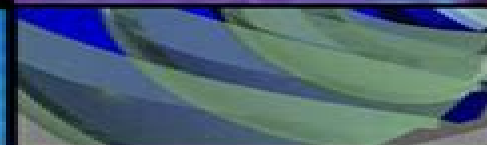


# Lens Design Fundamentals

SECOND EDITION



Rudolf Kingslake  
R. Barry Johnson



# Lens Design Fundamentals

**Rudolf Kingslake**



## **Lens Design Fundamentals:**

**Lens Design Fundamentals** Rudolf Kingslake, R. Barry Johnson, 2009-11-20 Thoroughly revised and expanded to reflect the substantial changes in the field since its publication in 1978 Strong emphasis on how to effectively use software design packages indispensable to today's lens designer Many new lens design problems and examples ranging from simple lenses to complex zoom lenses and mirror systems give insight for both the newcomer and specialist in the field Rudolf Kingslake is regarded as the American father of lens design his book not revised since its publication in 1978 is viewed as a classic in the field Naturally the area has developed considerably since the book was published the most obvious changes being the availability of powerful lens design software packages theoretical advances and new surface fabrication technologies This book provides the skills and knowledge to move into the exciting world of contemporary lens design and develop practical lenses needed for the great variety of 21st century applications Continuing to focus on fundamental methods and procedures of lens design this revision by R Barry Johnson of a classic modernizes symbology and nomenclature improves conceptual clarity broadens the study of aberrations enhances discussion of multi mirror systems adds tilted and decentered systems with eccentric pupils explores use of aberrations in the optimization process enlarges field flattener concepts expands discussion of image analysis includes many new exemplary examples to illustrate concepts and much more Optical engineers working in lens design will find this book an invaluable guide to lens design in traditional and emerging areas of application it is also suited to advanced undergraduate or graduate course in lens design principles and as a self learning tutorial and reference for the practitioner Rudolf Kingslake 1903 2003 was a founding faculty member of the Institute of Optics at The University of Rochester 1929 and remained teaching until 1983 Concurrently in 1937 he became head of the lens design department at Eastman Kodak until his retirement in 1969 Dr Kingslake published numerous papers books and was awarded many patents He was a Fellow of SPIE and OSA and an OSA President 1947 48 He was awarded the Progress Medal from SMPTE 1978 the Frederic Ives Medal 1973 and the Gold Medal of SPIE 1980 R Barry Johnson has been involved for over 40 years in lens design optical systems design and electro optical systems engineering He has been a faculty member at three academic institutions engaged in optics education and research co founder of the Center for Applied Optics at the University of Alabama in Huntsville employed by a number of companies and provided consulting services Dr Johnson is an SPIE Fellow and Life Member OSA Fellow and an SPIE President 1987 He published numerous papers and has been awarded many patents Dr Johnson was founder and Chairman of the SPIE Lens Design Working Group 1988 2002 is an active Program Committee member of the International Optical Design Conference and perennial co chair of the annual SPIE Current Developments in Lens Design and Optical Engineering Conference Thoroughly revised and expanded to reflect the substantial changes in the field since its publication in 1978 Strong emphasis on how to effectively use software design packages indispensable to today's lens designer Many new lens design problems and examples ranging from simple lenses to

complex zoom lenses and mirror systems give insight for both the newcomer and specialist in the field

**Lens Design Fundamentals** Rudolf Kingslake, 2012-12-02 A large part of this book is devoted to a study of possible design procedures for various types of lens or mirror systems with fully worked examples of each The reader is urged to follow the logic of these examples and be sure that he understands what is happening noticing particularly how each available degree of freedom is used to control one aberration Not every type of lens has been considered of course but the design techniques illustrated here can readily be applied to the design of other more complex systems It is assumed that the reader has access to a small computer to help with the ray tracing otherwise he may find the computations so time consuming that he is liable to lose track of what he is trying to accomplish

