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Engineering Tribology Encyclopedia of Tribology *Materials for Tribology* **Advances in Composite Tribology** **Tribology** Experimental Methods in Tribology Engine Tribology **Industrial Tribology** **Introduction to Tribology** *Tribology of Plastic Materials* Tribology for Scientists and Engineers **Dissipative Processes in Tribology** **Tribology on the Small Scale** **Principles of Tribology** **Fundamentals of Tribology** *Tribology* **Tribology of Thin Layers** *Tribology of Miniature Systems* *Friction, Wear, Lubrication* **ENGINEERING TRIBOLOGY** **Tribology in Materials and Manufacturing** *Principles and Applications of Tribology* **Applied Tribology** Handbook Of Polymer Tribology Extreme Tribology **Tribology** *Tribology in Machine Design* Encyclopedia of Tribology Contact Mechanics in Tribology Tribology on the Small Scale *Advances in Engine Tribology* *Polymer Tribology* **Mechanical Tribology** **Tribology for Engineers** *Engineering Tribology* Tribology and Characterization of Surface Coatings *Tribology in Materials and Applications* **Engineering Tribology** *Tribology of Additively Manufactured Materials* Tribology in Manufacturing Technology

This handbook provides an extensive reference source on the materials used in tribological applications. Materials used in tribological applications are, for the most part, common materials used for general engineering applications. Many conventional engineering materials have been adapted to tribological uses and examples of these are given throughout the text. Literature that so far has been scattered and difficult to retrieve is now presented for the first time in this comprehensive treatise. The author has used his expertise in selecting materials for a wide variety of friction and wear applications to develop this data base on materials for tribology. In addition information has been selected from the literature on the behaviour of these materials in bearings, seals, gears, brakes, clutches, wire rope, valves, cams and wear surfaces and is included in the descriptive text. The materials have been grouped in families, relating to their composition. A short table is provided at the beginning of each chapter, listing the ranges of selected properties for the materials under discussion. In addition there are short summaries of the

tribological applications this class of materials is used for. On the first page of each chapter one can find a guide for the selection of materials. Sufficient references to the literature are given to enable the reader to follow up in more detail the various topics discussed. This book deals with the new and now-expanding field of friction, wear, and other surface-related mechanical phenomena for polymers. Polymers have been used in various forms such as bulk, films, and composites in applications where their friction, wear resistance, and other surface-related properties have been effectively utilized. There are also many examples in which polymers have performed extremely well, such as in tyres, shoes, brakes, gears, bearings, small moving parts in electronics and MEMS, cosmetics/hair products, and artificial human joints. Around the world, much research is currently being undertaken to develop new polymers, in different forms, for further enhancing tribological performance and for finding novel applications. Keeping in view the importance of tribology of polymers for research and technology as well as the vast literature that is now available in research papers and review articles, this timely book brings together a wealth of research data for an understanding of the basic principles of the subject. Engineering Tribology, 4th Edition is an established introductory reference focusing on the key concepts and engineering implications of tribology. Taking an interdisciplinary view, the book brings together the relevant knowledge from different fields needed to achieve effective analysis and control of friction and wear. Updated to cover recent advances in tribology, this new edition includes new sections on ionic and mesogenic lubricants, surface texturing, and multiscale characterization of 3D surfaces and coatings. Current trends in nanotribology are discussed, such as those relating to lubricants, coatings and composites, and geotribology is introduced. Suitable as an introductory text, a refresher or an on-the-job reference, Engineering Tribology, 4th Edition is intended for final year undergraduate and postgraduate students in mechanical engineering as well as professional engineers. It is also relevant to those working in materials engineering, applied chemistry, physics and bioengineering. Offers a comprehensive overview of the mechanisms of wear, lubrication and friction in an accessible manner designed to aid novice engineers, non-specialists and students Provides a reader-friendly approach to the subject using illustrations to break down the typically complex problems associated with tribology Includes end-of-chapter problems to test understanding

