



Prof. Jaroslav Šesták, M.Eng., Ph.D., D.Sc., Dr.h.c.

Jaroslav was born in the village 'Držkov' (North Bohemian Mountains) where he still possesses a small farm. He obtained a degree MEng in silicate chemistry and cements (1962) and PhD in solid state physics (1968, both in Prague) latter degree was approved while he spend a year at the University of Missouri at Rolla as an assistant professor (teaching electronic processes) in ceramics (UMR 1970). He got married when working in Sweden (1969, Studsvik Nuclear Research Center) with a MEng graduate from Prague (Věra) who joined and then supported Jaroslav when he was staying at USA where she received her second degree in ceramics (M.S., UMR 1970). Since that Jaroslav and Věra have two children, daughter Elizabeth (Bětká, *1977) and boy Paul (*1980), grandson David (*2012).

Nationality: Czech Republic

Date and place of birth: 1938 in Držkov

Profession: Scientist, Educator and Photographer

Education, scientific and pedagogic degrees:

Chemical Engineering (M.Eng., 1962, Technical University of Prague), Solid State Physics (Ph.D., 1968, Institute of Solid-State Physics); Material Science (D.Sc., 1990), Inorganic Chemistry (Habil. Doc = Associate Professor, University of Pardubice, 1991), Material Science and Engineering (Full Professor, Institute of Chemical Technology in Prague 1993) and Dr.h.c. for his life achievements in solid-state chemistry and physics, Pardubice University, 2010.

Workplaces: Institute of Physics (since 1962), Nuclear centre in Studsvik (Sweden, 1969), University of Missouri at Rola (USA, 1969-70), Kyoto University (Japan, 1996 & 2005; emeritus), Pardubice University (1990-1998), Taiwan National University in Taipei (1994, 2005, 2006 & 2012), Charles University in Prague (1998-2002), University of West Bohemia in Pilzen (2001-today), University of New York in Prague (2000-today).

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Main fields of interest: Thermal physics and thermodynamics, chemical kinetics, solid-state chemistry and physics, material science and engineering: oxides (magnetics, superconductors, bioactive ceramics), glasses (both metallic and silicates), semiconductors (III-V compounds), quantum aspects of diffusion, interdisciplinarity of science and humanities, philosophy and education, wisdom of heat and scientific world in general; construction of TA instruments.

Awards: Mettler/NATAS (USA) 1974, Scientific book of the year 1984, Kurnakov Medal (USSR/Russia) 1985, Bodenheimer Award (Izrael) 1988,

ICTAC/TA Inter. Award (England) 1992, Hanus Medal (Czech Chemical Society) 1999, Heyrovsky Inter. Award (Czech Acad. of Sci.) 2000, Patras award in thermodynamics (Greece) 2007, Emeritus scientists Academy of Sciences 2011; Who is who in the Czech Republic (Praha) all volumes since 2003 and Who is who in the world, all volumes since 2000. Over 250 plenary and invited lectures home and abroad, number of publications: 284, number of citations: 2450, Hirsch citation factor 23.

Books: author (*at*), coauthor (*cat*), editor (*ed*) and coeditor (*ced*).

1974 - The Study of Processes by Thermal Analysis (*cat*, Special Issue of TCA, Elsevier), 1975 - Kinetics of thermochemical reactions in solids in Heterogeneous chemical reactions (*cat*, Minsk, USSR, in Russian), 1982 - Thermophysical Properties of Solids (*at*, in Czech, Academia, Praha), 1984 - dtto (*at*, in English, Elsevier, Amsterdam), 1988 - dtto (*at*, in Russian, Nauka, Moscow), 1990 - Thermochemistry of High T_c Superconductors (*ced*, Special Issue of TCA, Elsevier), 1991 - Kinetic Phase Diagrams, Non-equilibrium Phase Transitions (*cat*, Elsevier, Amsterdam), 1993 - Special Technologies and Materials (*at & coed*, in Czech, Academia, Praha), 1994 - Experimental Thermodynamics and Calorimetry (*ced*, Special Issue of TCA, Elsevier), 1995 - Phase Transitions in Condensed Matter (*ced*, Special Issue of TCA, Elsevier), 1996 - Vitrification, Transformation and Crystallization of Glasses (*ed*, Special Issue of TCA, Elsevier), 2004 - Heat, Thermal Analysis and Society (*at*, Nucleus, Hradec Králové), 2005 - Science of Heat and Thermophysical Studies (*at*, Elsevier), 2007 - Structure and properties of crystalline and amorphous materials (*ed*, Univ. Pardubice), 2009 - Some thermodynamic, structural and behavioral aspects of materials (*ed*, Pilsen), Selected topics of textile and materials science (*ed*, Pilsen-Liberec, 2011), Glassy, amorphous and nano-crystalline materials (*ed*, Springer 2011), Thermal analysis of micro-, nano- and non-crystalline materials (*ed*, Springer 2013).