Lens Design Fundamentals Rudolf Kingslake, 1978-04-28 A large part of this book is devoted to a study of possible design procedures for various types of lens or mirror systems with fully worked examples of each The reader is urged to follow the logic of these examples and be sure that he understands what is happening noticing particularly how each available degree of freedom is used to control one aberration Not every type of lens has been considered of course but the design techniques illustrated here can readily be applied to the design of other more complex systems It is assumed that the reader has access to a small computer to help with the ray tracing otherwise he may find the computations so time consuming that he is liable to lose track of what he is trying to accomplish

**Optical Design Fundamentals for Infrared Systems** Max J. Riedl, 2001 The practical popular 1995 tutorial has been thoroughly revised and updated reflecting developments in technology and applications during the past decade New chapters address wave aberrations thermal effects design examples and diamond turning

*Lens Design Basics* Christoph Gerhard, 2020 This book gives a comprehensive overview on the principles of optical imaging The first seven chapters provide an extensive summary of optical design as well as the mechanisms and interrelations leading to the formation of aberrations and the accompanying decrease in imaging performance Aside from the fundamentals of optics and imaging models topics covered include calculations of simple optical components and systems characterisation and quantification of aberrations and defects in optical systems and optimisation of imaging performance The second part focuses on problem based learning via multiple exercises and case examples derived from the first seven chapters It is an ideal guide for optics and photonics students Part of IOP Series in Emerging Technologies in Optics and Photonics

*Introduction to Lens Design* José Sasián, 2019-09-26 A concise introduction to lens design including the fundamental theory concepts methods and tools used in the field Covering all the essential concepts and providing suggestions for further reading at the end of each chapter this book is an essential resource for graduate students working in optics and photonics

**Lens Design** Milton Laikin, 2018-10-03 There is no shortage of lens optimization software on the market to deal with today's complex optical systems for all sorts of custom and standardized applications But all of these software packages share one critical flaw you still have to design a starting solution Continuing the bestselling tradition of the author's previous books *Lens Design* Fourth Edition is still the most complete and

reliable guide for detailed design information and procedures for a wide range of optical systems Milton Laikin draws on his varied and extensive experience ranging from innovative cinematographic and special effects optical systems to infrared and underwater lens systems to cover a vast range of special purpose optical systems and their detailed design and analysis This edition has been updated to replace obsolete glass types and now includes several new designs and sections on stabilized systems the human eye spectrographic systems and diffractive systems A new CD ROM accompanies this edition offering extensive lens prescription data and executable ZEMAX files corresponding to figures in the text Filled with sage advice and completely illustrated Lens Design Fourth Edition supplies hands on guidance for the initial design and final optimization for a plethora of commercial consumer and specialized optical systems

**A Course in Lens Design** Chris Velzel, 2014-03-28 A Course in Lens Design is an instruction in the design of image forming optical systems It teaches how a satisfactory design can be obtained in a straightforward way Theory is limited to a minimum and used to support the practical design work The book introduces geometrical optics optical instruments and aberrations It gives a description of the process of lens design and of the strategies used in this process Half of its content is devoted to the design of sixteen types of lenses described in detail from beginning to end This book is different from most other books on lens design because it stresses the importance of the initial phases of the design process paraxial lay out and thin lens pre design The argument for this change of accent is that in these phases much information can be obtained about the properties of the lens to be designed This information can be used in later phases of the design This makes A Course in Lens Design a useful self study book and a suitable basis for an introductory course in lens design The mathematics mainly used is college algebra in a few sections calculus is applied The book could be used by students of engineering and technical physics and by engineers and scientists

**Handbook of Optical Design** Daniel Malacara-Hernández, Zacarías Malacara-Hernández, 2017-12-19 Handbook of Optical Design Third Edition covers the fundamental principles of geometric optics and their application to lens design in one volume It incorporates classic aspects of lens design along with important modern methods tools and instruments including contemporary astronomical telescopes Gaussian beams and computer lens design Written by respected researchers the book has been extensively classroom tested and developed in their lens design courses This well illustrated handbook clearly and concisely explains the intricacies of optical system design and evaluation It also discusses component selection optimization and integration for the development of effective optical apparatus The authors analyze the performance of a wide range of optical materials components and systems from simple magnifiers to complex lenses used in photography ophthalmology telescopes microscopes and projection systems Throughout the book includes a wealth of design examples illustrations and equations most of which are derived from basic principles Appendices supply additional background information What's New in This Edition Improved figures including 32 now in color Updates throughout reflecting advances in the field New material on Buchdahl high order aberrations Expanded and improved coverage of the calculation of wavefront aberrations based on

optical path An updated list of optical materials in the appendix A clearer more detailed description of primary aberrations References to important new publications Optical system design examples updated to include newly available glasses 25 new design examples This comprehensive book combines basic theory and practical details for the design of optical systems It is an invaluable reference for optical students as well as scientists and engineers working with optical instrumentation

