-LTE

processes into radiative transfer algorithms and computer models of the atmosphere. Numerous examples are presented of the application of these methods to (a) atmospheric remote sensing, (b) atmospheric energy budget (cooling and heating rate) calculations, and (c) atmospheres other than the Earth's.

Radiation Heat Transfer, Augmented Edition E. M. Sparrow 2018-04-27 Revised to include more information on analytical models for wavelength independence, Radiation Heat Transfer, Augmented Edition has been rearranged, providing problems within each chapter rather than at the end of the book. Written by Ephraim M. Sparrow, a generalist who works on a very broad range of problems that encompasses almost all mechanical engineering topics, the book presents key ideas without being exhaustive. Sparrow oversees the Laboratory for Heat Transfer and Fluid Flow Practice, whose function is to undertake both industrially based and fundamental problems that fall within the bounds of heat transfer and fluid flow.

Planetary Atmospheres 1965

Emission, Absorption, and Transfer of Radiation in Heated Atmospheres Baxter H. Armstrong 1972

Climate Process and Change Edward Bryant 1997-10-28 Encompasses the true complexity of climate change, presenting in simple terms, the processes that drive the Earth's present climate system. The author outlines the nature and reasons for temperature fluctuations over millennia, including recent human-induced climate change.

Atmospheric Evolution on Inhabited and Lifeless Worlds David C. Catling 2017-04-13 As the search for Earth-like exoplanets gathers pace, in order to understand them, we need comprehensive theories for how planetary atmospheres form and evolve. Written by two well-known planetary scientists, this text explains the physical and chemical principles of atmospheric evolution and planetary atmospheres, in the context of how atmospheric composition and climate determine a planet's habitability. The authors survey our current understanding of the atmospheric evolution and climate on Earth, on other rocky planets within our Solar System, and on planets far beyond. Incorporating a rigorous

mathematical treatment, they cover the concepts and equations governing a range of topics, including atmospheric chemistry, thermodynamics, radiative transfer, and atmospheric dynamics, and provide an integrated view of planetary atmospheres and their evolution. This interdisciplinary text is an invaluable one-stop resource for graduate-level students and researchers working across the fields of atmospheric science, geochemistry, planetary science, astrobiology, and astronomy.

Physics of the Atmosphere and Climate Murry L. Salby 2012-01-16
Murry Salby's textbook provides an integrated treatment of processes controlling the Earth-atmosphere system for students and researchers.

Chemistry of the Upper and Lower Atmosphere Barbara J. Finlayson-Pitts 1999-11-17 Here is the most comprehensive and up-to-date treatment of one of the hottest areas of chemical research. The treatment of fundamental kinetics and photochemistry will be highly useful to chemistry students and their instructors at the graduate level, as well as postdoctoral fellows entering this new, exciting, and well-funded field with a Ph.D. in a related discipline (e.g., analytical, organic, or physical chemistry, chemical physics, etc.). Chemistry of the Upper and Lower Atmosphere provides postgraduate researchers and teachers with a uniquely detailed, comprehensive, and authoritative resource. The text bridges the "gap" between the fundamental chemistry of the earth's atmosphere and "real world" examples of its application to the development of sound scientific risk assessments and associated risk management control strategies for both tropospheric and stratospheric pollutants. Serves as a graduate textbook and "must have" reference for all atmospheric scientists Provides more than 5000 references to the literature through the end of 1998 Presents tables of new actinic flux data for the troposphere and stratosphere (0-40km) Summarizes kinetic and photochemical data for the troposphere and stratosphere Features problems at the end of most chapters to enhance the book's use in teaching Includes applications of the OZIPR box model with comprehensive chemistry for student use

Guide to Annual Subject Index for Technical Publications

Announcements, Apr.-Dec. 1962 United States. National Aeronautics and Space Administration 1962

