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SPACE SYSTEMS AND THEIR INTERACTIONS WITH EARTH'S SPACE ENVIRONMENT
v. 71

Edited by Henry B. Garrett and Charles P. Pike, Air Force Geophysics Laboratory

This volume presents a wide-ranging scientific examination of the many aspects of the interaction between space systems and the space environment, a subject of growing importance in view of the ever more complicated missions to be performed in space and in view of the ever growing intricacy of spacecraft systems. Among the many fascinating topics are such matters as: the changes in the upper atmosphere, in the ionosphere, in the plasmasphere, and in the magnetosphere, due to vapor or gas releases from large space vehicles; electrical charging of the spacecraft by action of solar radiation and by interaction with the ionosphere, and the subsequent effects of such accumulation; the effects of microwave beams on the ionosphere, including not only radiative heating but also electric breakdown of the surrounding gas; the creation of ionosphere "holes" and wakes by rapidly moving spacecraft; the occurrence of arcs and the effects of such arcing in orbital spacecraft; the effects on space systems of the radiation environment, etc. Included are discussions of the details of the space environment itself, e.g., the characteristics of the upper atmosphere and of the outer atmosphere at great distances from the Earth; and the diverse physical radiations prevalent in outer space, especially in Earth's magnetosphere. A subject as diverse as this necessarily is an interdisciplinary one. It is therefore expected that this volume, based mainly on invited papers, will prove of value.

737 pp., 6 × 9, illus., $30.00 Mem., $55.00 List

ENTRY HEATING AND THERMAL PROTECTION
v. 69

HEAT TRANSFER, THERMAL CONTROL, AND HEAT PIPES
v. 70

Edited by Walter B. Olstad, NASA Headquarters

The era of space exploration and utilization that we are witnessing today could not have become reality without a host of evolutionary and even revolutionary advances in many technical areas. Thermophysics is certainly no exception. In fact, the interdisciplinary field of thermophysics plays a significant role in the life cycle of all space missions from launch, through operation in the space environment, to entry into the atmosphere of Earth or one of Earth's planetary neighbors. Thermal control has been and remains a prime design concern for all spacecraft. Although many noteworthy advances in thermal control technology can be cited, such as advanced thermal coatings, louvered space radiators, low-temperature phase-change material packages, heat pipes and thermal diodes, and computational thermal analysis techniques, new and more challenging problems continue to arise. The prospects are for increased, not diminished, demands on the skill and ingenuity of the thermal control engineer and for continued advancement in those fundamental discipline areas upon which he relies. It is hoped that these volumes will be useful references for those working in these fields who may wish to bring themselves up-to-date in the applications to spacecraft and a guide and inspiration to those who, in the future, will be faced with new and, as yet, unknown design challenges.

Volume 69—361 pp., 6 × 9, illus., $22.00 Mem., $37.50 List
Volume 70—393 pp., 6 × 9, illus., $22.00 Mem., $37.50 List

INJECTION AND MIXING IN TURBULENT FLOW
v. 68

By Joseph A. Schetz, Virginia Polytechnic Institute and State University

Turbulent flows involving injection and mixing occur in many engineering situations and in a variety of natural phenomena. Liquid or gaseous fuel injection in jet and rocket engines is of concern to the aerospace engineer; the mechanical engineer must estimate the mixing zone produced by the injection of condenser cooling water into a waterway; the chemical engineer is interested in process mixers and reactors; the civil engineer is involved with the dispersion of pollutants in the atmosphere; and oceanographers and meteorologists are concerned with mixing of fluid masses on a large scale. These are but a few examples of specific physical cases that are encompassed within the scope of this book. The volume is organized to provide a detailed coverage of both the available experimental data and the theoretical prediction methods in current use. The case of a single jet in a coaxial stream is used as a baseline case, and the effects of axial pressure gradient, self-propulsion, swirl, two-phase mixtures, three-dimensional geometry, transverse injection, buoyancy forces, and viscous-inviscid interaction are discussed as variations on the baseline case.

200 pp., 6 × 9, illus., $17.00 Mem., $27.00 List

REMOTE SENSING OF EARTH FROM SPACE: ROLE OF "SMART SENSORS"
v. 67

Edited by Roger A. Breckenridge, NASA Langley Research Center

The technology of remote sensing of Earth from orbiting spacecraft has advanced rapidly from the time two decades ago when the first Earth satellites returned simple radio transmissions and simple photographic information to Earth receivers. The advance has been largely the result of greatly improved detection sensitivity, signal discrimination, and response time of the sensors, as well as the introduction of new and diverse sensors for different physical and chemical functions. But the systems for such remote sensing have until now remained essentially unaltered: raw signals are radioed to ground receivers where the electrical quantities are recorded, converted, zero-adjusted, computed, and tabulated by specially designed electronic apparatus and large main-frame computers. The recent emergence of efficient detector arrays, microprocessors, integrated electronics, and specialized computer circuitry has sparked a revolution in sensor system technology, the so-called smart sensor. By incorporating many or all of the processing functions within the sensor device itself, a smart sensor can, with greater versatility, extract much more useful information from the received physical signals than a simple sensor, and it can handle a much larger volume of data. Smart sensor systems are expected to find application for remote data collection not only in spacecraft but in terrestrial systems as well, in order to circumvent the cumbersome methods associated with limited on-site sensing.