Optical Engineering Fundamentals Bruce H. Walker, 1998 This text aims to expose students to the science of optics and optical engineering without the complications of advanced physics and mathematical theory      **Optical Principles and Technology for Engineers** James Stewart, 2018-10-08 Discussing the principles of physical and geometrical optics from an engineering point of view this book explains current optical technology and the applications of optical methods in a wide variety of fields from astronomy and agriculture to medicine and semiconductors It offers guidance in the selection of optical components for the construction of bread board models using commercially available standard components and provides immediately useful equations without unnecessary mathematical derivations      **Opto-Mechanical Systems Design, Volume 1** Paul Yoder, Daniel Vukobratovich, 2017-12-19 Opto Mechanical Systems Design Fourth Edition is different in many ways from its three earlier editions coauthor Daniel Vukobratovich has brought his broad expertise in materials opto mechanical design analysis of optical instruments large mirrors and structures to bear throughout the book Jan Nijenhuis has contributed a comprehensive new chapter on kinematics and applications of flexures and several other experts in special aspects of opto mechanics have contributed portions of other chapters An expanded feature a total of 110 worked out design examples has been added to several chapters to show how the theory equations and analytical methods can be applied by the reader Finally the extended text new illustrations new tables of data and new references have warranted publication of this work in the form of two separate but closely entwined volumes This first volume Design and Analysis of Opto Mechanical Assemblies addresses topics pertaining primarily to optics smaller than 50 cm aperture It summarizes the opto mechanical design process considers pertinent environmental influences lists and updates key parameters for materials illustrates numerous ways for mounting individual and multiple lenses shows typical ways to design and mount windows and similar components details designs for many types of prisms and techniques for mounting them suggests designs and mounting techniques for small mirrors explains the benefits of kinematic design and uses of flexures describes how to analyze various types of opto mechanical interfaces demonstrates how the strength of glass can be determined and how to estimate stress generated in optics and explains how changing temperature affects opto mechanical assemblies      *Optics in Photography* Rudolf Kingslake, 1992 This book explains fundamental optical principles that apply to photography cameras and lenses It is intended for professionals and serious amateur photographers as well as lens designers and optical engineers      **The Art and Science of Optical Design** Robert R. Shannon, 1997-06-13 The Art and Science of Optical Design is a comprehensive introduction to lens design covering the fundamental physical principles and key engineering issues Several practical

examples of modern computer aided lens design are worked out in detail from start to finish The basic theory and results of optics are presented early on in the book along with a discussion of optical materials Aberrations and their correction and image analysis are then covered in great detail Subsequent chapters deal with design optimisation and tolerance analysis Several design examples are then given beginning with basic lens design forms and progressing to advanced systems such as gradient index and diffractive optical components In covering all aspects of optical design including the use of modern lens design software this book will be invaluable to students of optical engineering as well as to anyone engaged in optical design at any stage

*Lens Design, Third Edition*, Milton Laikin, 2001-03-29 Featuring over 700 references equations tables and drawings this highly lauded and best selling reference emphasizes practical designs of over 30 lens systems including single element two element achromats air spaced triplets projection lenses and sophisticated wide angle and zoom lenses It comes with software that supplies starting solutions for computer optimization programs lens prescriptions and several shorter programs to compute the refractive index of glasses from a variety of manufacturers create lens drawings perform zoom computations do test glass fitting and calculate third order solutions for single lenses achromats and triplets

