Optical Properties of Solids Mark Solution Manual

Fundamentals of Inorganic Glasses
Optical Properties of Diamond
Non-Linear Optical Properties of Matter
Band Theory and Electronic Properties of Solids
Electronic Properties of Materials
Semiconductor Physics
Quantum Transport
Condensed-Matter and Materials Physics
Quantum Field Theory in a Nutshell
Optical Properties and Spectroscopy of Nanomaterials
Optical Properties of Solids
Optical Properties of Semiconductor Nanocrystals
Springer Handbook of Lasers and Optics
The Optical Properties of Solids in the Far Infrared and Submillimeter Regions
Nonlinear Optical Properties of Impurity-doped Solids
Optically Anomalous Crystals
Optical Materials and Applications
Optical Properties of Solids
Solid-State Spectroscopy
A Student's Guide to Atomic Physics
The Physics of Nanoelectronics
Handbook of Materials Modeling
Structure and Dynamics
Selected Papers on Color-center Lasers
Springer Handbook of Electronic and Photonic Materials
Bio-optical Modeling and Remote Sensing of Inland Waters
Polymer Electronics
Spectroscopic Ellipsometry for Photovoltaics
Mineralogy and Optical Mineralogy
Fundamentals of Semiconductors
Elementary Solid State Physics
Optical Engineering of Diamond
Optical Metamaterials
Optical Effects in Solids
Magnetism in Condensed Matter
The Handbook on Optical Constants of Metals
Optical Materials
Gateway to Condensed Matter Physics and Molecular Biophysics
Quantum Optics

Fundamentals of Inorganic Glasses

This is the first comprehensive book on the engineering of diamond optical devices. Written by 39 experts in the field, it gives readers an up-to-date review of the properties of optical quality synthetic diamond (single crystal and nanodiamond) and the nascent field of diamond optical device engineering. Application areas covered in detail in this book include quantum information processing, high performance lasers and light sources, and bioimaging. It provides scientists, engineers and physicists with a valuable and practical resource for the design and development of diamond-based optical devices.

Optical Properties of Diamond

This new edition features numerous updates and additions. Especially 4 new chapters on Fiber Optics, Integrated Optics, Frequency Combs and Interferometry reflect the changes since the first edition. In addition, major complete updates for the chapters: Optical Materials
and Their Properties, Optical Detectors, Nanooptics, and Optics far Beyond the Diffraction Limit. Features Contains over 1000 two-color illustrations. Includes over 120 comprehensive tables with properties of optical materials and light sources. Emphasizes physical concepts over extensive mathematical derivations. Chapters with summaries, detailed index Delivers a wealth of up-to-date references.

**Non-Linear Optical Properties of Matter**

A concise overview of the fundamental concepts and applications of atomic physics for students including examples, problems, and diagrams of key concepts.

**Band Theory and Electronic Properties of Solids**

Fundamentals of Inorganic Glasses, Third Edition, is a comprehensive reference on the field of glass science and engineering that covers numerous, significant advances. This new edition includes the most recent advances in glass physics and chemistry, also discussing groundbreaking applications of glassy materials. It is suitable for upper level glass science courses and professional glass scientists and engineers at industrial and government labs. Fundamental concepts, chapter-ending problem sets, an emphasis on key ideas, and timely notes on suggested readings are all included. The book provides the breadth required of a comprehensive reference, offering coverage of the composition, structure and properties of inorganic glasses. Clearly develops fundamental concepts and the basics of glass science and glass chemistry Provides a comprehensive discussion of the composition, structure and properties of inorganic glasses Features a discussion of the emerging applications of glass, including applications in energy, environment, pharmaceuticals, and more Concludes chapters with problem sets and suggested readings to facilitate self-study

**Electronic Properties of Materials**

Polymer electronics is the science behind many important new developments in technology, such as the flexible electronic display (e-ink) and many new developments in transistor technology. Solar cells, light-emitting diodes, and transistors are all areas where plastic electronics is likely to, or is already having, a serious impact on our daily lives. With polymer transistors and light-emitting diodes now being commercialised, there is a clear need for a pedagogic text that discusses the subject in a clear and concise fashion suitable for senior undergraduate and graduate students. The content builds on what has been learnt in an elementary (core) course in solid state physics and electronic behaviour, but care has been taken to ensure that important aspects such as the synthesis of these polymers are not overlooked. The chemistry is treated in a
manner appropriate to students of physics. Polymer Electronics presents a thorough discussion of the physics and chemistry behind this new and important area of science, appealing to all physical scientists with an interest in the field.

