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New books on physics and related sciences

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Isymov Yu A, Chashchin N I, Alekseev D S *Theory of Strongly Correlated Systems: The Generating Functional Method* (Moscow – Izhevsk: Izd-vo RKhD, 2006) 384 pp. ISBN 5-93972-502-3.

The basic models of the theory of strongly correlated systems used to describe physical phenomena in transition and rare-earth metals and their alloys and compounds — namely, the Heisenberg, Hubbard, t, sd, double exchange, and Anderson's periodic models — are presented in this book based on a unified approach. The book is clearly aimed at a wider audience than only theoretical physicists, with each chapter on a particular electronic model containing an extended review on what other theoretical methods available in the literature have to say about the model. (Science and Publishing Centre 'Regular and Chaotic Dynamics': 426034 Izhevsk, ul. Universitetskaya 1, Udmurt State University; tel.: (7-3412) 50-02- 95, (7-495) 332-48-92; e-mail: subscribe@rcd.ru; URL: http://shop.rcd.ru/)

Beskin V S *Axisymmetric Steady-State Flows in Astrophysics.* An undergraduate text (Moscow: Izd-vo Fizmatlit, 2006) 384 pp. ISBN 5-9221-0646-5.

This monograph is the first attempt at a unified survey of work on the astrophysical applications of the Grad – Shafranov equation. A unified framework is developed within which axisymmetric steady flows widely characteristic of compact astrophysical objects could be described for the first time in terms of their general properties. With its uniquely wide scope (which encompasses hydrodynamics, forceless approximation, and the full MHD version including the most general Kerr-metric case) and with its expository style (simple-to-complex progression, with ample use of problems), the author made the world's first systematic introduction to the analytical theory of axially symmetric stationary transonic flows. The book uses rather simple but solvable models to study the key properties of flows around real astrophysical objects like radio pulsars, accreting neutron stars and black holes, and central engines in active galactic nuclei. The primary goal of the book is not to viably model specific compact objects but to elucidate the key properties of MHD flows in the vicinity of real cosmic sources. Although the book is thus concerned with the purely physical — rather than astrophysical — aspects of theory, all the applications considered are astrophysical, so it is hoped that the book will also be of interest for astrophysicists, including those involved with numerical simulations. While heavily drawing on the author's own work of 1983 – 2004, when he first formulated the full MHD version of the Grad – Shafranov equation using the 3 + 1 expansion technique and when he obtained exact solutions for many cases of astrophysical interest, the book also includes a detailed analysis of practically all analytical solutions that have been obtained by others — making it what may be called an encyclopedia of exact astrophysically relevant solutions of the Grad – Shafranov equation. The edition was supported by the Russian Foundation for Basic Research under Grant No. 05-02-30015d and is recommended by the Academic Methodology Center for classical university education as a textbook for undergraduate physics and astronomy students. (Fizmatlit Publ.: 117997 Moscow, Profsoyuznaya ul. 90; tel. (7-495) 334-74-21, fax (7-495) 334-76-20; e-mail: fizmat@maik.ru; URL: http://www.fml.ru/)

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Translated by E G Strel'chenko

Boiko A V, Grek G R, Dovgal' A V, Kozlov V V *Physical Mechanisms of Transition to Turbulence in Open Flows*. Monograph and CD-ROM (Moscow – Izhevsk: Izd-vo RKhD, 2006) 304 pp. ISBN 5-93972-488-4.

The monograph covers the fundamentals and basic principles of the theory of hydrodynamic stability and presents the state-of-the-art in theoretical and experimental studies of the laminar-to-turbulence transition in open hydrodynamic systems. It discusses a variety of thematically relevant problems, including recent approaches to the study of transient phenomena. Some aspects of the transition problem that are examined in the book are relatively independent of one another and have already become traditional topics in the field. These include the generation of laminar flow perturbations (the so-called susceptibility problem), the behavior of these perturbations at the early stages of flow turbulization (where the small-amplitude perturbation approximation is valid in many cases), and the nonlinear properties of a perturbed flow at the final stage of the laminar-to-turbulence transition. Also discussed in this book are the influence of various factors on transient processes and existing methods for predicting the position of the transition to turbulence and for controlling the phenomenon by actively or passively affecting the flow characteristics. The companion CD-ROM contains the full text and program codes as well as additional illustrative (including video) material (referenced in the text) on the most interesting phenomena discussed. The monograph is intended for an audience incorporating fluid mechanics undergraduate and postgraduate students and specialists with an interest in the phenomenon of hydrodynamic instability. (Science and Publishing Center 'Regular and Chaotic Dynamics': 426034 Izhevsk, ul. Universitetskaya 1, Udmurt State University; tel.: (7-3412) 50-02-95, (7-495) 332-48-92; e-mail: subscribe@rcd.ru; URL: http://shop. rcd.ru/)

