

CONTENTS

PREFACE TO THE THIRD EDITION	xi
PREFACE TO THE SECOND EDITION	xx
PREFACE TO THE FIRST EDITION	xxiii

PART I: OPTICS **1**

1	RAY OPTICS	3
1.1	Postulates of Ray Optics	5
1.2	Simple Optical Components	8
1.3	Graded-Index Optics	20
1.4	Matrix Optics	27
	Reading List	37
	Problems	38
2	WAVE OPTICS	41
2.1	Postulates of Wave Optics	43
2.2	Monochromatic Waves	44
*2.3	Relation Between Wave Optics and Ray Optics	52
2.4	Simple Optical Components	53
2.5	Interference	61
2.6	Polychromatic and Pulsed Light	71
	Reading List	76
	Problems	77
3	BEAM OPTICS	79
3.1	The Gaussian Beam	80
3.2	Transmission Through Optical Components	91
3.3	Hermite–Gaussian Beams	99
3.4	Laguerre–Gaussian Beams	102
3.5	Nondiffracting Beams	105
	Reading List	108
	Problems	108
4	FOURIER OPTICS	110
4.1	Propagation of Light in Free Space	113
4.2	Optical Fourier Transform	124
4.3	Diffraction of Light	129
4.4	Image Formation	137
4.5	Holography	147
	Reading List	155
	Problems	157

5	ELECTROMAGNETIC OPTICS	160
5.1	Electromagnetic Theory of Light	162
5.2	Electromagnetic Waves in Dielectric Media	166
5.3	Monochromatic Electromagnetic Waves	172
5.4	Elementary Electromagnetic Waves	175
5.5	Absorption and Dispersion	181
5.6	Scattering of Electromagnetic Waves	192
5.7	Pulse Propagation in Dispersive Media	199
	Reading List	205
	Problems	207
6	POLARIZATION OPTICS	209
6.1	Polarization of Light	211
6.2	Reflection and Refraction	221
6.3	Optics of Anisotropic Media	227
6.4	Optical Activity and Magneto-Optics	240
6.5	Optics of Liquid Crystals	244
6.6	Polarization Devices	247
	Reading List	251
	Problems	252
7	PHOTONIC-CRYSTAL OPTICS	255
7.1	Optics of Dielectric Layered Media	258
7.2	One-Dimensional Photonic Crystals	277
7.3	Two- and Three-Dimensional Photonic Crystals	291
	Reading List	299
	Problems	301
8	METAL AND METAMATERIAL OPTICS	303
8.1	Single- and Double-Negative Media	306
8.2	Metal Optics: Plasmonics	320
8.3	Metamaterial Optics	334
*8.4	Transformation Optics	343
	Reading List	349
	Problems	351
9	GUIDED-WAVE OPTICS	353
9.1	Planar-Mirror Waveguides	355
9.2	Planar Dielectric Waveguides	363
9.3	Two-Dimensional Waveguides	372
9.4	Optical Coupling in Waveguides	376
9.5	Photonic-Crystal Waveguides	385
9.6	Plasmonic Waveguides	386
	Reading List	389
	Problems	389
10	FIBER OPTICS	391
10.1	Guided Rays	393
10.2	Guided Waves	397
10.3	Attenuation and Dispersion	415
10.4	Holey and Photonic-Crystal Fibers	426
10.5	Fiber Materials	429
	Reading List	430
	Problems	432

11	RESONATOR OPTICS	433
11.1	Planar-Mirror Resonators	436
11.2	Spherical-Mirror Resonators	447
11.3	Two- and Three-Dimensional Resonators	459
11.4	Microresonators and Nanoresonators	463
	Reading List	470
	Problems	471
12	STATISTICAL OPTICS	473
12.1	Statistical Properties of Random Light	475
12.2	Interference of Partially Coherent Light	489
*12.3	Transmission of Partially Coherent Light	497
12.4	Partial Polarization	506
	Reading List	510
	Problems	512
13	PHOTON OPTICS	514
13.1	The Photon	516
13.2	Photon Streams	529
*13.3	Quantum States of Light	541
	Reading List	550
	Problems	554
	PART II: PHOTONICS	559
14	LIGHT AND MATTER	561
14.1	Energy Levels	562
14.2	Occupation of Energy Levels	581
14.3	Interactions of Photons with Atoms	583
14.4	Thermal Light	602
14.5	Luminescence and Scattering	607
	Reading List	614
	Problems	617
15	LASER AMPLIFIERS	619
15.1	Theory of Laser Amplification	622
15.2	Amplifier Pumping	626
15.3	Representative Laser Amplifiers	636
15.4	Amplifier Nonlinearity	645
*15.5	Amplifier Noise	651
	Reading List	653
	Problems	655
16	LASERS	657
16.1	Theory of Laser Oscillation	659
16.2	Characteristics of the Laser Output	666
16.3	Types of Lasers	680
16.4	Pulsed Lasers	707
	Reading List	723
	Problems	728

