
Contents

Preface.....	xi
Biography.....	xiii
Chapter 1 Introduction	1
Optical Model.....	1
Active Medium Model	4
Heat Diffusion and Stress–Strain Models.....	5
Photonic Device Models	6
References	9
Chapter 2 Light Propagation in Homogenous Media	11
Fourier Method.....	11
Optical Beam Reflection and Refraction.....	27
Paraxial and Wide Angle Approximations	36
Transmission through Thin Optical Elements	44
References	52
Chapter 3 Optical Waveguides.....	55
Introduction to Optical Waveguide Theory	55
Planar Optical Waveguides	65
Waveguiding in Planar Optical Waveguides	66
Index Guiding Planar Optical Waveguides	66
Low Loss Leaky and Gain Guided Planar Optical Waveguides	70
Examples of Planar Optical Waveguides	70
Slab Optical Waveguide	73
Effective Index Method	83
Propagation Constant Calculation Techniques for Planar Optical Waveguides	85
Comparison of Polarised, Scalar, and Effective Index Approximations	90
Optical Fibres	94
Waveguiding in Optical Fibres	94
Examples of Optical Fibres	97
Step Index Circular Optical Fibre	100
A “Poor Man’s Approach” to Modelling MOFs	111
Propagation Constant Calculation Techniques for MOFs	118
References	121

Chapter 4	Beam Propagation Method.....	131
Introduction	133	
BPM Algorithms	138	
Split Operator BPM	139	
Eigenmode Expansion BPM.....	140	
Matrix Expansion BPM.....	142	
Bidirectional BPM.....	144	
Handling Abrupt Discontinuities	145	
Handling Multiply Reflected Waves.....	149	
Numerical Implementation of BPM	151	
Boundary Condition	157	
Dispersion Characteristics.....	159	
Staircasing Approximation.....	166	
Selected Examples of BPM Application	170	
Optical Taper	171	
Oblique and Bent Waveguides.....	173	
Y Junction.....	177	
Time Domain Analysis	180	
Time Domain BPM	180	
Travelling Wave Approach	181	
References	182	
Chapter 5	Thermal Modelling of Photonic Devices	193
Heat Flow	194	
Heat Flow in Photonic Devices	197	
Finite Difference Analysis of Heat Flow in Homogenous Media....	203	
Finite Difference Analysis of Heat Flow in Inhomogeneous Media.....	225	
Heat Sources, Boundary Conditions, and Thermal Boundary Resistance.....	232	
References	234	
Chapter 6	Flow of Current in Semiconductor Photonic Devices.....	237
Introduction	237	
Potential Distribution in Unbiased p–n Junction	242	
Potential and Quasi-Fermi Level Distribution in Biased p–n Junction	251	
Modelling of Current Flow in Photonic Semiconductor Devices....	270	
References	273	
Chapter 7	Fibre Amplifiers and Lasers.....	277
Photons and Atoms.....	277	
Silica Glass–Doped with Erbium Ions	282	

Fibre Amplifier Modelling	285
Copropagating and Counterpropagating Pump Fibre	
Amplifier Models.....	286
Amplified Spontaneous Emission	300
Fibre Laser Modelling	302
Time Domain Models	309
Extraction of Modelling Parameters	310
Lanthanide Ion Interaction Effects.....	320
References	322
 Chapter 8 Laser Diode Modelling	325
Introduction	325
0D LD Models.....	328
0D CW Model	332
0D Time Domain Model	340
0D Spectral Model.....	343
1D Laser Diode Models.....	352
Multidimensional LD Models	358
References	369
 Chapter 9 Pulse Propagation in Optical Fibres.....	375
Introduction	375
Propagation of Optical Pulses in Fibres	376
Split-Step Fourier Method.....	383
References	391
 Index.....	393