- Volume 1
- Preface p. xxv
- 1 Fourier Optics: Concepts and Applications p. 1
- 1.1 Plane Waves and Spatial Frequency p. 1
- 1.2 Fourier Transform and Diffraction Patterns in Rectangular Coordinates p. 9
- 1.3 Fourier Transform in Cylindrical Coordinates p. 16
- 1.4 Special Functions in Photonics and Their Fourier Transforms p. 20
- 1.5 The Convex Lens and Its Functions p. 40
- 1.6 Spatial Frequency Approaches in Fourier Optics p. 52
- 1.7 Spatial Filters p. 61
- 1.8 Holography p. 81
- Problems p. 101
- References p. 108
- 2 Boundaries, Near-Field Optics, and Near-Field Imaging p. 110
- 2.1 Boundary Conditions p. 110
- 2.2 Snell's Law p. 112
- 2.3 Transmission and Reflection Coefficients p. 113
- 2.4 Transmittance and Reflectance (at an Arbitrary Incident Angle) p. 124
- 2.5 Brewster's Angle p. 127
- 2.6 Total Internal Reflection p. 130
- 2.7 Wave Expressions of Light p. 132
- 2.8 The Evanescent Wave p. 134
- 2.9 What Generates the Evanescent Waves? p. 147
- 2.10 Diffraction-Unlimited Images out of the Evanescent Wave p. 150
- Problems p. 163
- References p. 164
- 3 Fabry-Perot Resonators, Beams, and Radiation Pressure p. 166
- 3.1 Fabry-Perot Resonators p. 166
- 3.2 The Scanning Fabry-Perot Spectrometer p. 176
- 3.3 Resolving Power of the Fabry-Perot Resonator p. 192
- 3.4 Practical Aspects of Operating the Fabry-Perot Interferometer p. 199
- 3.5 The Gaussian Beam as a Solution of the Wave Equation p. 205
- 3.6 Transformation of a Gaussian Beam by a Lens p. 214
- 3.7 Hermite Gaussian Beam (Higher Order Modes) p. 223
- 3.8 The Gaussian Beam in a Spherical Mirror Cavity p. 227
- 3.9 Resonance Frequencies of the Cavity p. 232
- 3.10 Practical Aspects of the Fabry-Perot Interferometer p. 234
- 3.11 Bessel Beams p. 237
- 3.12 Manipulation with Light Beams p. 249
- 3.13 Laser Cooling of Atoms p. 254
- Problems p. 255
- References p. 260
- 4 Propagation of Light in Anisotropic Crystals p. 263
- 4.1 Polarization in Crystals p. 264
- 4.2 Susceptibility of an Anisotropic Crystal p. 266
- 4.3 The Wave Equation in an Anisotropic Medium p. 268

- 4.4 Solving the Generalized Wave Equation in Uniaxial Crystals p. 269
- 4.5 Graphical Methods p. 282
- 4.6 Treatment of Boundary Problems Between Anisotropic Media by the Indicatrix Method p. 292
- Problems p. 298
- References p. 301
- 5 Optical Properties of Crystals Under Various External Fields p. 302
- 5.1 Expressing the Distortion of the Indicatrix p. 302
- 5.2 Electrooptic Effects p. 304
- 5.3 Elastooptic Effect p. 317
- 5.4 Magnetooptic Effect p. 326
- 5.5 Optical Isolator p. 327
- 5.6 Photorefractive Effect p. 331
- 5.7 Optical Amplifier Based on the Photorefractive Effect p. 334
- 5.8 Photorefractive Beam Combiner for Coherent Homodyne Detection p. 339
- 5.9 Optically Tunable Optical Filter p. 341
- 5.10 Liquid Crystals p. 341
- 5.11 Dye-Doped Liquid Crystal p. 357
- Problems p. 358
- References p. 359
- 6 Polarization of Light p. 362
- 6.1 Introduction p. 363
- 6.2 Circle Diagrams for Graphical Solutions p. 365
- 6.3 Various Types of Retarders p. 378
- 6.4 How to Use Waveplates p. 385
- 6.5 Linear Polarizers p. 394
- 6.6 Circularly Polarizing Sheets p. 409
- 6.7 Rotators p. 412
- 6.8 The Jones Vector and the Jones Matrix p. 421
- 6.9 States of Polarization and Their Component Waves p. 431
- Problems p. 446
- References p. 449
- 7 How to Construct and Use the Poincare Sphere p. 451
- 7.1 Component Field Ratio in the Complex Plane p. 452
- 7.2 Constant Azimuth [theta] and Ellipticity [epsilon] Lines in the Component Field Ratio Complex Plane p. 455
- 7.3 Argand Diagram p. 459
- 7.4 From Argand Diagram to Poincare Sphere p. 469
- 7.5 Poincare Sphere Solutions for Retarders p. 479
- 7.6 Poincare Sphere Solutions for Polarizers p. 485
- 7.7 Poincare Sphere Traces p. 490
- 7.8 Movement of a Point on the Poincare Sphere p. 494
- Problems p. 501
- References p. 503
- 8 Phase Conjugate Optics p. 504
- 8.1 The Phase Conjugate Mirror p. 504