Shibkova L V, Shibkov V M *Discharge in Inert Gas Mixtures* (Moscow: Izd-vo Fizmatlit, 2005) 200 pp. ISBN 5-9221-1196-5.

This monograph reflects the current state of research into nonequilibrium low-temperature plasma of a gas discharge in

inert gas mixtures. It summarizes and systematizes experimental work on the physical processes proceeding in the unsteady multicomponent plasma of inert gases. Highlighted in the text are processes capable of spatially redistributing binary mixture components; the dynamics of reaching the stationary separation level, and the effect of a longitudinal magnetic field on the radial separation of components in gas mixtures and discharge characteristics. The book is intended for research workers, engineers, and undergraduate and postgraduate students specializing in plasma physics, gas discharge physics, atomic physics, physical kinetics, and related fields. (Fizmatlit Publ.: 117997 Moscow, Profsoyuznaya ul. 90; tel.: (7-495) 334-74-21, fax: (7-495) 334-76-20; e-mail: fizmat@maik.ru; URL: http://www.fml.ru/)

Borisov A V, Mamaev I S *Rigid Body Dynamics*: *Hamiltonian Methods, Integrability, Chaos* (Moscow – Izhevsk: Izd-vo IKI, 2005) 576 pp. ISBN 5-93972-485-X.

The book examines the basic types of equations describing rigid body motions, including motion in potential fields and in a liquid (Kirchhoff equations) as well as motions in the presence of liquid-filled cavities in the body. All the systems considered in the book are amenable to describing within the Hamiltonian formalism. Practically all the integrable cases known to date are brought together, as are methods for explicitly integrating them. Added to the previous edition are sections on analyzing nonintegrability and chaotic behavior encountered in various problems in rigid body dynamics. The book draws widely on computer methods to convey the picture of motion. Most of the results presented are from the authors' own research. The target audience comprises undergraduate and postgraduate students in the disciplines of mechanics, mathematics, and physics, an well as specialists in mathematical physics and dynamical systems. (Institute for Computer Studies Publ.: 426034 Izhevsk, ul. Universitetskaya 1; tel./fax: (7-3412) 50-02-95; e-mail: subscribe@rcd.ru; URL: http://ics.org.ru/)

Stupitskii E L *Dynamics of High-Power Pulsed Radiations and Plasma Formations* (Moscow: Izd-vo Fiziko-Matematicheskoi Literatury, 2006) 280 pp. ISBN 5-94052-109-6.

Results of research and numerical simulation on the dynamical and kinetic aspects of the propagation of plasma and electromagnetic energy fluxes are presented in relation to their possible applications. Particular attention is given to the elaboration of numerical algorithms adapted to gaining a better insight into the physics of the phenomena under study. The book is designed for research workers specializing in plasma physics and interested in the propagation of radiation and charged particles in gases. It will also be useful to a final year degree and postgraduate students in related disciplines. (Fiziko-Matematicheskaya Literatura Publ.: 119071 Moscow V-71, Leninskii prosp. 15; tel.: (7-495) 952-49-25, fax: (7-495) 955-03-30; e-mail: fizmatlit@mtu-net.ru; URL: http://fizmatlit.narod.ru/)

Resonances in Celestial Mechanics ('Modern Celestial Mechanics' Series) (Moscow – Izhevsk: Izd-vo RKhD, 2006) 316 pp. ISBN 5-93972-491-4.