Projects/ Grants: [1] GA ČR 104/94/0706: "Evaluation and modeling values of enthalpy, entropy, heat capacity and temperatures of melting for complex inorganic compounds" (applicant and person in charge: J. Šesták, 1994-1996); [2] GA AV ČR A2010532: "Calculation of thermodynamic data in real systems of magnetics, semiconductors, superconductors and oxide glasses with regards to the microcrystalline phases formation" (applicant and person in charge: J. Šesták, 1995-1997); [3] GA ČR 104/97/0589: "Evaluation of kinetic and thermodynamic data in the selected inorganic systems suitable for the preparation of tailored phases through crystallization" (applicant and person in charge: J. Šesták, 1997-1999); [4] GA ČR 522/01/1399 "Thermodynamic analysis of water in plants" (applicant J. Zámečník a coapplicant J. Šesták, 2001-2003); [5] GA AV ČR A4010101: "Thermodynamic a kinetic study of transformation and crystallization processes in special oxide glasses" (applicant

and person in charge: J. Šesták, 2001-2003); [6] GA ČR 401/02/0579 „*Study and propagation transdisciplinary aspects in natural and philosophical disciplines*” (applicant Z. Kalva and coapplicant J. Šesták, 2002-2004); [7] GA ČR 522/04/0384 “*Study of thermodynamic principles of the formation of biological glasses during the cryopreservation of plants*” (applicant J. Zámečník and coapplicant J. Šesták, 2004-2006); [8] GA AV ČR IAA1010404 „*Generalization of transformation processes in solids enhancing specificity of glassy state*” (applicant and person in charge: J. Šesták, 2006-2008); [9] J. Šesták (edt) “*Physics of Structures of Amorphous and Crystalline Materials*” by B. Hlaváček, J.J. Mareš, Publication Center of Pardubice University, Pardubice 2008, 450 pp (in Czech); [10] M. Holeček, J. Málek, J. Šesták (edts) “*Some Thermodynamic, Structural and Behavioral Aspects of Materials Accentuating Non-crystalline States*” OPS, West Bohemian University, Plzen 2009; tem leader CENTEM, material research project by OP RDI program of the Ministry of Education, Youth and Sports, Plzen 2010-2015.

Professional activities: Cofounder of ICTAC in London 1965, Cofounder of Thermochemica Acta 1970, Program Chairman - V. ICTA Conference (Bratislava) 1974, Program Chairman - Int. Conf. of Thermodynamics (Praha) 1995, Program Chairman - Int. Conf. on Glass (Trenčín) 2004, ICTAC Council member and member of its various committees (kinetics, nomenclature), Chairman of the ICTAC working group on materials (1990-2000), Chairman of the Czech working group on thermal analysis (1994-2008), Member of Editorial Advisory Boards, Journal of Thermal Analysis (1986 -), Thermochemica Acta (1970-1996), Journal of Mining and Metallurgy (1996-), Member of Advisory Boards of both, Charles University, University of West Bohemia and Technical University in Liberec, Program auspice of the University of West Bohemia (1999-), Co-founder of the new School of Energy Sciences, Kyoto University (1996), Vice-director of the Institute of Advanced Studies, Charles University (1998-2002), Prague deputy (1994-2002) and member of the Prague Government (1994-1998), Independent candidate for the seat in the Czech Parliament (1997) and the Senate (1996), Co-founder of the new Faculty of Humanistic Studies of the Charles University (1999), Program Chairman Conference on Glass (Trencin 2004), Honorary member of the Czech Academy of Engineers (2005), Honorary Chairman of the International Conference on Glass, Trencin 2008, cofounder of the International Journal on Applied Glass Research (Wiley, USA 2009) and Global Journal of Analytical Chemistry (2010)..