*Semiconductor Physics*

*Quantum Transport*

This book presents the conceptual framework underlying the atomistic theory of matter, emphasizing those aspects that relate to current flow. This includes some of the most advanced concepts of non-equilibrium quantum statistical mechanics. No prior acquaintance with quantum mechanics is assumed. Chapter 1 provides a description of quantum transport in elementary terms accessible to a beginner. The book then works its way from hydrogen to nanostructures, with extensive coverage of current flow. The final chapter summarizes the equations for quantum transport with illustrative examples showing how conductors evolve from the atomic to the ohmic regime as they get larger. Many numerical examples are used to provide concrete illustrations and the corresponding Matlab codes can be downloaded from the web. Videostreamed lectures, keyed to specific sections of the book, are also available through the web. This book is primarily aimed at senior and graduate students.

*Condensed-Matter and Materials Physics*

Excellent bridge between general solid-state physics textbook and research articles packed with providing detailed explanations of the electronic, vibrational, transport, and optical properties of semiconductors "The most striking feature of the book is its modern outlook provides a wonderful foundation. The most wonderful feature is its efficient style of exposition an excellent book." Physics Today "Presents the theoretical derivations carefully and in detail and gives thorough discussions of the experimental results it presents. This makes it an excellent textbook both for learners and for more experienced researchers wishing to check facts. I have enjoyed reading it and strongly recommend it as a text for anyone working with semiconductors I know of no better text I am sure most semiconductor physicists will find this book useful and I recommend it to them." Contemporary Physics Offers much new material: an extensive appendix about the important and by now well-established, deep center known as the DX center, additional problems and the solutions to over fifty of the problems at the end of the various chapters.

*Quantum Field Theory in a Nutshell*

This book assembles both theory and application in this field, to
interest experimentalists and theoreticians alike. Part 1 is concerned with the theory and computing of non-linear optical (NLO) properties while Part 2 reviews the latest developments in experimentation. This book will be invaluable to researchers and students in academia and industry, particularly to anyone involved in materials science, theoretical and computational chemistry, chemical physics, and molecular physics.

**Optical Properties and Spectroscopy of Nanomaterials**

**Optical Properties of Solids**

This text is an introductory compilation of basic concepts, methods and applications in the field of spectroscopy. It discusses new radiation sources such as lasers and synchrotrons and describes the linear response together with the basic principles and the technical background for various scattering experiments.

**Optical Properties of Solids**

**Optical Properties of Semiconductor Nanocrystals**

Optical Materials, Second Edition, presents, in a unified form, the underlying physical and structural processes that determine the optical behavior of materials. It does this by combining elements from physics, optics, and materials science in a seamless manner, and introducing quantum mechanics when needed. The book groups the characteristics of optical materials into classes with similar behavior. In treating each type of material, the text pays particular attention to atomic composition and chemical makeup, electronic states and band structure, and physical microstructure so that the reader will gain insight into the kinds of materials engineering and processing conditions that are required to produce a material exhibiting a desired optical property. The physical principles are presented on many levels, including a physical explanation, followed by formal mathematical support and examples and methods of measurement. The reader may overlook the equations with no loss of comprehension, or may use the text to find appropriate equations for calculations of optical properties.

Includes a fundamental description of optical materials at the beginner and advanced levels Provides a thorough coverage of the field and presents new concepts in an easy to understand manner that combines written explanations and equations Serves as a valuable toolbox of applications and equations for the working reader.

**Springer Handbook of Lasers and Optics**
Metamaterials—artificially structured materials with engineered electromagnetic properties—have enabled unprecedented flexibility in manipulating electromagnetic waves and producing new functionalities. This book details recent advances in the study of optical metamaterials, ranging from fundamental aspects to up-to-date implementations, in one unified treatment. Important recent developments and applications such as superlens and cloaking devices are also treated in detail and made understandable. The planned monograph can serve as a very timely book for both newcomers and advanced researchers in this extremely rapid evolving field.

The Optical Properties of Solids in the Far Infrared and Submillimeter Regions

Written primarily for advanced undergraduate and masters level students in physics, this text includes a broad range of topics in applied quantum optics such as laser cooling, Bose-Einstein condensation and quantum information processing.

