

Contents

HISTORICAL INTRODUCTION	1
LASER LITERATURE AND BIBLIOGRAPHY	4
I. BACKGROUND MATERIAL ON RADIATION AND ATOMIC PHYSICS	8
1. Light and the General Laws of Radiation	8
2. Units and Physical Constants	12
3. Observation and Measurement of Radiation	14
4. Coherence of Light	23
5. Emission and Absorption of Radiation by Atoms	29
6. Interaction of Radiation with Atomic Systems	38
II. GENERAL DESCRIPTION AND THEORY OF LASERS	49
1. The Laser	49
2. Threshold Condition and Rate Equations	57
3. Theory of Oscillation and Radiation Modes	67
4. Linewidth Problems	83
III. SOLID-STATE LASERS	90
1. The Ruby Laser of Maiman	90
2. The Spectroscopy of Ruby	97
3. Ruby Lasers Operating at Unconventional Frequencies	101
4. Concentration of the Exciting Radiation	103
5. Continuously Operating Ruby Lasers	109
6. Four-Level Solid Lasers	112

xiv	Contents
7. Semiconductor Lasers	136
8. Phonon-Terminated Lasers	158
IV. FLUID-STATE LASERS	161
1. Exploration of Liquids as Laser Materials	161
V. GAS LASERS	168
1. Negative Absorption of Optical Radiation in Gases: Qualitative Discussion	168
2. Spectroscopy of Noble Gases	177
3. Conditions for Laser Oscillation in Gases	183
4. Common Helium-Neon Lasers	191
5. Noble Gas Lasers	201
6. Miscellaneous Gas Lasers	207
VI. VARIATION OF LASER OSCILLATIONS IN SPACE AND TIME	214
1. Mode Structure and Radiation Pattern	214
2. Pulsations of the Output of Solid Lasers	221
3. Giant Pulse Techniques	228
4. Giant Pulse Theory	235
VII. NONLINEAR PHENOMENA	252
1. Theory of Nonlinear Phenomena in Light Propagation	252
2. Frequency Conversion Experiments	261
3. Raman Effect	266
4. Classical Theory of Amplification and Raman Effect	272
5. Multiple-Photon Absorption	277
VIII. LASER APPLICATIONS	279
1. Applications to Measurement and Instrumentation	279
2. Communications and Ranging Applications	284
3. Applications to Shaping and Welding	287
4. Biological and Medical Applications, Discussion of Health Hazards	289
APPENDIX	293
INDEX	301