Hobbies: Recognized photographer (23 photo-exhibitions home and abroad), former basketball league player and mountaineer (Alps, Caucasus, Pamir, Himalaya, etc.).

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Single lecture of Prof. J. Šesták (available 2007/9):

- * “Bulk and mesoscopic thermodynamics and thermal studies of inorganic materials utilized for the bone tissue implantation”
- * “Modern advances in dental implantology - search for new materials with particular thermophysical properties such as titanium”
- * “Plant cryopreservation and biological glass occurrence”
- * “Can thermodynamic study and thermal analysis be of help for the safe keeping of biological germplasm?”
- * “What are modern trends in a more widely comprehended field of thermodynamics such as econophysics, ecosystems, entropy issues and informatics”
- * “Theory of historical ‘caloric’ and its impact to the concept of entropy and information”
- * “Thermodynamic laws versus human feelings: phase diagrams in science and society”
- * “Energy views and crisis - natural limits given by thermodynamics and the exploitation forecast of energy resources”
- * “Energy outlook and environmental quandary: would the use of hydrogen solve the green-house effect?”
- * “Energy from Sun, planet Earth, climate and civilization”
- * “Science of heat as thermal analysis: tradition versus innovation”
- * “Interdisciplinary science: close cooperation among research, development and utilization”
- * “Some historical aspect of thermal analysis, calorimetry and thermodynamics: from the early Greek philosophy to recent rational science.” or “History of physics in Bohemia and Czechia”
- * “Modern aspects of advanced inorganic materials”
- * “What is the glassy state and its thermodynamic description: advancement of technology and science of inorganic glasses”
- * “Special glasses: metallic, chalcogenide, oxide, biological etc.”
- * “The role of phases and phase diagrams in the chronicle of the recent progress and better understanding of high T_c oxide superconductors”
- * “Semiconductors and nanoelectronics research in the Prague institute of physics”
- * “Kinetic phase diagrams or how to include non-equilibrium phenomena in to the conventional phase diagrams”
- * “Theory and practice of thermometry: thermal analysis (DTA/DSC) and calorimetry”
- * “Non-isothermal kinetics by thermal analysis”
- * “Quantum diffusion: the way how to describe periodical behavior of self-organized chemical reactions”

Seminary courses:

- * “Theory and practice of thermal analysis and calorimetry “
- * “Advanced inorganic materials specially focused on non-equilibrium states”
- * “Inorganic glasses: history, thermodynamics and technology”
- * “Thermodynamics and thermostatics”
- * “Scientific world: On the borderland of philosophy and science of nature”
- * “Material science and engineering: from history to avant-garde”
- * “Man and science: from the creation of Universe to the Earth climate”

Book yet available at the Elsevier Publishing House, Amsterdam

SCIENCE OF HEAT AND THERMOPHYSICAL STUDIES

A Generalized Approach to Thermal Analysis



By

Jaroslav Šesták, Institute of Physics of the Academy of Sciences, Praha, Czech Republic

Description

Science of Heat and Thermophysical Studies provides a non-traditional bridging of historical, philosophical, societal and scientific aspects of heat with a comprehensive approach to the field of generalized thermodynamics. It involves Greek philosophical views and their impact on the development of contemporary ideas. Covered topics include:

- the concept of heat (caloric, entropy), temperature and gradients
- thermometry and calorimetry, theory and practice of DTA and DSC
- from Greek philosophy, alchemy to caloric theory, power laws and

modern thermal physics

- from thermostatics to non-equilibrium and quantum thermodynamics
- chemical kinetics and non-isothermal studies
- from heat to entropy, order and information
- thermal science applied to economy(econophysics), ecosystems and societal applications
- mesoscopic scales (quantum diffusion, vacuum: zero-point electromagnetic radiation)
- importance of energy science and its influence to societal life, energy resources and sustainability

Audience

This title is recommended to specialists in thermal science (thermodynamics) as well as the general scientist and students. It can serve as a reference text for those interested in the many concepts behind thermal physics and thermal analysis and possible applications in other areas, providing the reader with a wide background and framework of thermal sciences at present and in past. 712 references.