Nonlinear Optical Properties of Impurity-doped Solids

This book describes how the arrangement and movement of atoms in a solid are related to the forces between atoms, and how they affect the behaviour and properties of materials. The book is intended for final year undergraduate students and graduate students in physics and materials science.

Optically Anomalous Crystals

For final year undergraduates and graduate students in physics, this book offers an up-to-date treatment of the optical properties of solid state materials.

Optical Materials and Applications

This book begins with an historical introduction covering the contributions of many distinguished crystallographers. From this follows a tutorial in crystal optics. Further chapters discuss the two main mechanisms of optical dissymmetry, the piezo-optic effect and the kinetic ordering of atoms. The book treats the literature comprehensively, but uses illustrations from the authors’ laboratories as the subjects of detailed analyses.

Optical Properties of Solids

Introduction to Econometrics provides a step by step introductory guide to the core areas of this subject. This new edition of Dougherty's highly successful textbook has been substantially updated and revised with the inclusion of new material on
specification tests, binary choice models, tobit analysis, sample selection bias, nonstationary time series, and unit root tests and cointegration. In addition, the book will be accompanied by a website containing graphical treatment of all the topics covered in the text.

**Solid-State Spectroscopy**

An understanding of the quantum mechanical nature of magnetism has led to the development of new magnetic materials which are used as permanent magnets, sensors, and information storage. Behind these practical applications lie a range of fundamental ideas, including symmetry breaking, order parameters, excitations, frustration, and reduced dimensionality. This superb new textbook presents a logical account of these ideas, starting from basic concepts in electromagnetsim and quantum mechanics. It outlines the origin of magnetic moments in atoms and how these moments can be affected by their local environment inside a crystal. The different types of interactions which can be present between magnetic moments are described. The final chapters of the book are devoted to the magnetic properties of metals, and to the complex behaviour which can occur when competing magnetic interactions are present and/or the system has a reduced dimensionality. Throughout the text, the theoretical principles are applied to real systems. There is substantial discussion of experimental techniques and current research topics. The book is copiously illustrated and contains detailed appendices which cover the fundamental principles.

**A Student's Guide to Atomic Physics**

This book provides a basic understanding of spectroscopic ellipsometry, with a focus on characterization methods of a broad range of solar cell materials/devices, from traditional solar cell materials (Si, CuInGaSe2, and CdTe) to more advanced emerging materials (Cu2ZnSnSe4, organics, and hybrid perovskites), fulfilling a critical need in the photovoltaic community. The book describes optical constants of a variety of semiconductor light absorbers, transparent conductive oxides and metals that are vital for the interpretation of solar cell characteristics and device simulations. It is divided into four parts: fundamental principles of ellipsometry; characterization of solar cell materials/structures; ellipsometry applications including optical simulations of solar cell devices and online monitoring of film processing; and the optical constants of solar cell component layers.

**The Physics of Nanoelectronics**

An overview of the optical effects in solids, addressing the physics of various materials and their response to electromagnetic radiation. The discussion includes metals, semiconductors, superconductors, and insulators. The book begins by introducing the
dielectric function into Maxwell's macroscopic equations and finding their plane-wave solution. The physics governing the dielectric function of various materials is then covered, both classically and using basic quantum mechanics. Advanced topics covered include interacting electrons, the anomalous skin effect, anisotropy, magneto-optics, and inhomogeneous materials. Each subject begins with a connection to the basic physics of the particular solid, after which the measurable optical quantities are derived. It allows the reader to connect measurements (reflectance, optical conductivity and dielectric function) with the underlying physics of solids. Methods of analysing experimental data are addressed, making this an ideal resource for students and researchers interested in solid state physics, optics, and materials science.

Handbook of Materials Modeling

This book provides an introduction to band theory and the electronic properties of materials at a level suitable for final-year undergraduates or first-year graduate students. It sets out to provide the vocabulary and quantum-mechanical training necessary to understand the electronic, optical and structural properties of the materials met in science and technology and describes some of the experimental techniques which are used to study band structure today. In order to leave space for recent developments, the Drude model and the introduction of quantum statistics are treated synoptically. However, Bloch's theorem and two tractable limits, a very weak periodic potential and the tight-binding model, are developed rigorously and in three dimensions. Having introduced the ideas of bands, effective masses and holes, semiconductor and metals are treated in some detail, along with the newer ideas of artificial structures such as super-lattices and quantum wells, layered organic substances and oxides. Some recent 'hot topics' in research are covered, e.g. the fractional Quantum Hall Effect and nano-devices, which can be understood using the techniques developed in the book. In illustrating examples of e.g. the de Haas-van Alphen effect, the book focuses on recent experimental data, showing that the field is a vibrant and exciting one. References to many recent review articles are provided, so that the student can conduct research into a chosen topic at a deeper level. Several appendices treating topics such as phonons and crystal structure make the book self-contained introduction to the fundamentals of band theory and electronic properties in condensed matter physic today.