A collection of papers by Western and Russian experts on the long-period and secular evolution of the solar system is presented. The list of papers to be translated was suggested by Jacques Lascar of France, a celestial mechanics scientist and a Corresponding Member of the Paris Academy of Sciences. Although the collection volume is not too large, it clearly demonstrates the achievements the Russian and French schools of celestial mechanics have made in the study of resonances, captures, and other mechanisms that control the evolution of the solar system. Bearing in mind that this branch of celestial mechanics is closely related to various aspects of nonlinear physics, chaos, and theoretical and applied mechanics, specialists in a variety of fields will find this a useful book. (Science and Publishing Center 'Regular and Chaotic Dynamics': 426034 Izhevsk, ul. Universitetskaya 1, Udmurt State University; tel.: (7-3412) 50-02-95, (7-495) 332-48-92; e-mail: subscribe@rcd.ru; URL: http://shop.rcd.ru/)

Minkevich I G *Material – Energy Balance and the Growth Kinetics of Microorganisms* (Moscow – Izhevsk: Izd-vo RKhD, 2005) 352 pp. ISBN 5-93972-504-X.

This monograph provides the first systematic exposition of a new physico-chemical approach to energetics of microorganisms, known as the theory of material – energy balance. The author introduces a generalized unit of reducibility of chemical compounds, based on which relations between metabolic fluxes (consumption of substrates, the formation of biomass and of metabolism products) are found; then he presents formulas that relate biomass yield to biochemical cell characteristics, enabling the value of yield to be predicted based on biochemical studies. Experiments that support this theory and use its results in the analysis of cell bioenergetics are described. Advances in mathematically modeling microbial populations, including the development of distributed models, are discussed. Solutions to the dynamics of the age distribution of cells in a synchronous culture with allowance made for the effect of the substrate are obtained here for the first time, and the text also describes the bistat, a novel continuous cultivation method, which allows the effect of the substrate to be studied over the entire range of substrate concentration. This book was supported by Grant No. 04-04-62062 from the Russian Foundation for Basic Research. It is designed for a broad range of readers, including biologists, biotechnologists, and biophysicists, as well as mathematicians, physicists, and chemists with an interest in biology. (Science and Publishing Center 'Regular and Chaotic Dynamics': 426034 Izhevsk, ul. Universitetskaya 1, Udmurt State University; tel.: (7-3412) 50-02-95, (7-495) 332-48-92; e-mail: subscribe@rcd.ru; URL: http://shop.rcd.ru/)

Russia's Future in the Mirror of Synergetics ('Synergetics: from the Past to the Future' Series) Edited by G G Malinetskii (Moscow: Editorial URSS, 2006) 272 pp. ISBN 5-484-00277-X.

A collection of materials from an interdisciplinary conference devoted to the future of and strategic problems faced by Russia. The conference, hosted by the Presidential Russian Academy of State Service, had great resonance, both socially and politically, and raised much interest in the academic and educational communities. In analyzing possible development strategies for the country, a rapidly developing interdisciplinary approach — the theory of self-organization, also known as synergetics — was employed. Leading Russian and Ger-

man specialists in synergetics and social sciences participated in the forum. This collection of reports will serve as an essential reading for leaders in various contexts, civil servants, and researchers, as well as for a wide range of faculty and students. (Editorial URSS Publ.: 117312 Moscow, prosp. 60-letiya Oktyabrya 9, office 203 at the RAS Institute for Systems Analysis; tel./fax: (7-495) 135-4423, 135-4216; e-mail: urss@urss.ru; URL: http://www.urss.ru/)

Kolesnikov A A ***Synergetic Methods in Complex System Control: the Theory of System Synthesis*** (Moscow: Editorial URSS, 2006) 240 pp. ISBN 5-484-00198-6.