Contents

1. Some Philosophical Aspects of Scientific Research.
 2. Miscellaneous Features of Thermal Science.
 3. Fire as a Philosophical and Alchemical Archetype.
 4. Concept of Heat in the Renaissance and New Age.
 5. Understanding Heat, Temperature and Gradients.
 6. Heat, Entropy and Information.
 7. Thermodynamics and Thermostatics.
 8. Thermodynamics, Econophysics, Ecosystems and Societal Behavior.
 9. Thermal Physics of Processes Dynamics.
 10. Modeling Reaction Mechanism: The use of Euclidian and Fractal Geometry.
 11. Non-Isothermal Kinetics by Thermal Analysis.
 12. Thermometry and Calorimetry.
 13. Thermophysical Examinations and Temperature Control
- App.: brief characteristics of some important scholars and scientists

Bibliographic & ordering Information

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UNIVERSITY OF NEW YORK, PRAGUE

Course: *Scientific World* (“On the borderland of science and philosophy of nature”)
NP 75101, 3 credit hours, Legerova 72, Thursdays 09:00 – 12:00, Spring 2008
Instructor: Prof. Jaroslav Šesták, MEng., PhD., DSc., dr.h.c.

Catalogue Description

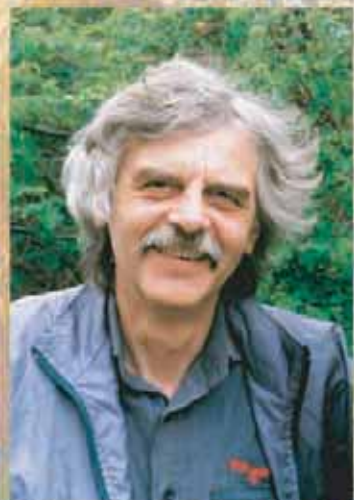
The course emphasizes critical thinking about personal and social needs for science. Specific topics illustrate purpose and thoughts in science: classical physics, quantum physics, astronomy, chemical bonding, geology, weather, living cell, genetics, evolution, etc..The course embodies general aspects of sciences and their impacts to cultural, technical, ecological and societal life of people and society.

Course Purpose

The science for MS non-majors is a fundamental introductory course in natural sciences and their conceptual understanding as well as reflection to various (ecological, historical, philosophical and sociological) features underlining aspects of human and environmental ecology. It calls attention to thoughts regarding personal and societal shares in science and is designed to familiarize students with history, knowledge and research progress of civilization without accentuating mathematical methods.

Contents of the Course

1. Development of basic terms, measurements and dimensionality, scales and horizons, geocentric and heliocentric ideas, the role of basic constants (speed of light), gravitational and acceleration forces, Newton’s mechanics, Euclidean, Lobatshevsky and Riemann geometry
2. Vital and mortal forces, early roots of civilisation, Greek philosophers, history of fire, concept of four elements, Hermetic philosophy and alchemy, transmutation, phlogiston, caloric, heat and temperature, Renaissance and New Age, heat and temperature
3. Energy and entropy, thermodynamic laws and engines, energy transducers, what is time, direction of time and entropy, relativity, living and non-living (inorganic systems), heat and energy, information and energy and entropy, energy availability and resources,
4. Atoms and bonds, particles and waves, what are waves and light, universality of laws, how we see the Universe, relativity, materials and their property, material technology and progress of civilisation
5. Numbers and letters, binary a decimal systems, linear and non-linear response, variables and arithmetic, Euclid geometry, Euler functions and graphs, IQ tests, general geometry of Universe
6. Order in crystals and in universe, symmetry laws, nucleation and growth, cosmology, the earth and universe, inorganic and organic matter, how life begun, science of life, geology
7. What is chaos, measures and dimensions, fractals, alometry, evolution, arts, equilibrium and non-equilibrium, irreversibility, bifurcations, snowflakes and dendrite growth, weather
8. Sustainable progress of civilisation, production of thermal and mechanical energy, engines, power plants, natural sciences and society, human feelings versus thermodynamic laws
9. Energy for the planet earth, materials and civilisation, recycling of wastes, plastic age, transformations, reinforced states, art and science of glasses
10. Traditional (coal, oil) and alternative (wind, solar) sources of energy, nuclear energy, nuclear plants - should we be afraid, ecology, ecosystems and what a sustainable progress is.
11. History of physiology of hearing, sensation of tones, dissonance and consonance, timbre and musical scale, atom like a music instrument
12. Human senses and associations, stimulus and sensation, responses of living creatures, logarithmic measure, psychology (convictions and reasons), Weber-Fechner law in physiology, common statistical nature, information and universe
13. How we fell, our senses, evolution and specialisation of mind, impulse transfer, neurons and neurotransmitters, function of drugs, living body as a chemical factory: smell, taste, sight and hearing