505 pp., 6 × 9, illus., $22.00 Mem., $42.50 List

INTERIOR BALLISTICS OF GUNS
v. 66

Edited by Herman Krier, University of Illinois at Urbana-Champaign, and
Martin Summerfield, New York University

In planning this volume of the Series, the volume editors were motivated by the realization that, although the science of interior ballistics has advanced markedly in the past three decades and especially in the decade since 1970, there exists no systematic textbook or monograph today that covers the new and important developments. The present volume, composed entirely of chapters written specially to fill this gap by authors invited for their particular expert knowledge, was therefore planned in part as a textbook, with systematic coverage of the field as seen by the editors.

Three new factors have entered ballistic theory during the past decade, each it so happened from a stream of science not directly related to interior ballistics. First and foremost was the detailed treatment of the combustion phase of the ballistic cycle, including the details of localized ignition and flame spreading, a method of analysis drawn largely from rocket propulsion theory. The second was the formulation of the dynamical fluid-flow equations in two-phase flow form with appropriate relations for the interactions of the two phases. The third is what made it possible to incorporate the first two factors, namely, the use of advanced computers to solve the partial differential equations describing the nonsteady two-phase burning fluid-flow system.

The book is not restricted to theoretical developments alone. Attention is given to many of today's practical questions, particularly as those questions are illuminated by the newly developed theoretical models. It will be seen in several of the articles that many pathologies of interior ballistics, hitherto called practical problems and relegated to empirical description and treatment, are yielding to theoretical analysis by means of the newer methods of interior ballistics. In this way, the book constitutes a combined treatment of theory and practice. It is the belief of the editors that applied scientists in many fields will find material of interest in this volume.

385 pp., 6 × 9, illus., $25.00 Mem., $40.00 List

OUTER PLANET ENTRY HEATING AND THERMAL PROTECTION
v. 64

THERMOPHYSICS AND THERMAL CONTROL
v. 65

Edited by Raymond Viskanta, Purdue University

The growing need for the solution of complex technological problems involving the generation of heat and its absorption, and the transport of heat energy by various modes, has brought together the basic sciences of thermodynamics and energy transfer to form the modern science of thermophysics.

Thermophysics is characterized also by the exactness with which solutions are demanded, especially in the application to temperature control of spacecraft during long flights and to the questions of survival of re-entry bodies upon entering the atmosphere of Earth or one of the other planets.

More recently, the body of knowledge we call thermophysics has been applied to problems of resource planning by means of remote detection techniques, to the solving of problems of air and water pollution, and to the urgent problems of finding and assuring new sources of energy to supplement our conventional supplies.

Physical scientists concerned with thermodynamics and energy transport processes, with radiation emission and absorption, and with the dynamics of these processes as well as steady states, will find much in these volumes which affects their specialties; and research and development engineers involved in spacecraft design, tracking of pollutants, finding new energy supplies, etc., will find detailed expositions of modern developments in these volumes which may be applicable to their projects.

Volume 64—404 pp., 6 × 9, illus., $20.00 Mem., $35.00 List
Volume 65—447 pp., 6 × 9, illus., $20.00 Mem., $35.00 List
Set (Volumes 64 and 65)—$40.00 Mem., $55.00 List

EXPERIMENTAL DIAGNOSTICS IN COMBUSTION OF SOLIDS
v. 63

Edited by Thomas L. Boggs, Naval Weapons Center, and Ben T. Zinn, Georgia Institute of Technology

The objective of this volume is to assemble in one place a set of advanced expository treatments of the newest diagnostic methods that have emerged in recent years in experimental combustion research in heterogenous systems and to analyze both the potentials and the shortcomings in ways that would suggest directions for future development.

This volume was planned as a means to disseminate the techniques hitherto known only to specialists to the much broader community of research scientists and development engineers in the combustion field. We believe that the articles and the selected references to the current literature contained in the articles will prove useful and stimulating.

