Preface

This book aims to present some recent results on a selection of nonlinear parabolic-hyperbolic coupled systems arising from physics, fluid mechanics and material science such as the compressible Navier-Stokes equations, viscous reactive and radiative gas, etc. Most of the material in this book is based on research carried out by the authors and their collaborators in recent years. Some of it has been previously published only in original papers, and some of the material has never been published until now.

There are five chapters in this book. Chapters 1–2 will be concerned with the study of non-isentropic Navier-Stokes equations. In Chapter 1, we shall investigate the global existence of spherically symmetric solutions for nonlinear compressible Navier-Stokes equations of initial boundary value problems with a non-autonomous external force and a heat source in bounded annular domains $G_n = \{r \in \mathbb{R}^n : a \leq r \leq b\}$ in $\mathbb{R}^n$ $(1 \leq n \leq 3)$. Thus we stress mainly the affect of non-autonomous terms on the global well-posedness and on the large-time behavior of solutions. Chapter 2 is concerned with the global existence and exponential stability of solutions for a real viscous compressible heat-conducting flow with general constitutive relations between two horizontal plates.

Chapters 3–4 are devoted to an investigation of the global existence and exponential stability of solutions to a pth power viscous reactive gas (Newtonian fluid) without and with a chemical reaction respectively. We should note that these models are quite different from the usual viscous heat-conductive reactive gas in Qin [59]. In detail, the models considered in Chapters 3–4 have more complicated constitutive relationships than those in Qin [59], and so we need to design more delicate and careful estimates to establish the uniform lower and upper bounds of the specific volume.

Chapter 5 is devoted to the study of viscous reactive and radiative gas. In Chapter 5, we shall establish the global existence and exponential stability of solutions in H^i $(i = 1, 2, 4)$ for a Stefan-Boltzmann model of a viscous, reactive and radiative gas with first-order Arrhenius kinetics in a bounded interval, which describes classical stellar evolution of a finite mass of a heat-conducting viscous reactive fluid in local equilibrium with thermal radiation: pressure, internal energy and thermal conductivity have Stefan-Boltzmann radiative contributions.

We sincerely hope that the reader will learn the main ideas and essence of the basic theories and methods in deriving global well-posedness, asymptotic behavior and regularity of global solutions for the models under consideration in this book. Also we are confident that the reader will be stimulated by some ideas from this book and undertake further study and research after having read the related references and our bibliographic comments.

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