Prof. *Jaroslav Šesták*, MEng., PhD., DSc.,

was born in Držkov 1938 and obtained an education in ceramics (1962) and solid-state physics (1968) together with a worldwide experience in Sweden (1969) and USA (1970). He devoted his scientific proficiency to experimental and theoretical studies related to the thermodynamics of materials, particularly to non-equilibrated systems such as glasses. He authored and edited 12 books and monographs (such as „Kinetic Phase Diagrams“ 1991 or „Special Technologies and Advanced Materials“ 1993) and published almost 300 scientific papers that have received over 2000 citations. He is member of various editorial (J. Thermal Analysis, Thermochim. Acta or J. Mining and Metallurgy) and scientific boards. He gave over 150 invited and plenary lectures. He was presented with various scientific awards and medals such as NATAS, USA 1974; Kurnakov, USSR 1985; Bodenheimer, Izrael 1988; ICTAC, England 1992; Hanuš (Czech Chem. Soc.) and Heyrovský (Czech Acad. Sci.) both in Prague 1998 and 2000. He is a renowned teacher and mentor who have tried to introduce many new methods of interdisciplinary learning (Charles University and Institute of Chemical Technology in Prague, Czech Regional Universities of Pardubice, Liberec and Pilzen, University of New York in Prague and Kyoto University in Japan). He is also a recognized photographer (more than 20 photoexhibitions home and abroad); some of his art photos are presented in the book as the chapter's frontispieces.

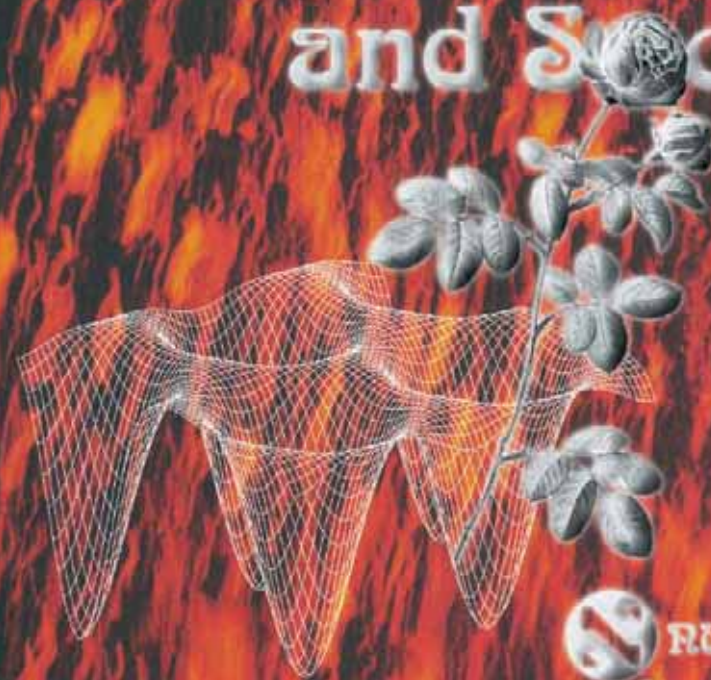
The size of this book is A4 (210 x 297mm); it comprises 400 pages with 169 illustrations, 23 tables and includes about 1000 bibliographical references, index data and 360 short characteristics of some great scientists as well as 56 photos. The text endeavors to elucidate wide spectrum of scientific and philosophical problems from classical to quantum thermodynamics, from energy science to informatics or from Euclidian to fractal geometry including the general impact of power laws. The book emphasizes the study of properties of various interfaces not only in physics but also in learning and cultural frontiers. Text requires minimum effort on reader's mathematics and is thus recommendable to students and interested public readers as well as to the advanced scientific community. The book has already received very positive review responses from both the humanistic and scientific sources appreciating its innovative, cross-disciplinary and wide-ranging approach, which is presented in an instructive and nontraditional manner worth reading. The book is printed black on the coated (scratchboard) paper and is hardbound.