Radiative Heat Transfer Michael F. Modest 2013-02-20 The third edition of Radiative Heat Transfer describes the basic physics of radiation heat transfer. The book provides models, methodologies, and calculations essential in solving research problems in a variety of industries, including solar and nuclear energy, nanotechnology, biomedical, and environmental. Every chapter of Radiative Heat Transfer offers uncluttered nomenclature, numerous worked examples, and a large number of problems—many based on real world situations—making it ideal for classroom use as well as for self-study. The book's 24 chapters cover the four major areas in the field: surface properties; surface transport; properties of participating media; and transfer through participating media. Within each chapter, all analytical methods are developed in substantial detail, and a number of examples show how the developed relations may be applied to practical problems. Extensive solution manual for adopting instructors Most complete text in the field of radiative heat transfer Many worked examples and end-of-chapter problems Large number of computer codes (in Fortran and C++), ranging from basic problem solving aids to sophisticated research tools Covers experimental methods

Clinical Handbook of Air Pollution-Related Diseases Fabio Capello 2018-02-21 This book examines in detail the clinical implications of those diseases that either are primarily triggered by air pollution or represent direct consequences of air pollutants. The aim is to provide medical practitioners with practical solutions to issues in diagnosis and treatment while simultaneously furnishing other interested parties with crucial information on the field. The book introduces the concept that air pollution-related diseases constitute a new class of pathologies. A wide range of conditions mainly attributable to air pollution are discussed, covering different body systems and pollution impacts in subsets of the population. In addition to presenting state of the art overviews of clinical aspects, the book carefully examines the implications of current knowledge for social and public health strategies aimed at disease

prevention and prophylaxis. The Clinical Handbook of Air Pollution-Related Diseases will greatly assist doctors and healthcare workers when dealing with the consequences of air pollution in their everyday practice and will provide researchers, industry, and policymakers with valuable facts and insights.

Atmospheres of Earth and the Planets Billy McCormac 2012-12-06
This book contains the lectures presented at the Summer Advanced Study Institute, 'Physics and Chemistry of Atmospheres' which was held at the University of Liege, Belgium, during the period July 29-August 9, 1974. One-hundred nineteen persons from eleven different countries attended the Institute. The authors and publisher have made a special effort for rapid publication of an up to-date status of the physics and chemistry of the atmospheres of Earth and the planets, which is an ever-changing area. Special thanks are due to the lecturers for their diligent preparation and excellent presentations. The individual lectures and the published papers were deliberately limited; the authors' cooperation in conforming to these specifications is greatly appreciated. The contents of the book are organized by subject area rather than in the order in which papers were presented during the Institute. Many thanks are due to Drs Alv Egeland, Donald M. Hunten, Gunther Lange-Hesse, Marcel Nicolet, Harold I. Schiff, Lance Thomas, Alister Vallance Jones, Richard Wayne, and Gilbert Weill who served as session chairmen during the Institute and contributed greatly to its success by skillfully directing the discussion period in a stimulating manner after each lecture. Many persons contributed to the success of the Institute. Drs Alv Egeland, Donald M. Hunten, Gunther Lange-Hesse, Marcel Nicolet, Harold I. Schiff, Erwin R. Schmerling, Lance Thomas, Alister Vallance Jones, Richard Wayne, and Gilbert Weill were especially helpful in preparing the technical program.

Scientific and Technical Aerospace Reports 1991 Lists citations with abstracts for aerospace related reports obtained from world wide sources and announces documents that have recently been entered into the NASA Scientific and Technical Information Database.

Introduction to Heat Transfer Theodore L. Bergman 2011-06-13

Completely updated, the sixth edition provides engineers with an in-depth look at the key concepts in the field. It incorporates new discussions on emerging areas of heat transfer, discussing technologies that are related to nanotechnology, biomedical engineering and alternative energy. The example problems are also updated to better show how to apply the material. And as engineers follow the rigorous and systematic problem-solving methodology, they'll gain an appreciation for the richness and beauty of the discipline.

Remote Sensing and Global Climate Change Robin A. Vaughan 2013-06-29 Experts report the state of the art in the study of global climate change using remote sensing techniques. Topics covered include the principles of remote sensing, the management of data, data requirements in climatology, the principles of modelling, the input of data into models, and the application of remote sensing to the atmosphere, ice and snow, seas and land. The book is highly topical given the current great public and scientific awareness of possible man-made changes to the climate. It is essential reading for anyone new to the field, and invaluable as a reference work to those already working in it.