339 pp., 6 × 9, illus., $20.00 Mem., $35.00 List

ALTERNATIVE HYDROCARBON FUELS: COMBUSTION AND CHEMICAL KINETICS
v. 62

Edited by Craig T. Bowman, Stanford University, and Jφrgen Birkeland, Department of Energy

This volume is based on a set of original papers delivered at a special workshop called by the Department of Energy and the Department of Defense for the purpose of discussing the problems of switching to fuels producible from nonpetroleum sources for use in automotive engines, aircraft gas turbines, and stationary power plants. The authors were asked also to indicate how research in the areas of combustion, fuel chemistry, and chemical kinetics can be directed toward achieving a timely transition to such fuels, should it become necessary. Research scientists in those fields, as well as development engineers concerned with engines and power plants, will find this volume a useful up-to-date analysis of the changing fuels picture.

463 pp., 6 × 9, illus., $20.00 Mem., $35.00 List

RADIATION ENERGY CONVERSION IN SPACE
v. 61

Edited by Kenneth W. Billman, NASA Ames Research Center

The principal theme of this volume is the analysis of potential methods for the effective utilization of solar energy for the generation and transmission of large amounts of power from satellite power stations down to Earth for terrestrial purposes.

Physicists interested in the basic processes of the interaction of space radiation and matter in various forms, engineers concerned with solutions to the terrestrial energy supply dilemma, spacecraft specialists involved in satellite power systems, and economists and environmentalists concerned with energy will find in this volume many stimulating concepts deserving of careful study.

670 pp., 6 × 9, illus., $24.00 Mem., $45.00 List

AERODYNAMIC HEATING AND THERMAL PROTECTION SYSTEMS
v. 59

HEAT TRANSFER AND THERMAL CONTROL SYSTEMS
v. 60

Edited by Leroy S. Fletcher, University of Virginia

Volume 59 and Volume 60 offer a coordinated set of original papers representing some of the latest developments in the field of heat transfer. In Volume 59, the topics covered are: 1) The Aerothermal Environment, particularly aerodynamic heating combined with radiation exchange and chemical reaction; 2) Plume Radiation, with special reference to the emissions characteristic of the jet components; and 3) Thermal Protection Systems, especially for intense heating conditions. Volume 60 is concerned with: 1) Heat Pipes, a widely used but rather intricate means for internal temperature control; 2) Heat Transfer, especially in complex situations; and 3) Thermal Control Systems, a description of sophisticated systems designed to control the flow of heat within a vehicle so as to maintain a specified temperature environment.

Vol. 59—424 pp., 6 × 9, illus., $20.00 Mem., $35.00 List
Vol. 60—382 pp., 6 × 9, illus., $20.00 Mem., $35.00 List

TURBULENT COMBUSTION
v. 58

Edited by Lawrence A. Kennedy, State University of New York at Buffalo

In the last few years, two strong forces have emerged that now compel research scientists to attack the subject of turbulent combustion anew. One is the development of novel instrumental techniques that permit rather precise nonintrusive measurement of reactant concentrations, turbulent velocity fluctuations, temperatures, etc., generally by optical means using laser beams. The other is the compelling demand to solve hitherto bypassed problems such as identifying the mechanisms responsible for the production of the minor compounds labeled pollutants and discovering ways to reduce such emissions.

This new climate of research in turbulent combustion and the availability of new results led to the Symposium from which this book is derived. Anyone interested in the modern science of combustion will find this book a rewarding source of information.

485 pp., 6 × 9, illus., $20.00 Mem., $30.00 List

SPACE-BASED MANUFACTURING FROM NONTERRESTRIAL MATERIALS
v. 57

Editor: Gerard K. O'Neill, Assistant Editor: Brian O'Leary

Some of the most important engineering problems are dealt with in this book in a series of papers derived from a NASA-sponsored study organized by Prof. Gerard K. O'Neill: how to gather material resources from the nearby moon or nearby

asteroids, how to convert the materials chemically and physically to useful forms, how to construct such gigantic space structures, and necessarily, how to plan and finance so vast a program.

192 pp., 6x9, illus., $15.00 Member $23.00 List

THERMOPHYSICS OF SPACECRAFT AND OUTER PLANET ENTRY PROBES
v. 56

Edited by Allie M. Smith, ARO, Inc., Arnold Air Force Station, Tennessee

Stimulated by the ever-advancing challenge of space technology in the past 20 years, the science of thermophysics has grown dramatically in content and technical sophistication. The practical goals are to solve problems of heat transfer and temperature control, but the reach of the field is well beyond the conventional subject of heat transfer. As the name implies, the advances in the subject have demanded detailed studies of the underlying physics, including such topics as the processes of radiation, reflection and absorption, the radiation transfer with material, contact phenomena affecting thermal resistance, energy exchange, deep cryogenic temperature, and so forth. This volume is intended to bring the most recent progress in these fields to the attention of the physical scientist as well as to the heat-transfer engineer.

467 pp., 6x9, illus., $20.00 Member $40.00 List