Structure and Dynamics

A collection of papers dealing with the colour-center laser. The first section deals with fundamental research that preceded the colour-center laser, the second covers the discovery and development of several types of laser and the final section contains examples of applications of the laser.
Selected Papers on Color-center Lasers

The second, updated edition of this essential reference book provides a wealth of detail on a wide range of electronic and photonic materials, starting from fundamentals and building up to advanced topics and applications. Its extensive coverage, with clear illustrations and applications, carefully selected chapter sequencing and logical flow, makes it very different from other electronic materials handbooks. It has been written by professionals in the field and instructors who teach the subject at a university or in corporate laboratories. The Springer Handbook of Electronic and Photonic Materials, second edition, includes practical applications used as examples, details of experimental techniques, useful tables that summarize equations, and, most importantly, properties of various materials, as well as an extensive glossary. Along with significant updates to the content and the references, the second edition includes a number of new chapters such as those covering novel materials and selected applications. This handbook is a valuable resource for graduate students, researchers and practicing professionals working in the area of electronic, optoelectronic and photonic materials.

Springer Handbook of Electronic and Photonic Materials

The first reference of its kind in the rapidly emerging field of computational approaches to materials research, this is a compendium of perspective-providing and topical articles written to inform students and non-specialists of the current status and capabilities of modelling and simulation. From the standpoint of methodology, the development follows a multiscale approach with emphasis on electronic-structure, atomistic, and mesoscale methods, as well as mathematical analysis and rate processes. Basic models are treated across traditional disciplines, not only in the discussion of methods but also in chapters on crystal defects, microstructure, fluids, polymers and soft matter. Written by authors who are actively participating in the current development, this collection of 150 articles has the breadth and depth to be a major contributor toward defining the field of computational materials. In addition, there are 40 commentaries by highly respected researchers, presenting various views that should interest the future generations of the community. Subject Editors: Martin Bazant, MIT; Bruce Boghosian, Tufts University; Richard Catlow, Royal Institution; Long-Qing Chen, Pennsylvania State University; William Curtin, Brown University; Tomas Diaz de la Rubia, Lawrence Livermore National Laboratory; Nicolas Hadjiconstantinou, MIT; Mark F. Horstemeyer, Mississippi State University; Efthimios Kaxiras, Harvard University; L. Mahadevan, Harvard University; Dimitrios Maroudas, University of Massachusetts; Nicola Marzari, MIT; Horia Metiu, University of California Santa Barbara; Gregory C. Rutledge, MIT; David J. Srolovitz, Princeton University; Bernhardt L. Trout, MIT; Dieter
**Bio-optical Modeling and Remote Sensing of Inland Waters**

This handbook is the most comprehensive compilation of data on the optical properties of diamond ever written. It presents a multitude of data previously for the first time in English. The author provides quick access to the most comprehensive information on all aspects of the field.

**Spectroscopic Ellipsometry for Photovoltaics**

Bio-optical Modeling and Remote Sensing of Inland Waters presents the latest developments, state-of-the-art, and future perspectives of bio-optical modeling for each optically active component of inland waters, providing a broad range of applications of water quality monitoring using remote sensing. Rather than discussing optical radiometry theories, the authors explore the applications of these theories to inland aquatic environments. The book not only covers applications, but also discusses new possibilities, making the bio-optical theories operational, a concept that is of great interest to both government and private sector organizations. In addition, it addresses not only the physical theory that makes bio-optical modeling possible, but also the implementation and applications of bio-optical modeling in inland waters. Early chapters introduce the concepts of bio-optical modeling and the classification of bio-optical models and satellite capabilities both in existence and in development. Later chapters target specific optically active components (OACs) for inland waters and present the current status and future direction of bio-optical modeling for the OACs. Concluding sections provide an overview of a governance strategy for global monitoring of inland waters based on earth observation and bio-optical modeling. Presents comprehensive chapters that each target a different optically active component of inland waters Contains contributions from respected and active professionals in the field Presents applications of bio-optical modeling theories that are applicable to researchers, professionals, and government agencies.