The Warming Papers David Archer 2013-04-29 Chosen for the 2011 ASLI Choice - Honorable Mention (History Category) for a compendium of the key scientific papers that undergird the global warming forecast. Global warming is arguably the defining scientific issue of modern times, but it is not widely appreciated that the foundations of our understanding were laid almost two centuries ago with the postulation of a greenhouse effect by Fourier in 1827. The sensitivity of climate to changes in atmospheric CO₂ was first estimated about one century ago, and the rise in atmospheric CO₂ concentration was discovered half a century ago. The fundamentals of the science underlying the forecast for human-induced climate change were being published and debated long before the issue rose to public prominence in the last few decades. The Warming Papers is a compendium of the classic scientific papers that constitute the foundation of the global warming forecast. The paper trail ranges from Fourier and Arrhenius in the 19th Century to Manabe and Hansen in

modern times. Archer and Pierrehumbert provide introductions and commentary which places the papers in their context and provide students with tools to develop and extend their understanding of the subject. The book captures the excitement and the uncertainty that always exist at the cutting edge of research, and is invaluable reading for students of climate science, scientists, historians of science, and others interested in climate change.

Radiative Heat Exchange in the Atmosphere K. Ya. Kondrat'Yev 2013-09-03 Radiative Heat Exchange in the Atmosphere analyzes the concerns in thermal radiation and the radiation balance of the earth's surface and of the atmosphere. The text first covers the basic definitions and concepts, and then proceeds to discussing the development of basic theories of actinometric measurements of thermal radiation fluxes. Next, the selection deals with the absorption of long-wave radiation in the atmosphere. In the fourth chapter, the title covers the solution of the problem of radiative heat transfer in the atmosphere. Chapter 5 details the examination of the approximate methods of calculation of thermal radiation fluxes, while Chapter 6 discusses the problem of the atmosphere and the net radiation at the ground. The seventh chapter tackles the radiation balance, and the last chapter covers the features of the methods and the results of calculating temperature changes caused by radiation. The book will be of great use to researchers and practitioners of astrophysics and meteorology. Ecologists and other environmental scientist will also benefit from the text.

The Physics of Atmospheres John T. Houghton 1977-05-26 Dr Houghton has revised the acclaimed first edition of The Physics of Atmospheres in order to bring this important textbook completely up-to-date. Several factors have led to vigorous growth in the atmospheric sciences, particularly the availability of powerful computers for detailed modelling, the investigation of the atmospheres of other planets, and techniques of remote sensing. The author describes the physical processes governing the structure and circulation of the atmosphere. Simple physical models are constructed by applying the principles of classical thermodynamics, radiative transfer and fluid mechanics,

together with analytic and numerical techniques. These models are applied to real planetary atmospheres. This new edition is essential for undergraduates or graduate students studying atmospheric physics, climatology or meteorology, as well as planetary scientists with an interest in atmospheres.

Radiation Heat Transfer Ephraim M. Sparrow 1978
NASA Scientific and Technical Reports and Publications for 1969 - A Selected Listing United States. National Aeronautics and Space Administration. Scientific and Technical Information Division 1970
Thermal Radiation Heat Transfer: The blackbody, electromagnetic theory, and material properties Robert Siegel 1968
NASA Technical Note United States. National Aeronautics and Space Administration 1974

Observation, Theory And Modeling Of Atmospheric Variability - Selected Papers Of Nanjing Institute Of Meteorology Alumni In Commemoration Of Professor Jijia Zhang Xun Zhu 2004-02-25 This book contains tutorial and review articles as well as specific research letters that cover a wide range of topics: (1) dynamics of atmospheric variability from both basic theory and data analysis, (2) physical and mathematical problems in climate modeling and numerical weather prediction, (3) theories of atmospheric radiative transfer and their applications in satellite remote sensing, and (4) mathematical and statistical methods. The book can be used by undergraduates or graduate students majoring in atmospheric sciences, as an introduction to various research areas; and by researchers and educators, as a general review or quick reference in their fields of interest.