A new synergetic theory of system synthesis is presented, whose underlying idea is the unified nature of directional self-organization and control processes in complex dynamical macrosystems. Emphasis is laid on developing new methods for analytically constructing objective laws of control that enable us to allow for the natural (physical, chemical, biological, etc.) properties of the nonlinear systems being synthesized in the maximum degree. One of the central aim of the book is the dissemination among specialists of the modern cutting-edge ideas of synergetics and nonlinear dynamics as a tool for controlling complex nonlinear systems of various natures. The book addresses undergraduate and postgraduate students, engineers, and scientists and university faculty in various fields who are engaged in the interdisciplinary problems of synergetics and control science. (Editorial URSS Publ.: 117312 Moscow, prosp. 60-letiya Oktyabrya 9, office 203 at the RAS Institute for Systems Analysis; tel./fax: (7-495) 135-44-23, 135-42-16; e-mail: urss@urss.ru; URL: http://www.urss.ru/)

Zinov'ev G S ***Fundamentals of Power Electronics.*** A manual; 3rd ed. revised and enlarged (Novosibirsk: Izd-vo NGTU, 2004) 672 pp. ISBN 5-7782-0464-7.

This textbook examines electric energy conversion principles realized in basic rectification, inversion, and frequency and voltage transformation schemes. Topics covered include the fundamentals of methods for directly analyzing energy processes in such schemes; the main characteristics of all the basic transformation schemes, and how to control valve transformers. The book is structured by presenting the material in a three-level mode ('three-in-one' approach) as concerns the depth of its exposition. The upper two levels are designed for students seeking technician qualification through the master's and engineering degree courses in the disciplines of power electronics and industrial electronics. The lower level is destined for undergraduate general engineering courses in power electronics for students in the electrical engineering, electric power, and radio engineering disciplines. Exercises and self-test questions ('tests' in the electronic version of the text) are included with each chapter. Specialists with different power electronics backgrounds, who participate in in-service training programs, will also benefit from this book. (Novosibirsk State Technical University Publishing – Printing Complex: 630092, Novosibirsk, prosp. K. Marksa 20; tel./fax: (7-3832) 46-31-87; e-mail: office@publish.nstu.ru; URL: http://www.publish.nstu.ru/)

Pobedrya B E, Georgievskii D V ***Fundamentals of Continuum Mechanics.*** A lecture course (Moscow: Izd-vo Fizmatlit, 2006) 272 pp. ISBN 5-9221-0649-X.

This original lecture course covers the kinematics of continua, the theory of stressed and strained states, conservation laws, dimensional analysis, and the isothermal models of ideal and viscous liquids and of an elastic body. It discusses the fundamentals of phenomenological thermodynamics and uses its laws to obtain closed problem formulations for non-isothermal models, including the coupled problems of thermal mechanics, electrothermoelasticity, and magnetic hydrodynamics. Particular emphasis is placed on the theory of defining relations. Featured in the book is the program of the course 'Continuum Mechanics'. The Mathematics and Mechanics Council of the Academic Methodology Center for classical university education recommended this book as a textbook for undergraduate students taking a course in mechanics. (Fizmatlit Publ.: 117997 Moscow, Profsoyuznaya ul. 90; tel.: (7-495) 334-74-21, fax: (7-495) 334-76-20; e-mail: fizmat@maik.ru; URL: http://www.fml.ru/)

Smol'yakov E R ***Theory of Conflict Equilibria*** (Moscow: Editorial URSS, 2005) 304 pp. ISBN 5-354-00596-5.

This monograph provides an introduction to the theory of conflict equilibria — an entirely new scientific discipline which, given that all our world embodies a continuous chain of conflicts, will in time find natural applications in economics, politics, art and culture, science and technology, and indeed in any human activity. The most obvious application areas are in game problems, for which a theory of cooperative, noncooperative, and antagonistic games has been built, based on a unified system of equilibria and including classical game theory as a special case; in politics and economics, where the theory of conflict equilibria provides a behavior selection strategy for achieving a desired end result and finding the most stable and universally suitable equilibrium state; and even in physics, where it provides a tool with which stable states of a physical vacuum can be found. It will be equally valuable to specialists in conflict, game, optimization, and decision-making theories, and to those active in theoretical physics and mechanics. (Editorial URSS Publ.: 117312 Moscow, prosp. 60-letiya Oktyabrya 9, office 203 at the RAS Institute for Systems Analysis; tel./fax: (7-495) 135-44-23, 135-42-16; e-mail: urss@urss.ru; URL: http://www.urss.ru/)

Bakulin V N, Malkov S Yu, Goncharov V V, Kovalev V I ***Robustness Control of Complex Engineering Systems*** (Moscow: Izd-vo Fizmatlit, 2006) 304 pp. ISBN 5-9221-0664-3.