- 8.2 Generation of a Phase Conjugate Wave Using a Hologram p. 504
- 8.3 Expressions for Phase Conjugate Waves p. 507
- 8.4 Phase Conjugate Mirror for Recovering Phasefront Distortion p. 508
- 8.5 Phase Conjugation in Real Time p. 511
- 8.6 Picture Processing by Means of a Phase Conjugate Mirror p. 512
- 8.7 Distortion-Free Amplification of Laser Light by Means of a Phase Conjugate Mirror p. 513
- 8.8 Self-Tracking of a Laser Beam p. 514
- 8.9 Picture Processing p. 519
- 8.10 Theory of Phase Conjugate Optics p. 521
- 8.11 The Gain of Forward Four-Wave Mixing p. 533
- 8.12 Pulse Broadening Compensation by Forward Four-Wave Mixing p. 537
- Problems p. 541
- References p. 543
- Appendix A Derivation of the Fresnel-Kirchhoff Diffraction Formula from the Rayleigh-Sommerfeld Diffraction Formula p. 545
- Appendix B Why the Analytic Signal Method is Not Applicable to the Nonlinear System p. 547
- Appendix C Derivation of P[subscript NL] p. 551
- Answers to Problems p. 554
- Index p. 1
- Volume II
- Preface p. xxv
- 9 Planar Optical Guides for Integrated Optics p. 605
- 9.1 Classification of the Mathematical Approaches to the Slab Optical Guide p. 606
- 9.2 Wave Optics Approach p. 607
- 9.3 Characteristic Equations of the TM Modes p. 610
- 9.4 Cross-Sectional Distribution of Light and its Decomposition into Component Plane Waves p. 615
- 9.5 Effective Index of Refraction p. 619
- 9.6 TE Modes p. 620
- 9.7 Other Methods for Obtaining the Characteristic Equations p. 622
- 9.8 Asymmetric Optical Guide p. 638
- 9.9 Coupled Guides p. 643
- Problems p. 652
- References p. 654
- 10 Optical Waveguides and Devices for Integrated Optics p. 655
- 10.1 Rectangular Optical Waveguide p. 655
- 10.2 Effective Index Method for Rectangular Optical Guides p. 661
- 10.3 Coupling Between Rectangular Guides p. 664
- 10.4 Conflection p. 666
- 10.5 Various Kinds of Rectangular Optical Waveguides for Integrated Optics p. 670
- 10.6 Power Dividers p. 673
- 10.7 Optical Magic T p. 678
- 10.8 Electrode Structures p. 680
- 10.9 Mode Converter p. 685