The cost of the book is 89 €. ISBN 80-86225-54-2.

The book is available on request at the Publishing House NUCLEUS HK® (RNDr. Ing. F. Skopec, CSc.), Divišova 882, CZ - 500 03 Hradec Králové, Czech Republic and is distributed by post parcel service. Phone/fax: (+420) 495 217 146, E-mail: info@nucleus.cz, • www.nucleus.cz

Jaroslav Šesták

Heat, Thermal Analysis and Society



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CONTENTS

Volume one

Aspects of history and links to modern science – development of understanding

1) What makes thermal science beneficial?

- Searching nature and the scale dimensions
- Thermal feeling (fuzzy versus deliberated)
- Databases in thermal material sciences
- Horizons of knowledge
- Appraisal of the Internet

2) Roots of Western civilization

- Heat as a manufacturing tool
- Mechanical motion and heat transfer
- Ways to better understanding of our universe
- Miracle of commencement – rising new ideas
- Growth of modern theories and hypothesis

3) Fire as a philosophical archetype

- Sources and effects of fire
- Early Greek philosophical views
- Concept of four elements (fire, air, water, earth)
- Impact of alchemy (Hermetic philosophy)

4) Renaissance and the New Age

- Emerging new ideas (alchemy versus chemistry)
- Phlogiston and caloric (dilatation explained)
- Heat and energy (latent heat and temperature)
- Atomists and matter (periodicity)
- Underpinning of thermodynamics

Volume two

Appreciation of heat and thermal physics

5) Heat, temperature and gradients

- Development of the concept of temperature
- Heat transfer – analogy of Fick and Ohm Laws
- Non-stationary heat diffusion and the Schrödinger equation – common characteristics of transfer
- Practical aspects of heat flow – contact resistance and periodical outcome (thermal noise)
- Warm-cool feeling (such as the touch of clothes)
- Turbulent boundary layers
- Special aspects of non-equilibrium heat transfer

6) Thermodynamic principles

- Aspects of chemical thermodynamics
- Effect of the rate of heating
- Thermal properties and measurable quantities
- Chemical reactions (affinity, activity, enthalpy)
- Estimation and simulation of thermodynamic data for some inorganic compounds (data tabulation)
- Heterogeneous systems and the effect of surface energy (formation of a critical radius)
- Effect of perturbations and features of a rational approach (nonequilibrium state, entropy query)

7) Equilibrium and kinetic phase diagrams, nucleation and growth, glasses

- Equilibria and generalized Clapeyron equations
- Ideal and real solid solutions, phase diagrams
- Nucleation phenomena and phase transitions
- Kinetic phase diagrams (extent of metastability)
- Aspects of invariant and variant processes
- Thermodynamics of non-equilibrium glass transition (vitrification, relaxation, fictitiousity)
- Use of temperature diagrams for a better understanding of transition processes in glasses

8) Thermal physics of processes dynamics

- Phase transitions and their order
- Broadened phase transformations
- Equilibrium background and kinetic degree of a phase transition (isothermal and nonisothermal)
- Constitutive equations applied in chemical kinetics (concentration – interface geometry)
- Modeling used in the description of reaction mechanism (spherical models, activation energy)
- T-T-T and C-T phase diagrams

Volume three

Thermal treatment and the methods of thermal analysis

9) Thermophysical examinations and temperature control

- Measurements and modes of assessment
- Treatment of the output signal
- Characterization of experimental curves
- Purpose of the measurement – exemplifying thermogravimetry and its practical execution
- Origins of modern thermal analysis

