Preface

All analysts spend half their time hunting through the literature for inequalities which they want to use and cannot prove.

G.H. Hardy.

The study of dynamic inequalities on time scales has received a lot of attention in the literature and has become a major field in pure and applied mathematics. This book is devoted to some fundamental dynamic inequalities on time scales such as Young's inequality, Jensen's inequality, Hölder's inequality, Minkowski's inequality, Steffensen's inequality, Čebyšev's inequality, Opial's inequality, Lyapunov's inequality, Halanay's inequality, and Wirtinger's inequality.

The book on the subject of time scale, i.e., measure chain, by Bohner and Peterson [51] summarizes and organizes much of time scale calculus. The three most popular examples of calculus on time scales are differential calculus, difference calculus, and quantum calculus (see Kac and Cheung [89]), i.e, when $\mathbb{T} = \mathbb{R}$, $\mathbb{T} = \mathbb{N}$, and $\mathbb{T} = q^{\mathbb{N}_0} = \{q^t : \ t \in \mathbb{N}_0\}$ where $q > 1$. There are applications of dynamic equations and inequalities on time scales to *quantum mechanics, electrical engineering, neural networks, heat transfer, combinatorics, and population dynamics.* A cover story article in New Scientist [141] discusses several possible applications. In population dynamics the dynamic equations can be used to model insect populations that are continuous while in season, die out in say winter, while their eggs are incubating or dormant, and then hatch in a new season, giving rise to a nonoverlapping population.

This book presents a variety of integral inequalities. We assume the reader has a good background in time scale calculus. The book consists of six chapters. In Chap. 1 we present preliminaries and basic concepts of time scale calculus, and in Chap. 2 we discuss and prove dynamic inequalities on time scales such as Young's inequality, Jensen's inequality, Holder's inequality, Minkowski's inequality, Steffensen's inequality, Hermite–Hadamard inequality, and Čebyšv's inequality. Opial type inequalities on time scales and their extensions with weighted functions will be discussed in Chap. 3. In Chap. 4 we present some inequalities of Lyapunov type for some dynamic equations, and in Chap. 5 we employ the shift operators $\delta_{\pm}$ to construct delay dynamic inequalities on time scales and use them to derive Halanay type inequalities for dynamic equations on time scales. Using Halanay's inequalities and the properties of exponential function on time scales, we establish new conditions that lead to stability for nonlinear dynamic equations. Finally in Chap. 6 we discuss Wirtinger-type inequalities on time scales and their extensions.

We wish to express our thanks to our families and friends.

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