Fundamentals of Tribology deals with the fundamentals of lubrication, friction

and wear, as well as mechanics of contacting surfaces and their topography. It begins by introducing the reader to the importance of tribology in everyday life and offers a brief history of the subject. It then describes the nature of rough surfaces and the mechanics of contacting elastic solids and their deformation under load and friction in their relative motion. The book goes on to discuss the importance of lubricant rheology with respect to viscosity and density. Then, the principles of hydrodynamic lubrication are covered with derivations of the governing Reynolds and energy equations. Applications of hydrodynamic lubrication in various forms of bearings -- journal bearings, thrust bearings and externally pressurised bearings -- are outlined. The important and still evolving subject of elastohydrodynamic lubrication is treated in some detail, both at its fundamentals and its applications in thin shell or overlay bearings, cam-followers and internal combustion engine pistons. The fundamentals of biotribology are also covered, particularly its applications to endo-articular mammalian joints such as hip and knee joints and their arthroplasty. In addition, there is a treatment of the rapidly emerging knowledge of tribological phenomena in lightly loaded vanishing conjunctions (nanotribology), in natural systems and very small devices, such as MEMS and high density data storage media. There is also a new chapter on the rapidly emerging subject of surface texturing to promote retention of microreservoirs of lubricant, acting as microbearings and improving lubrication of otherwise poorly lubricated conjunctions. This book targets the undergraduate and postgraduate body as well as engineering professionals in industry, where often a quick solution or understanding of certain tribological fundamentals is sought. The book can also form an initial basis for those interested in research into certain aspects of tribology. TRIBOLOGY – the study of friction, wear and lubrication – impacts almost every aspect of our daily lives. The Springer Encyclopedia of Tribology is an authoritative and comprehensive reference covering all major aspects of the science and engineering of tribology that are relevant to researchers across all engineering industries and related scientific disciplines. This is the first major reference that brings together the science, engineering and technological aspects of tribology of this breadth and scope in a single work. Developed and written by leading experts in the field, the Springer Encyclopedia of Tribology covers the fundamentals as well as advanced applications across material types, different length and time scales, and encompassing various engineering applications and technologies. Exciting new areas such as nanotribology,

tribochemistry and biotribology have also been included. As a six-volume set, the Springer Encyclopedia of Tribology comprises 1630 entries written by authoritative experts in each subject area, under the guidance of an international panel of key researchers from academia, national laboratories and industry. With alphabetically-arranged entries, concept diagrams and cross-linking features, this comprehensive work provides easy access to essential information for both researchers and practicing engineers in the fields of engineering (aerospace, automotive, biomedical, chemical, electrical, and mechanical) as well as materials science, physics, and chemistry.

Tribology in Materials and Manufacturing - Wear, Friction and Lubrication brings an interdisciplinary perspective to accomplish a more detailed understanding of tribological assessments, friction, lubrication, and wear in advanced manufacturing. Chapters cover such topics as ionic liquids, non-textured and textured surfaces, green tribology, lubricants, tribolayers, and simulation of wear. This introductory yet comprehensive book presents the fundamental concepts on the analysis and design of tribological systems. It is a unique blend of scientific principles, mathematical formulations and engineering practice. The text discusses properties and measurements of engineering surfaces, surface contact geometry and contact stresses. Besides, it deals with adhesion, friction, wear, lubrication and related interfacial phenomena. It also highlights recent developments like nanotribology and fractal analysis with great clarity. The book is intended as a text for senior undergraduate and postgraduate students of mechanical engineering, production/industrial engineering, metallurgy and material science. It can also serve as a reference for practising engineers and designers. This book presents a thorough overview on workable theories and reliable experimental data on the use of plastic materials for sliding parts. Divided into four parts. Chapters 1 and 2 deal with current theories of friction and wear, and include discussion of various hypotheses based upon experimental studies. Chapter 3 details experiments designed to improve tribological performance via polymer blending and composite production, whilst Chapter 4 explains how the data obtained from these experiments can be applied to sliding machine parts. The work will prove useful in the design of plastic materials and components and will also provide a stepping-stone toward future innovations in this field. This is an indispensable guide to both researchers in academia and industry who wish to perform tribological experiments more effectively. With an extensive range of illustrations which

communicate the basic concepts in experimental methods tribology more effectively than text alone. An extensive citation list is also provided at the end of each chapter facilitating a more thorough navigation through a particular subject. * Contains extensive illustrations * Highlights limitations of current techniques

