

Mathematical models for phase change problems with hysteresis effect

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Abstract

The paper deals with a phase change problem which includes hysteresis effect. The system under consideration could be applied to various biological models by choosing appropriate conditions. Numerical simulations of the behaviour of solutions are presented.

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1. Introduction

In this paper, we consider the following system

$$\Theta_t + u\Theta_x = \kappa\Theta_{xx} + \partial I_{K(u)}(\Theta) \ni F(\Theta, u) \quad \text{in } (0, T) \times (0, 1), \quad (1)$$

$$u_t - u_{xx} = h(\Theta, u) \quad \text{in } (0, T) \times (0, 1), \quad (2)$$

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Mathematical Models For Phase Change Problems

S.C. Gupta



Mathematical Models For Phase Change Problems:

Mathematical Models for Phase Change Problems J.F. Rodriques, 2013-03-07 This monograph collects research and expository articles reflecting the interaction and the cooperation of different groups in several European institutions concerning current research on mathematical models for the behaviour of materials with phase change. These papers were presented and discussed in a Workshop held at Obidos Portugal during the first three days of October 1988 and grew out of a two year period of intensive exploitation of different abilities and mathematical experiences of the six participating groups namely in the University of Augsburg which was the coordination center of this project the Laboratoire Central des Ponts et Chaussées of Paris the Aristoteles University of Thessaloniki the University of Florence the University of Lisbon and the University of Oxford. This project was carried out under the title Mathematical Models of Phase Transitions and Numerical Simulation in the framework of twinning program for stimulation of cooperation and scientific interchange sponsored by the European Community. The underlying idea of the project was to create and study the mathematical models arising in applied engineering problems with free boundaries in a broad sense namely in melting and freezing problems diffusion reaction processes solid solid phase transition hysteresis phenomena mushy region descriptions contact problems with friction and/or adhesion elastoplastic deformations etc. This large spectrum of applied problems have in common the main feature of brusque transitions of their qualitative behaviour that correspond in general to non classical discontinuous monotone or non monotone strong nonlinearities in the mathematical equations.

Mathematical Models for Phase Change Problems J.F. Rodriques, 1989-09-01

Models of Phase Transitions Augusto Visintin, 2012-12-06 What do you call work? Why ain't that work? Tom resumed his whitewashing and answered carelessly Well I like it is and maybe it aint All I know is it suits Tom Sawyer Oil CO I'll IOW Will do not mean to let 011 that you like it The brush continued to move Like it Well I do not see why I oughtn't to like it Does a boy get a chance to whitewash a fence every day That put the thing ill a little light Ben stopped nibbling the apple From Mark Twain's Adventures of Tom Sawyer Chapter II Mathematics can put quantitative phenomena in a new light in turn applications may provide a vivid support for mathematical concepts This volume illustrates some aspects of the mathematical treatment of phase transitions namely the classical Stefan problem and its generalizations The intended reader is a researcher in application oriented mathematics An effort has been made to make a part of the book accessible to beginners as well as physicists and engineers with a mathematical background Some room has also been devoted to illustrate analytical tools This volume deals with research I initiated when I was affiliated with the Istituto di Analisi Numerica del C.N.R. in Pavia and then continued at the Dipartimento di Matematica dell'Università di Trento It was typeset by the author in plain TEX

Mathematical Modeling Of Melting And Freezing Processes V. Alexiades, 2018-05-02 This reference book presents mathematical models of melting and solidification processes that are the key to the effective performance of latent heat thermal energy storage systems LHTES utilized in a wide range of heat transfer and industrial applications This topic

has spurred a growth in research into LHTES applications in energy conservation and utilization space station power systems and thermal protection of electronic equipment in hostile environments Further interest in mathematical modeling has increased with the spread of high powered computers used in most industrial and academic settings In two sections the book first describes modeling of phase change processes and then describes applications for LHTES It is aimed at graduate students researchers and practicing engineers in heat transfer materials processing multiphase systems energy conservation metallurgy microelectronics and cryosurgery

Handbook of Differential Equations: Evolutionary Equations C.M. Dafermos, Milan Pokorný, 2008-10-06 The material collected in this volume discusses the present as well as expected future directions of development of the field with particular emphasis on applications The seven survey articles present different topics in Evolutionary PDEs written by leading experts Review of new results in the area Continuation of previous volumes in the handbook series covering Evolutionary PDEs Written by leading experts

Mathematical Modelling and Simulation of Electrical Circuits and Semiconductor Devices Randolph Bank, R. Bulirsch, H. Gajewski, K. Merten, 2012-12-06 Progress in today's high technology industries is strongly associated with the development of new mathematical tools A typical illustration of this partnership is the mathematical modelling and numerical simulation of electric circuits and semiconductor devices At the second Oberwolfach conference devoted to this important and timely field scientists from around the world mainly applied mathematicians and electrical engineers from industry and universities presented their new results Their contributions forming the body of this work cover electric circuit simulation device simulation and process simulation Discussions on experiences with standard software packages and improvements of such packages are included In the semiconductor area special lectures were given on new modelling approaches numerical techniques and existence and uniqueness results In this connection mention is made for example of mixed finite element methods an extension of the Baliga Patankar technique for a three dimensional simulation and the connection between semiconductor equations and the Boltzmann equations

