It is known that many dynamic systems in our world can be better described by
differential equations of a non-integer-order, i.e., they behave like non-integer-
order (fractional-order) systems. Such systems can be found not only in electronics
and signal processing, but also in thermodynamics, biology, chemistry, medicine,
mechanics, control theory, nanotechnologies, finances, etc. Thus, fractional-order
systems are an emerging area of multidisciplinary research labeled even as the
“twenty-first century systems.” Electronic engineers are very interested in applying
the concept of fractional calculus. It is motivated mainly by the interdisciplinary
nature of this research and possibility to obtain qualitatively new circuit solutions
that can provide characteristics not available at integer-order systems. For example,
the capability for stepless control of the slope of frequency characteristics in
fractional-order filters in comparison with the corresponding integer-order filters
is an attractive feature. Fractional-order impedance circuits are also very promising
in modeling electrical properties of biological materials, tissues, or cells. Oscilla-
tors of fractional-order provide possibility of obtaining higher oscillation frequen-
cies compared to the integer-order counterparts with the same values of passive
element parameters offering arbitrary phase shift between output signals.

This book deals with the design and realization of analog fractional-order
circuits, which offer the following benefits: (i) capability for on-chip implementa-
tion, (ii) capability for low-voltage operation, and (iii) electronic adjustment of their
characteristics. Applications of fractional-order circuits, including: a preprocessing
stage suitable for the implementation of the Pan-Tompkins algorithm for detecting
the QRS complexes of an electrocardiogram (ECG), a fully tunable implementation
of the Cole-Cole model used for the modeling of biological tissues, and a simple
non-impedance based measuring technique for super-capacitors. A part of the
material presented in this book, originates from the work done by Georgia
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Rio Patras, Greece
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Georgia Tsirimokou
Costas Psychalinos
Ahmed Elwakil
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