Insightful working knowledge of friction, lubrication, and wear in machines Applications of tribology are widespread in industries ranging from aerospace, marine and automotive to power, process, petrochemical and construction. With world-renowned expert co-authors from academia and industry, *Applied Tribology: Lubrication and Bearing Design, 3rd Edition* provides a balance of application and theory with numerous illustrative examples. The book provides clear and up-to-date presentation of working principles of lubrication, friction and wear in vital mechanical components, such as bearings, seals and gears. The third edition has expanded coverage of friction and wear and contact mechanics with updated topics based on new developments in the field. Key features: Includes practical applications, homework problems and state-of-the-art references. Provides presentation of design procedure. Supplies clear and up-to-date information based on the authors' widely referenced books and over 500 archival papers in this field. *Applied Tribology: Lubrication and Bearing Design, 3rd Edition* provides a valuable and authoritative resource for mechanical engineering professionals working in a wide range of industries with machinery including turbines, compressors, motors, electrical appliances and electronic components. Senior and graduate students in mechanical engineering will also find it a useful text and reference. This book broadens the knowledge of tribology. This book is evolved out of current research trends on tribological performance of systems related to nano tribology, rheology, engines, polymer brushes, composite materials, erosive wear and lubrication. The book deals with enhancing the ideas on tribological properties, the different types of wear phenomenon and lubrication enhancement. Further, the tribological performance of systems, whether nano, micro or macro-scale, depends upon a large number of external parameters and important among them are temperature, contact pressure and relative speed. Thus, the book focus on the theoretical aspects to industrial applications of tribology. The multidisciplinary nature of tribology, the conflicting theories and approaches to it found in the literature, plus the fact that definitions of the same phenomenon often differ widely, prompted the authors to compile this work. The aim of this encyclopedia is to provide information on specific tribological terms. The

entire field of tribology encompassing lubrication, friction and wear, i.e. the science and technology of interacting surfaces in relative motion, is covered. An extensive description of the chemical and biological aspects of tribology is given, including a wide range of current references and authors. The reader is also referred to relevant literature for most of the terms listed. The information presented has been made as up-to-date as possible, taking into account both the theoretical and practical nature of the subject. The encyclopedia will be an indispensable reference source in the work of engineers, chemists, physicists, metallurgists, materials and surface scientists, biotechnologists, as well as research workers in these fields. Customer expectations and international competition are obliging car and commercial vehicle manufacturers to produce more efficient and cleaner products in shorter product cycle times. The consideration of Engine Tribology has a leading role to play in helping to achieve these goals. Specific areas of interdisciplinary interest include: design influences on fuel economy and emissions; new materials (ceramics, steels, coatings, lubricants, additives); low viscosity lubricants; and low heat rejection (adiabatic) engines. This volume gives a detailed and current review on some basic features of tribology particularly associated with internal combustion engines such as: lubrication analysis relevant to plain bearings, Hertzian contact theory and elastohydrodynamic lubrication associated with cams and followers and friction and wear in a general context. Several chapters examine engine bearings, valve trains, (cams and followers) and piston assemblies. For each machine element a background introduction is followed by design interpretations and a consideration of future developments. The important topic of materials, solids and lubricants is focused upon in the concluding chapters. The work will be of interest to engineers and researchers in the automobile, automotive products, petroleum and associated industries. This fully updated Second Edition provides the reader with the solid understanding of tribology which is essential to engineers involved in the design of, and ensuring the reliability of, machine parts and systems. It moves from basic theory to practice, examining tribology from the integrated viewpoint of mechanical engineering, mechanics, and materials science. It offers detailed coverage of the mechanisms of material wear, friction, and all of the major lubrication techniques - liquids, solids, and gases - and examines a wide range of both traditional and state-of-the-art applications. For this edition, the author has included updates on friction, wear and lubrication, as well as completely revised material including the latest breakthroughs in tribology at