**Mineralogy and Optical Mineralogy**

Examines the optical properties of low-dimensional semiconductor structures, a hot research area for graduate students and researchers.
**Fundamentals of Semiconductors**

This book presents data on the optical constants of metal elements (Na, Au, Mg, Hg, Sc, Al, Ti, β-Sn, V, Cr, Mn, Fe, La, Th, etc.) semimetal elements (graphite, Sb, etc.), metallic compounds (TiN, VC, TiSi2, CoSi2, etc.) and high-temperature superconducting materials (YBa2Cu3O7-δ, MgB2, etc.). A complete set of the optical constants are presented in tabular and graphical forms over the entire photon-energy range. They are: the complex dielectric constant \( \varepsilon(E) = \varepsilon_1(E) + i\varepsilon_2(E) \), the complex refractive index \( n^*(E) = n(E) + ik(E) \), the absorption coefficient \( \alpha(E) \) and the normal-incidence reflectivity \( R(E) \). The book will aid many who are interested to know the optical constants of the metals, semimetals, metallic compounds and high-temperature superconducting materials in the course of their work.

**Elementary Solid State Physics**

**Optical Engineering of Diamond**

This handbook gives a complete survey of the important topics and results in semiconductor physics. It addresses every fundamental principle and most research topics and areas of application in the field of semiconductor physics. Comprehensive information is provided on crystalline bulk and low-dimensional as well as amorphous semiconductors, including optical, transport, and dynamic properties.

**Optical Metamaterials**

Books are seldom finished. At best, they are abandoned. The second edition of "Electronic Properties of Materials" has been in use now for about seven years. During this time my publisher gave me ample opportunities to update and improve the text whenever the book was reprinted. There were about six of these reprinting cycles. Eventually, however, it became clear that substantially more new material had to be added to account for the stormy developments which occurred in the field of electrical, optical, and magnetic materials. In particular, expanded sections on flat-panel displays (liquid crystals, electroluminescence devices, field emission displays, and plasma dis. : plays) were added. Further, the recent developments in blue- and green emitting LED's and in photonics are included. Magnetic storage devices also underwent rapid development. Thus, magneto-optical memories, magneto resistance devices, and new' magnetic materials needed to be covered. The sections on dielectric properties, ferroelectricity, piezoelectricity, electrostriction, and thermoelectric properties have been expanded. Of course, the entire text was critically reviewed, updated, and improved. However, the most extensive change I undertook was the conversion of all

equations to SI units throughout. In most of the world and in virtually all of the international scientific journals use of this system of units is required. If today's students do not learn to utilize it, another generation is "lost" on this matter. In other words, it is important that students become comfortable with SI units.

Optical Effects in Solids

This new volume provides the necessary background material and brings into focus the fundamental concepts essential for advanced research in theoretical condensed matter physics and its interface with molecular biophysics. It is the outcome of the author's long teaching and research career in theoretical condensed matter physics and related interdisciplinary fields. The author aims to motivate students to take up research in condensed matter physics and march toward new frontiers. He writes: "My long understanding of students' attitude and orientation brings me to the conclusion that many of them are quite excited about the developments in the frontier research areas at the beginning of their career; however, a sizeable fraction of them start losing interest gradually as they are often unable to connect these developments with the basic physics they have studied. I have tried to fill this gap in this book." To this end, special care has been taken to balance the physical concepts and mathematical expressions as well as proper mixing of theoretical and experimental aspects. He starts with the very well-known elementary ideas or basic concepts and goes forward so as to remove the apparent conceptual and technical gap between the known laws and various interesting, challenging, and novel experimental results and effects, some of which are amongst the latest discoveries. Key features: • Introduces a new way of looking at various important and fundamental phenomena in condensed matter from the perspective of microscopic theory • Explores a new interface of quantum condensed matter physics and molecular biophysics, highlighting research potentialities • Addresses the crucial questions surrounding these phenomena when they are mutually coexisting or competing in real condensed matter systems or materials, from both theoretical and experimental angles • Deals with biological molecules and some of their properties and processes and discusses the modeling of these with the help of condensed matter physics and statistical physics • Emphasizes fundamental concepts, particularly in condensed matter physics and making proper use of them