Nuclear Science Abstracts 1975-10
A Selected Listing of NASA Scientific and Technical Reports United States. National Aeronautics and Space Administration. Scientific and Technical Information Division 1970
Non-LTE Radiative Transfer in the Atmosphere Manuel López-Puertas 2001 Ch. 1. Introduction and overview. 1.1. General introduction. 1.2. Basic properties of the Earth's atmosphere. 1.3. What is LTE? 1.4. Non-LTE situations. 1.5. The importance of non-LTE. 1.6. Some historical

background. 1.7. Non-LTE models. 1.8. Experimental studies of non-LTE. 1.9. Non-LTE in planetary atmospheres. 1.10. References and further reading -- ch. 2. Molecular spectra. 2.1. Introduction. 2.2. Energy levels in diatomic molecules. 2.3. Energy levels in polyatomic molecules. 2.4. Transitions and spectral bands. 2.5. Properties of individual vibration-rotation lines. 2.6. Interactions between energy levels. 2.7. References and further reading -- ch. 3. Basic atmospheric radiative transfer. 3.1. Introduction. 3.2. Properties of radiation. 3.3. The radiative transfer equation. 3.4. The formal solution of the radiative transfer equation. 3.5. Thermodynamic equilibrium and local thermodynamic equilibrium. 3.6. The source function in non-LTE. 3.7. Non-LTE situations. 3.8. References and further reading -- ch. 4. Solutions to the radiative transfer equation in LTE. 4.1. Introduction. 4.2. Integration of the radiative transfer equation over height. 4.3. Integration of the radiative transfer equation over frequency. 4.4. Integration of the radiative transfer equation over solid angle. 4.5. References and further reading -- ch. 5. Solutions to the radiative transfer equation in non-LTE. 5.1. Introduction. 5.2. Simple solutions for radiative transfer under non-LTE. 5.3. The full solution of the radiative transfer equation in non-LTE. 5.4. Integration of the RTE in non-LTE. 5.5. Intercomparison of non-LTE codes. 5.6. Parameterizations of the non-LTE cooling rate. 5.7. The Curtis matrix method. 5.8. References and further reading -- ch. 6. Non-LTE modelling of the Earth's atmosphere I: CO₂. 6.1. Introduction. 6.2. Useful approximations. 6.3. Carbon dioxide, CO₂. 6.4. References and further reading -- ch. 7. Non-LTE modelling of the Earth's atmosphere II: Other infrared emitters. 7.1. Introduction. 7.2. Carbon monoxide, CO. 7.3. Ozone, O₃. 7.4. Water vapour, H₂O. 7.5. Methane, CH₄. 7.6. Nitric oxide, NO. 7.7. Nitrogen dioxide, NO₂. 7.8. Nitrous oxide, N₂O. 7.9. Nitric acid, HNO₃. 7.10. Hydroxyl radical, OH. 7.11. Molecular oxygen atmospheric infrared bands. 7.12. Hydrogen chloride, HCl, and hydrogen fluoride, HF. 7.13. NO⁺. 7.14. Atomic Oxygen, O (3P), at 63[μ m]. 7.15. References and further reading -- ch. 8. Remote sensing of the non-LTE atmosphere. 8.1. Introduction. 8.2. The analysis of emission measurements. 8.3. Observations of carbon dioxide in emission. 8.4. Observations of ozone in

emission. 8.5. Observations of water vapour in emission. 8.6. Observations of carbon monoxide in emission. 8.7. Observations of nitric oxide in emission. 8.8. Observations of other infrared emissions. 8.9. Rotational non-LTE. 8.10. Absorption measurements. 8.11. Simulated limb emission spectra at high resolution. 8.12. Simulated Nadir emission spectra at high resolution. 8.13. Non-LTE retrieval schemes. 8.14. References and further reading -- ch. 9. Cooling and heating rates. 9.1. Introduction. 9.2. CO₂ 15 [μ m] cooling. 9.3. O₃ 9.6[μ m] cooling. 9.4. H₂O 6.3[μ m] cooling. 9.5. NO 5.3[μ m] cooling. 9.6. O(3P) 63[μ m] cooling. 9.7. Summary of cooling rates. 9.8. CO₂ solar heating. 9.9. References and further reading -- ch. 10. Non-LTE in planetary atmospheres. 10.1. Introduction. 10.2. The terrestrial planets: Mars and Venus. 10.3. A non-LTE model for the Martian and Venusian atmospheres. 10.4. Mars. 10.5. Venus. 10.6. Outer planets. 10.7. Titan. 10.8. Comets. 10.9. References and further reading.