the nano- and micro- level and a revised introduction to nanotechnology. Also included is a new chapter on the emerging field of green tribology and biomimetics. Tribology is an unfamiliar term for many, but is experienced by all. It is the science of friction, wear and lubrication of contacting surfaces in relative motion. The aim of this book is to introduce the fundamentals of tribology as well as its challenges in extreme operating conditions. The book comprises a historical background and an introduction to familiarize both undergraduate and postgraduate readers with such an important topic. It addresses a comprehensive coverage of classical tribology of solid contacts, friction mechanics, wear mechanisms and lubrication technologies. The tribology of polymer composites, MEMS and NEMS are explored. In addition, tribology of automotive components is presented, as are tribological applications in many practical situations. Various test methods used in evaluating wear are reviewed. Diverse techniques applied in predicting wear behavior by mathematical models, FE modeling and ANN approach are discussed. The book reviews key features of extraordinary conditions associated with, but not limited to, harsh environments, severe sliding and poor lubrication challenges. A basic understanding of failure modes in tribological systems is covered. The state-of-the-art research on tribology under these extreme conditions is extensively discussed, which will be of interest to researchers. The book highlights solutions for extreme tribology problems and provides an overview of various factors affecting tribosystems in harsh conditions. Professors Wen and Huang present current developments in tribology research along with tribology fundamentals and applications, including lubrication theory, lubrication design, friction mechanism, wear mechanism, friction control, and their applications. In addition to classical tribology, Wen and Huang cover the research areas of the modern tribology, as well as the regularities and characteristics of tribological phenomena in practice. Furthermore, the authors present the basic theory, numerical analysis methods, and experimental measuring techniques of tribology as well as their applications in engineering. Provides a systematic presentation of tribology fundamentals and their applications Discusses the current states and development trends in tribology research Applies the applications to modern day engineering Computer programs available for download from the book's companion site Principles of Tribology is aimed at postgraduates and senior-level undergraduates studying tribology, and can be used for courses covering theory and applications. Tribology

professionals and students specializing in allied areas of mechanical engineering and materials science will also find the book to be a helpful reference or introduction to the topic. Companion website for the book: www.wiley.com/go/wen/tribology

Industrial Tribology Tribology of Additively Manufactured Materials: Fundamentals, Modeling, and Applications starts with a look at the history, methods and mechanics of additive manufacturing (AM), focusing on power bed fusion-based and direct energy deposition-based additive manufacturing. Following sections of the book provide a foundational background in the fundamentals of tribology, covering the basics of surface engineering, friction and wear, corrosion and tribocorrosion, and the tribological considerations of a variety of AM materials, such as friction and wear in non-metallic and metallic AM materials, degradation in non-metallic AM components, and corrosion and tribocorrosion in AM components. The book then concludes with a section covering modeling and simulation scenarios and challenges related to the tribology of AM materials, providing readers with the processing conditions needed to extend and strengthen the lifetime and durability of AM materials and components. Provides theoretical, experimental and computational data for a better understanding of the complex tribological behaviors in additively manufactured components Discusses applications of additively manufactured components, considering their tribological properties Studies how unique surface roughness and texture develop in additively manufactured components and how these unique characteristics affect their tribological function Outlines variables, additive manufacturing methods and performance of additively manufactured components Equips readers with a better understanding of degradation effects due to tribology and corrosion The interdisciplinary nature of tribology encompasses knowledge drawn from disciplines such as mechanical engineering, materials science, chemistry and physics. The interaction between these different fields of knowledge to achieve the final result, the control of friction and wear, is reviewed in this volume. This interdisciplinary approach has proven to be a very successful way of analysing friction and wear problems. In many cases tribology is viewed as an inaccessible subject which does not produce useful answers. In this volume the authors redress this problem by providing a comprehensive treatment of the subject. A basic feature of the book is the emphasis on describing various concepts in an accessible manner for the benefit of non-specialists. This principle is applied from the beginning of the book, where the