This monograph discusses the fundamentals and methodology of creating complex engineering systems resisting attack by destabilizing factors of various kinds. It uses the example of an aircraft to illustrate a calculation-and-experiment-based robustness estimation procedure. It is shown how using the developed methods allows control over the stability of complex engineering systems at various stages of their development: during justification and specification of robustness requirements; in designing and experimental developing the system, and during the check for the fulfillment of these requirements at the acceptance test stage. Intended audience is designers of complex engineering systems and engineering students from senior undergraduate level upwards. (Fizmatlit Publ.: 117997 Moscow, Profsoyuznaya ul. 90; tel.: (7-495) 334-74-21; fax: (7-495) 334-76-20; e-mail: fizmat@maik.ru; URL: http://www.fml.ru/)

Yanovskaya T B, Porokhova L N ***Inverse Problems in Geophysics.*** A manual; 2nd ed. revised and enlarged (St.-Petersburg: SPb State University Publ., 2004) 214 pp. ISBN 5-288-03429-X.

This manual, whose first edition was published in 1983, formulates the inverse geophysical problem as one of modeling a medium based on the observed characteristics of the geophysical field, provided that the operator for directly transforming the model of the medium to the corresponding field characteristics is well known. The book describes mathematical methods for solving the problem, including statistical methods, the regulation method, as well as the Beicus – Hilbert and pseudoinversion methods. The Monte Carlo method, widely used in geophysics, is described in more detail, and the principles of the annealing simulation method are outlined. The possibility of applying the Beicus – Hilbert method to nonlinear problems is also considered. Accompanying the text are example solutions of inverse problems encountered in seismology, tomography, and situations involving horizontally nonuniform media. The intended audience is senior undergraduates and postgraduates in geophysics, although the book can also be useful to professionals engaged in interpreting geophysical observations. (SPb University Publ.: 199034 St.-Petersburg, Universitetskaya nab. 7/9; tel.: (7-812) 328-77-63; fax: (7-812) 328-44-22; e-mail: books@dk2478.spb.edu; URL: http://www.unipress.ru/)

Kuliev V D ***Singular Boundary Value Problems*** (Moscow: Izd-vo Fizmatlit, 2005) 720 pp. ISBN 5-9221-0588-4.

The monograph systematically reviews research conducted by the author on the theory of integral equations and the theory of boundary value problems for analytical functions. Some part of the book covers the application of these theories to various classes of problems in the mechanics of brittle and fatigue failure and, as a particular result, presents a more adequate approach by the author to the failure of an n(n-1)-layered elastic media with a crack. The author also suggests a method for solving canonical singular problems in the theory of elastic piecewise homogeneous media. Using this method, a number of problems are solved and key results on elasticity theory and failure mechanics are obtained. The book is aimed at senior undergraduate students in physics and mathematics departments, as well as research engineers, postgraduate students, and research workers in the fields of applied mathematics and mechanics. (Fizmatlit Publ.: 117997 Moscow, Profsoyuznaya ul. 90; tel.: (7-495) 334-74-21; fax: (7-495) 334-76-20; e-mail: fizmat@maik.ru; URL: http://www.fml.ru/)

Goppa V D ***Universal Irreducible Modules*** (Moscow: Izd-vo Fiziko-Matematicheskoi Literatury, 2004) 88 pp. ISBN 5-94052-063-6.

A number of new representation algorithms are presented in this book intended for physicists, mathematicians, and engineers on the subject of realizing symmetric group representations. (Fiziko-Matematicheskaya Literatura Publ.: 119071 Moscow V-71, Leninskii prospekt 15; tel.: (7-495) 952-49-25; fax: (7-495) 955-03-30; e-mail: fizmatlit@mtu-net.ru; URL: http://www.fizmatlit.narod.ru/)

Compiled by *E V Zakharova*
(e-mail: zaharova@ufn.ru)