

Contents

Preface	ix
Authors' Biographies	xi
1. Introduction	1
1.1 Historical Developments	1
1.2 Semiconductor Materials	2
1.3 Operating Principles	6
1.4 Applications	8
1.5 Book Overview	9
1.6 Future Challenges	11
1.7 References	11
2. Basic Concepts	15
2.1 Introduction	15
2.2 Optical Gain	16
2.3 Dielectric Waveguide	19
2.4 Condition for Amplification	21
2.5 P-N Junction	23
2.6 Amplifier Characteristics	26
2.7 Multiquantum Well Amplifiers	30
2.8 References	32
3. Recombination Mechanisms and Gain	35
3.1 Introduction	35
3.2 Radiative Recombination	36
3.3 Nonradiative Recombination	44

3.4	Quantum Well Amplifiers	58
3.5	Gain in Quantum Wire (QWR) and Quantum Dot (QD) Structures	70
3.6	References	76
4.	Epitaxial Growth and Amplifier Designs	81
4.1	Introduction	81
4.2	Material Systems	82
4.3	Epitaxial Growth Methods	85
4.4	Strained Layer Epitaxy	89
4.5	Selective Area Growth	91
4.6	Amplifier Designs	96
4.7	Growth of QWR and QD Materials	101
4.8	References	106
5.	Low Reflectivity Facet Designs	111
5.1	Introduction	111
5.2	Low Reflectivity Coatings	113
5.3	Buried Facet Amplifiers	115
5.4	Tilted Facet Amplifiers	118
5.5	Amplified Spontaneous Emission and Optical Gain	122
5.6	References	126
6.	Amplifier Rate Equations and Operating Characteristics	129
6.1	Introduction	129
6.2	Amplifier Rate Equations for Pulse Propagation	130
6.3	Pulse Amplification	133
6.4	Multichannel Amplification	136
6.5	Amplifier Application in Optical Transmission Systems	139
6.6	Amplifier Noise	148
6.7	Gain Dynamics	156
6.8	References	169
7.	Photonic Integrated Circuit Using Amplifiers	173
7.1	Introduction	173
7.2	Integrated Laser and Amplifier	174
7.3	Multichannel WDM Sources with Amplifiers	176
7.4	Spot Size Conversion (SSC)	177

7.5	Mach-Zehnder Interferometer	178
7.6	References	181
8.	Functional Properties and Applications	183
8.1	Introduction	183
8.2	Four-Wave Mixing	183
8.3	Cross Gain Modulation	197
8.4	Cross Phase Modulation	203
8.5	Wavelength Conversion	205
8.6	Optical Demultiplexing	208
8.7	OTDM System Applications	212
8.8	References	218
9.	Optical Logic Operations	221
9.1	Introduction	221
9.2	Optical Logic XOR	221
9.3	Optical Logic OR	243
9.4	Optical Logic AND	250
9.5	Optical Logic INVERT	257
9.6	References	259
10.	Optical Logic Circuits	263
10.1	Introduction	263
10.2	Adder	263
10.3	Parity Checker	268
10.4	All-Optical Pseudorandom Binary Sequence (PRBS) Generator	276
10.5	All-Optical Header Processor	279
10.6	References	285
	Index	289