reader is introduced to the fundamental concept of tribology. This concept is then often used to show how the various topics in tribology are interrelated to form one coherent subject. A direct graphical illustration of the mechanisms controlling tribological phenomena is presented. Carefully prepared diagrams allow rapid appreciation of the basic ideas and facts in tribology. The numerical analysis of hydrodynamic lubrication is supported by a number of computer programs which are included in the book. The control of wear is given extensive treatment with a thorough discussion of lubricant additives, solid lubricants and surface coatings. The effectiveness of coatings in suppressing specific forms of wear is analyzed together with the methods of coatings deposition. The book contains 474 figures and 44 tables. More than 1000 references are provided to give the reader access to more specialized information if required. The volume is intended to provide graduates in engineering or materials science with an understanding of the fundamental concepts of friction, wear and lubrication. This book describes available tribology technologies and introduces a comprehensive overview of tribology. General, up-to-date knowledge on how tribology is approached in various related areas of research, both experimental and computational is provided. This book aims to show how tribological concepts can be applied in order to improve manufacturing technology in modern industry. It can be used as a guide book for engineering students or a reference useful for academics in the fields of tribology, manufacturing, materials and mechanical engineering. Shows how algorithms developed from the basic principles of tribology can be used in a range of practical applications in mechanical devices and systems. Includes: bearings, gears, seals, clutches, brakes, tyres. **TRIBOLOGY AND CHARACTERIZATION OF SURFACE COATINGS** The book provides updated information on the friction and wear behavior of coatings used in various industrial applications. Surface modification is a cost-effective process of increasing the life of components so that the whole device need not be changed if the surface is worn out. The tribological behavior of biological implants is currently an active topic and a thorough discussion is one of the book's features. Tribology and Characterization of Surface Coatings explores key issues which are important in the research and development of surface coatings by providing updated information on friction and wear behavior of coatings used in different industrial applications. It covers the various coating deposition techniques, tribological response of nanocomposite coatings, multilayer hardfacing, and wear testing methods for

coatings at nanoscale. The use of nanostructures may alter the tribological, characterization, and mechanical properties of the materials. Thermal spraying is the most widely used technique in industry for the deposition of coatings and their tribological properties need to be determined. This book also includes the recent trends in biotribology and the materials used in implants to counter the abrasive wear. Audience The book will serve as a reference to researchers, scientists, academicians, industrial engineers, and students who work in the fields of materials/polymer science and mechanical engineering. Apart from their applications to aerospace and electronics industries, the coatings are also used in the field of biomedical engineering. Much research has been carried out and a lot of progress has been made towards the use of composite materials in a wide field of tribological applications. In recent years studies have been made to determine to what degree phenomena governing the tribological performance of composites can be generalized and to consolidate interdisciplinary information for polymer-, metal- and ceramic matrix composites. The importance of promoting better knowledge in the areas of friction, lubrication and wear, in general, is demonstrated by the contents of this volume. It covers a wide range of subjects extending from fundamental research on the tribological characteristics of various multi-phase materials up to final applications of composites in wear loaded, technical components. Besides the emphasis on composites tribology, the great practical aspect of the field in many industrial applications is also reviewed by authors who are engaged in applied research as well as those in more academic activities. The articles in this volume will facilitate both researchers and mechanical designers in their work towards a set of predictive, materials engineering-related models for a more reliable use of composites as tribo-materials. Through the study of, and observation of, the tribology of sensibly formulated composite systems may emerge a clear and more profound understanding of the subject of tribology. In this sense, this book offers a major and critical evaluation of the state of understanding of the principles of tribology and its ability to serve the practical and commercial needs of this technology generally, and particularly in the context of composite systems. Tribology: Friction and Wear of Engineering Materials, Second Edition covers the fundamentals of tribology and the tribological response of all classes of materials, including metals, ceramics, and polymers. This fully updated and expanded book maintains its core emphasis on friction and wear of materials, but now also has a strengthened coverage of the more traditional

tribological topics of contact mechanics and lubrication. It provides a solid scientific foundation that will allow readers to formulate appropriate solutions when faced with practical problems, as well as to design, perform and interpret meaningful tribological tests in the laboratory. Topics include the fundamentals of surface topography and contact mechanics, friction, lubrication, and wear (including tribo-corrosion), as well as surface engineering, selection of materials and design aspects. The book includes case studies on bearings, automotive tribology, manufacturing processes, medical engineering and magnetic data storage that illustrate some of the modern engineering applications in which tribological principles play vital roles. Each chapter is complemented by a set of questions suitable for self-study as well as classroom use. This book provides valuable material for advanced undergraduates and postgraduates studying mechanical engineering, materials science and other technical disciplines, and will also be a useful first reference point for any engineer or scientist who encounters tribological issues. Provides an excellent general introduction to friction, wear, and lubrication of materials Acts as the ideal entry point to the research literature in tribology Provides the tribological principles to underpin the design process Through systematic coverage of the subject and appropriate questions, develops the reader's understanding and knowledge of tribology in a logical progression. Engineering Tribology by John Williams of Cambridge University is an ideal textbook for a first tribology course and a reference for designers and researchers. Engineering Tribology gives the reader interdisciplinary understanding of tribology including materials constraints. Real design problems and solutions, such as those for journal and rolling element bearings, cams and followers, and heavily loaded gear teeth, elucidate concepts and motivate understanding. This work integrates qualitative and quantitative material from a wide variety of disciplines including physics, materials science, surface and lubricant chemistry, with traditional engineering approaches. Studying the morphology, defects, and wear behavior of a variety of material surfaces, Mechanical Tribology examines popular and emerging surface characterization techniques for assessment of the physical, mechanical, and chemical properties of various modified surfaces, thin films, and coatings. Its chapters explore a wide range of tribological applications while promoting reduced component deterioration and improved efficiency and reliability of mechanical systems. The book includes extensive coverage of critical technologies that are usually absent in