Magnetism in Condensed Matter

Advances in nanotechnology have allowed physicists and engineers to miniaturize electronic structures to the limit where finite-size related phenomena start to impact their properties. This book discusses such phenomena and models made for their description. The book starts from the semiclassical description of nonequilibrium
effects, details the scattering theory used for quantum transport
calculations, and explains the main interference effects. It also
describes how to treat fluctuations and correlations, how
interactions affect transport through small islands, and how
superconductivity modifies these effects. The last two chapters
describe new emerging fields related with graphene and
nanoelectromechanics. The focus of the book is on the phenomena
rather than formalism, but the book still explains in detail the
main models constructed for these phenomena. It also introduces a
number of electronic devices, including the single-electron
transistor, the superconducting tunnel junction refrigerator, and
the superconducting quantum bit.

The Handbook on Optical Constants of Metals

The definition of optical material has expanded in recent years,
largely because of IT advances that have led to rapid growth in
optoelectronics applications. Helping to explain this evolution,
Optical Materials and Applications presents contributions from
leading experts who explore the basic concepts of optical materials
and the many typical applications in which they are used. An
invaluable reference for readers ranging from professionals to
technical managers to graduate engineering students, this book
covers everything from traditional principles to more cutting-edge
topics. It also details recent developmental trends, with a focus on
basic optical properties of material. Key topics include:
Fundamental optical properties of solids Fundamental optical
materials (including thin films) from both linear and nonlinear
perspectives Use of bulk materials in the design of various
modifications Application of optical thin films in artificial
components Formation of artificial structures with sub-wavelength
dimensions Use of physical or chemical techniques to control
lightwave phase One-, two-, and three-dimensional structures used to
control dispersion of materials for nanophotonics Progress of the
optical waveguide, which makes optical systems more compact and
highly efficient This book carefully balances coverage of theory and
application of typical optical materials for ultraviolet, visible
and infrared, non-linear optics, solid state lasers, optical
waveguides, optical thin films and nanophotonics. It addresses both
basic ideas and more advanced topics, making it an equally
invaluable resource for beginners and active researchers in this
growing field.

Optical Materials

Gateway to Condensed Matter Physics and Molecular
Biophysics

This book identifies opportunities, priorities, and challenges for
the field of condensed-matter and materials physics. It highlights exciting recent scientific and technological developments and their societal impact and identifies outstanding questions for future research. Topics range from the science of modern technology to new materials and structures, novel quantum phenomena, nonequilibrium physics, soft condensed matter, and new experimental and computational tools. The book also addresses structural challenges for the field, including nurturing its intellectual vitality, maintaining a healthy mixture of large and small research facilities, improving the field's integration with other disciplines, and developing new ways for scientists in academia, government laboratories, and industry to work together. It will be of interest to scientists, educators, students, and policymakers.

Quantum Optics

A fully updated edition of the classic text by acclaimed physicist A. Zee Since it was first published, Quantum Field Theory in a Nutshell has quickly established itself as the most accessible and comprehensive introduction to this profound and deeply fascinating area of theoretical physics. Now in this fully revised and expanded edition, A. Zee covers the latest advances while providing a solid conceptual foundation for students to build on, making this the most up-to-date and modern textbook on quantum field theory available. This expanded edition features several additional chapters, as well as an entirely new section describing recent developments in quantum field theory such as gravitational waves, the helicity spinor formalism, on-shell gluon scattering, recursion relations for amplitudes with complex momenta, and the hidden connection between Yang-Mills theory and Einstein gravity. Zee also provides added exercises, explanations, and examples, as well as detailed appendices, solutions to selected exercises, and suggestions for further reading. The most accessible and comprehensive introductory textbook available Features a fully revised, updated, and expanded text Covers the latest exciting advances in the field Includes new exercises Offers a one-of-a-kind resource for students and researchers Leading universities that have adopted this book include: Arizona State University Boston University Brandeis University Brown University California Institute of Technology Carnegie Mellon College of William & Mary Cornell Harvard University Massachusetts Institute of Technology Northwestern University Ohio State University Princeton University Purdue University - Main Campus Rensselaer Polytechnic Institute Rutgers University - New Brunswick Stanford University University of California - Berkeley University of Central Florida University of Chicago University of Michigan University of Montreal University of Notre Dame Vanderbilt University Virginia Tech University

Copyright code :  ba3b0c0f051b37433a1066b7d36bb96a