- Problems p. 688
- References p. 690
- 11 Modes and Dispersion in Optical Fibers p. 692
- 11.1 Practical Aspects of Optical Fibers p. 693
- 11.2 Theory of Step-Index Fibers p. 709
- 11.3 Field Distributions Inside Optical Fibers p. 730
- 11.4 Dual-Mode Fiber p. 739
- 11.5 Photoimprinted Bragg Grating Fiber p. 741
- 11.6 Definitions Associated with Dispersion p. 748
- 11.7 Dispersion-Shifted Fiber p. 749
- 11.8 Dispersion Compensator p. 755
- 11.9 Ray Theory for Graded-Index Fibers p. 759
- 11.10 Fabrication of Optical Fibers p. 775
- 11.11 Cabling of Optical Fibers p. 783
- 11.12 Joining Fibers p. 786
- Problems p. 790
- References p. 793
- 12 Detecting Light p. 796
- 12.1 Photomultiplier Tube p. 796
- 12.2 Streak Camera p. 798
- 12.3 Miscellaneous Types of Light Detectors p. 800
- 12.4 PIN Photodiode and APD p. 801
- 12.5 Direct Detection Systems p. 805
- 12.6 Coherent Detection Systems p. 807
- 12.7 Balanced Mixer p. 814
- 12.8 Detection by Stimulated Effects p. 815
- 12.9 Jitter in Coherent Communication Systems p. 819
- 12.10 Coherent Detection Immune to Both Polarization and Phase Jitter p. 826
- 12.11 Concluding Remarks p. 830
- Problems p. 830
- References p. 831
- 13 Optical Amplifiers p. 833
- 13.1 Introduction p. 833
- 13.2 Basics of Optical Amplifiers p. 834
- 13.3 Types of Optical Amplifiers p. 836
- 13.4 Gain of Optical Fiber Amplifiers p. 838
- 13.5 Rate Equations for the Three-Level Model Of Er[superscript 3+] p. 848
- 13.6 Pros and Cons of 1.48-[mu]m and 0.98-[mu]m Pump Light p. 853
- 13.7 Approximate Solutions of the Time-Dependent Rate Equations p. 857
- 13.8 Pumping Configuration p. 864
- 13.9 Optimum Length of the Fiber p. 867
- 13.10 Electric Noise Power When the EDFA is Used as a Preamplifier p. 868
- 13.11 Noise Figure of the Receiver Using the Optical Amplifier as a Preamplifier p. 880
- 13.12 A Chain of Optical Amplifiers p. 882
- 13.13 Upconversion Fiber Amplifier p. 889
- Problems p. 889

- References p. 892
- 14 Transmitters p. 893
- 14.1 Types of Lasers p. 893
- 14.2 Semiconductor Lasers p. 895
- 14.3 Rate Equations of Semiconductor Lasers p. 909
- 14.4 Confinement p. 930
- 14.5 Wavelength Shift of the Radiation p. 943
- 14.6 Beam Pattern of a Laster p. 946
- 14.7 Temperature Dependence of L-I Curves p. 951
- 14.8 Semiconductor Laser Noise p. 952
- 14.9 Single-Frequency Lasers p. 956
- 14.10 Wavelength Tunable Laser Diode p. 970
- 14.11 Laser Diode Array p. 980
- 14.12 Multi-Quantum-Well Lasers p. 984
- 14.13 Erbium-Doped Fiber Laser p. 1004
- 14.14 Light-Emitting Diode (LED) p. 1007
- 14.15 Fiber Raman Lasers p. 1009
- 14.16 Selection of Light Sources p. 1011
- Problems p. 1013
- References p. 1014
- 15 Stationary and Solitary Solutions in a Nonlinear Medium p. 1017
- 15.1 Nonlinear (Kerr) Medium p. 1017
- 15.2 Solutions in the Unbounded Kerr Nonlinear Medium p. 1021
- 15.3 Guided Nonlinear Boundary Wave p. 1030
- 15.4 Linear Core Layer Sandwiched by Nonlinear Cladding Layers p. 1037
- 15.5 How the Soliton Came About p. 1049
- 15.6 How a Soliton is Generated p. 1050
- 15.7 Self-Phase Modulation (SPM) p. 1053
- 15.8 Group Velocity Dispersion p. 1055
- 15.9 Differential Equation of the Envelope Function of the Solitons in the Optical Fiber p. 1059
- 15.10 Solving the Nonlinear Schrodinger Equation p. 1067
- 15.11 Fundamental Soliton p. 1068
- 15.12 Pulsewidth and Power to Generate a Fundamental Soliton p. 1071
- 15.13 Ever-Expanding Soliton Theories p. 1074
- Problems p. 1077
- References p. 1079
- 16 Communicating by Fiber Optics p. 1081
- 16.1 Overview of Fiber-Optic Communication Systems p. 1082
- 16.2 Modulation p. 1085
- 16.3 Multiplexing p. 1097
- 16.4 Light Detection Systems p. 1102
- 16.5 Noise in the Detector System p. 1113
- 16.6 Designing Fiber-Optic Communication Systems p. 1129
- Problems p. 1147
- References p. 1149

- Appendix A PIN Photodiode on an Atomic Scale p. 1151
- A.1 PIN Photodiode p. 1151
- A.2 I-V Characteristics p. 1156
- Appendix B Mode Density p. 1160
  Appendix C Perturbation Theory p. 1164
- Answers to Problems p. 1167 •
- Index p. 1 •