other references on the subject, delving into procedures affecting metal cutting and forming, physicochemical issues involved in the design of fiber finishes, and recent progress in biotribological research. It provides strategies to characterize the friction and wear properties of tribological systems and procedures to assess the quality and lifetime of ceramic materials. It also outlines methods to avoid scuffing and seizure in machine operations and novel techniques to prevent oil from spreading and creeping in lubricating applications. Mechanical Tribology is a practical guide for mechanical, industrial, chemical, process, design, and process engineers, materials scientists, and tribologists in the selection of materials, surface treatments, coatings, and environments best suited for a particular industrial application. The second edition of a bestseller, this book introduces tribology in a way that builds students' knowledge and understanding. It includes expanded information on topics such as surface characterization as well as recent advances in the field. The book provides additional descriptions of common testing methods, including diagrams and surface texturing for enhanced lubrication, and more information on rolling element bearings. It also explores surface profile characterization and elastic plastic contact mechanics including wavy surface contact, rough surface contact models, friction and wear plowing models, and thermodynamic analysis of friction. Tribology for engineers discusses recent research and applications of principles of friction, wear and lubrication, and provides the fundamentals and advances in tribology for modern industry. The book examines tribology with special emphasis on surface topography, wear of materials and lubrication, and includes dedicated coverage on the fundamentals of micro and nanotribology. The book serves as a valuable reference for academics, tribology and materials researchers, mechanical, physics and materials engineers and professionals in related industries with tribology. Edited and written by highly knowledgeable and well-respected researchers in the field Examines recent research and applications of friction, wear and lubrication Highlights advances and future trends in the industry This handbook is a collection of authoritative information in the new and expanding field of polymer tribology. It brings together various research topics in the field of polymer tribology in a single volume, and provides relevant data in polymer tribology for research and industrial applications. The book's chapters are written by active, world-renowned researchers in the field. Subjects covered in this book range from the fundamentals of polymer tribology to highly applied topics such as

machine element design (bearing and gears), hip prosthetic and microsystems applications. Readers in the field of tribology, in general, and polymer tribology, in particular, will find it very useful as it covers nearly all aspects of polymer tribology. Academics creating new courses based on polymer tribology will also find this book's comprehensive coverage valuable. Researchers will find this book a ready source of the state-of-the-art in the field of polymer tribology. This book discusses dissipative phenomena, in particular the origins of friction at all scales, in mechanics, physics and chemistry, encountered in all fields of tribology, from thick film lubrication to dry friction. Tribology is the science of friction, lubrication and wear of moving components. Results obtained from tribology are used to reduce energy losses in friction processes, to reduce material losses due to wear, and to increase the service life of components. Contact Mechanics plays an important role in Tribology. Contact Mechanics studies the stress and strain states of bodies in contact; it is contact that leads to friction interaction and wear. This book investigates a variety of contact problems: discrete contact of rough surfaces, the effect of imperfect elasticity and mechanical inhomogeneity of contacting bodies, models of friction and wear, changes in contact characteristics during the wear process, etc. The results presented in this book were obtained during my work at the Institute for Problems in Mechanics of the Russian Academy of Sciences. The first steps of this research were carried out under the supervision of Professor L. A. Galin who taught me and showed me the beauty of scientific research and solutions. Some of the problems included in the book were investigated together with my colleagues Dr. M. N. Dobyshin, Dr. O. G. Chekina, Dr. I. A. Soldatenkov, and Dr. E. V. Toriskaya from the Laboratory of Friction and Wear (IPM RAS) and Prof. F. Sadeghi from Purdue University (West Lafayette, USA). I would like to express my thanks to them. I am very grateful to Professor G. M. L. A fully updated version of the popular Introduction to Tribology, the second edition of this leading tribology text introduces the major developments in the understanding and interpretation of friction, wear and lubrication. Considerations of friction and wear have been fully revised to include recent analysis and data work, and friction mechanisms have been reappraised in light of current developments. In this edition, the breakthroughs in tribology at the nano- and micro- level as well as recent developments in nanotechnology and magnetic storage technologies are introduced. A new chapter on the emerging field of green tribology and biomimetics is included. Introduces the