**A History of the Photographic Lens** Rudolf Kingslake, 1989-11-22 The lens is generally the most expensive and least understood part of any camera In this book Rudolf Kingslake traces the historical development of the various types of lenses from Daguerre's invention of photography in 1839 through lenses commonly used today From an early lens still being manufactured for use in low cost cameras to designs made possible through such innovations as lens coating rare earth glasses and computer aided lens design and testing the author details each major advance in design and fabrication The book explains how and why each new lens type was developed and why most of them have since been abandoned This authoritative history of lens technology also includes brief biographies of several outstanding lens designers and manufacturers of the past

*Introduction to Infrared and Electro-optical Systems* Ronald G. Driggers, Melvin H. Friedman, Jonathan Nichols, 2012 This comprehensive reference details the principles and components of the Linear Shift Invariant LSI infrared and electro optical systems and shows you how to combine this approach with calculus and domain transformations to achieve a successful imaging system analysis Ultimately the steps described in this book lead to results in quantitative characterizations of performance metrics such as modulation transfer functions minimum resolvable temperature difference minimum resolvable contrast and probability of object discrimination The book includes an introduction to two dimensional functions and mathematics which can be used to describe image transfer characteristics and imaging system components You also learn diffraction concepts of coherent and incoherent imaging systems which show you the fundamental limits of their performance By using the evaluation procedures contained in this desktop reference you become capable of predicting both sensor test and field performance and quantifying the effects of component variations

*Foundations of Optical System Analysis and Design* Lakshminarayan Hazra, 2022-02-06 Since the incorporation of scientific approach in tackling problems of optical

instrumentation analysis and design of optical systems constitute a core area of optical engineering. A large number of software with varying level of scope and applicability is currently available to facilitate the task. However, possession of an optical design software per se is no guarantee for arriving at correct or optimal solutions. The validity and/or optimality of the solutions depend to a large extent on proper formulation of the problem which calls for correct application of principles and theories of optical engineering. On a different note, development of proper experimental setups for investigations in the burgeoning field of optics and photonics calls for a good understanding of these principles and theories. With this backdrop in view, this book presents a holistic treatment of topics like paraxial analysis, aberration theory, Hamiltonian optics, ray optical and wave optical theories of image formation, Fourier optics, structural design, lens design, optimization, global optimization etc. Proper stress is given on exposition of the foundations. The proposed book is designed to provide adequate material for self-learning the subject. For practitioners in related fields, this book is a handy reference. *Foundations of Optical System Analysis and Synthesis* provides a holistic approach to lens system analysis and design with stress on foundations. Basic knowledge of ray and wave optics for tackling problems of instrumental optics. Proper explanation of approximations made at different stages. Sufficient illustrations for facilitation of understanding. Techniques for reducing the role of heuristics and empiricism in optical lens design. A sourcebook on chronological development of related topics across the globe. This book is composed as a reference book for graduate students, researchers, faculty, scientists and technologists in R & D centres and industry in pursuance of their understanding of related topics and concepts during problem solving in the broad areas of optical, electro-optical and photonic system analysis and design.

*Modern Lens Design* Warren J. Smith, 2004-11-12. Unlike the first edition which was more a collection of lens designs for use in larger projects, the 2nd edition of *Modern Lens Design* is an optical how-to. Delving deep into the mechanics of lens design, optics legend Warren J. Smith reveals time-tested methods for designing top quality lenses. He deals with lens design software primarily OSLO, by far the current market leaders, and provides 7 comprehensive worked examples, all new to this edition. With this book in hand, there's no lens an optical engineer can't design.

**Advances in Imaging and Electron Physics** Peter W. Hawkes, 2011-07-29. *Advances in Imaging and Electron Physics* merges two long running series, *Advances in Electronics and Electron Physics* and *Advances in Optical and Electron Microscopy*. This series features extended articles on the physics of electron devices, especially semiconductor devices, particle optics at high and low energies, microlithography, image science and digital image processing, electromagnetic wave propagation, electron microscopy and the computing methods used in all these domains.



## **Lens Design Fundamentals** Book Review: Unveiling the Power of Words

In a world driven by information and connectivity, the power of words has become more evident than ever. They have the capacity to inspire, provoke, and ignite change. Such is the essence of the book **Lens Design Fundamentals**, a literary masterpiece that delves deep to the significance of words and their effect on our lives. Written by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we shall explore the book's key themes, examine its writing style, and analyze its overall effect on readers.

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