17	SEMICONDUCTOR OPTICS	731
17.1	Semiconductors	733
17.2	Interactions of Photons with Charge Carriers	766
	Reading List	782
	Problems	784
18	LEDs AND LASER DIODES	787
18.1	Light-Emitting Diodes	789
18.2	Semiconductor Optical Amplifiers	817
18.3	Laser Diodes	831
18.4	Quantum-Confined Lasers	844
18.5	Microcavity Lasers	854
18.6	Nanocavity Lasers	862
	Reading List	864
	Problems	868
19	PHOTODETECTORS	871
19.1	Photodetectors	873
19.2	Photoconductors	883
19.3	Photodiodes	887
19.4	Avalanche Photodiodes	895
19.5	Array Detectors	907
19.6	Noise in Photodetectors	909
	Reading List	935
	Problems	938
20	ACOUSTO-OPTICS	943
20.1	Interaction of Light and Sound	945
20.2	Acousto-Optic Devices	958
*20.3	Acousto-Optics of Anisotropic Media	967
	Reading List	972
	Problems	972
21	ELECTRO-OPTICS	975
21.1	Principles of Electro-Optics	977
*21.2	Electro-Optics of Anisotropic Media	989
21.3	Electro-Optics of Liquid Crystals	996
*21.4	Photorefractivity	1005
21.5	Electroabsorption	1010
	Reading List	1012
	Problems	1013
22	NONLINEAR OPTICS	1015
22.1	Nonlinear Optical Media	1017
22.2	Second-Order Nonlinear Optics	1021
22.3	Third-Order Nonlinear Optics	1036
*22.4	Second-Order Nonlinear Optics: Coupled Waves	1047
*22.5	Third-Order Nonlinear Optics: Coupled Waves	1059
*22.6	Anisotropic Nonlinear Media	1066
*22.7	Dispersive Nonlinear Media	1069
	Reading List	1074
	Problems	1075

23	ULTRAFAST OPTICS	1078
23.1	Pulse Characteristics	1079
23.2	Pulse Shaping and Compression	1088
23.3	Pulse Propagation in Optical Fibers	1102
23.4	Ultrafast Linear Optics	1115
23.5	Ultrafast Nonlinear Optics	1126
23.6	Pulse Detection	1146
	Reading List	1159
	Problems	1161
24	OPTICAL INTERCONNECTS AND SWITCHES	1163
24.1	Optical Interconnects	1166
24.2	Passive Optical Routers	1178
24.3	Photonic Switches	1187
24.4	Photonic Logic Gates	1211
	Reading List	1220
	Problems	1222
25	OPTICAL FIBER COMMUNICATIONS	1224
25.1	Fiber-Optic Components	1226
25.2	Optical Fiber Communication Systems	1238
25.3	Modulation and Multiplexing	1257
25.4	Coherent Optical Communications	1266
25.5	Fiber-Optic Networks	1274
	Reading List	1281
	Problems	1284
A	FOURIER TRANSFORM	1287
A.1	One-Dimensional Fourier Transform	1287
A.2	Time Duration and Spectral Width	1290
A.3	Two-Dimensional Fourier Transform	1293
	Reading List	1295
B	LINEAR SYSTEMS	1296
B.1	One-Dimensional Linear Systems	1296
B.2	Two-Dimensional Linear Systems	1299
	Reading List	1300
C	MODES OF LINEAR SYSTEMS	1301
	Reading List	1305
	SYMBOLS AND UNITS	1306
	AUTHORS	1331
	INDEX	1333