Phase Transitions and Hysteresis Augusto Visintin, 2006-11-15

- 1 Phase Transitions represented by generalizations of the classical Stefan problem This is studied by Kenmochi and Rodrigues by means of variational techniques
- 2 Hysteresis Phenomena Some alloys exhibit shape memory effects corresponding to a stress strain relation which strongly depends on temperature mathematical physical aspects are treated in Müller's paper In a general framework hysteresis can be described by means of hysteresis operators in Banach spaces of time dependent functions their properties are studied by Brokate
- 3 Numerical analysis Several models of the phenomena above can be formulated in terms of nonlinear parabolic equations Here Verdi deals with the most updated approximation techniques

An Ethical Global Information Society Jacques J. Berleur, Diane Whitehouse, 2013-11-11 Many challenges lie ahead in the development of a global information society Culture and democracy are two areas which may be under particular threat The book reflects on today's complex and uncertain cultural and democratic developments arising as a result of an increasingly global technologically connected world

In particular it focuses on the Internet examining new metaphors for communication defining the issues at stake and proposing options actions and solutions Among the issues discussed were multi cultural developments cultural sensitivities and the involvement of cultural minorities generation gaps gender issues technology access for the elderly and the disabled technology transfer

Progress in Applied Mathematical Modeling Fengshan Yang, 2008 This book presents new research related to the mathematical modelling of engineering and environmental processes manufacturing and industrial systems It includes heat transfer fluid mechanics CFD and transport phenomena solid mechanics and mechanics of metals electromagnets and MHD reliability modelling and system optimisation finite volume finite element and boundary element procedures decision sciences in an industrial and manufacturing context civil engineering systems and structures mineral and energy resources relevant software engineering issues associated with CAD and CAE and materials and metallurgical engineering

The Classical Stefan Problem S.C. Gupta, 2017-10-13 The Classical Stefan Problem Basic Concepts Modelling and Analysis with Quasi Analytical Solutions and Methods New Edition provides fundamental theory concepts modelling and analysis of the physical mathematical thermodynamical and metallurgical properties of classical Stefan and Stefan like problems as applied to heat transfer problems involving phase changes such as from liquid to solid This self contained work reports and derives the results from tensor analysis differential geometry non equilibrium thermodynamics physics and functional analysis and is thoroughly enriched with many appropriate references for an in depth background reading on theorems This new edition includes more than 400 pages of new material on quasi analytical solutions and methods of classical Stefan and Stefan like problems The book aims to bridge the gap between the theoretical and solution aspects of the afore mentioned problems Provides both the phenomenology and mathematics of Stefan problems Bridges physics and mathematics in a concrete and readable manner Presents well organized chapters that start with proper definitions followed by explanations and references for further reading Includes both numerical and quasi analytical solutions and methods of classical Stefan and Stefan like problems

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Table of Contents Mathematical Models For Phase Change Problems

1. Understanding the eBook Mathematical Models For Phase Change Problems
 - The Rise of Digital Reading Mathematical Models For Phase Change Problems
 - Advantages of eBooks Over Traditional Books
2. Identifying Mathematical Models For Phase Change Problems
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Mathematical Models For Phase Change Problems
 - User-Friendly Interface
4. Exploring eBook Recommendations from Mathematical Models For Phase Change Problems
 - Personalized Recommendations
 - Mathematical Models For Phase Change Problems User Reviews and Ratings
 - Mathematical Models For Phase Change Problems and Bestseller Lists

5. Accessing Mathematical Models For Phase Change Problems Free and Paid eBooks
 - Mathematical Models For Phase Change Problems Public Domain eBooks
 - Mathematical Models For Phase Change Problems eBook Subscription Services
 - Mathematical Models For Phase Change Problems Budget-Friendly Options
6. Navigating Mathematical Models For Phase Change Problems eBook Formats
 - ePub, PDF, MOBI, and More
 - Mathematical Models For Phase Change Problems Compatibility with Devices
 - Mathematical Models For Phase Change Problems Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Mathematical Models For Phase Change Problems
 - Highlighting and Note-Taking Mathematical Models For Phase Change Problems
 - Interactive Elements Mathematical Models For Phase Change Problems
8. Staying Engaged with Mathematical Models For Phase Change Problems
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Mathematical Models For Phase Change Problems
9. Balancing eBooks and Physical Books Mathematical Models For Phase Change Problems
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Mathematical Models For Phase Change Problems
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Mathematical Models For Phase Change Problems
 - Setting Reading Goals Mathematical Models For Phase Change Problems
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Mathematical Models For Phase Change Problems
 - Fact-Checking eBook Content of Mathematical Models For Phase Change Problems
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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