Physically-Based Modelling and Simulation of Climate and Climatic Change M.E. Schlesinger 2012-12-06 PREFACE xv LIST OF LECTURERS xix LIST OF PARTICIPANTS xx]. VOLUME I PART I - DESIGN AND DEVELOPMENT OF PHYSICALLY-BASED MODELS OF THE ATMOSPHERE Section 1 - Introduction GATES, W. L. - Climate and the Climate System 3 SIMMONS, A. J. and L. BENGTSSON - Atmospheric General Circulation Models: Their Design and Use for Climate Studies 23 Section 2 - Numerical Methods for Large-Scale Dynamics ARAKAWA, A. - Finite-Difference Methods in Climate Modeling 79 BOURKE, W. - Spectral Methods in Global Climate and Weather Prediction Models 169 Section 3 - Parameterization of Subgrid-Scale Physical Processes FOUQUART, Y. - Radiative Transfer in Climate Models 223 LAVAL, K. - Land Surface Processes 285 SELLERS, P. J. , Y. MINTZ, Y. C. SUD and A. DALCHER - A Brief Description of the Simple Biosphere Model (SiB) 307 SOMMERIA, G. - Parameterization of the Planetary Boundary Layer in Large-Scale Atmospheric Models 331 x TABLE OF CONTENTS TIEDTKE, M. - Parameterization of Cumulus Convection in Large-Scale Models 375 SUNDQVIST, H. - Parameterization of Condensation and Associated Clouds in Models for Weather Prediction and General Circulation

Simulation 433 PART II - DESIGN AND DEVELOPMENT OF PHYSICALLY-BASED MODELS OF THE OCEAN AND SEA ICE HAN, Y. - J. - Modelling and Simulation of the General Circulation of the Ocean 465 HIBLER, W. D. - Modelling Sea Ice Thermodynamics and Dynamics in Climate Studies 509 PART III - METHODS OF COUPLING ATMOSPHERE, OCEAN AND ICE MODELS BRYAN, K.

Energy and Climate Change U.S. DOE 1990-04-30 Exclusively published by Lewis, and authored by world class scientists, this is one of the most current works published on energy and climate change. It is the best written synopsis of the chemical, climatic, and environmental effects of continuing emissions of carbon dioxide and other radiatively and chemically active trace gases. This timely work includes energy scenarios, cost and risk analyses, energy emissions, atmospheric chemistry, climate effects, as well as what is accepted as the best possible technical evaluation available, even while recognizing complex social aspects. All scientists and regulators will want *Energy and Climate Change*.

Izvestiya Академия наук СССР 1974

Book catalog of the Library and Information Services Division Environmental Science Information Center. Library and Information Services Division 1977

Green Chemistry Bela Torok 2017-11-07 *Green Chemistry: An Inclusive Approach* provides a broad overview of green chemistry for researchers from either an environmental science or chemistry background, starting at a more elementary level, incorporating more advanced concepts, and including more chemistry as the book progresses. Every chapter includes recent, state-of-the-art references, in particular, review articles, to introduce researchers to this field of interest and provide them with information that can be easily built upon. By bringing together experts in multiple subdisciplines of green chemistry, the editors have curated a single central resource for an introduction to the discipline as a whole. Topics include a broad array of research fields, including the chemistry of Earth's atmosphere, water and soil, the synthesis of fine chemicals, and sections on pharmaceuticals, plastics, energy related issues (energy

storage, fuel cells, solar, and wind energy conversion etc., greenhouse gases and their handling, chemical toxicology issues of everyday products (from perfumes to detergents or clothing), and environmental policy issues. Introduces the topic of green chemistry with an overview of key concepts Expands upon presented concepts with the latest research and applications, providing both the breadth and depth researchers need Includes a broad range of application based problems to make the content accessible for professional researchers and undergraduate and graduate students Authored by experts in a broad range of fields, providing insider information on the aspects or challenges of a given field that are most important and urgent

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