topic of tribology from a mechanical engineering, mechanics and materials science points of view Newly updated chapter covers both the underlying theory and the current applications of tribology to industry Updated write-up on nanotribology and nanotechnology and introduction of a new chapter on green tribology and biomimetics This book focuses on novel materials for advanced engine design including the study of friction, wear, lubrication, suitable lubricant additives, and durability of different engine components of alcohol/biodiesel fueled engines. The contents highlight different lubrication systems to overcome friction and wear problems of automotive transportation systems. It also discusses different materials for future applications, wear of wheels and axels of locomotives, friction-induced noise and vibration and tribological behavior of texture surfaces in the automotive transport sector. This book will be of interest to those in academia and industry involved in alternative fuels application in IC engines, friction and wear study of various engine components, lubrication approaches and different additives of lubricants, and novel materials for advanced engine design. Tribology of Thin Layers The tribology of miniature systems is quite different from the tribology of large machinery. This is the first publication to cover on an academic level both the basic concepts of the tribology of miniature systems and some areas of its practical application. A comprehensive survey is given on the specific problems encountered in this field, providing a volume that will be useful in solving professional engineering problems in the fast growing field of precision engineering and microtechnology. The suitability of various materials and lubricants for the tribological systems in miniature mechanisms is discussed. The tribological properties and the friction and wear properties which occur in such systems are analysed. Specific lubrication problems are examined in detail; in particular, the use of special tribological coatings to solve many difficult lubrication problems and to obtain high wear resistance of the rubbing elements is considered. The special investigation techniques used to characterize miniature tribological systems and their elements (e.g. lubricants) are reviewed. The tribological aspects of many of the most common assemblies found in miniature mechanism and electromechanism design are analysed and some practical suggestions are put forward for the rational design of such systems. Also special tribological problems such as those met in computer technology, bioengineering, etc. are presented. The book is intended for tribologists (both seasoned researchers and newcomers) studying the problems of this specific branch of tribology and also for

practising engineers active in the design, manufacture and exploitation of various miniature systems. Friction, lubrication, adhesion, and wear are prevalent physical phenomena in everyday life and in many key technologies. This book explains how these tribological phenomena originate from atomistic and microscale physical phenomena and shows how this understanding can be used to solve macroscale tribology problems. The book is intended to serve both as a textbook for advanced undergraduate and graduate courses in tribology and as an introduction to the field for those scientists and engineers working with technologies where a good grasp of tribology is essential. Friction, lubrication, adhesion, and wear are prevalent physical phenomena in everyday life and in many key technologies. This book incorporates a bottom-up approach to friction, lubrication, and wear into a versatile textbook on tribology. This is done by focusing on how these tribological phenomena occur on the small scale — the atomic to the micrometer scale — a field often called nanotribology. The book covers the microscopic origins of the common tribological concepts of roughness, elasticity, plasticity, friction coefficients, and wear coefficients. Some macroscale concepts (like elasticity) scale down well to the micro- and atomic-scale, while other macroscale concepts (like hydrodynamic lubrication) do not. In addition, this book also has chapters on topics not typically found in tribology texts: surface energy, surface forces, lubrication in confined spaces, and the atomistic origins of friction and wear. These chapters cover tribological concepts that become increasingly important at the small scale: capillary condensation, disjoining pressure, contact electrification, molecular slippage at interfaces, atomic scale stick-slip, and atomic bond breaking. Throughout the book, numerous examples are provided that show how a nanoscale understanding of tribological phenomena is essential to the proper engineering of important modern technologies such as MEMS, disk drives, and nanoimprinting. For the second edition, all the chapters have been revised and updated to incorporate the most recent advancements in nanoscale tribology. Another important enhancement to the second edition is the addition of problem sets at the end of each chapter.

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