10) Thermal study of materials and substances

- Temperature control
- Temperature detection
- Extreme temperature changes and the sample preparation methods – principles of quenching
- Surface treatment by lasers
- Controversial character of bulk and spot observations (DTA/DSC versus SEM)
- Particularity of temperature modulation

11) Thermal analysis and calorimetry

- Systematic of calorimetry
- Classification of thermoanalytical methods – heat balance and their analytical description
- DTA and DSC as quantitative instruments
- DTA calibration and the use of defined electrical pulses (what parts compose a DTA peak)
- Practical cases of applications – Cp data
- Temperature modulated modes

CONTENTS

12) Non-isothermal kinetics by thermal analysis

- Fundamental aspects of kinetic data evaluation
- Formal kinetic models and the role of an accommodation function (activation energy)
- Peculiarities of non-isothermal models
- Optimal evaluation procedures
- Oscillation-controlled-rate modes of thermal analysis (CRTA methods)
- Kinetic compensation effect

Volume four

Thermal dynamics and non-equilibrium phenomena – state progression

13) Power laws, fractals, chaos and information; or how nature is smart

- Stimulation responses, power and logarithmic dependencies – sensation and perception
- Significance of limits and self-similarity
- Sierpinski gaskets and fractal dimensions
- Deterministic chaos, periodic points and logistic functions – Faigenbaum universality constant
- Order, entropy and information (joule versus bit)
- Information and organization

14) Oscillation modes and modern theories of state

- Pendulum and related theory of ordered and chaotic motions
- Particles and their energies
- Vibration structures in condensed state and the description of vacancies creation
- Mathematical treatment of strong non-linearity above T_g transition
- Micro-model of solid-liquid transition: two types of vibration units
- Source of diffusion movements: nondeterministic elements

15) Advanced evaluation of processes – disequilibria and dendritic growth

- Classical kinetics and non-equilibrium thermodynamics – how to make evaluation
- Accounting on multiple fluxes
- Stereology aspects – sectioning by random probe
- Dissipative structures (bifurcations)
- Interface stability, perturbation and oscillatory modes – growth of perturbed grains
- Chaotic-like case of dendritic growth

16) The principle of least action and selforganization of chemical reactions

- How to evaluate unusual experiments
- Regular patterns provided by living organisms
- Repetitious order in some inorganic reactions
- Bénard convective rolls (instabilities)

- Principle of least action – Liesegang rings
- Diffusion action of Brownian particles
- Oscillatory regime of the Belousov-Zhabotinsky reactions – diffusivity, impact of Planck constant
- Quantum criterion and speed of diffusion

Volume five

Society, science and ecology – progress against survival

17) Energy science and society – environmental dilemma, its present state and future potentials

- Heat as a motive power – Otto and Diesel engines
- Alternative energy sources perspective to replace intermediary heat production, wind and fuel cells
- Resources of energy – how long they would last
- Heat production as a source of unwanted emission – problem of ‘clean energy’
- Non-equilibrium thermodynamics of fluid systems and our ‘cosmological engine’

18) Thermodynamics and civilization – laws versus feelings – phase diagrams applied to society

- Application of thermodynamic laws to society behavior – functions versus dispositions
- Some extended thermodynamic thoughts in economics – Carnot customized cycle
- Rules of behavior: strategy for survival and evolution – theory of games

19) Modern materials and society

- Intelligent processing and manufacturing of advanced materials – foreseeing the future
- Metallic glasses
- Ceramic high-temperature superconductors
- Bio-compatible glass-ceramics as mimetic materials for the bone tissue implantations

20) Advanced trends in understanding our Universe – mesoscopic thermodynamics

- Bartoli’s thermal engine and the zero-point radiation (spectral distribution)
- Energy in vacuum and Casimir forces
- Hypothetical Bartoli’s engine working with zeropoint electromagnetic radiation (quantum face of the second law applicability)
- Quantum impact on the study of low dimensional systems (quantum-wire patchcord)
- Quantum information processing (bit versus qubit, teleportation)
- Solar microwave background radiation