

CONTENTS

<i>Preface</i>	<i>xi</i>
<i>Introduction</i>	<i>xiii</i>
Chapter 1: Modeling Methodology Using COMSOL Multiphysics 5.x	1
Guidelines for New COMSOL Multiphysics 5.x Modelers	1
Hardware Considerations	2
Simple Model Setup Overview	4
Basic Problem Formulation and Implicit Assumptions	12
1D Window Heat Flow Models	13
1D 1 Pane Window Heat Flow Model	13
1D 2 Pane Window Heat Flow Model	35
1D 3 Pane Window Heat Flow Model	49
First Principles as Applied to Model Definition	60
Some Common Sources of Modeling Errors	62
References	63
Suggested Modeling Exercises	63
Chapter 2: Materials Properties Using COMSOL Multiphysics 5.x	65
Materials Properties Guidelines and Considerations	65
COMSOL Materials Properties Sources	66
Other Materials Properties Sources	68

	Material Property Entry Techniques	69
	Multipane Window Model	69
	Set Boundary Conditions	86
	References	88
Chapter 3:	0D Electrical Circuit Interface Modeling Using COMSOL Multiphysics 5.x	89
	Guidelines for Electrical Circuit Interface Modeling in 5.x	90
	Electrical / Electronic Circuit Considerations	90
	Simple Electrical Circuit Interface Model	
	Setup Overview	99
	Basic Problem Formulation and Implicit Assumptions	104
	0D Basic Circuit Models	105
	0D Resistor-Capacitor Series Circuit Model	105
	0D Inductor-Resistor Series Circuit Model	112
	0D Series-Resistor Parallel-Inductor-Capacitor Circuit Model	118
	0D Basic Circuit Models Analysis and Conclusions	125
	First Principles as Applied to 0D Model Definition	126
	References	127
	Suggested Modeling Exercises	128
Chapter 4:	1D Modeling Using COMSOL Multiphysics 5.x	129
	Guidelines for 1D Modeling in 5.x	129
	1D Modeling Considerations	130
	1D Basic Models	131
	1D KdV Equation Model	131
	1D Telegraph Equation Model	148
	1D Spherically Symmetric Transport Model	167
	1D Spherically Symmetric Transport Model Animation	184
	1D Advanced Model	186
	1D Silicon Inversion Layer Model: A Comparison of the Results obtained from using the Density-Gradient (DG) Theory and the Schrodinger-Poisson (SP) Theory Methodologies	186

	First Principles as Applied to 1D Model Definition	223
	References	224
	Suggested Modeling Exercises	226
Chapter 5:	2D Modeling Using COMSOL Multiphysics 5.x	227
	Guidelines for 2D Modeling in 5.x	227
	2D Modeling Considerations	228
	2D Basic Models	233
	2D Electrochemical Polishing Model	233
	2D Hall Effect Model	256
	First Principles as Applied to 2D Model Definition	270
	References	271
	Suggested Modeling Exercises	272
Chapter 6:	2D Axisymmetric Modeling Using COMSOL Multiphysics 5.x	273
	Guidelines for 2D Axisymmetric Modeling in 5.x	273
	2D Axisymmetric Modeling Considerations	274
	2D Axisymmetric Heat Conduction in a Cylinder Model	278
	2D Axisymmetric Basic Models	278
	2D Axisymmetric Cylinder Conduction Model	278
	2D Axisymmetric Transient Heat Transfer Model	290
	First Principles as Applied to 2D Axisymmetric Model Definition	303
	References	304
	Suggested Modeling Exercises	304
Chapter 7:	2D Simple and Advanced Mixed Mode Modeling Using COMSOL Multiphysics 5.x	307
	Guidelines for 2D Simple Mixed Mode Modeling in 5.x	307
	2D Simple Mixed Mode Modeling Considerations	308
	2D Simple Mixed Mode Models	313
	2D Electric Impedance Sensor Model	313
	2D Metal Layer on a Dielectric Block Model	332
	Heat Transfer 2 (ht2) Interface	346
	Heat Transfer in Solids (ht) Interface	358

	First Principles as Applied to 2D Simple Mixed Mode Model Definition	363
	References	364
	Suggested Modeling Exercises	365
Chapter 8:	2D Complex Mixed Mode Modeling Using COMSOL Multiphysics 5.x	367
	Guidelines for 2D Complex Mixed Mode Modeling in 5.x	367
	2D Complex Mixed Mode Modeling Considerations	368
	2D Complex Mixed Mode Models Using the RF Module	370
	Finding the Impedance of a Two (2) Wire, Parallel-Wire, Air-Dielectric, Transmission Line	370
	2D Finding the Impedance of a Two (2) Wire, Parallel-Wire, Air-Dielectric, Transmission Line Model Summary and Conclusions	389
	2D Finding the Impedance of a Concentric, Two (2) Wire, Transmission Line (Coaxial Cable)	389
	2D Finding the Impedance of a Concentric, Two (2) Wire	405
	2D Axisymmetric Transient Modeling of a Coaxial Cable	405
	First Principles as Applied to 2D Complex Mixed Mode Model Definition	431
	References	431
	Suggested Modeling Exercises	432
Chapter 9:	3D Modeling Using COMSOL Multiphysics 5.x	433
	Guidelines for 3D Modeling in 5.x	433
	3D Modeling Considerations	434
	3D Models	438
	3D Spiral Coil Microinductor Model	438
	3D Linear Microresistor Beam Model	455
	Multiphysics Thermal Linear Elastic 1 (te1)	476
	Heat Transfer in Solids (ht)	477
	First Principles as Applied to 3D Model Definition	489
	References	489
	Suggested Modeling Exercises	490

Chapter 10:	Perfectly Matched Layer Models Using COMSOL Multiphysics 5.x	493
	Guidelines for Perfectly Matched Layer (PML) Modeling in 5.x	493
	Perfectly Matched Layer (PML) Modeling Guidelines and Coordinate Considerations	494
	Perfectly Matched Layer Models	497
	Building the 2D Concave Metallic Mirror PML Model	497
	Building the 2D Energy Concentrator PML Model	517
	First Principles as Applied to PML Model Definition	539
	References	540
	Suggested Modeling Exercises	540
Chapter 11:	Bioheat Models Using COMSOL Multiphysics 5.x	543
	Guidelines for Bioheat Modeling in 5.x	543
	Bioheat Modeling Considerations	544
	Bioheat Transfer Models	547
	2D Axisymmetric Microwave Cancer Therapy Model	574
	First Principles as Applied to Bioheat Model Definition	601
	References	602
	Suggested Modeling Exercises	602
Appendix:	A Brief Introduction to LiveLink™ for MATLAB® Using COMSOL Multiphysics 5.x	605
	Guidelines for LiveLink Exploration through Modeling in 5.x	605
	Getting Started using LiveLink for MATLAB with COMSOL Multiphysics 5.x on a Windows® 10 platform	606
	First Principles as Applied to Scripting and GUI Model Definition	614
	References	615
	Suggested Modeling Exercises	615
Index		617

